



# TIGER CONSERVATION PLAN

SUNDARBAN  
TIGER RESERVE

2017 – 2027





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TIGER RESERVE

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भारत सरकार  
Government of India  
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय  
Ministry of Environment, Forest and Climate Change  
राष्ट्रीय व्याघ्र संरक्षण प्राधिकरण  
National Tiger Conservation Authority

F.No. 1-14/2011-NTCA (Part-II)

New Delhi, the July 06, 2020

To

The Chief Wildlife Warden,  
Government of West Bengal,  
Kolkata.

**Sub: Approval of Tiger Conservation Plan (TCP) for the Sundarban Tiger Reserve – reg.**

Sir,

The draft Tiger Conservation Plan (TCP) prepared by the State of West Bengal for Sundarban Tiger Reserve, **under sub-section (3) of section 38V of Wildlife (Protection) Act, 1972**, was submitted to this Authority requesting for approval under section 38O (1) (a) of the said Act.

After examination of the said TCP by the Expert Committee of the NTCA constituted for the purpose, observations of NTCA/ Experts were communicated to the Chief Wildlife Warden (West Bengal) & the Field Director, Sundarban Tiger Reserve, for their incorporation in the TCP.

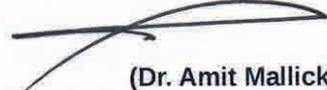
In this context, I am directed to say that further to the compliance furnished by the State Government vide its letter No. 1241/FD/2M-118 dated February 18, 2020, and based on the recommendation of the technical committee, **approval of the NTCA is hereby granted for the TCP of Sundarban Tiger Reserve for the period from 2017-18 to 2026-27, under section 38O (1) (a) of the Wildlife (Protection) Act, 1972**, subject to following conditions:

- a. No deviation shall be made from the prescriptions of the TCP, read with conditions stipulated herein, without prior approval of the NTCA u/s 38 O (1) (a) of Wildlife (Protection) Act, 1972.
- b. The approved TCP shall have a provision for mid-term review corresponding to the proposed period of the plan, for appropriate mid course alteration, if any, as required.
- c. The State Government shall comply with the guidelines and advisories issued by the NTCA/ Project Tiger from time to time and the commitments made in the tripartite Memorandum of Understanding (MoU).
- d. Since the core/ critical tiger habitat has the status of a National Park/ Wildlife Sanctuary, all provisions under Chapter IV of Wildlife (Protection) Act, 1972 would be applicable to such areas, in addition to sections 51 (1C), (1D) and 55 (ab), (ac).
- e. At no stage of implementation of various prescriptions of the TCP relating to the tiger reserve, shall overrule the provisions of:
  - i. The Wildlife (Protection) Act, 1972
  - ii. The Indian Forest Act, 1927
  - iii. The Biological Diversity Act, 2002
  - iv. The Environment (Protection) Act, 1986
  - v. The Forest (Conservation) Act, 1980
  - vi. The National Forest Policy, 1988

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National Tiger Conservation Authority

- vii. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006  
viii. Directives issued from time to time by Hon'ble Supreme Court of India
- f. The NTCA reserves right to review, modify and withdraw this approval at any time, if any of the conditions of approval are violated.
- g. The following need to be ensured while executing forestry operations in the buffer area of the tiger reserve:
- To ensure minimum 'patch disturbance' and minimum human-wildlife conflicts, forestry operations should be restricted only in those coupes which are due for the current year.
  - Compliance of section 38V (2) of the Wildlife (Protection) Act, 1972 should be strictly ensured.
  - No working or camping should be permitted in the area after sunset.
  - Daily monitoring of the tiger movement, water points and cattle kill should be done and recorded.
- h. The Tourism activities should be strictly managed/ regulated as per the comprehensive guidelines issued by the NTCA under section 38O (c) of the Wildlife (Protection) Act, 1972 vide letter dated 15/10/2012.

Yours faithfully,

  
(Dr. Amit Mallick)  
Inspector General of Forests (NTCA)  
E-mail: [ig-ntca@nic.in](mailto:ig-ntca@nic.in)  
Tel. (EPABX): + 91 11 24364837-39  
FAX: +91 11 24367836

**Copy to:**

- The Principal Secretary of Forests, Government of West Bengal, Kolkata.
- The Additional Principal Chief Conservator of Forests (Central), MoEF, Regional Office (Eastern), A/3, Chandrasekharpur, Bhubaneswar-751023.
- The Field Director, Sundarban Tiger Reserve, West Bengal for necessary action and information please.

  
(Dr. Amit Mallick)  
Inspector General of Forests (NTCA)

# FOREWORD

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Sundarban is the largest mangrove delta of the world and encompasses over hundreds of islands, with a maze of innumerable rivers, rivulets, and creeks. The name 'Sundarban' means "beautiful forest" and it is believed to be derived from a mangrove tree species 'Sundari' (*Heritiera fomes*). The Indian Sundarban is the southernmost part of the estuarine delta formed by the River Ganges and Brahmaputra, bordering the Bay of Bengal.

Sundarban Tiger Reserve is one of the initial nine tiger reserves declared during 1973 and encompasses a total area of 2584.89 km<sup>2</sup> of which 1699.62 km<sup>2</sup> has been declared as the Critical Tiger Habitat and 885.27 km<sup>2</sup> as the buffer area.

The Sundarbans constitutes over 60% of the total mangrove forest area in the entire country and has 90% of the total Indian mangrove species. These comprise of true mangroves or major elements, minor elements of mangroves or and mangrove associates, back mangrove trees and shrubs, non-halophytic non-mangrove associates in the area, halophytic herbs, shrubs, and weeds and epiphytic and parasitic plants. The mangrove forests act as a natural shelter belt and protect the hinterland from storms, cyclones, tidal surges, sea water seepage and intrusion. The mangroves serve as nurseries to shell fish and fin-fishes and sustain the coastal fisheries of the entire eastern coast.

The Sundarbans has been classified as a Tiger Conservation Landscape of global priority, as it is the only mangrove habitat (along with Bangladesh), which supports a significant tiger population. The Tiger Reserve is also home to a large number of endangered and globally threatened species like the fishing cat (*Prionailurus viverrinus*) and estuarine crocodile (*Crocodylus porosus*), Gangetic (*Platanista gangetica*) and Irrawaddy Dolphin (*Oracella brevirostris*), King cobra (*Ophiophagus hannah*), water monitor lizard (*Varanus salvator*) etc. along with a very good diversity of avian fauna. It is known as a kingfisher's paradise as out of the 12 species of kingfishers found in the country eight species are found here. Two species of horse shoe crabs (which are considered as living fossils as they are thought to be more than 400 million years old), i.e. *Tachypleus gigas* and *Carcinoscorpius rotundicauda* out of the four species found in the world are found here.

Thus, owing to the uniqueness of the habitat and its biodiversity and a plethora of services (both tangible and intangible) associated with the site at local, regional and global level, makes the protection and management of Sundarban Tiger Reserve a conservation priority.

The current Management Plan has been prepared considering the facts that Sundarban Tiger Reserve is a World Heritage site and Biosphere Reserve which also shares international boundary with Bangladesh. The main emphasis in managing the Sundarban Tiger Reserve is imparted to Protection

allied with management of Man-Animal Conflict, population monitoring, Joint Forest Management and eco-tourism activities.

The Tiger Conservation Plan has been divided into core and buffer and its chapters with special notes on carrying capacity of eco-tourism, smart patrolling, and camera trapping exercise for monitoring of the tiger population. The management prescription is almost same for core and buffer except in certain points. The appendices have lots of information and data related to map of the area, Man animal conflict and various Government notifications and order etc.

The Tiger Conservation Plan consists of comprehensive information on Sundarban Tiger Reserve and the data on important aspect about its configuration, administration and Management. It has been prepared with the active assistance of Deputy Field Director, Shri Ajoy Kumar Das, IFS, Deputy Field Director, Shri Deepak M., Assistant Field Director Shri Kanu Chakraborty, WBFS, Shri Anindya Guha Thakurta, WBFS, Shri Soumen Mondal WBFS and Research Officer, Dibyadeep Chatterjee. My sincere thanks also go to all the field and office staff of Sundarban Tiger Reserve who contributed in implementation of works, compilation of data and information etc.

I am also thankful to the PCCF & Head of Forest Force, West Bengal, PCCF, Wildlife and Chief Wildlife Warden, West Bengal for their support and encouragement. The help and support rendered by APCCF & Director of Sundarban Biosphere Reserve is duly acknowledged. Lastly thanks to the Member Secretary, NTCA and all officers for providing necessary guidelines and support to finish this important task.

This plan would serve as a useful tool for the conservation and management of tiger population and its habitat, for the officers concerned.



**Chief Conservator of Forests & Field Director  
Sundarban Tiger Reserve**

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# CORE AREA

## PART A

### Existing Situation

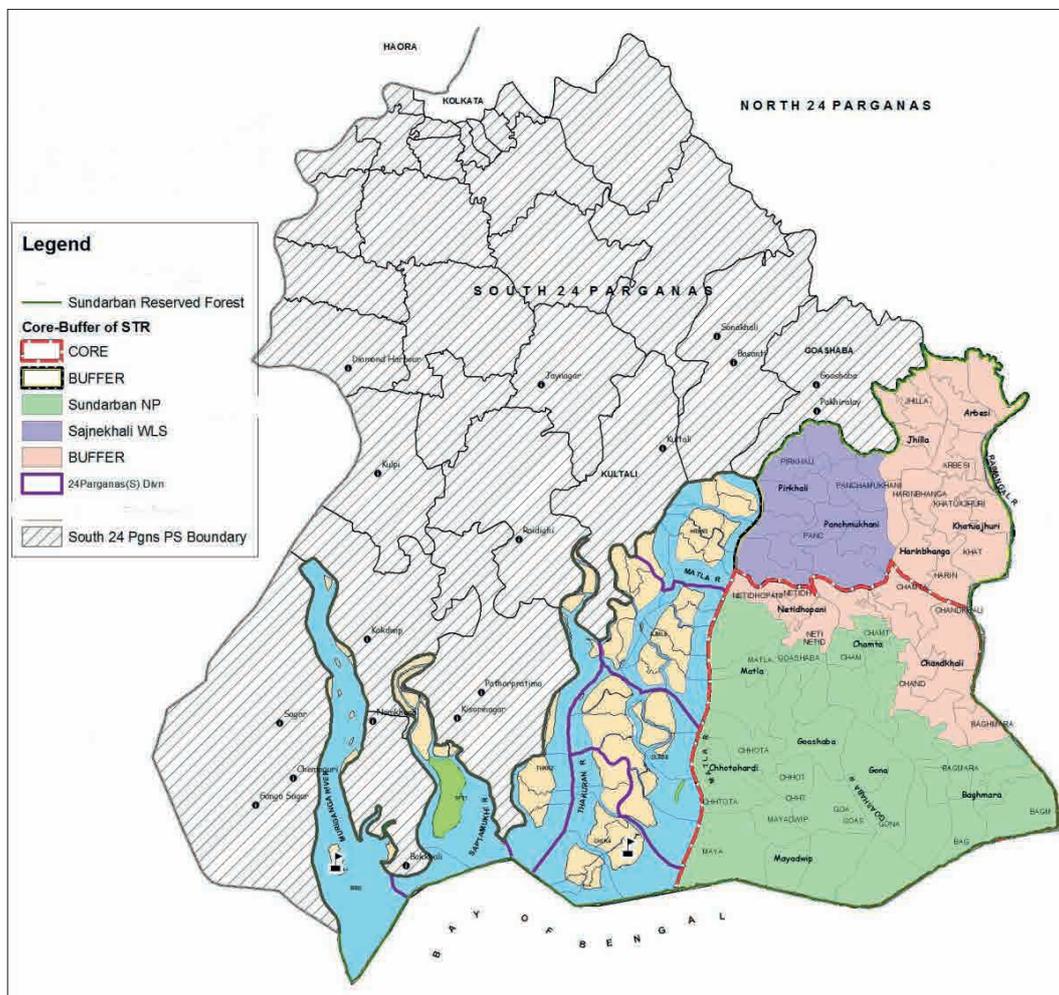


# Introduction of the Area



## CHAPTER 01

### 1.1. NAME, LOCATION, CONSTITUTION AND EXTENT



1.1.1 Sundarban Tiger Reserve.

1.1.2 It is located in the State of West Bengal in the Districts of South 24-Parganas and North 24-Parganas. There are fringe villages all along the northern boundary of the Tiger Reserve. On the eastern boundary lies Bangladesh separated by the rivers Kalindi, Raimangal and Harinbhanga. On the western boundary lies the territorial Division of 24-Parganas South and towards the south lies Bay of Bengal.

**1.1.3** The Tiger Reserve comprises of an area of 2584.93 sq.km. The legal status of the Reserve is as follows: (Area Statement: **Appendix 1**).

(i) Sajnekhali Wildlife Sanctuary	362.40 sq. km.
(ii) The Sundarban National Park	1330.10 sq. km.
(iii) Reserve Forest	892.43 sq. km.

Administratively the area is divided into four territorial ranges namely:

- (i) Sajnekhali Wildlife Sanctuary Range has an area of 432.86 sq. km. of which 362.40 sq. km. is the notified sanctuary area (Notification see **Appendix 2**). It is situated to the north-west of the Tiger Reserve.
- (ii) The Bashirhat Range, which lies to the north-east of the Tiger Reserve and shares the common boundary with Bangladesh. It has an area of 452.44 sq. km.
- (iii) The National Park East Range having an area of 809.56 sq. km. of which 533.03 sq. km. is the National Park area. (Notification see **Appendix 3**). An area of 124.40 sq. km. (Chamta 4-8) within the core area is preserved as primitive zone to act as gene pool. Lying in the south-east it shares the eastern border with Bangladesh, which is separated by the river Harinbhanga. The southern boundary is formed by the Bay of Bengal.
- (iv) The National Park West Range lies in the south-west of the Tiger Reserve and has an area of 890.06 sq. km. of which 797.06 sq. km. is the National Park area. It is separated on the western border by rivers Matla and Bidya from the adjacent Forest Division of 24-Parganas South. The southern boundary is formed by the Bay of Bengal.

**1.1.4** Sundarbans lies a little south of Tropic of Cancer between the latitudes 21°31' and 22°31' North and longitude 88°10' and 89°51' East.

## 1.2 APPROACH AND ACCESS

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The Headquarters of Sundarban Tiger Reserve is located at Canning Town, South 24-Parganas District and is connected by broad gauge Railway line with Sealdah South Suburban station, which is 46 km. from Canning. The Reserve can be approached by road from Kolkata upto embarkment points at Sonakhali, Godkhali, Dhamakhali and Jharkhali. From these points, the Reserve is approachable by waterway only. The Reserve can also be approached from Basirhat and Hasnabad under North 24-Parganas District. There are numerous train and bus services upto Canning and Hasnabad and bus services upto Dhamakhali, *i.e.* (80 km. from Kolkata), Sonakhali (90 km. from Kolkata), and Gadkhali (120 km. from Kolkata). However, inside the Reserve the only means of transport are service launches and ferry boats, which take people to both places of tourist interest and to different inhabited villages located on the fringes of the Reserve. Kolkata is the nearest major city well connected through air and rail.

## 1.3 KEY BENEFITS OF THE SITE AT

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### Local Level

- The mangrove forests act as a natural shelter belt and protect the hinterland from storms, cyclones, tidal surges, sea water seepage and intrusion.
- The mangroves serve as nurseries to shell fish and fin-fishes and sustain the coastal fisheries of the entire eastern coast.



## Regional/State level

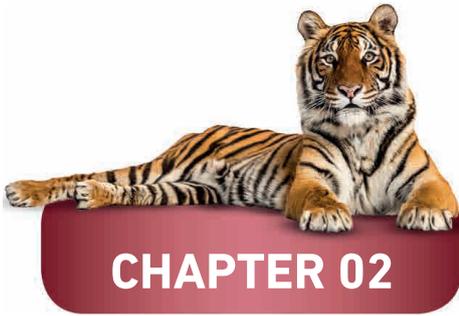
- The mangrove forests trap debris and silt and stabilise the near shore environment. Certain mangrove species also act as bio-filters as they have been found to bio-accumulate heavy metals. They filter ground-water and storm-water runoff which often contains harmful pesticides. They recharge the ground-water by collecting rain-water and slowly releasing it to the underground reservoir.

## National Level

- It constitutes over 60% of the total mangrove forest area in the entire country and has 90% of the total Indian mangrove species.
- There are 140 plant species under 59 families and 101 genera have been reported from the entire Biosphere region by Naskar *et al.* These comprise of true mangroves or major elements, minor elements of mangroves or and mangrove associates, back mangrove trees and shrubs, non-halophytic non-mangrove associates in the area, halophytic herbs, shrubs, and weeds and epiphytic and parasitic plants.
- It is known as a kingfisher's paradise as out of the 12 species of kingfishers found in the country eight species are found here.
- Inaccessibility and absence of human habitation provides a pristine habitat for the biodiversity within the Tiger Reserve

## Global Level

- The Sundarbans has been classified as a Tiger Conservation Landscape of global priority, as it is the only mangrove habitat (along with Bangladesh), which supports a significant tiger population.
- The Tiger Reserve is home to a large number of endangered and globally threatened species like the fishing cat (*Prionailurus viverrinus*), Gangetic (*Platanista gangetica*) and Irrawaddy Dolphin (*Oracella brevirostris*), King cobra (*Ophiophagus hannah*), water monitor lizard (*Varanus salvator*) etc.
- It harbours the population of the Northern river terrapin (*Batagur baska*), in captive breeding facility in the Tiger Reserve, which was once believed to be extinct.
- It is the nesting ground for marine turtles like Olive ridley (*Lepidochelys olivacea*), Green sea turtle (*Chelonia mydas*) and Hawksbill turtle (*Eretmochelys imbricata*).
- A number of heronries are formed here during monsoon, which harbour large bird populations, which come and breed here. Also, during the winters it is home for Trans- Himalayan migratory birds. Goliath heron (*Ardea goliath*) is another important bird is found in the area.
- Two species of horse shoe crabs (which are considered as living fossils as they are thought to be more than 400 million years old), *i.e.* *Tachypleus gigas* and *Carcinoscorpius rotundicauda* out of the four species found in the world are found here.



# Background Information and Attributes

## 2.1 GEOLOGY, ROCK AND SOIL

The deltaic region of South Bengal is covered solely by the quaternary sediments carried and deposited by the river Ganges (Hooghly), Matla and Bidyadhari river courses. (Fox C S. 1938). Geologically there are two major groups of deposits (GSI, 1974) are found here:

- (i) **Quaternary:** Recent to sub-recent ie Newer alluvium. Consist of sand, silt, clay and pebbles.
- (ii) **Pleistocene:** Older Alluvium. The pleistocene deposits comprise of clay, silt, kankar and boulders (assorted), which are locally cemented. These are characteristically coloured as reddish brown on the exposed surface.

The Sundarbans delta is the largest prograding delta of the globe. The formations of different lithologic units of deltaic deposition in this system took place at major shifts of strand lines. The high strand shoreline was far west 2,15,000 years back, a strandline change took place 82000 years back and the present deposition of detritus formed since last 6000 years of stable phase. There is general slope towards south as well as west to east. The upper 100 m. layer is composed of thick clay with occasional clay balls. There occurs an unconsolidated sediment at 137 to 152 m. depth composed of sand, silt and clay and gravels of varying colours. This serves as boundary of upper aquifer. At about 350 m. level there lies a second aquifer of potable water. The whole sediment is composed mainly of montmorillonitic, which is very sticky. They are derived from the basic and semi-acidic rocks like Dolerite, Gneiss and Mica schists lying within the course of Ganga flow. Soil salinity reaches upto 3%. Older the sediments, higher is the salinity within Tiger Reserve area.

The Sundarbans saline soils are considered to cause higher plant mortality and the white salt encrustations are very often visible on the soil surface. The salinity rises to the maximum in the middle of May and decreases on the onset of monsoon. The salt contents are of mostly chlorides and sulphates of sodium, magnesium and calcium, though bicarbonates are also present in traces. The subsoil layer remains under reduced condition along with mottles of different sized dark coloured horizons. The soil is slightly acidic to alkaline, pH ranges between 5.4 and 8.5 in reaction. Salinity rises with the age of the sediment, older the sediment, higher is the salinity within the Tiger Reserve area. pH has been reported by the Management Plan of STR – 2000-2010 (Anon, 2001) to be as low as 6.9 in case of *Excoecaria - Ceriops* association and as high as 9.7 in case of *Rhizophora - Bruguiera* association. In submerged condition and with higher salinity, the decomposition of the organic matter is less as the bacterial population in those areas are generally poor. The organic matter decomposition in these tidal zones are carried out by some facultative and obligate anaerobic bacteria. Mangroves, usually have a low decomposition rate of root biomass relative to root production, which results in the accumulation of organic matter in the soil.

The average elevation varies from 5.8 m. to 6.1 m. above msl with several low-lying depressions.



## 2.2 HYDROLOGY AND WATER SOURCES

### 2.2.1 River systems

A close network of rivers, channels and creeks intersects the whole area, which has resulted in formation of innumerable flat islands. These are submerged completely during high spring tides and partially during ordinary high tides. The main rivers in and around the Reserve area are Matla, Bidya, Gomdi, Goasaba, Gona, Jhilla, Kapura, Raimangal, Harinbhangra and Kalindi. The existing large rivers running north to south are the remnants of the old courses of the Ganga. During the 16<sup>th</sup> - 18<sup>th</sup> Century the Bengal basin was affected by a neo-tectonic movement by way of which an easterly tilt came along a hinge zone, *i.e.* from Sagar to north of the district of Malda, West Bengal, and then gradually curving towards Dhaka, Bangladesh. As a result of the trend of surface elevation contours ENE-WSW, the present course of Ganges, which used to flow along the course of Tamralipta till 12<sup>th</sup> Century A.D., started flowing along the river Padma within Bangladesh leaving Hooghly as a mere tidal channel. Even till the early eighties the tidal effect of Hooghly could be felt upto 281 km. upstream upto Nabadwip in the district of Nadia, West Bengal. During this period the Matla and Bidyadhari river system formed innumerable network of creeks between Ganges and Padma, however, these river systems got completely cut off from sweet-water source and are presently fed by the back-waters of sea.

During the rains the Raimangal receives an overflow of the Ganga through the Ichhamati, which connects them. All the rivers receive a considerable quantity of local drainage. The rivers Matla, Saptamukhi and Thakuran lying on the Western side of the Reserve have practically no connection with their original parent stream and are now creeks of the sea. These are highly brackish all the year round in comparison with the Hooghly and the Raimangal. The Hooghly is fed mainly by the Rupnarayan and is also connected with the Ganga through the Jalangi and the Bhagirathi. But the estuary of the Hooghly remains brackish even during the rains on account of its great width. With the coming up of Farakka Barrage sweet-water flow in Hooghly has increased and is now brackish below Diamond Harbour. The sources of all the rivers in the western Sundarbans are being progressively silted up leaving hardly any passage for fresh-water, with the result that the rivers are getting more brackish and shallow year after year.

### 2.2.2 Climate

Although the tract is situated south of the Tropic of Cancer, the temperature is equable due to its proximity to the sea. It receives good amounts of rainfall and is humid for most parts of the year. The summer extends from the middle of March to the middle of June and the winter extends from December to February. The climate is more equable in the areas covered by forest than in the neighboring cleared areas. The monsoon starts usually between the middle of June and lasts up to the middle of September. This is followed by autumn lasts from middle of September to November. Overall, the rough weather lasts from 15<sup>th</sup> March to 15<sup>th</sup> September and the fair-weather prevails between middle of September to middle of March.

Every year, 4-5 cyclonic storms are common. Locally known as '*Kaalbaisakhi*', these are of common occurrence in the lower Ganga delta during mid-March – mid-June and occasionally during October–November. During cyclones and storms, the sea or the river-water rises up much more than what it normally rises. The accompanying winds impart it with much force with which the waves dash against the surrounding areas. The funnel shape of the Bay of Bengal in the lower part of the Gangetic delta, poses the most serious threat, from the surges, driven by storm waves (Fosberg, 1971). The role of Sundarbans forest vegetation for reducing and breaking the impact of these cyclonic waves has been documented time and again.

### 2.2.3 Rainfall

The average annual rainfall of the Sundarbans Tiger Reserve is reported to be 1920.30 mm.

#### Relative Humidity:

The average humidity is just over 80 per cent and is more or less uniform throughout the year. During the months of January and February dense ground mists occur in the early morning.

## 2.2.4 Tidal Amplitude

In the Sundarbans high-tides and ebb-tides occur twice daily and the current changes its direction every six hours. The spring tides, which occur at the vernal equinox (March-April), produce the maximum rise and fall, as there is very little current in the rivers during this time. The tidal effect is felt in the rivers far inland beyond forest areas. The tidal current passes from west to east, so the change of tide is earlier in the west than in the east.

The velocity of the tidal current increases in the northern part of the tract where the rivers are narrow and the maximum rise and fall occur where the speed is the highest. Near the sea coast the average rise and fall is about 2.15 m. While a south wind prolongs the period of the flow, a north wind shortens the same. The maximum and minimum tides recorded at Sagar Island (west part of Sundarbans) are given below:

Maximum	5.68 mtrs.
Minimum	0.96 mtrs.

However, as a rule, the flood tide in estuarine system lasts more than the ebb-tides. In the resulting effect, unless there is excess river energy from upstream flush, the decantation of traction load sediments takes place. Thus, these backwater channels are getting silted up day by day. With the change in seasons, tidal interactions in the estuarine system in and around the Indian Sundarbans also change (Pillay, 1958). During the monsoon months, the effect of flood tide is more or less countered and nullified by freshets and there is a strong predominance of ebb-tide. The strength of flood tide over ebb-tide is at a minimum during the post-monsoon season. Conversely, during the pre-monsoon season, the effect of flood tide is considerably stronger than that of the ebb-tide.

## 2.2.5. Water Supply

Cultivation in Sundarbans is solely dependent on rainwater. The fishermen, honey collectors and woodcutters carry large earthen pots for carrying their ration of sweet waters whenever they go to the field. There is acute scarcity of water in the islands of Gosaba, Bidya, Choto Mollakhali, Kumirmari and Samsernagar. A deep tubewell (nearly 300 m. deep) has been sunk at Bidya station and is the primary source of water for all touring launches and few camps where there is no source of drinking water. In addition, this point also regularly supplies drinking water to the West Bengal Tourist Development Corporation's Tourist Lodge at Sajnekhali and other line Departments though on a case to case basis. At present, there are deep tube wells at Jhila-1, Haldi, Dobanki, Khatuajhuri, Harinbhanga, Bagmara, Sudhanyakhali, Netidhopani, and Chamta camps. Among the camps Sajnekhali and Pakhiralaya and Lahiripur along with floating camps, in the Western sector source water from Bidya and Jhingekhali along with the floating camps in the Eastern sector is supplied with drinking water which is sourced from Jhilla and Bagna as till date deep tube well boring has been unsuccessful in these sites. Most of these field camps have fresh water ponds and recently, rain water harvesting has been carried out at Sajnekhali, Pakhiralaya, Jhingekhali and Lahiripur where rain water is collected and stored in large overground and underground tanks. This has given encouraging results and shall be replicated in other camps as well.

In addition to these, sweet water ponds have also been dug for wild animals. These serve as monitoring points for wildlife also. Tanks are generally dug down to the layer of impervious sodic clay. Rainwater collects therein and is subsequently bailed out. By such repeated washing with rain water in about three years a tank becomes sweet. Sweet water in small quantity can sometimes be obtained by digging holes on beach sands. The temporary layers of sweet water float on heavier saline waters as a geomorphologic phenomenon.

Presently these wildlife ponds are there in all major camps like Sajnekhali, Sudhanyakhali, Dobanki, Jhingekhali, Khatuajhuri, Haldibari. Few years back a number of such ponds had been dug up all over the Tiger Reserve to serve as a source of water for the wild animals.



**Table 1:** List of Water-holes (Sweet-Water Pond) in sundarban Tiger Reserve

Sl. No.	Range	Beat	No. of Ponds	Compartment	Name of Pond
1	Sajnekhali Wildlife Sanctuary	Sajnekhali	4 Nos.	Pirkhali – 1 (2 Nos.) Panchamukhani-3 (1 No.) Panchamukhani-5 (1 No.)	Sajnekhali Padmapukur Sudhanyakhali Choragazi Panchamukhani Khal Side
	-do-	Dobanki	2 Nos.	Pirkhali – 5 (1 No.) Pirkhali – 6 (1 No.)	Dobanki Camp side Deulbharani Pond
	-do-	Duttar	3 Nos.	Jhilla – 4 (2 Nos.) Jhilla – 5 (1 No.)	Bijoybharani, Bhajjhora Choto Bhajjhora
2	National Park (W)	Haldibari	6 Nos.	Gosaba-2 (1 No.) Matla-4 (1 No.) Gosaba-3 (2 Nos.) Mayadwip-1 (1 No.) Chotohardi-3 (1 No.)	
		Netidhopani	6 Nos.	Matla-2 (1 No.) Matla-3 (1 No.) Gosaba-1 (1 No.) Netidhopani-1 (2 Nos.) Netidhopani-2 (1 No.)	
3	National Park (E)	Chamta	5 Nos.	Chamta-4 (1 No.) Chamta-4 (1 No.) Chamta-6 (1 No.) Chandkhali-3 (1 No.) Chandkhali-3 (1 No.)	Out side of the camp Chandraduani Chotodhuya Bakultala Chandkhali Bharani
		Baghmara	4 Nos.	Baghmara-4 (1 No.) Baghmara-3 (1 No.) Baghmara-5 (1 No.) Gona-2 (1 No.)	Gona Bhurkunda Gorankathi Baghmara Khal Side Gona Khejurtala
4	Basirhat	Jhingakhali	5 Nos.	Arbesi-1 (1 No.) Arbesi-2 (1 No.) Arbesi-3 (1 No.) Arbesi-4 (1 No.) Arbesi-5 (1 No.)	Outside of Office Compound Outside of Office Compound Jhilla Burirdabri Junction Outside of Burirdabri Camp Kaukhali/Gabboni
	Basirhat	Khatuajhuri	2 Nos.	Khatuajhuri-1 (1 No.) Khatuajhuri-2 (1 No.)	Tushkhali Khal Side North Chara South Chara Junction
		Harinbhanga	4 Nos.	Harinbhanga-1 (1 No.) Harinbhanga-1 (1 No.) Harinbhanga-3 (1 No.) Harinbhanga-1 (1 No.)	Balkhali/Jhill side Cherakarikhali Jhilla Junction Baraharikhali Out side of Harikhali camp
		Jhilla	2 Nos.	Jhilla-3 (1 No.) Jhilla-2 (1 No.)	Kaksa Chilmari

## 2.3 VEGETATION TYPES

Mangroves and mangrove associates constitute the dominant vegetation type of the area. These salt loving plants which are found throughout the tropical and subtropical regions of the world have been variously categorized by different authors. Mac Nae (1968) has designated the total mangrove ecosystem as 'mangal' and the intertidal plant assemblage as 'mangroves'. Tomlinson (1985) has categorized them into

- i) major elements of mangroves,
- ii) minor elements of mangroves,
- iii) back mangroves or mangrove associates. These are highly productive ecosystems with productivity about 20 times that of the average oceanic ecosystem.

These are detritus based ecosystems unlike others which are plankton based. The detritus supplied by this ecosystem triggers the growth of plankton community in the water. This is then fed upon by zooplanktons and juveniles of finfish and shellfish.

The Sundarban forests have been variously classified by different authors. These include:

1. Prain (1903) divided the entire Sundarbans (Sundribans) into three zones, namely—
  - (i) southern coastal strip and south-western part consisting of mangrove species;
  - (ii) central zones of *Heritiera fomes*; and
  - (iii) north-eastern part of Savannah type vegetation.

The Indian Sundarbans falls in the first category. Tansley and Chipp (1926) found that certain conditions of soil make the development of the climatic climax permanently impossible and vegetation ultimately developed on such soil is best considered as an *edaphic climax*. Troupe (1926) shared this view and stated that edaphic forest formations are well represented in India and among the most obvious examples, which may be mentioned, are the mangrove and tidal forests of the littoral region.

2. Curtis (1933) also divided the Sundarbans into three mangrove forest types, these being
  - (i) freshwater forest;
  - (ii) moderately salt-water forest; and
  - (iii) salt-water forest.
3. Champion (1936) classified the tidal forests under primary seral type of moist tropical seral formations and did not regard the mangrove as a climax or pre-climax forest types. He divided the forests of the Sundarbans region into mangrove forests consisting of (i) low mangrove forest; (ii) salt-water *Heritiera fomes* forest and (iii) freshwater *Heritiera fomes* forest. The Indian Sundarbans falls under categories (i) and (ii) while the Sundarbans forest in Bangladesh are at large considered to be representative of category (iii).
4. Champion and Seth (1968) later made one of the most comprehensive assessments of the vegetation communities of the Indian Sundarbans. They divided the forest into categories based on broad characteristics of physiognomy and structure. These communities were defined irrespective of physiographic, edaphic or biotic factors. Champion and Seth (1968) were of the opinion that some communities were clearly associated with a definite site factor, which differed appreciably from the surrounding areas.

According to Champion and Seth's classification falls under sub-group 4B Tidal Swamp forests with sub-divisions mentioned below:

**(i) Mangrove Scrub: 4B/TS<sub>1</sub>**

*Ceriops, Avicennia alba, Aegialitis rotundifolia, Excoecaria agallocha, Phoenix paludosa* (drier ground).

Along the edge of tidal waterways and sheltered muddy coast. Dense forest with average height 3-6 mts. Few species and markedly gregarious, all evergreen with leathery leaves. Vivipary seen. Common in Western Sundarban.



(ii) **Mangrove Forest: 4B/TS<sub>2</sub>**

*Rhizophora*, *Kandelia candel*, *Avicennia alba*, *Excoecaria agallocha*, *Ceriops decandra*, *Ceriops tagal*, *Bruguiera* sp, *Xylocarpus granatum*, *Sonneratia apetala*.

Found on mud banks of of delta streams and near sea-face where accretion is in progress. An evergreen forest of moderate height. Tidal mud permanently wet with salt- water and submerged with every tide. Stilt roots and vivipary seen.

(iii) **Salt-water Mixed Forest: 4B/TS<sub>3</sub>**

*Heritiera fomes*, *Excoecaria agallocha*, *Ceriops decandra*, *Xylocarpus mekongensis*, *Avicennia officinalis*, *Aegialitis rotundifolia* (near sea-face).

*Nypa fruticans* relatively uncommon. Fairly dense forest, more than the fresh-water type but not as high. Rarely over 20 mts. Trees do not attain girth. Ground flooded every tide with brackish water. Less silt deposition than fresh-water type. Less humus, soil stiffer, clayey liable to crack extensively when exposed. Bigger river deltas.

(iv) **Brackish-water Mixed Forest: 4B/TS<sub>4</sub>**

*Heritiera fomes*, *Sonneratia apetala*, *Acanthus ilicifolius*, *Xylocarpus mekongensis*, *Bruguiera* sp, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Ceriops decandra*, *Phoenix paludosa* (high land), *Acanthus ilicifolius*, *Hibiscus tiliaceus*, *Nypa fruticans* (fringing banks).

In the larger deltas, notably of the Ganges. High forests over 33 mts., stilt roots rarely met but pneumatophores present. Forest is flooded for some portion each day the water never very salty and very fresh during rainy season or slightly brackish. Good amounts of fresh silt deposition.

(v) **Palm Swamp Type: 4B/E<sub>1</sub>**

*Phoenix paludosa*.

Seen on drier areas within salt-water mangrove scrub or forest. Forest area is partly flooded for some part of the day.

- Blasco (1975) identified the following 5 species compositions in his classification: (i) back mangroves (euhaline zone), found on the river bank; (ii) dense mangrove consisting of many species of plants; (iii) tall, dense trees of *Heritiera fomes* with primary associate *Excoecaria agallocha*; (iv) brackish-water of mixed *Heritiera fomes* forests with *Rhizophora* species over a very limited area; (v) palm swamps consisting of pure *Phoenix paludosa*.
- According to Blasco (1975) and Champion and Seth (1968) had not considered the anthropogenic and biotic factors for spatial zonation. On the other hand Sidhu (1960) pointed out that as a result of constant biotic interference species of *Acanthus* and *Avicennia* may be generally pioneers.
- Naskar and Guha Bakshi (1982) grouped this forest into five major zones as— (i) sea-face of beach forest; (ii) formative island flora; (iii) flora of reclaimed land and low lying area; (iv) flora of river banks and (v) swamp forest. The first category is dominated by xerophytic plants due to the dryness of the soil and numerous sand dunes. The flora of the formative islands consists mainly of *Porteresia coarctata*, *Salicornia brachiata*, *Suaeda maritima*, *S. nudiflora*, *Phragmites vallatoria* (*P. karka*), *Acanthus ilicifolius* and a few tree species such as *Avicennia*, *Sonneratia* and *Excoecaria*. The reclaimed land and low lying areas are dominated by mesophytic flora while the last two zones are dominated by halophytic mangrove species.
- As per Naskar et al (2010) the total plant species are grouped into 59 families, and 101 genera and 140 species. These comprise of true mangroves or major elements, minor elements of mangroves or and mangrove associates, back mangrove trees and shrubs, non-halophytic non-mangrove associates in the area, halophytic herbs, shrubs, and weeds and epiphytic and parasitic plants. Among the important mangrove families are Rhizophoraceae, Avicenniaceae, Meliaceae, Sonneratiaceae, Sterculiaceae, Myrsinaceae etc. The list of Mangrove and associated species has been given in **Appendix 4**

### Characteristic Features of Mangrove Flora:

Mangrove plants are salt-loving or halophytic plants, which show numerous modifications and adaptations in order to survive in the anoxic, waterlogged saline soils. Few of these are given below:

- There exists extensive lateral root system for a proper anchorage against diurnal tidal inundation/scouring, eg. *Excoecaria* sp.
- Supporting roots like stilt roots or prop roots, root buttress are formed in species like *Rhizophora*, *Xylocarpus*. Vertical knee roots from horizontal lateral roots are given out by species like *Lumnitzera*, *Bruguiera gymnorrhiza*, *Kandelia candel* etc.
- As the lateral roots get submerged due to tidal movement and do to get oxygen breathing roots or 'pneumatophores' have been developed. These roots grow above the earth surface and contain pores called as lenticels through which gaseous exchange occurs. In addition to pneumatophores even the stilt roots contain lenticels as seen in the case of *Rhizophora mucronata*.
- *Excoecaria agallocha* shows perforated burr formation on its stem in more inundated areas, to facilitate gaseous exchange.
- To counter the excess saline conditions outside the plant cells exert very high osmotic pressure in order to draw water from outside salt solution. It has been seen that the cell sap is rich in organic electrolyte in case of *Rhizophora* sp. and inorganic electrolyte in case of *Suaeda* sp.
- The leaves are normally thick and often contains salt excretory channels to deposit crystals and waxes of various composition on leaves. Salt hairs on leaves of *Porteresia coarctata* bursts to excrete salt. *Avicennia alba*, *Acanthus ilicifolius*, *Aegialitis rotundifolia*, *Aegiceras corniculatum* also show salt excretory mechanisms.
- Mangrove leaves have sunken stomata to prevent water loss.
- The fruits of *Rhizophora*, *Bruguiera* etc. germinate right on the tree and fall like a dart on the mud flats to get anchored against tidal inundation. This phenomenon is called as 'Vivipary' and is an adaptation unique to mangrove plants.

These mangroves have also started manifesting quaint adaptations (being out of normal domain), as in case of *Avicennia* species which never throws stilt roots and is an outer estuarine species but, when found in the mid-estuarine creeks at the foreshore gives rise to stilt pneumatophores in order to combat the higher velocity and undermining effect of water. Both stilt roots and normal pneumatophores of *Avicennia* are histologically alike and contain chlorophyll unlike other stilt rooted mangroves. The species like *Excoecaria agallocha* (an inner estuarine species) which normally does not have pneumatophore or stilt root, give rise to perforated 'Burr' formations on the lower stem in order to ensure gaseous exchanges at places where tidal amplitude is more severe, i.e. like the mid-estuarine environment. Thus the mangroves of Indian Sundarbans exhibit a unique pattern of species movement setting the whole consociation in a dynamic state of phyto-plasma, overlapping the normal estuarine modes and developing resultant adaptational abnormalities.

### Succession:

Naskar and Guha Bakshi (1987) worked extensively on the succession of mangrove flora. They identified five ecological succession of the Sundarbans swamp based mainly on tidal magnitude, viz.—

- **Phase I:** Swampy Mangrove or Intertidal Mangrove Zones
- **Phase II:** Tidal Mangrove
- **Phase III:** True Mangrove Decline
- **Phase IV:** colonisation of non littoral species
- **Phase V:** xerophytic non-mangrove and dry evergreen forest

The mangrove forest is a very dynamic eco-system. It is in continuous state of erosion and accretion leading to subsidence or erosion of existing banks and appearance of new lands and mud flats. Mangrove succession starts with the appearance of the pioneer species locally known as dhani ghas or *Porteresia coarctata* on the newly arisen mud flats. With the passage of time this grass species traps the propagules of *Avicennia* and *Sonneratia* sp., which come up well in freshly silted and firm mudflats. Once the land gets consolidated Goran or *Ceriops* sp. and Genwa or *Excoecaria agallocha*



comes and colonises the area. *Phoenix paludosa* considered as the climax species which comes up on high lands and forms gregarious growth.

However, not all areas of the forest contain plant growth. There are some saline blanks, which have been identified with the help of satellite imageries, some of which are saucer and some inverted saucer shaped. These blanks are high lands where water does not reach even during full tides. However, extent of such blanks is very limited. The blanks are generally devoid of any vegetation, but some of these blanks show the signs of primary succession and others contain either scrubby growth of *Ceriops decandra* or scanty growth of *Excoecaria agallocha* (Genwa), *Phoenix paludosa* (Hental). The central section of mangrove patch of the Sundarbans delta between rivers Thakuran and Harinbhanga is typified, by the accelerated geomorphic action of ingressing back waters, which does not get any upstream resistance of sweet-water. This has resulted in movement of plant association within outer, inner and mid-estuaries.

In general, the northern boundary and new depositions are characterised by Bain (*Avicennia marina*, *A. alba*, *A. officinalis*) flanked by foreshore grassland of *Porteresia coarctata*. Bain is gradually replaced by Genwa (*Excoecaria agallocha*) and then Goran (*Ceriop decandra*). About 70% of the area is covered with Genwa-Goran association. There are, however, southern and eastern associations of Garjan (*Rhizophora apiculata*, *R. mucronata*), Kankra (*Bruguiera sexangula*, *B. gymnorhiza*, *B. cylindrica*, and *B. parviflora*) and patches of Sundari (*Heritiera fomes*)–Genwa–Goran. Pure 'Hental (*Phoenix paludosa*) forests exists on relatively high lands. These hental forests are considered as the climax vegetation. *Xylocarpus granatum* and *X. mekongensis* are distributed through out the forests. *Nypa* palm swamp are common on central, eastern and southern portions, along side creeks and rivers having soft mud deposition. The sea-facing areas have *Excoecaria* sp., *Lumnitzera racemosa*, *Saccharum*, *Derris indica*, *Thespesia populnea*, *Ipomea pes caprae* etc.

*Heritiera fomes*, which was once found throughout the area has over the years become confined to the eastern and southern sector. This shift in distribution has been attributed to the gradual reduction of sweet water into the system as the river sources have been cut of from their origin owing to siltation and are purely arms of the sea. Thereby, leading to an overall increase in the salinity regime.

#### **Mangrove species preferred by Wildlife:**

The species most favoured by the herbivores is Keora (*Sonneretia* spp.) whose fruits and leaves are preferred alike by Cheetal and *Rhesus macaque*. Pangas fish has been found to eat Keora fruits. Apart from this, fresh shoots of Hental is browsed by Cheetal and hental fruits are preferred by birds and macaques. Bain and Genwa are also browsed quite often by the herbivores. Succulent tips of dhani ghas growing on newly colonised mud flat have also been seen to attract cheetal groups.

## **2.4 WILD FAUNA AND HABITATS**

### **2.4.1 Historical Perspective**

A detailed account of the wildlife, which was once present in the area is given in the **Hunter's Statistical Account of Sundarbans (1878)**. Some excerpts of which are reproduced below:

"Tigers, leopards, rhinoceros, wild buffaloes, wild hogs, wild cats, bara singa or large deer, spotted deer, hog deer, barking deer, porcupines, otters, and monkeys are the principal varieties of wild animals found in the Sundarbans. Tigers are very numerous, and their ravages form one of the obstacles to the extension of cultivation.

The serpents found in the Sundarbans are the boa constrictor, cobra-di-capello or gokhura, kuriat, sankhachur or saltwater snake, gosap and green viper.

**The Birds of the Sundarbans comprise the following:** Adjutants of two kinds, viz. *Ardea gigantia*, and the Marabout adjutant–vultures, kites, hawks, owls, mainas, doves, green pigeons, parrots, parroquets, jungle-fowl, woodpeckers, sandpipers, egrets, waders, large and small spoonbills, pelicans, storks, paddy birds of several kinds, herons, snipe, crows, several varieties of kingfishers, divers, hornbills, jays, orioles, teal, seagulls, curlew, Indian pheasants, waterfowl, reedbirds, plovers, partridges, and a great variety of wild geese and ducks.

FISH abound in nearly all the rivers. Porpoises and crocodiles (commonly called alligators) abound, but the latter are less numerous than they were twenty years ago.

Sharks, also, are by no means uncommon in the larger streams and estuaries. No trade is carried on in wild beast skins, with the exception of the skins and horns of the spotted deer, which are sold for a trifle, and to a very small extent”.

However, over a period of time we have lost a number of animals due to ecological changes, habitat degradation, and related anthropogenic activities. Some of the animals, which were once present but have been lost include:

The animals that once existed in Sundarbans and have become extinct over a period of time include:

1. **Javan Rhinoceros (*Rhinoceros sondaicus*):** Remains of this animal were found in pond excavations in upper layers collected in 1870, displayed in Indian Museum, Calcutta. According to **Gupta (1964)** the last reports of evidences proving the presence of the Javan Rhinoceros in the Sundarban mangals dates back to the year the year 1888. In April 2000, skeletal remains of *R. sondaicus* were found 2.7 meters below the surface by the side Mollakhali island under Gosaba P.S.
2. **Wild Buffalo (*Bubalis arnee*):** The wild buffalo roamed about in the Sundarbans till 1885 and died out by the end of the 19<sup>th</sup> Century. According to **Gupta (1964)** the last reports of evidences proving the presence of Wild Buffalo in the Sundarbans mangroves dates back to 1890. On 3<sup>rd</sup> March, 2001, some bones were recovered from Netidhopani (Compartment 1) within the Sundarbans Tiger Reserve, which was badly eroded by recent storms. The bones were sent to ZSI for identification and were identified as the bones of Wild Buffalo.
3. **Swamp Deer (*Cervus duvaucelli*):** This animal existed in good numbers till the earlier part of the present century. Probably got extinct by 1930.
4. **Barking Deer (*Muntiacus muntjak*):** Barking deer used to exist in the southern portion of the Sundarbans, even upto 1976. It was seen in Halliday Island and Bulcherry area.
5. **Hog deer (*Axis porcinus*):** It was reported from Sundarbans till 1945.

Over the years, excavations have yielded evidence of the presence of these animals in the area. In the recent past, fossil of ***Rhinoceros sondaicus*** have been collected from Bakkhali. Fossils of sweet-water tortoise and jaws of Gharial (*Gavialis gangeticus*) were found in the excavations of Dumdum near Kolkata along with stumps of Sundari (*Heritiera* spp.) and fruits of *Derris* and *Cerriops*. Sweet-water enabled the survival of Javan Rhino, water buffalo and swamp deer within mangrove forests of Sundarbans until the last Century.

#### **The Current Status:**

Mangrove fauna in general, is found to occur in both the terrestrial and the aquatic ecosystems. These areas can be differentiated as littoral or supra-littoral forests, inter-tidal mudflat and estuary. The littoral or supralittoral (*i.e.* areas beyond the high tide) forest biome is typically a terrestrial environment, which includes both aerial and arboreal forms and the soil inhabitants. The intertidal (region between high and low tide) mudflats are essentially semi-terrestrial or semi-aquatic habitat supporting mainly the soil forms and the benthos. While the other faunal components in the mudflat and estuary can broadly be divided into zoo-plankton, nekton and benthos. Several species of crustaceans and larvae of fishes form the main component of the zoo-plankton in this region. The pattern of distribution of animals in mangrove eco-system is influenced by the substratum, salinity, tidal amplitude, vegetation, light, temperature etc.

#### **LITTORAL OR SUPRALITTORAL FOREST FAUNA**

The supra-littoral forest habitat includes area where water may or may not reach at all and is essentially densely covered with halophytes. It offers forest floor, roots, stems, branches and leaves of trees as the abode. Mangrove forests here are



inhabited by terrestrial animal communities. They may occupy tree or ground or both. Most of the mangrove animal communities should distinct zonation in relation to tidal height, but the tree fauna exhibit vertical zonation in the vegetation.

### **The Arboreal Community:**

Animals under this community include both aerial and arboreal forms. The upper canopy of mangrove trees is the home of birds, bats, monkeys and insects. But such as the *Pigmy pipistrella*, *Pipistrellus mimes* can be found flying on the onset of evening inside the Tiger Reserve areas. The Rhesus macaque (*Macaca mulatta*) the only species of primate occurring in the Sundarban is well-distributed in the entire forest. They are often found feeding on Keora trees (*Sonneratia apetala*) but are also well adapted to crab eating. It is interesting to note that the herds of deer follow the troops or Rhesus Monkey from one Keora tree to another in search of leaves what the monkeys drop from the trees tops in course of their feeding; the deer also get advance information about the movement of the tiger from the monkey's call. The wild boars are seen burrowing beneath the roots of Ceriops, Hental for roots and tubers. Mammals, reptiles, birds etc. are also seen inhabiting cavities of *Sonneratia*.

Many species of birds build their nests in the mangrove trees. Herons, Egrets, Cormorants and Darters enjoy roosting in colonies on the tall trees of Bain, Sundari and Genwa. The *Sonneratia* tree is especially preferred by parakeets and woodpeckers, many snakes, water monitors and even otters have been seen living in the hollows of this tree. Several species of birds use trunk, branches and aerial roots of mangrove as observation posts for feeding on fishes, molluscs, crustaceans and aquatic insects.

Honey bee, *i.e.* *Apis dorsata* is responsible for pollination in about 80% of the mangrove species thereby plays a very important ecological role in the mangrove forests. These bees are known to build their honeycomb inside the forest in large numbers. Yearly more that 20 tonnes of honey is produced by the bees in the entire Sundarbans area. About 39% of honey are produced from *Excoecaria agallocha* (Genwa), 16% from *Avicennia species* (Bain), 11% from *Ceriops species* (Goran), 10% from *Rhizophora species* (Garjan) and only 24% from the rest of the plants. *Phoenix, Excoecaria* (Hental-Genwa) association is thought to be the ideal sites for honey comb formation.

### **Terrestrial/Aquatic Community:**

#### **Mammals:**

The terrestrial mangrove eco-system in Sundarbans is the domain of the Royal Bengal Tiger, *Panthera tigris tigris*, which is at the apex of the food chain. It leads an almost amphibious life and is an excellent swimmer. It has been seen to cross rivers as wide as 2 km. at a stretch. It has adapted itself nicely to this difficult terrain which is characterized by sharp pneumatophores, muddy substratum, innumerable rivers and creeks with tidal rhythm, variable salinity and lack of freshwater source. The principal prey species of the tiger are spotted deer, wild boar, and *Rhesus macaque* who also swim across the streams and water channels. In addition, it also feeds upon fish, crab and water monitor. In one instance, a post-mortem of a dead animal revealed the presence of a Monocellate cobra and a King cobra from the stomach of the animal. This is only one of the very few recorded instances of tigers eating King cobras. The man-eating trait of Sundarban tigers have become almost a legend in Bengal and elsewhere. It is considered that man-eating propensity of tiger in this area is an acquired trait over a period of generations given the harsh surrounding conditions. It has been noticed that in the last 10 years apart from one case where the tiger had accidentally killed a girl. All the deaths have occurred inside the forest. This peculiarity in the tiger behavior has been explained by various experts that within the forest area, *i.e.* their habitat, they consider all moving objects as their prey. It is generally believed that the tigers in this mangrove forest do not have territories due to the obliteration of urination marks by the tidal waters. However, this is yet to be borne out by scientific facts. Recent data from radiocollared tigers reveals that the animals are using specific areas possibly indicating territoriality.

Though the tigers may breed at any time of the year but in Sundarban it has been observed that the mating season starts in winter and continue up to March - April. During this period, males often fight with each other but there has never been any report of fatal fights in Sundarban. General gestation period of tiger is 95 to 110 days. In Sundarban the litter size of 1 to 2 is very common and rarely three or more cubs have been sighted. Usually cubs stay with their mother upto 2 to 3 years but in Sundarban it is seen that they are separated by the time they are two years old approximately. Generally, inter-cub interval of tigress is approximately three years but not much observation has been made regarding Sundarban tigers due to difficult terrain and their man-eating propensity. Occasionally, up to five tigers have been sighted together in Sundarbans. This could be a case of the sub-adults with the male and female.

Based on the preliminary results of the radio telemetry studies in Bangladesh Sundarban (Barlow,2008) documented home range sizes for two adult females of between 12 and 15 sq. km. Also, studies conducted on the skulls of Bangladesh Sundarbans tigers (Barlow, 2008) found that it is significantly different craniometrically from all other currently defined subspecies, both in terms of size and shape. This distinction was most notable for male tigers, which tend to have more variable morphology than females. This findings add to previous work on tiger craniometrics that found substantial differences between the mainland and Sunda island. As per Mukherjee, general osteological study of selected long bones of Sundarbans tiger reveals that different parameters of all bones are somewhat lesser than corresponding long bones of Indian tigers of other region such as tiger of Project Tiger Melghat, Amaravati. Skull size of Sundarbans tiger is lesser than that of Melghat tigers. (Pandit, 1994)

Apart from the tiger, the secondary predators are mainly the fishing cats (*Prionailurus viverrinus*) and to some extent the jungle cat (*Felis chaus*). They feed on small birds, snakes, fish etc. Among other ground dwelling fauna are Spotted Deer (*Axis axis*), wild boar, (*Sus scrofa*). The wild boars feed on underground tubers but also relish dead fishes, prawns, crabs, molluscs and sea turtle eggs. The Spotted Deer preferably browse on leaves, twigs and fruits of Keora (*Sonneratia apetala*) 'Bain' (*Avicennia officinalis*) and Genwa (*Excoecaria agallocha*).

The cetaceans like Gangetic Dolphin (*Platinista gangetica*) and the Irrawaddy Dolphin (*Orcella brevirostris*) are frequently found in the eastern side particularly in rivers like the Raimongal, Goasaba, Matla and the sea-facing areas. The Black Finless Porpoise (*Necmeris phoceanoides*) is also found in rivers near the estuary. Detail list of fauna is given in **Appendix 5**.

### **Reptiles:**

The estuarine crocodile (*Crocodylus porosus*) is the top-most predator in the aquatic eco-system. Apart from the estuarine crocodile, the water monitor lizard (*Varanus salvator*), which reaching upto 2.4 mtr. in length, can be frequently found within the Reserve. The sea-facing beach of the Reserve forms a nesting ground for olive ridley sea turtle (*Lepidochelys olivacea*), which come to lay eggs on the sandy beaches of the Tiger Reserve. The egg laying is sporadic and takes place mainly during December to March. The water monitors are the greatest predators of their eggs and hatchlings along with wild boars, terns and sea gulls. The critically endangered Northern River Terrapin (*Batagur baska*) also uses the beaches as their nesting ground. The Mechua beach in Bagmara block is an important nesting ground for such terrapin. Dr A.K. Mukherjee of ZSI has recorded other coastal soft-shell turtle (*Pelochels bibroni*), Bengal eyed terrapin (*Morenia ocellata*) and three keeled terrapin (*Geomyda tricarinata*) from the area. Occasional reports of presence of green sea turtle (*Chelonia mydas*) and Hawksbill turtle (*Eritmochelys imbricata*) have also been received.

Since the 1980's ex situ conservation program was started and eggs of the turtles were collected from turtle pits and incubated at Sajnekhali. The hatchlings were subsequently released in the sea. This practice has been subsequently discontinued and now in situ conservation of the turtle is carried out on the beaches. The egg pits are surrounded by wire meshes to prevent the eggs from being destroyed by the wild boars and water monitor lizards. After hatching the wire mesh is removed and the hatchlings move out into the sea. Similarly, an ex situ conservation program for the estuarine crocodiles is going on at Bhagbatpur. The crocodiles reared here are released into the tidal waters. This is an ongoing program.



Around 53 species of snakes are found in the area. Prominent among the poisonous are the king cobra, monocellate cobra, banded krait, Russell's viper, common krait. The python, chequered keelback, dhaman, green whip snake, ornamental snake, and several other species constitute the non-venomous snakes. The tidal creeks also harbour Homalopsid snakes adapted to living in water, the most common being the *Cerberus rhynchops* or dog-faced water snake. Snake bite cases are very common in the fringe villages between July and October, especially due to cobra and krait. Detail list is given in **Appendix 6**.

#### **Avifauna:**

There are over 200 species of birds, which have been recorded from the area as per the bird surveys conducted in the area. These include a large number of migrants from the higher latitudes that visit the area in winter. During the monsoons heronaries develop in Arbesi and Jhilla block. Common birds found in the area include herons, egrets, darters, spoonbills, cormorants and storks etc., which come out and nest in the area. Earlier there was a heronry around Sajnekhali covering 1.5 sq. k.m. area, which used to develop from June to end of September. However, this nesting ground suffered intense damage during the cyclone of 1988 and is no more active.

The bird species, which are most abundant in the Sundarbans Tiger Reserve include the Common Sandpiper, Indian Ringed Dove, Whimbrel, Tailorbird, Black-capped Kingfisher, Jungle Myna, Rose-ringed Parakeet, Large Egret, Bronzed Drongo, White-collared Kingfisher, Mag-pie Robin, Pond Heron, Common Iora, and Red-vented bulbul.

The mangrove is also known as the kingfishers paradise with 8 species out of 12 species of kingfishers found throughout the country are found here. Apart from these, few of the birds found in the area are Large and median egret, brahminy kite, white bellied sea eagle, lesser adjutant stork, osprey, Goliath heron, whiskered tern, brown winged gull, whimbrel, common sandpiper, jungle myna, rose ringed parakeet etc. A detailed list is given in **Appendix 7**.

#### **Aquatic Community:**

Aquatic habitat has not yet been studied in full details. However, some works have been done by ZSI. The most interesting is the formation of Phytoplankton in the shallow clear water of the tidal creeks receiving enough sunlight for a luxuriant growth. The phytoplanktons are the sources of augmentation of oxygen content in the water. This influx, however, is checked by the zoo-plankton particularly by the shrimp population, which invade mangrove estuary during the semi-larval stage to adult stage. The zoo-plankton consumes the phytoplankton and diminishes the oxygen content and the whole equilibrium is also controlled by the seasonal salinity of the creeks. The total catch fish diminishes to a minimum during the highest salinity as has been recorded by Chakraborty and Chaudhury. The micro-organisms, like *Noctiluca*, dinoflagellates produce bioluminescence during winter night particularly near the sea-face and entire atmosphere turns into a fairy land.

#### **Fishes, Crabs etc:**

A wide and varied assortment of fishes, molluscs, crabs and prawns inhabit the estuaries. The mangrove leaves, which decompose slowly, offer food and shelter for the larval shrimps and they migrate from the sea to the mangrove estuary for attaining maturity. Even the snappers or mullets depend very much on the mangroves. Mulletts like Bhetki and Bhangor constitute the main form the edible fishes in the area. The studies of fish made by Shri Chaudhury and Chakraborty also reveal that *Pangasius pangasius*, i.e. Pangas fish is the primary heterotrophy, which often swallow full keora fruit. The amphibious mud skipper fish such as *Periophthalmus* and *Boleopathalmus* arouse considerable interest. The former creeps up the trees with the rising water level. Among the crustaceans, the one-armed fiddler crab (*Uca* species) often shows off to his mate with the colourful arm. They have diurnal clock inside which regulates their colour change along with tides. Another interesting crab is the *Clibarius padavensis* (deman), i.e. Hermit crabs occupying gastropod shells of genus *Telescopium*, *Nerita*, *Cerithidea* or *Semifusus*, apart from the edible crab *Scylla serrata*, there are 11 species of crabs found within the creek waters. Amongst which ghost crab and patal chingri (*Thalacina anomala*) are important ones. Marine borer like *Teredo* often causes concern to the watercrafts.

There are two species of trilobite, viz. *Tachepleursgygus* and *Carcinoscropius rotundicauda* commonly known as Horse shoe crab or king crab. King crabs are now protected owing to its ability or high sensitivity to bacterial endotoxins. The cell lysates obtained from the blue blood of the species is widely used for estimation of bacterial endotoxin. They have hardly changed in 400 million years are also called living fossils. They visit Sundarbans during pre monsoon season (March to June) when the salinity reaches its peak. During this season they are found mating in mangrove creeks and mudflats. They are often killed by people owing to the belief that they can cure arthritis.

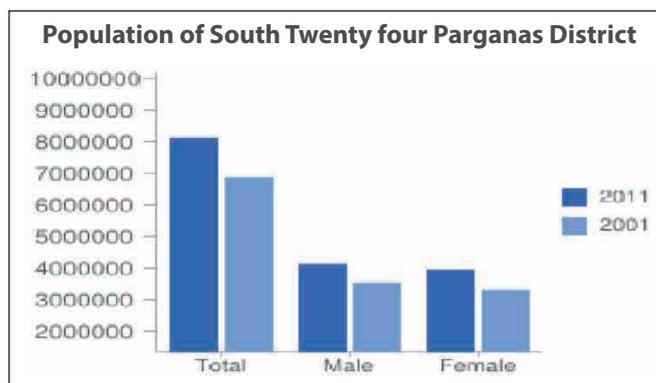
The fish fauna of the estuarine waters in and around the Sundarbans have been classified into residents and transients (migrants). The residents include *Mugil parsia*, *M. tade*, *Polynemus paradiseus*, *Polydactylus indicus*, *Otolithoides biauritus*, *Lates calcarifer*, *Hilsa toil*, *Arius jella*, *Harpodon nehereus*, *Ilisha elongata*, *Pama pama*, *Sillaginopsis panijus* etc. The transient or migratory fish which enter the estuary for a short time mainly to spawn include *Tenualosa ilisha*, *Pangasius pangasius* and *Polydactylus indicus* etc.

The sharks and rays found in Sundarban include the Ganges shark (*Glyphus gangeticus*), Small toothed saw fish (*Pristis microdon*), Pointed saw fish (*Anoxypristis cuspidate*), and white spotted shovel nosed guitar fish (*Rhynchobatus djiddensis*) all of which are Schedule-I species in the Wildlife (Protection) Act, 1972. In addition to these, the following are also found— *Rhinobatus granulates*, *Himantura alcockii*, *Rhinoptera javanica*, *Sphryna zygaena* etc.

Detailed list of fishes and crabs species recorded so far in the area is given in **Appendix 8**.

## 2.5 MAJOR CONSPICUOUS CHANGES IN THE HABITAT SINCE INCEPTION

1. Exponential increase in the fringe human population leading to increased pressure on the natural sources.



Description	2011	2001
Population	81.62 Lakhs	69.07 Lakhs
Actual Population	8,161,961	6,906,689
Male	4,173,778	3,564,993
Female	3,988,183	3,341,696
Population Growth	18.17%	20.85%
Area Sq. Km	9,960	9,960
Density/km2	819	693
Proportion to West Bengal Population	8.94%	8.61%
Sex Ratio (Per 1000)	956	937
Child Sex Ratio (0-6 Age)	963	964
Total Child Population (0-6 Age)	1,025,679	1,050,120
Male Population (0-6 Age)	522,552	534,626
Female Population (0-6 Age)	503,127	515,494

2. Due to siltation in the upper reaches of the river as a result of which there is no fresh-water inflow into the system. The rivers now are just extended arms of the sea. This change has been reflected in the gradual reduction of the Sundari trees, which are now mostly confined only in the Southern and Eastern sector.
3. Many of the upstream rivers have silted up which is becoming a problem in the navigation of watercrafts.
4. Largescale silting up of the Shakunkhali khal in Bashirhat range. It is hardly 2-3 mts. wide at a few places. It poses a threat of encroachment in the coming future.
5. A continuous cycle of erosion and deposition has led to decrease in the area of certain blocks and compartments and increase in the area of others. The accretion is more in the southern blocks and erosion more in the northern side.

## BIODIVERSITY OF STR



**Northern river terrapin**



**Buffy fish owl**



**Rhesus macaque**



**Water monitor**

## LOCALLY EXTINCT SPECIES OF STR



**Barking deer**



**Swamp deer**



**Hog deer**



**Javan rhinoceros**



**Asiatic wild buffalo**

## DIFFERENT LANDSCAPES OF STR



***Sonneratia* forest**



***Phoenix paludosa* forest**



**Mixed forest patch**



***Avicennia* forest**



***Aegiceras corniculatum* forest**



***Nypa fruticans* forest patch**

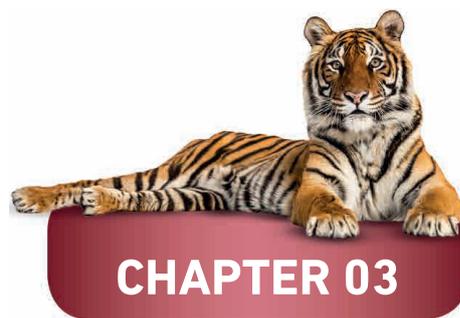


**Grass patch**



**Sand beaches**

# Status of Tiger and Co-Predators



## 3.1. DISTRIBUTIONS

Tigers are found throughout the area. This has been evident by the direct and indirect evidences like pugmarks and scat as observed by the field staff, researchers, etc. While patrolling and monitoring in and around the area. This has also been carried out by the All India Tiger Estimation exercise which was completed in December, 2018. Apart from the tiger, the other co predator on land is the fishing cat. It is very difficult to sight the animal however the widespread presence of the animal has been confirmed through camera trap captures throughout the Tiger Reserve. In the aquatic system the estuarine crocodile is the topmost predator. It is also distributed all the over Sundarban landscape.

## 3.2 ABUNDANCE STATUS

Though all of these animals are present throughout the area as is seen in the daily wildlife monitoring programs and also in the All India predator and prey monitoring exercise. According to these the tigers are fairly abundant. However, the status of the fishing cat and estuarine crocodile cannot be commented on pertaining to the dearth of adequate data. There have been no dedicated surveys for determining the population of these especially the estuarine crocodile.

## 3.3 PREY–PREDATOR RELATIONSHIP

The tiger is the top-most predator in the terrestrial ecosystem. Its principal prey species are Spotted Deer, Wild Boar and Rhesus macaque. The analysis of the 113 scats reveals the presence of eight prey species with a high prevalence of the medium sized ungulates, viz. the deer and wild boar. This is because large sized ungulates have long become extinct from this eco-system. Together with deer and wild boar there are a lot more species in the form of Rhesus monkey, water monitors, different species of turtles, fish and crabs upon which the Sundarbans tiger feeds. This diversity in food habits has enabled the tiger to adapt to the adverse environment of Sundarbans.

The Sundarbans tiger have tendency to attack inside the forest, however they have not ventured out to kill humans in the village area. Water Monitor is formidable predator for the nesting birds and Olive ridley turtles. The crocodiles which feed on aquatic animals and predator fishes in turn help to increase the population of edible fish.

## 3.4 ASSESSMENT OF THREATS

There are many threats both to the ecosystem and the fauna inhabiting the area. First is the destruction of habitat by the local communities having a natural resource dependency. Poaching is another threat as the spotted deer and wild boar were traditionally eaten by the locals especially on festive occasions. In addition to these, destruction of habitat by upstream effluents, soil erosion also poses serious threat to the area. Destruction of seeds of various fish in the process

of catching tiger prawn seeds is also one of the major threats, which shall have an adverse effect in maintenance of ecological balance in the area on account of elimination of different species of fauna. It has been calculated that with every single tiger prawn seed, 46.7 other prawn seeds, 4.1 fingerlings of fishes and 0.3 other aquatic fauna (crustaceans and annelids) get trapped and most of them do not survive later on.

All these have been dealt in detail in the proposed management.

### Distribution of Tiger in Sundarban

#### All India Tiger Monitoring exercise 2010

In 2010 camera trapping has been done in only few points on experimental basis.

Due to the unique and hostile habitat of the Sundarbans the methodology used across India (Phase I) for monitoring tigers and their prey could not be applied. We adapted the methodology to suit the environment of the Sundarbans. Since it was not possible to walk in the mangrove forests for recording tiger sign encounter rates due to lack of proper animal trails as well as the ever present threat of tiger attack, we used tidal channel searches across the Sundarbans to record sign and animal encounter rates. One hundred and twenty-six boat transects with an effort of 1163 kms were sampled across the entire tiger reserve. A similar approach has also been used in the Bangladesh Sundarbans as well (Barlow et al. 2008). The sign intensity data across the Sundarbans constituted the Phase I data set. We then used a combination of satellite-telemetry and camera traps to estimate home range size, population and density of tigers (Phase III).

### Collaring of Tigers

A total of five tigers, 2 adult females and 3 adult males were tagged with satellite radio collars as a part of an on-going study on the Sundarbans tigers. The tigers were trapped in cages using bait and were anesthetized using 3 mg/kg Ketamine and 1.5 mg/kg Xylazene (Kreeger, 1996) administered intra muscularly using a blowpipe. The satellite collars (VECTRONIX GPS Plus) weighed less than 1.5 % of the body weight of the tigers. The collars were programmed to provide GPS fixes every 30 minutes during phases of intensive sampling and later remotely reprogrammed to provide five GPS fixes per day to conserve battery power. Locations of tigers were analysed with ArcView v3.3 software (ESRI, Redlands, California) and Animal Movement extension v1.1 (Hooge and Eichenlaub 1997), to construct Minimum Convex Polygon (MCP) (Mohr and Stumpf 1966) and Fixed Kernel (FK) (Worton 1989) home ranges. Activity time periods, frequency of crossing water channels of various widths, and distances moved within a day were also computed



**Figure 1:** Home ranges of collared tigers (n = 4) in the Sundarbans.  
*Note:* the Khatajuri tiger moved into Bangladesh and its home range covered the entire Island of Talpati. It was possible to track this tiger due to the satellite link of its collar.

**Table 1:** Home Ranges of Radio-collared Tigers (n = 4)

Individuals	Total Fixes	95% Fixed kernel (km <sup>2</sup> )	100% MCP (km <sup>2</sup> )
Sona Gaon Female	454	474.9	335.8
Netidhopani Male	680	116	207.1
Dhubni Male	122	75.3	92.9
Khatuajhuri Male	929	156.3	120.5
Average		205.6	189.1
SE		45.6	54.6

Due to the difficulty of walking in the mangrove forests and locating game trails for setting camera traps, camera traps had to be deployed in a systematic grid based approach used across India. Instead, camera traps were set up at strategic locations, near fresh and brackish water ponds, using attractants to lure tigers to our camera stations. Fishing nets were used to orient the approaching tigers to get proper flank photographs for uniquely identifying each tiger from its stripe patterns. Estimation of tiger population has been done in a mark re-capture framework with closed population estimators in an area of about 200 km<sup>2</sup>. This setup allowed us to estimate population size reliably. But due to the small number of camera stations (12) and uneven geographical spread of camera traps, it was not possible to obtain a reliable estimate of mean maximum distance (MMDM) moved by recaptured tigers nor use the spatially explicit models (Efford *et al.* 2009) effectively. Models estimating effective trapping area attempt to estimate home range radius either by estimating MMDM or through centers of activity, in the case of the Sundarbans we had direct estimates of home ranges based on telemetry data. Therefore used home range radius from 95% fixed kernel area estimates of tiger home ranges were used as a buffer to the camera trap polygon for estimating effectively trapped area. The telemetry data suggested that though tigers do cross wide channels, crossing of channels >1 km in width was rare. Therefore a habitat mask was used wherein channels >1km in width were considered barriers to movement over the short term duration of the camera trapping exercise.

Ten adult tigers and two cubs were photo-captured. The best model selected by CAPTURE was model Mh (incorporating individual heterogeneity) and the population estimate was 11 (se 3) tigers. The home range radius of four satellite-radio tagged tigers was 6 km and was used to calculate the buffer width around the camera trapped polygon, giving an area of 438 km<sup>2</sup>. After applying a habitat mask bounded by channels >1 km the effectively camera trapped area was 257 km<sup>2</sup>. Tiger density was computed to be 4.3 (se 0.3) tiger per 100 km<sup>2</sup>.



**Figure 2:** Map showing the camera trapped study area with (A) Camera Trapped area buffered by the Home Range Radius; (B) Habitat mask defined by channels > 1km width; (C) Effectively camera trapped area (257 km<sup>2</sup>)

Since tiger occupied area of the Sundarbans Tiger Reserve was 1645 km<sup>2</sup> and the tiger signs were found throughout this area with a similar variation across the Tiger Reserve as found within the camera trapped area, it would be possible to extrapolate this tiger density across the reserve without much loss of accuracy. Ideally, 2-4 additional camera trap replicate areas need to be sampled and additional data from radio collared tigers are needed to provide more accurate and precise estimates of tiger density. But till these are obtained, this first quantitative assessment estimates the number of tigers to be around 70 (64 to 90) tigers for the Sundarbans Tiger Reserve (in 1645 km<sup>2</sup>).

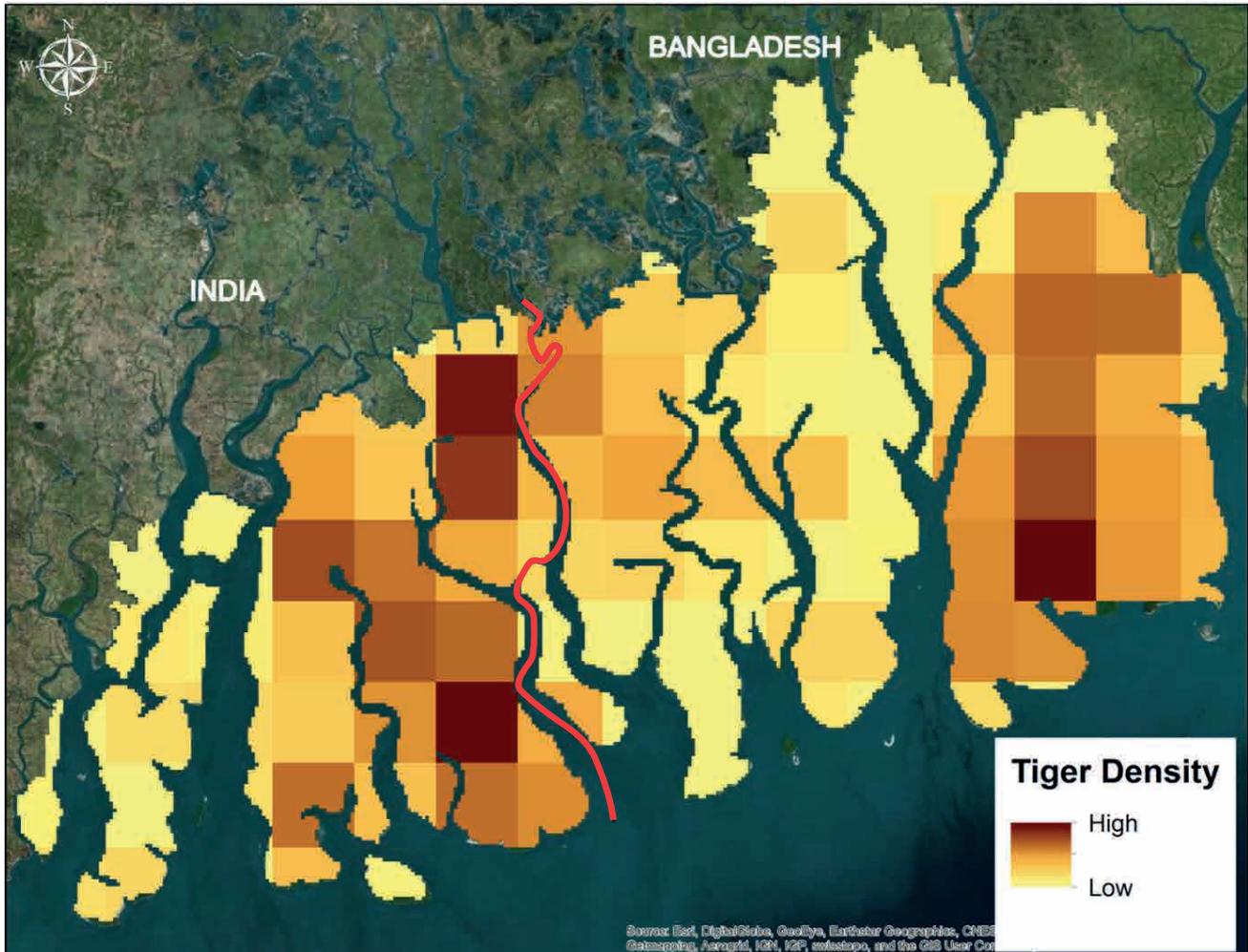
The Principal Chief Conservator of Forests has communicated to NTCA through their letter No. DO No. 12119/CS/2M-22/09(Pt.II) Dated 30-03-2011, that they were not satisfied with the methodology used for population estimation of the Sundarbans tigers. Further refinement in methodology, involvement of other institutions is needed and mention must be made that the 2010 estimate is subject to further study and by better methodology.



**Figure 3:** Map showing Tiger occupancy, home ranges of radio-collared tigers and camera trapped area in the Sundarban Tiger Reserve.

### All India Tiger Monitoring exercise 2014

The information on the encounter rates Tiger and its prey base obtained from the camera trapping exercise conducted as a part of All India Tiger Estimation, 2014, has been used to prepare maps in GIS Domain to get the spatial distribution of the key species of Sundarban Tiger Reserve. Maps of distribution of key species Sundarban Tiger Reserve is given below.



**Figure 4:** Tiger density across Sundarban obtained from camera trap based spatially explicit capture recapture and covariate based regression model (Jhala et al. 2016)

### Distribution of tigers within tiger reserve according to 2014 census:

Name	No. of days sampled	No. of camera locations	No. of individuals captured (Mt+1)	Bounding polygon area (sq. km.)	Model with lowest AIC values in secr	Density (SE) in tigers/100 sq.km.	g0 estimate (SE)	$\sigma$ (SE) estimate in km.
Block IV (Basirhat)	31	56	14	325.4	D(.)g0(bk) $\sigma$ (.)	3.43(0.99)	0.01 (0.003)	3.07 (0.41)
Block V (Ramganga)	36	30	5	228.76	D(.)g0(.) $\sigma$ (.)	1.57(0.74)	0.01 (0.004)	9.06 (1.87)
Block VI (East)	31	60	20	485.45	D(.)g0(bk) $\sigma$ (.)	3.77 (1.03)	0.003 (0.001)	5.84 (1.17)
Block VII (West)	32	76	14	420.33	D(.)g0(bk) $\sigma$ (h2)	3.15(0.88)	0.04 (0.007)	$\sigma$ 1=1.89 (0.21), $\sigma$ 2 = 4.24 (0.43), $\rho$ mix = 0.71 (0.10)
Block VIII (Sajnekhali)	23	40	14	188.51	D(.)g0(bk) $\sigma$ (h2)	4.79(1.31)	0.04 (0.007)	$\sigma$ 1=1.89 (0.21), $\sigma$ 2= 4.24 (0.43)

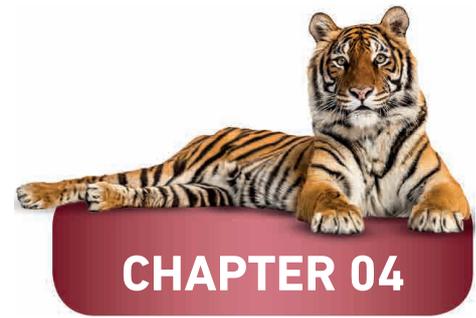
**Minimum Number of Tigers Captured During Camera trapping Exercise, 2012-13 onwards, in Sundarban Landscape**

Year	Minimum No. of Adult Individual	Minimum No. of cubs	Total	Remarks
2012-13	89	2	91	Survey carried out in the entire Sundarban Landscape in collaboration with WWF
2013-14	62	–	62	Based on All India Tiger Estimation Report, 2014. Survey Carried out at Sundarban Tiger Reserve Division and Ramganga Range of 24 Parganas (South) Forest Division
2014-15	31	7	38	Survey carried out at 24 Parganas (South) Forest Division and Basirhat Range of Sundarban Tiger Reserve Division, in collaboration with WWF
2015-16	81	4	85	Survey carried out in the entire Sundarban Landscape in collaboration with WWF
2016-17	87	4	91	Survey carried out in the entire Sundarban Landscape

**CAMERA TRAPPING EXERCISE IN SUNDARBAN TIGER RESERVE**



# History of Past Management and Present Practices



## 4.1 CONSERVATION AND FOREST MANAGEMENT HISTORY

Between 321-226 BC the Mauryan Empire created a Department of Forest Products headed by an official called a "*kupyadhyaksta*". This department supervised the use of eight forest divisions called "*gaja-vasas*" or "elephant forests", classified with respect to their intended use: (1) religious, (2) supply of general forest produce, (3) grazing for royal elephants, (4) royal hunting ground and (5) public hunting ground. The Sundarbans was part of the Angireya-vasa, which included forests from North and South Bengal (Farooque 1997; Iftekhar and Islam 2004a). New regulations were enacted during the Gupta dynasty (320-415 AD), after which forest management declined and extensive tracts of land were cleared for agriculture (Farooque 1997). From 1204-1575, the Sundarbans was ruled by the Indo-Turkish sultans. During this period, land reclamation was catalyzed by Islamic holy men called "*pirs*", including Khan Jahan, Mubarra Ghazi, Zindah Gazi, Mehr Ali and Umar Shar.

During the Mughal Empire, which reigned from 1575 to 1765, newly reclaimed land was encompassed into management. This land was catalogued as administrative units called "*pargana*", recognized as capable of producing revenue. The first *pargana* in the Sundarbans area (Ambarabad, 175 square miles) was established in 1734. From the 15th to 18th Centuries, the administration of the Sundarbans became increasingly complex, with plots of land "*ta'alluq*" owned by "*ta'allug-dar*". The *ta'allug-dar* let out subplots for clearing, and supplied revenue to "*zamindars*", who passed on a portion of their earnings to the government.

This land tenure system continued to develop when the East India Company took over administration of the 24 *parganas* area, and then into the period of formal British colonial rule, which started in 1757. The British conducted the first survey of the Sundarbans from 1769 to 1773, took over rights to the area in 1828, and started leasing out land for further clearance in 1830. The rate of forest clearance then increased until the formulation of the Forest Act in 1855. At one stage, reclamation grants were suspended and the forest was leased to the Port Canning Company, but this decision was later revoked because the company treated the traditional forest users badly.

The first management plan for the Sundarbans, formulated in 1871, was designed to regulate harvesting of *sundri*. Under the earlier recommendation of a Conservator of Forests in Burma, and in line with the Forest Act of 1855, some parts of the Sundarbans were declared as reserved forest in 1878. The boundary of the protected area has been subsequently re-plotted several times in response to an ever shrinking forest. The most comprehensive plan, in the early 1900s, delineated the Sundarbans into management units called compartments, to be periodically harvested and monitored by a complex system that relied upon estimation of tree composition and standing crop in each area (Curtis 1933).

After gaining independence from the British rule in 1947, and administration of the Sundarbans was split between India and East Pakistan. Bangladesh was subsequently created in 1971 after a war of independence with Pakistan. A series of management plans subsequently evolved to update the harvesting strategies of an increasing number of forest

products (Heinig 1892; Lloyd 1904; Trafford 1911; Curtis 1933; Choudhury 1937; Roy Chaudhary 1948, Lahiri 1973 and the Field Directors subsequently.

The whole area in 24-Parganas District was declared first as protected forests following the efforts of Mr. A.L.Home, DCF, Dr. Schlich and Sir Richard Temple by a notification dated 7th December 1878 and the boundaries of the remaining protected forests were fixed by the notification No.4457-For dated 9th April 1926. The protected forests in the Basirhat Sub-Division of the District (the present Basirhat Range in Tiger Reserve area) were constituted as Reserve Forests as per Govt. Notification No. 15340-For. dated 9th August, 1928. Due to fresh colonization in the Mahisani and Patibania islands a further exclusion was made from the above mentioned protected forests under notification Nos. 1024-For. dated the 20th August, 1935 and 5174-For. dated the 2nd May, 1939. The residual protected forests (Namkhana Range) were finally declared as Reserved Forests under notification No. 7737-For., dated the 29th May, 1943, with the result that the whole of the existing forests of the Division is now reserved. The Indian Forest Act 1927 prohibits or otherwise restricts the carrying of guns, cattle grazing, tree cutting, removal of forest produce, or land clearance. Within the reserved forest there are neither villages nor any agricultural land. There is one sanctuary within the Tiger Reserve area viz., ‘**Sajnekhali Wildlife Sanctuary**’ covering an area of 362.335 sq. k.m. vide notification No.5396-For., dated 24.6.76 and the ‘**Sundarbans National Park**’ covering an area of 1330.10 sq. k.m. This was finally declared as a National Park u/s 35(3) of Indian Wild Life (Protection) Act, 1972 vide Govt. Notification No. 2867-For, dated 4,5.1984. Considering the importance of this biogeographic region of Bengalian River Forests, the National Park area of Sundarban Tiger Reserve had been included in the list of the World Heritage Sites in 1985. The whole Sundarban region including the protected area of Sundarban Tiger Reserve was declared as Biosphere Reserve on 29th March, 1989 with the broad objective of:

1. Conservation of its ecosystem and the genetic diversities.
2. Promotion of basic and applied research works and its monitoring.
3. Dissemination of experience for education and training.

#### 4.1.1 Past System of Management of Forests

Management practices of the forests in Sundarbans evolved with the increasing pressure on the Sundarbans for meeting the demand for agricultural land and forest produces. The settlements started more than 200 years ago with clearing of forests and construction of embankments to stop the ingression of tidal water. The population, inspite of problems of communication, shortage of drinking water, irrigation facilities and maintenance of embankments and dykes kept on growing. The Working and or Management Plans of the Sundarbans reflect the change in management objectives with the increase of population pressure in these area, because of the changed mindset wherein the forest were not thought to be an inexhaustible resource. With the gradual change in quality of the forest along with the steady decrease in area, led the conservationists to realise the conservation values of these mangrove forests and consecutive Management Plans/ Schemes put restriction and regulation for the use of the forest products.

The current Management plan from 2000 to 2010 is the third Management Plan written for the area. The changes in the observations and objectives of the previous Working/ Management Plans/ Schemes have been analysed below:

Sl. No.	Period	Working/ Management Plan/Scheme	Observations	Prescriptions
1.	1863-1869	Dr. Brandis (Anon., 1952)	Forests are valuable resource for revenue generation by the Government.	The Port Canning Land Reclamation and Rehabilitation Private Company was given the lease to collected toll from 24 forest blocks from the forest produce.
2.	1871-1872	A. L. Home (Anon., 1952)	Forests were dense, impenetrable and with undergrowth primarily of <i>Cerriops</i> . Each square mile of forest could produce 700 quintals of serviceable timber.	Government took over the lease in 1869 and started collecting the revenue from the forest produce.

Contd.



Sl. No.	Period	Working/ Management Plan/Scheme	Observations	Prescriptions
3.	1873-1874	Sir R. Temple & Dr. S. Schlich (Anon., 1952)	Forests had 40 different species of trees and herbs. <i>Heritiera fomes</i> the most economically valuable species was confined to the north - eastern corner and in the areas farthest from the sea. Forests adjoining rivers got depleted and no good quality forest remained due to unregulated felling.	<i>Heritiera fomes</i> required protection and in 1878 forests were declared protected. In 1879 a Forest Division was established for the protection of forest.
4.	1893-1903	Heining (1893)	Indiscriminate felling was depleting the forest with <i>Heritiera fomes</i> being the most affected species, especially in the present Bangladesh areas due to relatively high population pressure.	The Annual Coups were established in Bangladesh part of Sundarbans. Felling girth limit of <i>Heritiera fomes</i> was restricted to > 90 cm.
5.	1903-1908	Lloyd's Working Scheme (Anon., 1952)	Forests were found to be under increased anthropogenic pressure, for which stringent transportation rules and silviculture practices need to be implemented.	Rules were prescribed for felling of <i>Heritiera fomes</i> , <i>Sonneratia</i> spp. and <i>Xylocarpus mekongensis</i> in 24 Parganas District. Staff strength was increased and patrolling was intensified.
6.	1906-1912	Farrington's Working Scheme (Anon., 1952)	Forests were found to be under increased anthropogenic pressure, for which stringent transportation rules and silviculture practices need to be implemented.	Felling girth for <i>Heritiera fomes</i> was raised to 105 cm and Government Hammer marks were prescribed prior to felling. In the 24 Parganas District the felling of <i>Amoora sp.</i> , <i>Bruguiera sp.</i> , <i>Heritiera fomes</i> , <i>Sonneratia spp.</i> and <i>Xylocarpus mekongensis</i> were prohibited. The rules to control the transport of forest produce was introduced vide Notification No.- 2821-For, 8 <sup>th</sup> November, 1906.
7.	1912-1932	Trafford's Working Plan (1912)	A single Management Practice cannot be applicable for the entire Sundarbans. Based on salinity 2 circles as western with more salinity (Indian part) and eastern with less salinity having fresh water (Bangladesh part) required to be designated.	In the western circle the felling girth were restricted for <i>Amoora sp.</i> (60 cm), <i>Bruguiera sp.</i> (60 cm), <i>Heritiera fomes</i> (105 cm), <i>Sonneratia spp.</i> (120 cm) and <i>Xylocarpus mekongensis</i> (60 cm). In both the circles 5 felling blocks were laid which were to be worked on rotation for extraction of fuel.
8.	1930-1959	Curtis, 1933	The forest of Basirhat range was already declared as Reserve Forest by Government Notification for scientific conservation. So the rest of Sundarbans located west of Matla river required stringent legal control against illegal felling. The growth pattern of species was found to be zone specific. The Forest Administration required decentralization and delegation of powers.	The forest in the west of Matla river was declared as Reserve Forest in 1946, viz., 2 Ranges - Basirhat, and Western and 3 Working Circles were established. The felling series were fixed based on species requirement, viz., 40 yrs for <i>Avicennia</i> spp. and 20 yrs for <i>Sonneratia spp.</i> The felling girth for different species were fixed based on the block in which they were found. For meeting the fuel requirement felling of <i>Ceriops tagal</i> , <i>C. decandra</i> and <i>Aegiceras majus</i> were allowed.
9.	1937-1951	Chaudhuri, S. Working Scheme (Anon., 1952)	Silviculture system of the forest had to be Block specific.	The forests were felled as per Selection - cum - Thinning Silviculture System. The yield was fixed by area on a felling cycle of 20 years. Only 2 felling series were created in the Indian Part of Sundarbans - at Basirhat and Namkhana. Fuel woods and leaves of <i>Nypa fruticans</i> collection were allowed.
10.	1949-1959	Roy Chowdhury (Anon., 1952) Working Plan (The First Working Plan for 24 Parganas Forest Division, Southern Circle)	Ongoing Silviculture system needed change since the forest during that time was observed to be of poor stock and growth and demand for quite a number of species had increased manifold. Many gaps were noticed in the natural forest areas.	The forests were worked under Selection - cum - Improvement Felling System. Felling cycle was still 20 years and the area for felling was about 30,000 hectares, which was spread over 5 felling series. The exploitable DBH were fixed at - <i>Avicennia spp.</i> (12.5 cm), <i>Bruguiera spp.</i> (15 cm), <i>Excoecaria agallocha</i> (10 cm), <i>Heritiera fomes</i> (7.5 cm), <i>Xylocarpus granatum</i> (12.5), <i>X. mekongensis</i> (15 cm) and <i>Sonneratia spp.</i> (23.5 - 45.5 cm). Artificial regeneration and stocking were initiated.

Contd.

Sl. No.	Period	Working/ Management Plan/Scheme	Observations	Prescriptions
11.	1959-1973	Annual Working Schemes	Forests were under great pressure leading to habitat degradation of tiger. The problems accelerated due to Refugee Rehabilitation after partition of Sundarbans and 2 wars of 1965 and 1971.	The felling cycle continued to be of 20 years. Natural regeneration was encouraged. Revenue collection and transportation of timber was streamlined.
12.	1973-1979	1 <sup>st</sup> Management Plan Lahiri, R. K., (1973)	The loss of habitat of tigers was identified to be the most important leading to the destruction of the total ecosystem. Holistic treatment approach towards the conservation of the ecosystem was identified as priority area.	Project Tiger was launched in 1973 in the eastern parts of Matla river in an area 2,585 sq. km. The principle objective was to preserve the habitat of the wildlife to achieve optimum level of population of tiger and its prey base and along with other floral and faunal associations. Digging of fresh water ponds started.
13.	1979-1985	Annual Plans of Operation for the STR (by Field Director, STR)	Holistic approach towards the conservation of the ecosystem continued to remain the focal issue. It was identified that scientific research is needed to reduce tiger - human conflicts. Tiger and prey base poaching and habitat degradation continued alarmingly but poaching of crocodile and water monitor reduced to a large extent.	<i>Phoenix</i> permit was discontinued in 1980, felling was restricted in buffer areas, electric dummies were introduced in 1983 to study the human attacking behavior of the tiger. Farm bred crocodiles were released in the STR areas from 1984 onwards for restocking the crocodile population. Salinity studies along with climate monitoring were taken up.
14.	1986-1995 (extended till 2000)	2 <sup>nd</sup> Management Plan (by Field Director, STR)	Tiger - Human conflicts along with habitat degradation was identified as the main management problem. Scientific research specific to Sundarbans conditions was identified as a tool to tackle the problem along with intensive protection works. Afforestation with mangrove species was identified as a possible method for soil conservation and fulfilling the needs of the villagers. Afforestation in the village land with non mangrove species was identified as a solution for meeting the fodder and fuel requirements of the people. JFM was identified as an important management tool. Increasing pressure on forest demanded intensification of protection works. Eco tourism was identified as an important tool for management.	Human face masks were introduced in 1987. Felling had been restricted strictly in buffer areas in Khatuajhuri, Arbesi, Harinbhanga and Jhilla blocks. From 1991 - 1992 coupe working was restricted to fair weather conditions and rough weather coupe was discontinued. Annual prescriptions for felling of 1000 ha. Large scale afforestation with the mangrove species in the forest areas and mud flats and with non mangrove species in human habitation areas were taken up. Broadening participation from local people and NGO's, eco-development works were taken up which were need based and ecologically viable. JFMC's and JFMC'c were formed in 1996. Surface camps were constructed in Dobanki and Chamta.
15.	2000-2010	3 <sup>rd</sup> Management Plan (by Field Director, STR)	GIS was identified as a management tool. The need for research, capacity building of staff and local people was identified. Emphasis was given on scientific research and ecological monitoring. Cross border problems were found to be a hindrance towards the management of this vulnerable ecosystem.	GIS data were updated, interpreted and were ultimately used in tackling management problems. Surface camps started functioning in Dobanki, Chamta and Khatuajhuri. Ecotourism facilities were developed in Dobanki and Burirdabri. Collaborative programs were taken up with a focus on common management policy with Bangladesh. Though this Plan also provided for felling of 1000 ha annually however, coupe felling was stopped from 2000 onwards.

**Table showing the work done as per the prescription of the previous TCP (2012-13 to 2016-17)**

SL No.	Management Aspect	Work Done
1	Protection	1. Construction of new protection camps at Kaksa (earlier a floating camp at Basirhat), Samsernagar Camp (Basirhat Range), Kendo Camp (National Park West Range), Chandkhali Camp (National Park East)  2. Developing Infrastructure of the existing protection camps: Electric connection at camps (SWLS) and Jhingekhali (Basirhat range); Construction of wireless control tower and its maintenance all over STR; Installation of Solar power plants including solar electrification system all over STR; Construction of raised tube-well and deep tubewell all over STR; Construction of Staff Barrack along with approach path at Rampura Range, Netidhopani (NPW range), Kaksa (BHT range), Chamta (NPE), Chandkhali (NPE); Construction of Jetty at Kaksa (BHT), Dobanki (SWLS), Gosaba (NPE), Chandkhali (NPE), Harikhali and Jhila (BHT); Construction of Watch Towers at Netidhopani and Sajnekhali, renovation at Haldibari
2	Human Wildlife Conflict Management	Maintenance of the existing nylon net fencing along the interface of forest and the fringe villages
3	Wildlife Management	Excavation of Sweet water ponds at Basirhat, Sajnekhali Wildlife Sanctuary Range, National Park West and National Park East Range

## 4.1.2 Harvesting of Timber and Firewood

Since inception of the Project Tiger scheme in 1973, the core area of the Tiger Reserve has been kept free from harvesting of timber, fuel-wood etc. Prior to that in areas falling within the present core area the forests were worked with the yield being regulated by area. Till 1994, there used to be two felling coupe operations, one in fair weather and another in rough weather. Since 1994, there has been only one coupe during fair weather that is from October to March. The yield calculation was done on the basis of area for annual operation of coupes and was not based on the mean annual increment of the crop. Average production of timber and fuel-wood was very high viz-a-vis the rest of the area. During the year 1981-82 when regular coupes were laid out in accordance with the prescription of first Management Plan of Sundarban Tiger Reserve, the annual yield on the basis of area was calculated as 2,930 ha. in the First Management Plan of Sundarban Tiger Reserve and in the Revised Management Plan, the yield was fixed at 2,484 ha. Yield of timber and fuel-wood from annual coupes since 1985-86 is given in the **Appendix 9**.

### 4.1.2.1 Analysis of Felling Coupes in the STR

The Third Working Plan (Curtis, 1931) that divided Sundarban Forests into two felling series (Harinbhanga and Haldi felling series) pertains to the period between 1930-59 prior to the declaration of tiger reserve. The general felling cycle was fixed at 40 years, but for Keora (*Sonneratia*) and Bain (*Avicennia*) it was reduced to 20 years. Fellings were confined to the principal annual coupes only for the supply of timber and fuel. The exploitable diameters of Sundri, Genwa, Pasur, Dhundal, Kankra and Bain were fixed differently for different blocks to provide for the variations in the rates of growth in the blocks. All over the area mature and unsound trees were allowed to be removed from the annual coupes. Unregulated fellings were allowed in the coupe for Goran (*Ceriops decandra*), Math-Goran (*Ceriops tagal*), Singra (*Cynometra iripa*), Khalsi (*Aegiceras corniculatum*), Kirpa (*Lumnitzera racemosa*) and Tora (*Aegialitis rotundifolia*).

However in the working schemes of Chaudhuri from 1937-1941 (Anon., 1952) the entire forest division of 24 Parganas district were put under one working circle of the Selection cum Thinning system. The yield was fixed by area on a felling cycle of 20 years. The exploitable sizes of sundri, genwa, pasur, dhundal, keora, kankra and bain were fixed in Bashirhat felling series. The scheme appears to have worked satisfactorily. From the old records it is found that from 1963 to 74-75 the average area felled/year was 2500 ha to 3000 ha in Harinbhanga, Gona, Panchmukhani, Khatuajhuri, Bagmara, Chamta, Chandkhali, Mayadwip - 1 and 3 compartments. Felling was also done in Harinbhanga, Khatuajhuri, Arbesi and Jhilla compartments. From 1974-75 to 84-85 the area of felling were mainly confined to Arbesi, Jhilla, Netidhopani, Chandkhali, Harinbhanga and Khatuajhuri blocks but the major felling area was restricted to the buffer areas of STR. The total area of felling in 1975 - 76 was 15,913.01 ha which was the highest area in the last four decades.

Followed by felling area in the year 1974 -75 that was 9724.80 ha. However from 1985-86 to 1999-2000 the felling was restricted strictly to buffer area that is Khatuajhuri, Harinbhanga and Arbesi blocks. The felling area also was limited to 1000 ha from 1991-1992 onwards. It appears that over the period of time the emphasis was given on the habitat improvement and to preservation of the fodder species like Keora and timber species like Pasur, Dhundul, Kankra and Sundari which were dwindling fast. As per MOE&F, GOI Correspondence No.9-89/FCE, 01.03.2000 (Anon., 2001) felling is subject to prescription chalked out by the Ministry which incorporates estimation of felled volume and checks against over exploitation and maintenance of sample plots for gathering data on growth and bio-diversity including the assured regeneration in the felled area. **The timber coupes were all together stopped from the year 2000 onwards.**

### 4.1.3 Extraction of Non-timber Forest Produce

Honey, Bees-wax, Golpata, Hental etc. are the minor forest produces which were usually collected by the outsiders annually during the short periods for which permit were issued. Golpata collection has however, been stopped since 1978. Extraction of Hental had also been gradually reduced and discontinued since 1991. Presently, only honey collection is permitted in the buffer area. Permits are given to collect honey at a fixed tariff per kg. which is fixed in consultation with the West Bengal Forest Development Corporation Ltd. to whom all the collected honey is finally handed over. Previously, the crude honey used to be supplied to 24-Parganas Division for filtering and processing in their unit but subsequently since 1995-96 the processing unit has been transferred to West Bengal Forest Development Corporation for processing of crude honey and its marketing.

### 4.1.4 Fishing

Since creation of Sundarban Tiger Reserve fishing is not allowed in the core area. Buffer zone except Sajnekhali Wildlife Sanctuary is open for fishing in case of registered permit-holders. However, a number of fishermen and crab collectors try to enter the restricted area for fish and crab collection.

## 4.2 PROTECTION OF TIGER, ITS PREY AND HABITAT

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The northern boundary of Sundarban Tiger Reserve is constituted by the fringe villages where a large portion of the human population is dependent upon fishing. More than 50% of the population is land less and belongs to weaker section of the society having a high natural resource dependency. The Sundarban Tiger Reserve has a common boundary of approximately 20 km with the Bangladesh Sundarbans. This boundary is very porous and there is periodic intrusion by Bangladeshi Nationals who indulge in timber smuggling, poaching of tigers, deer and other animals. The southern side of Sundarbans opens up in the Bay of Bengal.

Presently, protection is carried out by means of patrolling the area using watercrafts which include dingi boats, mechanized boats, speed boats and launches. Patrolling is carried out regularly both at day and night and by the field staff and officers. Apart from this field based camps are located at strategic points both inside the forest and in the fringe areas. These camps are both land based and floating. These floating camps are mobile in nature and have their designated area of operation. The entire area is well connected by means of RT network. There are RT(wireless) sets at all camps in addition the patrolling teams also have mobile RT handsets. The staff are equipped with firearms. Foot patrolling is restricted to certain areas owing to staff safety issues. Tiger guards have been provided to all field staff for wearing at the time of foot patrolling.







Sundarban is a unique landscape and the zone of influence is restricted due to the presence of various river channels and creeks. Also there are no villages inside the Tiger Reserve. So, there are neither any encroachment nor any enclave villages and the problems associated with this Reserve. There was only one illegal settlement in the Jhilla block known as Marichjhapi, which was removed in 1975-76 by the special police operation. Most of the people living in these fringe villages who come under direct zone of influence are from the weaker section of the society and majority of them are land less labourers. Most of the area falls under Choto Mollakhali coastal PS and under Gosaba P.S. The entire length of this interface zone is about 65 km. These villages are situated under direct zone of influence and within 5 km from the boundary of the Reserve area.

SI No	Block	Compartment	Area(in square km)	Legal Status
1	Arbesi	1-2	84.04	RF
2	Jhila	1-5	95.367	RF
3	Panchamukhani	1-2	52.298	RF
4	Pirkhali	1-2, 4-5	113.029	RF

Agriculture is the mainstay of the economy with 75% of the human population directly or indirectly depending on it. The agricultural land holdings are mostly small and marginal. Paddy is the main crop and is planted as aman( June – Oct), boro(Dec-mid March) and aus (mid March –May) crops in winter, rains and summer respectively. Apart from paddy lentils, chillies, vegetables, and water melons are also grown in the area. Chemical fertilizers are used indiscriminately and these are washed off as surface runoff into the mangrove ecosystem. The agriculture is mainly rain fed. Few years back only one crop was taken by the villagers in the absence of proper irrigation facilities. However, over the years the forest department has re excavated a number of irrigation canals and sweet water ponds which act as water harvesting structures and have enabled the farmers to take at least two crops instead of one. Each such irrigation channel or canal ie one km long has been estimated to irrigate an area of 25-30 ha. Also, in winters it is seen that strayed out tigers often take shelter in the uncut paddy fields.

Tourism is another industry which is coming up quite rapidly in the area. The unique mangrove tiger land of Sundarban criss-crossed by a network of streams and creeks is always fascinating to the visitors for its scenic beauty and thrill of sighting the "Royal Bengal Tiger". Since inception of Tiger Reserve, craze for visit to Sundarban gradually increased and these had been sharp rise in the tourist flow in Sundarbans. No. of tourists who have visited Sundarbans in last ten years has risen exponentially. In view of the interest of tourists, Department of tourism, Govt. of West Bengal has set up a tourist lodge at Sajnekhali to provide accommodation facilities for the tourists. In May 1996, Zillaparishad 24-Parganas (North) has created accommodation facilities at Hemnagar close to the northern boundary of Sundarban Tiger Reserve keeping tourists interest in mind. The Zilla Parishad of 24-Parganas (S) has also developed an accommodation facility at Pakhiralaya opposite to Sajnekhali to cater to the need of the tourists.

In the last couple of years, a large number of tourist lodges have come up on the boundary of the Tiger Reserve in the absence of any guideline restricting these constructions. Most of these lodges are located in Gosaba and Satjelia islands. Most of these lodges have no means of proper garbage and sewage disposal. Most of the garbage is dumped in open pits on the side of the river banks. During high tides much of this non degradable waste is transported by the tidal waters into the mangrove ecosystem.

The entry of the tourists is however, restricted only within the specified Ecotourism zone on realization of entry fees. The Tiger Reserve is open for tourists throughout the year. Entry within the core area which is also a National Park is strictly prohibited for the outsiders except for scientific research and Officials on duty with, prior permission of Chief Wildlife Warden and/ Field Director. Apart from this there are no major industries in the area.



**Figure 1:** Map showing the zone of Influence of STR

**INDEX**

- International Boundary
- District Boundary
- Block Boundary
- Village/Mouza Boundary (with J.L.No)
- \* Block HQ
- Other Road
- Embankment Cum Road

**Built Up Area**

- Rural Settlement

**Agricultural Land**

- Single Crop
- More Than One Crop (Kharif-subject to Flood / Water logging)
- Aquaculture

**Forest**

- Notified Forest Area (As per SOI Toposheet 1970's)
- Mangrove-Dense
  - Mangrove-Open
  - Plantation (Mangrove)
  - Mud Flat within Forest Boundary
  - Aquaculture within Forest Boundary

**Wetlands**

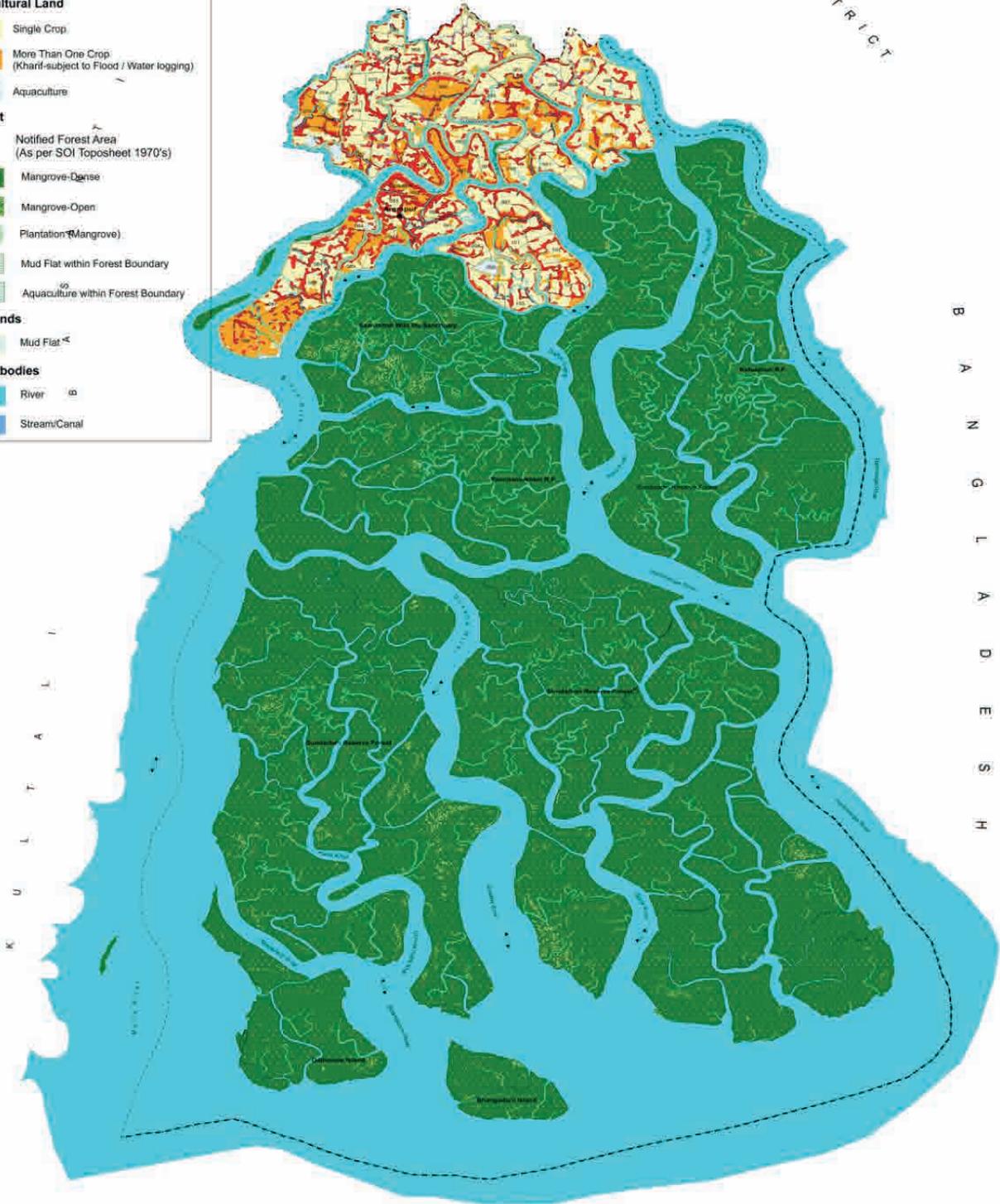
- Mud Flat

**Waterbodies**

- River
- Stream/Canal

**LAND USE MAP OF STR AND ADJOINING VILLAGES**

NORTH 24 PARGANAS DISTRICT



## 4.5 RESEARCH, MONITORING AND WILDLIFE HEALTH

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The Sundarban mangrove eco-system provides conditions for collection of uninterrupted research data for interdisciplinary research programme involving natural and social sciences. The zones of lesser interference provide scope for monitoring the changes in both physical as well as biological components. However, research is one of the weak areas of the Sundarban Tiger Reserve.

Among the studies carried out are the preliminary floral survey had been conducted jointly by Sundarban Tiger Reserve and Botanical Survey of India which has set up a research station at Canning. For study of edaphic changes in Sundarban area, Soil Saline Research Institute has also established a station at Canning. Hatching of Olive Ridley turtle and Northern river terrapin which was done at Sajnekhali in the past has been stopped and in its place in situ conservation is being carried out. Under Biosphere programme a research sub-committee has also been formed which co-ordinates and monitors the research activities relating to Sundarbans by all the Institutes, Organisations, Government Departments and Universities.

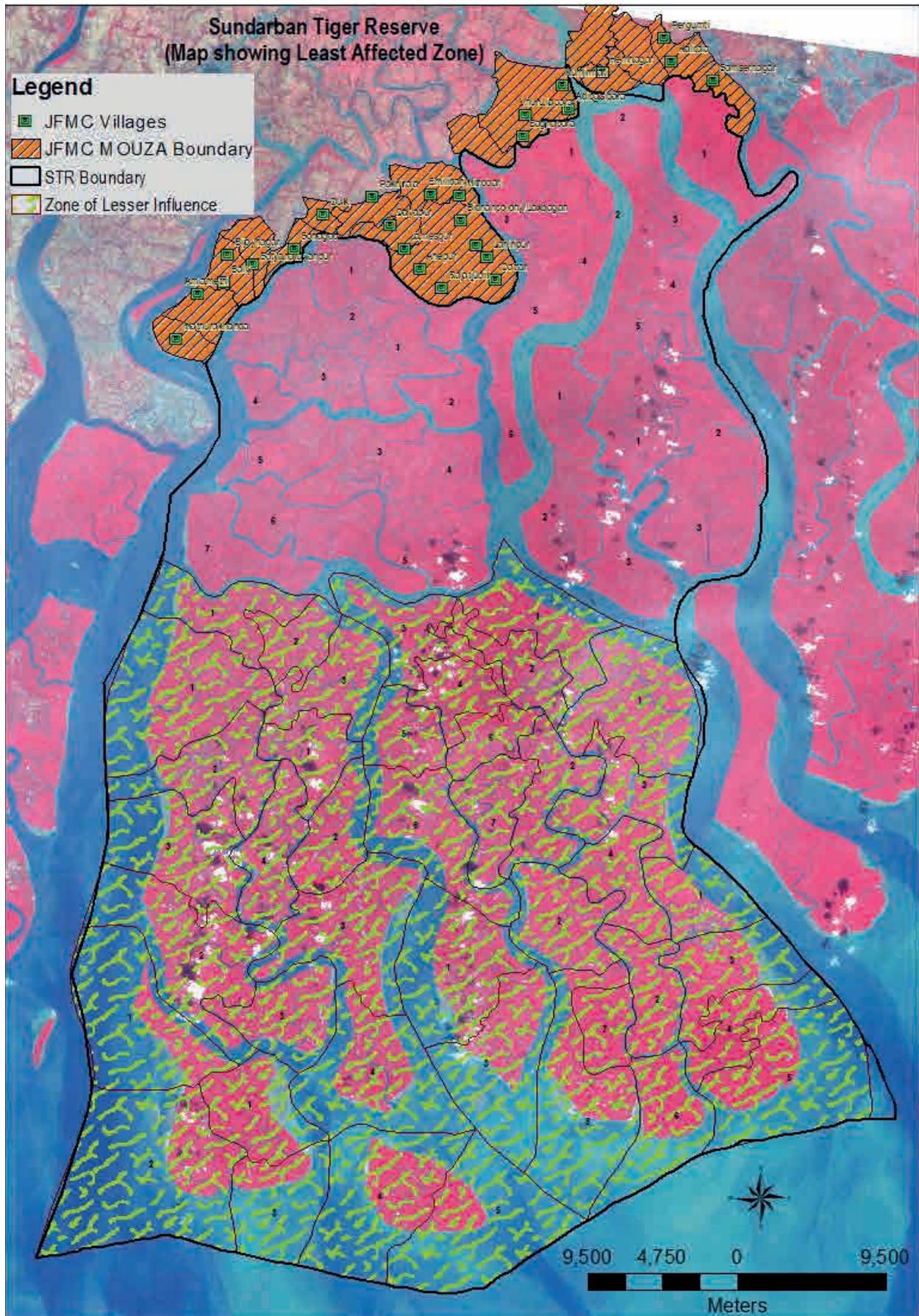
Outside the Tiger Reserve also, there are a number of institutions which are engaged in carrying out studies on the mangrove ecosystem. These include a station of Central Inland Fisheries Institute station at Kakdwip on the western side. An estuarine crocodile breeding centre at Bhagabatpur where artificial hatching of estuarine crocodile and Olive Ridley Turtle has been standardized since 1976. A research laboratory at Namkhana which facilitates researchers and scholars in their field study. Lothian island Sanctuary which is an representative area of the entire mangrove ecosystem has been used for carrying out studies on biodiversity of the area.

Though, there is a research unit in Sundarban Tiger Reserve which in the past was active and from time to time carried out different activities related to monitoring of salinity and seasonal variation, artificial hatching and breeding biology of River Terrapin and Olive Ridley turtle, factors associated with man eating and tiger straying, estimate of population of major faunal spp. including tiger and its prey-base, local migration of tiger and other major fauna, change of vegetation-consociation, as well as nature of migration of avifauna. At present, the Range has been lying vacant in the absence of a designated Research Officer and a dedicated research Range Officer. Details of the different research carried out have been given in.

### List of Research Activities in Sundarban Tiger Reserve

- 1874 On two new species of Heriteria
- 1893 Blind Root Suckers of Sundarbans
- 1958 Symposium on Mangrove Vegetation
- 1960 The genus *Bruguiera* in the Sundribans
- 1963 The Genus *Phoenix* Linn. In India.
- 1963 On the Distribution, structure and ontogeny of stone cells in *Avicennia officinalis*.
- 1965 Sundarbans
- 1972 Some Observations on the Macrovegetation in and around Bheris of Sundarbans, West Bengal.
- 1974 Main Characteristics of Indian Mangrove
- 1975 The Mangrove of India
- 1976 A Note on the Halophytes in India.
- 1978 Mangroves of Sundarbans, India
- 1979 The Genus *Bruguiera* Lamk. (Rhiphoraceae) in India.





**Figure 2:** The Core or the Critical Tiger Habitat of the Tiger Reserve has been identified as the zone of lesser interference

- 1981 Photosynthesis in Mangroves.
- 1981 Structural Variability and Biomass Production of Mangroves in Lothian Island of Sundarbans, India.
- 1982 Sundarbans the World Famous Mangrove Forests of the Districts 24 Parganas in West Bengal (India)
- 1983 Halophytes and their Unique Adaptations on the Sundarbans Mangrove Swamps in India
- 1983 An Eco-Taxonomical Studies of the Typical Halophytic Flora of Sundarbans in the District 24 pgs, West Bengal with Special Reference to their Socio-Economic Impact.
- 1983 Comparative Studies of Stomata in some Halophytes, Cultivated Rice and Rice Mutants in Relation to Salt Resistance
- 1984 Potentiality of compost made of leaves of the plant *Avicennia officinalis* and straw mulch for coastal pond fertilization.
- 1984 Importance of Mangroves - Raw Material Function and Role in Environment.
- 1984 Mangrove wealth of Indian Sundarbans - Utilisation and Conservation.
- 1985 Litter Production in Mangrove Forests. Lothian Island, Sundarbans, West Bengal.
- 1986 Preliminary Studies of Artificial Regeneration Of Mangrove Forests in Sundarbans, West Bengal.
- 1986 Adaptations in Mangroves of Sundarbans.
- 1986 Role of *Avicennia* L. Plantation on the Brackish Water Fisheries with Special Reference to Their Taxonomy and Ecological Note in the Tidal Mangrove Forests of Sundarbans.
- 1986 On the Verge of Extinction of Some Important Mangrove Species from the Sundarbans Delta in West Bengal
- 1986 Some observations on Abnormal Adaptations of Mangrove in Indian Sundarbans
- 1986 Comparative Study of Mangrove of Sundarbans and that of the Mahanadi Delta in eastern India.
- 1987 Mangrove Ecology of the Sundarbans Delta in West Bengal and its Role on the Brackishwater Fisheries.
- 1987 Sundarbans Mangroves of India-A Study on Conservation Status.
- 1987 Sundarbans Mangroves Biomass Productivity and Resources Utilisation on Mangroves- An in Depth Study.
- 1988 Maintenance of Leaf Temperature and the Optimisation of Carbon Gain in Relation to Water Loss in A Tropical Mangrove Forest.
- 1988 Economic Potentialities of the Tidal Mangrove Forests of Sundarbans in India
- 1988 Ecological Studies of the Mangrove Flora of Bhagabatpur (Sunderbans)
- 1990 Pollen Morphology of Some Mangrove Plants of Sundarbans, West Bengal.
- 1990 Mangrove Litter Production in a Tidal Creek of Lothian Island of Sundarbans, India.
- 1990 Artificial Regeneration of *Sonneratia apetala* (Buch-Ham) in Sundarbans, West Bengal.
- 1991 Productivity of Grass *Porteresia coarctata* in Mangrove Forest of Sundarbans.
- 1991 Succession of the different Species of *Sonneratia* L. f. in the Sundarbans Mangrove Ecosystems.
- 1991 Aerial Seedling in Mangrove Swamps.
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The need for Research has been acknowledged and a policy with clear objectives has been set out which gives priorities to research work which directly contribute towards improvement of management.

Wildlife health monitoring is not carried out on a routine basis. However, all the cases where wild animals are captured or rescued they are treated and checked for diseases before being released back into the wild. Similarly, in case of the dead animals post mortem is carried out to know the actual cause of death. This is routinely carried out in the tiger Reserve. In case of the captive deer it was seen that there were cases of parasitic infections including that of tuberculosis which were treated by the Veterinary doctor of the Tiger Reserve. In addition to the above vaccination camps are conducted in the fringe villages to prevent outbreak of diseases.

#### 4.6. NATURE EDUCATION AND INTERPRETATION

One of the stated goals of the management of the Tiger Reserve has been to promote ecotourism with a view to encourage nature education, interpretation thereby creating nature awareness for tiger and mangrove conservation. In addition it has also been the endeavour of the Tiger Reserve to enlist support and collaboration from voluntary organisations/associations in awareness building and participatory management for evolving effective conservation strategy.

Sundarban Tiger Reserve is one of the oldest Tiger Reserves in the country and only tiger bearing mangrove ecosystem in the country. It harbours one of the largest stand alone populations of tiger in the entire country. From an average of 30,000 tourists the number has risen to over one lakh in the past couple of years. Unlike other Protected Areas which are closed for tourists in the rainy season Sundarban is open for tourists throughout the year. Though the main tourist period is from October to mid February after which the weather gets rough due to the onset of the cyclonic storms.

The wildlife tourism is primarily organised by the West Bengal Tourism Development Corporation Limited (WBTDC) and the private tour operators. There is a tourist lodge having 29 double bedded rooms and one dormitory. The WBTDC Ltd. arranges for conducted tour through its launches M V Madhukar and M V Chitrarekha and M.V Sarbojaya. The private tour operators organise the trips to Sundarbans from Gadkhali, Canning/Basanti, Hasnabad and Dhamakhali.

Tourists permits are issued from Head Quarter Range in Canning, Sajnekhali, Sonakhali, Gosaba, and Bagna in Basirhat Range. The tourists are allowed to cruise through the rivers in the designated tourist area. This restricts the visibility upto the river banks only thereby impacting the sighting probability of the wild animals. The tidal movement, coupled with thick mangrove vegetation further restricts sighting of the animals. This results in poor visitor satisfaction. Further,

unrestricted movement of water crafts add to the pollution of the river system by way of oil spills and dumping of waste materials. The use of plastics has been banned inside the PA but visitors do throw plastics cups, plates, wrappers etc in the river outside the Tiger Reserve and these enter the PA with the tide. Although, there had been development in tourism facilities outside the PA in last five years, but there is yet no mechanism to regulate tourism development activities.

The tourism here is a highly regulated one due to difficult terrain of Sundarban. The tourists are not allowed to walk on the land except in some designated places where proper protection, measures have been provided. Presently, tourists visit Sajnekhali, Sudhanyakali, Dobanki, Netidhopani, Burirdabri and Jhingekhali. The Tourist circuit is more active on the western side of the Reserve. The cage path at Burirdabri, which passes through the section of the vegetation and walk through the cage path, is a thrilling experience and so is the canopy walk at Dobanki.

In the year 1997, a Mangrove Interpretation Centre was opened at Sajnekhali with an objective of priming the visitor about the floral and faunal values of the area. An audio visual centre was also established as part of the unit for organising film shows related to wildlife and the mangrove ecosystem in particular to the visiting tourists. Recently, the Interpretation Centre has been remodelled to include new aspects and concepts being used in the management of the Tiger Reserve. In addition to this, there are a number of tourist guides who are stationed in Sajnekhali and accompany the different watercrafts carrying tourists. These guides besides interpreting the biodiversity values of the area also act as eyes and ears of the management and help in enforcing the rules in the area.

A number of pamphlets on the birds, biodiversity and general management are also sold to the tourists from Sajnekhali. Boards containing information regarding the birds, common mangroves etc are also there in different tourist sites which help enhance the learning experience of the common visitor. Feedback forms are also taken from visitors to improve their experience through valid suggestions.

Study tours of school children to the Tiger Reserve is done with an aim of creating goodwill ambassadors for the area. The Tiger Reserve also organises essay competitions, street plays, Sit and draw competition during wildlife week, Aranya saptah etc where the field officers directly interact with the masses and spread the conservation message.

## 4.7 ADMINISTRATION AND ORGANISATION

The Tiger Reserve is headed by the Field Director who is in charge of the overall administration of the area. He is assisted by the Deputy Field Director and two Assistant Field Directors. The entire area has been divided into 4 (four) territorial and 8 (eight) functional Ranges. The Territorial Ranges include Basirhat Range, Sajnekhali Wildlife Sanctuary Range, National Park (West) Range and National Park (East) Range. These 4 Territorial Ranges have 17 Territorial Beats/ Stations. Basirhat Range has two revenue stations viz. Jhingakhali and Bagna and Sajnekhali Wildlife Sanctuary Range has one revenue stations namely Sajnekhali. National Park (East) range has one revenue station namely Sonakhali revenue station and Headquarter Range has also one revenue station at Canning. Nomenclature of revenue station is legacy of old erstwhile Khulna Division when the forests were being managed for the sole purpose of revenue collection. It is proposed that revenue station should be converted into territorial beat jurisdiction with DR/Fr in charge as Beat Officer instead of Station Officer. Apart from the land based camps/stations there are a number of floating camps at strategic locations. The sanctioned staff pattern for managing this huge area is given in **Appendix 14**

### A. Territorial Ranges in the Sundarbans Tiger Reserve:

- 1. Basirhat Range:** With its headquarters at Jhilla it covers an area of 452.26 sq. km. and has 5 Beats, viz., Bagna, Jhingekhali, Khatuajhuri and Harinbhanga. Recently the Burirdabri camp has also been upgraded into a beat.
  - (i) Bagna:** It was the headquarter prior to development of the Jhilla camp. It has an jurisdiction of Jhilla 1, 2 and 3 Compartments. The total area of the Beat is 52.58 sq. km. It was originally a revenue station, which was re-designated as Territorial Beat. Main works of this Beat are protection of forest including collection of



revenue for honey collection, and fishing. This also includes afforestation works and works related with eco-development. This beat is susceptible to illegal fishing, illegal collection of tiger prawn seeds and poaching etc., because it lies in the vicinity of highly populated fringe villages. Bagna Beat has 2 floating camps ie Chilhari, Kankhari and one new land base Satellite camp at Kanksa, which previously was a floating camp. Being close to International Border this camp is prone to trans-border problems like illegal entry of Bangladeshi nationals for felling poaching, tiger prawn seedling collection etc. The staff of this camp are mainly engaged in protection works. There are nine JFMC's under its jurisdiction and it carries out the JFM works in these areas.

(ii) **Jhilla:** It is the new headquarter of the Bashirhat Range. This land based camp was developed with a view of being in close proximity of the forest. It houses the office of the Range Officer, Attached Officer and the beat officer Bagna beat along with other Staff. The State Armed Police also stay in one of the Barracks within the Jhilla campus. A mangrove nursery has also been developed here. It also looks after the area covered by the Bagna Beat. It is also involved in the maintenance of the nylon net fencing along Jhilla 1 forest area.

In addition to Jhilla camp there are two floating and one satellite camps which patrol Jhilla block. These are

a. **Chilhari Floating Camp:** it looks after Jhilla 1 and 2 compartments.

b. **Kankhari Floating Camp:** it looks after Jhilla 3 and 4 compartments.

(iii) **Kanksa Satellite Camp:** This is a newly constructed land base camp in 2016-17 in place of the existing floating camp, it looks after Jhilla 2 and 3 compartments

(iv) **Jhingekhali:** This Beat has Headquarters in Jhingekhali and Arbesi 1, 2 compartments covering an area of about 84.03 sq. km. under its jurisdiction. This Beat was earlier a revenue station and was later re-designated as a Territorial Beat. It is the most disturbed Beat of STR with reference to forest and wildlife protection. The main works of this Beat are protection, which also includes afforestation and eco-development works. The area of this Beat is susceptible Tiger straying which has been a major problem of this Beat since long. This has been accentuated by the silting up of the Shakunkhali khal which separates this beat from the adjoining forest area with the distance between the forest boundary and the village side as less as 2-3 metres. This also makes it vulnerable to illegal fishing, illegal tiger prawn collection and poaching etc. It is also a tourist spot with a watch tower and a sweet water pond on the forest side along with observation lines. The beat has three JFM Committees under its jurisdiction. It is involved in carrying JFM activities in these areas. Besides this it is also responsible for maintenance of the nylon net fencing along the forest area from Jhingekhali to Kalindi river.

(v) **Samshernagar Satellite Camp:-This was a floating camp till 2016 and upgraded to a Land base Satellite camp at Arbesi -1.** It patrols over Arbesi 1. It is also involved in the maintenance of the nylon net fencing along Arbesi 1 forest area. Regular activities of the camp is controlled by the beat officer of Jhingekhali Beat. Strategically the location of the camp is a very important because of proximity of Bangladesh Border.

(vi) **Burirdabri:** This was a camp till recently and has been upgraded to a beat. It patrols over Arbesi 3, 4 and 5 having an area of 66.43 sq km. It has interface with the international border with Bangladesh. It is a well known tourist spot with the cage trail and a watch tower overlooking the Bangladesh border.

(vii) **Khatuajhuri:** The beat was created in the year 2001. The Headquarter of this Beat is in Khatuajhuri and its jurisdiction lies in Khatuajhuri 1, 2 and 3 compartments covering an area of 132.40 sq km. The works for construction of this Beat was started in the year 2001 because of its strategic location and proximity to International Border. The main works of this Beat is to tackle trans-border problems and honey collection operations and a little bit of eco tourism. This Beat has a sweet water pond, as well.

(viii) **Harinbhanga/Harikhali:** Activities of the beat previously was controlled by Beat is in Bagna and its jurisdiction is in Harinbhanga 1, 2 and 3 compartments covering an area of 116.86 sq.km. This Beat was earlier a Patrolling

Unit, which was later re-designated as a Beat. The main work of this Beat is protection works. Recently, a new campus was developed for this beat which was now upgraded to a beat and a Beat Officer is in the charge of it.

**2. Sajnakhali Wildlife Sanctuary Range:** It is a territorial range, its headquarter is at Pakhiralaya and covers an area of 432.92 sq. km of which 362.60 sq. km is a notified Wildlife Sanctuary. It has 3 beats namely Sajnakhali, Dattar, and Dobanki. Apart from these fixed camps another camp is at **Sudhanyakhali** which is also a famous tourist spot with a watch tower from where tigers are frequently sighted. It also has **three floating camps namely Sadak khali, Tentultala and Pirkhali camps**. The Sajnakhali Mobile Patrolling Party (MPP) also doubles up as a floating camp. Sajnakhali range has a huge area of interface with the fringe villages. This range also has the major work of tourism management other than normal protection works.

(i) **Sajnakhali:** Sajnakhali beat has its headquarters in Sajnakhali and covers an area of 43.81 sq. km. and has jurisdiction over Pirkhali 1 and 3 compartments. This beat was earlier a revenue station, which was later re-designated as a beat. The main works of this beat are protection of the forest and wildlife including collection of revenue from honey collectors and fishermen. The works also include that of afforestation and eco-development. This beat has a surface camp in Sudhanyakhali, which covers the jurisdiction of 32.98 sq. km. in Pirkhali 2. Sudhanyakhali is a tourist spot with the watchtower, mangrove park and sweet water pond. There is huge pressure during tourism season on the surface camp but in the lean period this camp does the protection works of Pirkhali 2. It also maintains the nylon net fencing along the village forest interface.

(ii) **Dattar:** The head quarter of Dattar beat is in Dattar village besides the Dattar river. The total area of this beat is 96.85 sq. km. with its jurisdiction in Panchmukhani 2 and Jhilla 4, 5 and 6 compartments. This beat was also a revenue station earlier and later was re-designated as a beat. The beat covers a very disturbed area with a big zone of interface. The main works of this beat are protection works related to illegal fishing, illegal collection of tiger prawn seedlings and poaching etc. The works also include eco-development and afforestation. It has four JFMC's under its jurisdiction and carry out ecodevelopment activities there. Also it is responsible for maintenance of the nylon net fencing from Sadak khali camp to Duttar river. It also looks after nylon net fencing along the forest village interface.

(iii) **Dobanki:** This beat camp which is very strategically located in Dobanki was established in the year 2000. The area of Dobanki beat is 108.94 sq. km. and has its jurisdiction in Pirkhali 4, 5, 6 and 7 compartments. The main work in this beat is to protect the vulnerable forest. It is also a major tourist point with a watch tower and an elevated canopy walk which gives the tourists a feel of the mangrove forest.

(iv) **Sajnakhali Mobile Patrolling Party( Chayan):** The head quarters of this beat is in Sajnakhali. This beat covers an area of 124.37 sq. km. and has its jurisdiction in Panchmukhani 3, 4 and 5 compartments. The main work of this beat is protection of forest and wild life for the entire SWLS range. This beat is primarily used to act as strike force after collection of information from intelligence networks and perform tiger straying duties.

(v) **Sarakkhali Floating Camp:** it has jurisdiction of Panchmukhani 1 and covers an area of 25.97 sq. km. Sarakkhali patrolling camp is situated in a very sensitive zone and deals with problems of illegal fishing, illegal collection of tiger prawn seedlings and poaching and in case of tiger straying. It has six JFMC's under its jurisdiction and carry out ecodevelopment activities there. Also it is responsible for maintenance of the nylon net fencing upto Sadak khali camp.

(vi) **Tentultala Floating Camp:** is a fixed floating camp which secures the Tentultala khal from the entry of illegal fishermen, crab collectors and poachers.

(vii) **Pirkhali Floating Camp:** is a fixed floating camp which secures the Pirkhali khal from the entry of illegal fishermen, crab collectors and poachers.

**3. National Park (East) Range:** It is a territorial range with its head quarters in Gosaba. The head quarters of National Park (East) Range has main control of Radio Transmitter system (RT CONTROL) for Sundarban Tiger Reserve. The area of this range is 809.46 sq. km. This range has three beats namely Sonakhali and Chamta and Bagmara under



its jurisdiction. Earlier Mechua floating camp used to perform the duties in fair weather time in place of the present Baghmara camp.

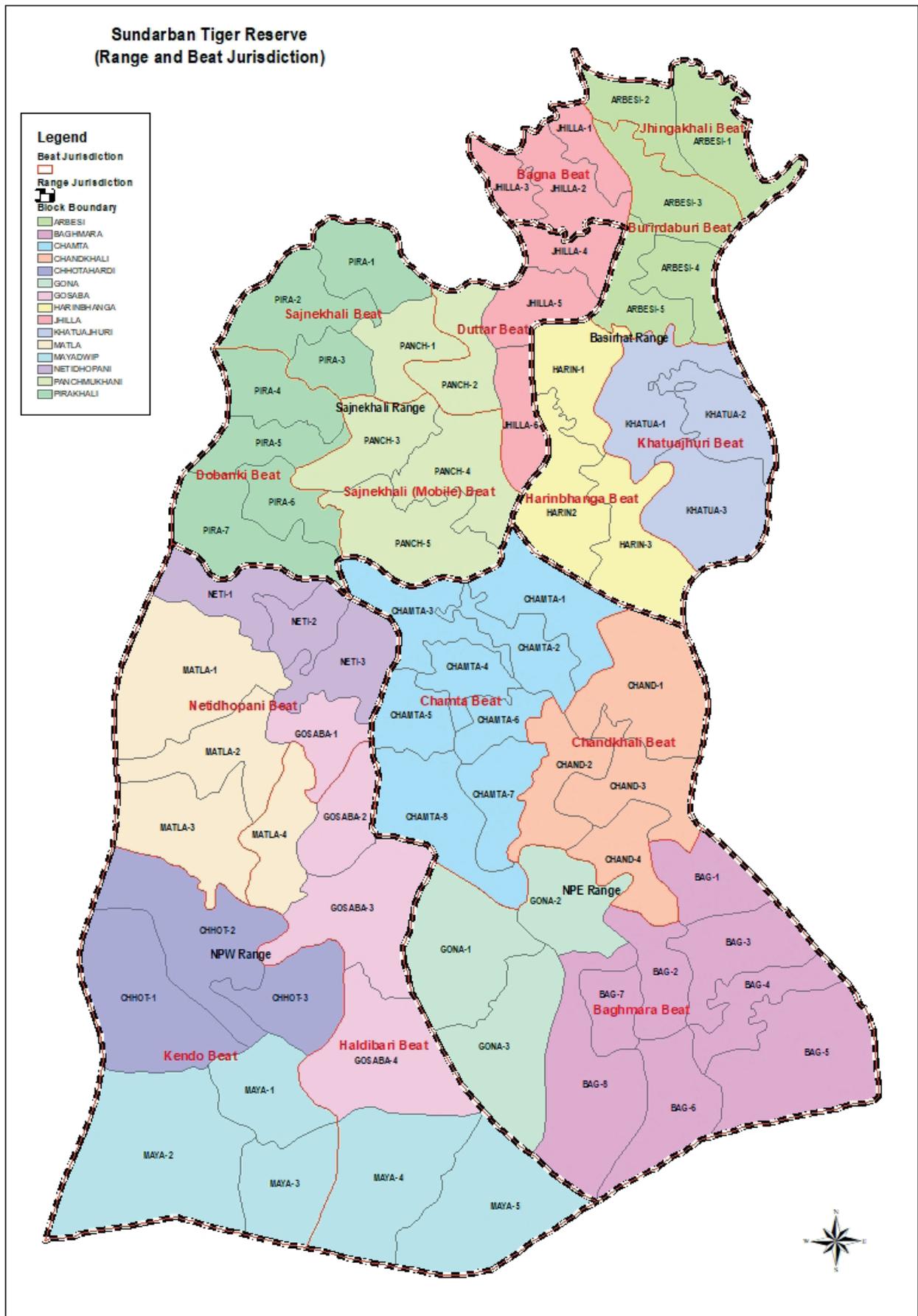
- (i) **Sonakhali:** The head quarters of this beat are at Sonakhali and it is a gateway point for the Reserve. The beat has a tourist permit-issuing centre at Sonakhali. The works of this beat includes spreading of awareness regarding nature conservation, rescue of wild animals, coordination of joint patrolling operations, and promoting social forestry in the fringe villages. However, with the gradual silting up of the Hogal river and development of a good road network upto Gadkhali this point has lost its importance. In the coming future an office shall be opened up at Gadkhali the new gateway to Sundarban.
  - (ii) **Chamta:** The head quarters of this beat are at Chamta. It was earlier a patrolling camp and started functioning as beat from 2001 after construction of Chamta Beat Camp. This beat has an area of about 231.37 sq. km. and its jurisdiction is in Chamta 1 to 8 and Chamta 1-8 forms part of the National Park area. The location of this beat is very important in view of protection aspects. The main works of this beat is protection of forest and wild life. This is very vulnerable to intrusion from Bangladesh especially during the honey season and the fair weather coupe operations in Bangladesh.
  - (iii) **Bagmara:** This land based camp which started functioning in the year 2009 in place of the earlier floating camp of Mechua and looks after an area of about 432.95 sq. km. The jurisdiction of this beat is in Bagmara 1 to 8 and Gona 1, 2 and 3 compartments. Bagmara 2-8 and Gona 1-3 also form part of the National Park. The primary work of this camp is protection of forest and wild life including the protection of Olive ridley turtles which lay eggs on the sandy beaches of the National Park.
  - (iv) **Chandkhali:** This land base camp which started functioning in the yaer 2013. The jurisdiction of the beat Chandkhali 1 to 4 compartments and look after area of about 154.77 sq. km. This is very vulnerable to intrusion from Bangladesh especially during the honey season and the fair weather coupe operations in Bangladesh.
  - (v) **Mechua Floating Camp:** This is fair weather camp which is present in the field from Late October to end of March after which the weather turns rough. It secures the Mechua khal which is an important route used by fishermen and illegal timber collection from the beach. It also looks after the adjacent area of Baghmara- 6 and 8 compartments
4. **National Park (West) Range:** It is a territorial range with its head quarters in Bidya and has an area of 890.08 sq. km. It has three beats namely Netidhopani, Bidya Head Quarter and Haldibari.
- (i) **Bidya Head Quarter:** The head quarters of this beat is at Bidya and it has overlapping jurisdiction over Pirkhali 2 compartment with SWLS range because of its proximity to the forest. The main works of this beat is the protection of forest and wild life. The beat has a sensitive zone and main works of this beat are protection works related to illegal fishing, illegal collection of tiger prawn seedlings and poaching etc. It has five JFMC under its jurisdiction and carries out eco-development and afforestation works in the JFMC areas. This beat also looks after the nylon net fencing maintenance along Pirkhlali 2 and tiger straying incidences. There is a deep tubewell in Bidya and this water station supplies the sweet water for Sajnakhali Wild Life Sanctuary Range and to the tourist lodge. Many of the watercrafts especially the launches take water from here before venturing out into the field.
  - (ii) **Netidhopani:** The head quarter of this beat is at Netidhopani with an area of 266.66 sq. km. in its jurisdiction in Netidhopani 1, 2, 3 and Matla 1, 2, 3 and Goasaba 1 compartments. Netidhopani 2,3 and Matla 1-3, Goasaba 1 are all part of the National Park. Its primary work is to protect the forest and the wild life. It also has a watchtower and sweet water pond in its head quarters and is a favourite tourist spot. There is huge pressure of tourists during the peak period of tourism.

- (iii) **Haldibari:** The head quarters of this beat is at Haldibari with an area of 328.53 sq. km. with its jurisdiction in Chottohardi 1, Goasaba 2 to 4 and Matla 4 compartments. The entire area falls under the National Park. Its primary work is to protect the Forest and the Wild life. Before constructions of Chamta, Dobanki and Khatuajhuri camps, this camp was the only permanent surface camp inside the forest area in the entire Sundarban Tiger Reserve. It also has sea facing beaches and the staff is also involved in the protection of Olive ridley turtles which lay eggs in its jurisdiction.
- (iv) **Kendo Camp:** This camp development has started in 2009 and it was functional since 2012. This camp has been developed as a substitute for the Arabhanga floating camp which was looking after the area over 272.12 sq. Km covering Mayadwip block 1-5 compartments and Chotohardi block 2-3 compartment. The entire area falls under the National Park. This area is illegally used by trawlers to venture out into the deep seas. Many times they have also been found illegally fishing within the Tiger Reserve.
- (v) **Havate Floating Camp:** This is fair weather camp which is present in the field from Late October to mid April after which the weather turns rough. It secures the Havate khal which is an important route used by fishermen and other illegal entrants into the Reserve. It also looks after the adjacent area of Matla 2 and 3 compartments.

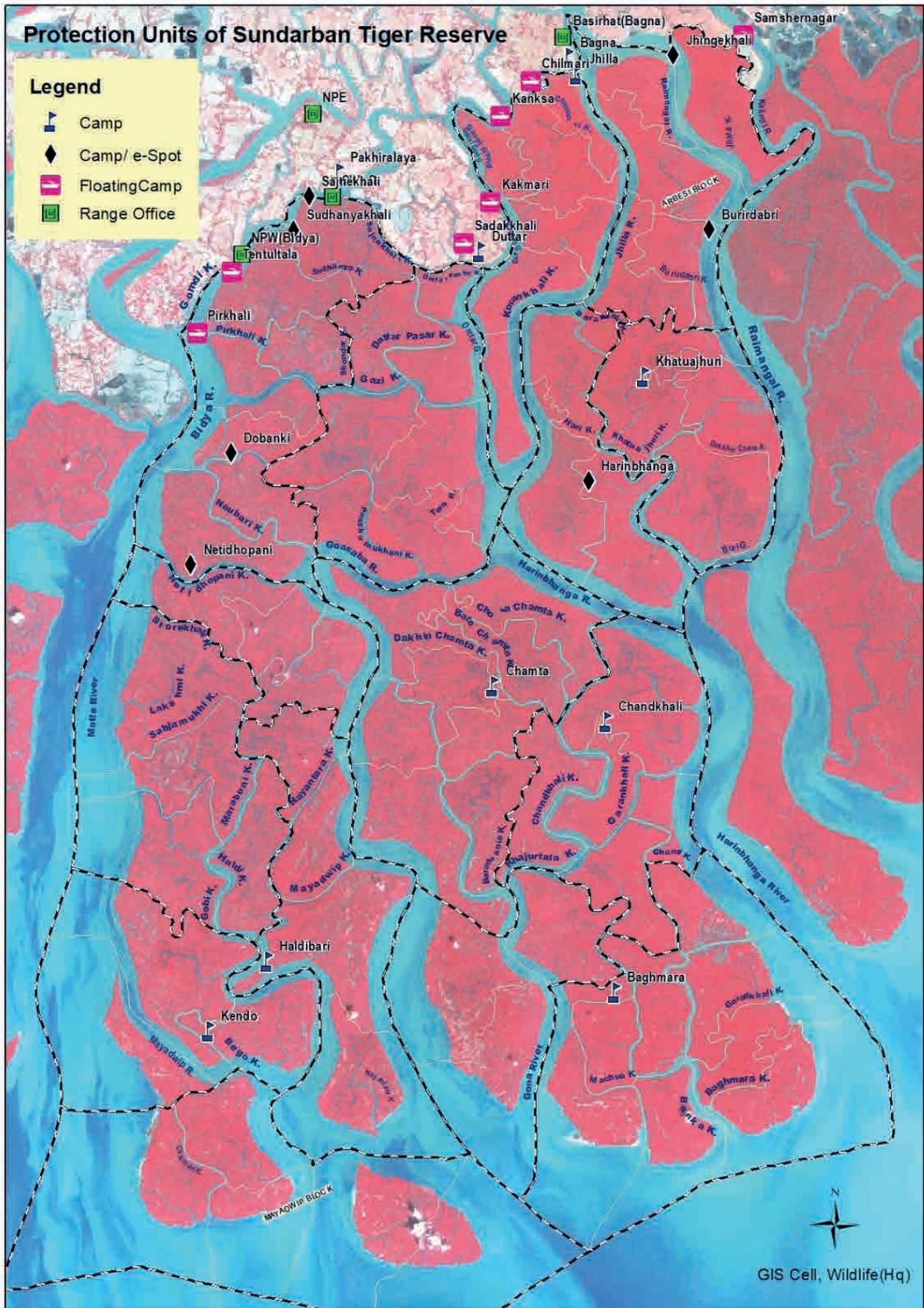
## **B. Functional Ranges in the Sundarban Tiger Reserve:**

1. **Rampura Mobile Range:** It's a functional range and its head quarters is at Rampura under the district of 24 Parganas (N) situated on the other side of Dhamakhali, which is also a gateway-point for the STR. It has two beats namely Rampura Head quarter and Rampura MPP under it. The range has its jurisdiction all over the forest area of Basirhat Range and main works is to augment the protection works of Basirhat Range.
  - (i) **Rampura Head Quarter:** It was a primary a revenue station which collected the revenue for the felling coupes. Presently it assists in the protection duties and eco-development works in the fringe villages.
  - (ii) **Rampura MPP:** The main work of this mobile and floating patrol camp is to augment the protection works of Basirhat range.
2. **Eco-tourism Range:** It is a functional range with its headquarters at Sajnakhali. The main works of this range is related to tourism management including maintenance of Mangrove Interpretation Centre at Sajnakhali. This range also has a tourist permit issuing centre at Sajnakhali.
3. **AFR has been redesignated as the Head Quarter Range:** It is a functional range with its headquarters at Canning. The main works of this range is to issue license/ permits to the tourists, fishermen, honey collectors and timber merchants. This range also works in the field of intelligence network collection and looks after the works of protection outside the TR areas. It has two beats under its jurisdiction namely Head Quarter beat and Head Quarter MPP.
  - (i) **Head-Quarter Beat:** It was earlier a revenue station and now mainly looks after the works of issue of permits /license etc. It also works in the field of protection and animal rescue operations.
  - (ii) **Head-Quarter MPP:** It is a mobile and floating patrol camp with its head quarter at Canning and its jurisdiction is all over the TR. The main works of the beat is to augment the protection works for the entire STR.
4. **Basanti Mobile:** This is a functional range with its head quarters at Basanti. This Range is not working because of shortage of staff and other paraphernalia support, like boats, arms, etc.
5. **Land and Law Cell:** It is a functional range with its head quarters at Canning. The main works of this cell is related with legal matters and court cases.
6. **Research Range:** It is a functional range with its head quarters at Canning. The main works of this range is to undertake research works related to the field of the tiger conservation. This has been lying moribund in the absence of a permanent Research Officer.



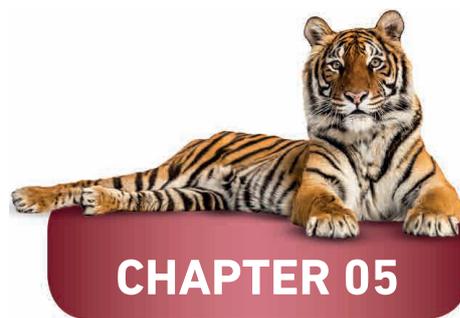


**Figure 2:** Territorial Ranges of Sundarban Tiger Reserve



**Figure 2:** Map Showing Protection Camps, Floating Camps, Range offices Sundarban Tiger Reserve

# Land-use Patterns and Conservation Issues



## 5.1 LAND-USE CLASSIFICATION

The erstwhile mangrove in the intertidal zone which falls south of imaginary line called Dampier and Hodges line have been partly reclaimed for cultivation and agriculture. All the reclaimed area lies on the northern side of the Reserve. The total mangrove area below the Dampier and Hodges line is 9630 sq. k.m. comprising 102 islands out of these 54 are inhabited where agriculture is being carried out and the rest 48 islands measuring 4262 sq.k.m. comprising of the Reserve Forest area which includes both the forests under 24-Parganas (South) Division and Sundarban Tiger Reserve. In the reclaimed area, tidal flow is checked by construction of embankments. The total length of embankment protecting the reclaimed land is approximately 3500 kms. Since the reclamation was started before the completion of siltation process therefore, most of the reclaimed lands are below the high tide level thus making them vulnerable during the cyclones. Many times there are frequent breaches in the embankments which causes enormous damage to the villages. The reclaimed land yield only a single crop as agriculture is rainfed. The major fringe villages are (West to East) Mathurakhand, Amlamethi, Satyanarayanpur, Bally, Bijohnagar, Sonagaon, Pakhirala, Dulki, Dayapur, Enpur, Jamespur, Rajatjubilee, Lahiripur, Chargheri, Santigachi, Imlibari, Bhuruliapara, Mitrabari, Hentalbari, Adibasipara, Bagnapara, Kalitala, Shamshernagar, Hemnagar etc. Apart from agriculture aqua-culture farms and brick kilns have also come up on these reclaimed lands. Of late, tourism is coming up in a big way in the fringe area bordering the Reserve.

## 5.2 SOCIO-ECONOMIC PROFILE OF THE VILLAGES

Since there are no villages inside the boundary of tiger reserve and the core area is restricted to all kinds of anthropogenic activities hence this is not applicable for core area.

## 5.3 RESOURCE DEPENDENCE OF THE VILLAGES

### 5.3.1 Fuel wood and Timber Collection

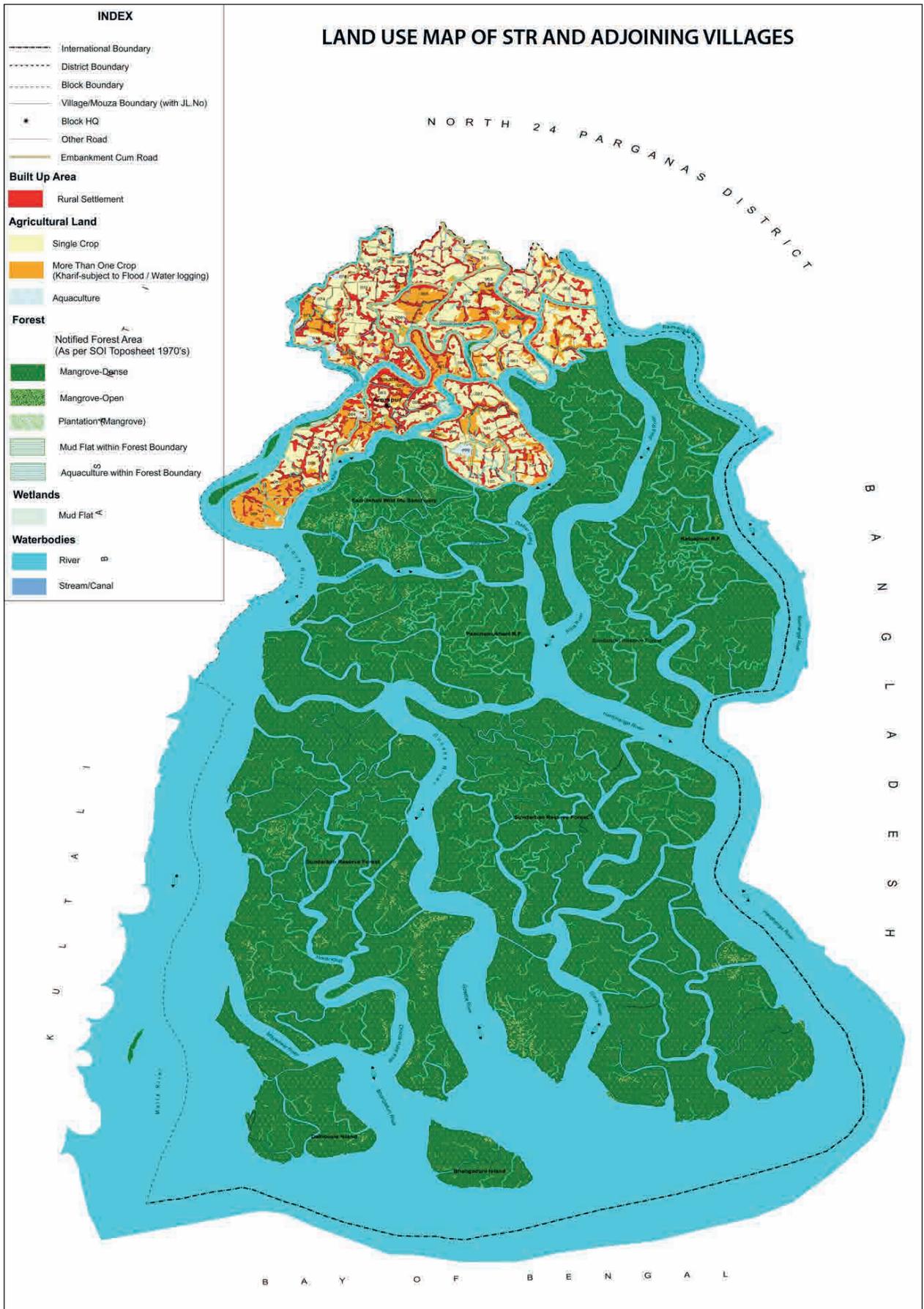
Since there are no villages inside the boundary of tiger reserve and the core area is restricted to all kinds of anthropogenic activities hence this is not applicable for core area.

### 5.3.2 Fishing

Since there are no villages inside the boundary of tiger reserve and the core area is restricted to all kinds of anthropogenic activities hence this is not applicable for core area.

### 5.3.3 Tiger Prawn Seed Collection

Since there are no villages inside the boundary of tiger reserve and the core area is restricted to all kinds of anthropogenic activities hence this is not applicable for core area.



**Figure1:** Data source-Map and details obtained from Department of Agriculture, West Bengal

### 5.3.4 Honey Collection

Since there are no villages inside the boundary of tiger reserve and the core area is restricted to all kinds of anthropogenic activities hence this is not applicable for core area.

### 5.3.5. Threat to poaching

Many species like tiger, deer, wild boar, water monitor and Olive Ridley turtles are vulnerable to poaching. Poachers in Sundarbans use many techniques like nylon rope traps, steel wire traps, gun shots, poisoning etc. to poach the target animals. There are clandestine local markets for deer and boar meat. Olive Ridley turtles are also poached by fishermen because of their meat.

#### Poaching Cases In Sundarban Tiger Reserve

Year	Name of Animal	Number
2003-2004	Spotted Deer	1
	Olive Ridley Turtle	1
2004-2005	Wild Boar	1
2005-2006	Spotted Deer	2
2006-2007	Wild Boar	4
2007-2008	Spotted Deer	4
2008-2009	Tiger	1
2009-2010	Spotted Deer	3 (POR cases have been lodged after arresting the accused)
2010-2011	NIL	NIL
2011-2012	Jungle cat	1 No. (Accused arrested & POR drawn)
2012-2013	Spotted Deer	1 (Accused arrested & POR initiated)
2013-2014	NIL	N.A.
2014-2015	Wild Boar	1 No. (Accused arrested & POR drawn)
	Spotted Deer	POR drawn
2015-16	Spotted Deer	2 Nos. (Accused arrested & POR drawn)
2016-17	NIL	NA
2017-18	NIL	NA

## 5.4 HUMAN-WILDLIFE CONFLICTS

### 5.4.1 Human-Wildlife Conflict Outside the Forest

The peripheral villages outside the tiger reserve are localised only on the north western part of the tiger reserve boundary and hence there are no conflict scenarios outside the forest.

### 5.4.2 Human-Wildlife Conflict within the Forest Areas

There are no villages inside the boundary of tiger reserve and the core area is restricted to all kinds of anthropogenic activities hence this is not applicable for core area. However sometimes people tend to enter illegally for fishing and crab collection along the narrow creeks, where some incidents of tiger attacks has been reported.

### 5.4.3 Inputs of Line Agencies/Other Departments

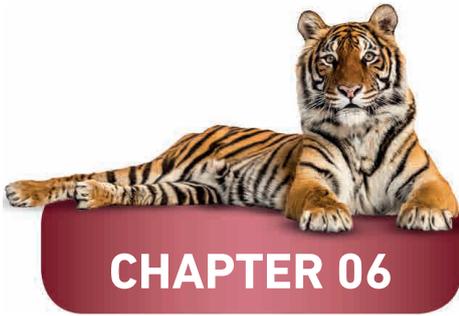
Since there are no villages inside the boundary of tiger reserve, hence this is not applicable for core area.



# CORE AREA

## **PART B**

### **Proposed Management**



# Vision, Goal, Objectives and Problems

## 1.1. CORE ZONE

### 1.1.1. Vision

Conservation of viable populations of the tiger, its co predator and prey species, along with all other floral and faunal assemblages of this unique mangrove ecosystem which is devoid of any human disturbance and management of biodiversity and wildlife in the mangrove ecosystem is the main goal. The mangrove ecosystem in itself is highly productive, self sustaining and with a high regenerative capacity.

### 1.1.2. Management Goals

To provide a secure habitat for the tiger and its prey species so as to serve as an area for source population for tigers as also the reference point for all ecological processes.

### 1.1.3. Management Objectives

1. To protect the tiger along with the mangrove ecosystem by strengthening the existing protection regime by augmenting and upgrading the existing infrastructural facilities like protection camps, patrolling boats, arms etc.
2. To identify knowledge gaps and promote research activities as per the identified managerial priority areas to enable informed management interventions.
3. To improve the existing monitoring programmes by including new parameters, and methodologies.
4. To promote staff welfare through capacity building programmes, special incentives and training program.

### 1.1.4 Problems in Achieving Objectives

There are a multitude of problems being faced in the area which pose a challenge in achieving the desired management goals and objectives. These are listed below:

1. A porous international boundary with Bangladesh which makes the area vulnerable to international poachers, timber and honey smugglers.
2. Inadequate staff strength with considerable vacancy in the frontline staff category is another challenge for protection. This results in below per performance output.
3. The forest on the northern and western fringes is surrounded by human habitations with very high population density. The poor socio-economic condition of the people and lack of employment opportunities leads to a high degree of natural resource dependency for both sustenance and livelihood.
4. Absence of a research officer despite a sanctioned post has adversely impacted research related activities.

5. Unstable nature of land poses a major challenge especially in creation and maintenance of infrastructure like buildings and jetties which become vulnerable due to sudden incidences of soil erosion and subsidence of land.
6. Corrosive nature of sea breeze and saline water also pose threat to infrastructure like fences, boats, iron based doors, windows, grills etc leading to very high maintenance costs.
7. Natural calamities like cyclones 'Sidr' and 'Aila', which have resulted in large scale destruction of property and life especially by damaging houses and flooding arable land with saline water also caused large scale damage to many of the protection camps.
8. Climate change is a worldwide phenomenon has resulted in changed weather patterns leading to few but more intense cyclonic storms; delayed rainfall, flooding at many places and even rise in sea water level over a period of time. This poses a long term threat to the very existence of Tiger Reserve.

## 1.1.5. Strength - Weakness - Opportunities - Limitations (SWOT) Analysis

### 1.1.5.1 Strength

- (i) Absence of any villages/settlements in the Tiger Reserve.
- (i) Inaccessible nature of forest acts as a natural barrier.
- (ii) Ecological contiguity of habitat (mangrove forests) on both sides of the area i.e. Bangladesh Sundarbans on the East, adjoining forest Division 24 Parganas South on the West and adjoining Reserve Forest area in the North.
- (iii) Extremely rich in biodiversity especially populations of many endangered animals like horse shoe crabs, Irrawaddy and Gangetic dolphins, olive ridley turtles, king cobra etc.
- (iv) Largest contiguous patch of mangrove forest (along with Bangladesh) in the world and biggest patch of mangrove forest in the country.
- (v) A World Heritage property and a globally recognized Biosphere Reserve.
- (vi) Compact and dense nature of forest acts as a natural shelter belt and protect the hinterland especially Kolkata and its surrounding areas from natural calamities like tidal surges and cyclones.
- (vii) The mangrove ecosystem is highly productive, self sustaining and with a high regenerative capacity.
- (viii) It sustains the coastal fisheries of the entire east coast.
- (ix) National and international level support.

### 1.1.5.2 Weakness

- (i) Porous international border with Bangladesh.
- (ii) Poor socio- economic condition of people living in the fringe areas due to lack of employment opportunities and proper infrastructure leading to high resource dependence.
- (iii) Considerable vacancy in frontline staff positions, and difficulty to work due to remoteness of the area.
- (iv) Inadequate numbers of protection camps at strategic locations, coupled with old weapons and slow moving boats.
- (v) Lack of proper research and monitoring of ecological processes and population dynamics of key species.
- (vi) Inadequate interagency coordination.
- (vii) Absence of adequate modern fire arms and water crafts to combat poachers and other threats.

### 1.1.5.2 Opportunities

- (i) High tiger densities given the extremely good quality habitat with good prey base if, proper protection is provided.
- (ii) Potential increase in the fish production if, properly regulated by restriction on fishing during breeding time, no. of people fishing in the area, along with the types of fishing net used.
- (iii) Excellent scope for carrying out research and monitoring studies especially those related to climate change, radiotelemetry studies on the tiger to study its ranging pattern territory and breeding biology.
- (iv) Preserving the world's largest contiguous mangrove forest in the world and the largest mangrove area in the country.
- (v) Liasoning with different government and non governmental agencies for coordinated efforts in protection and development of the area.
- (vi) Scope for raising conservation awareness among the fringe populations and tourist visiting the area.

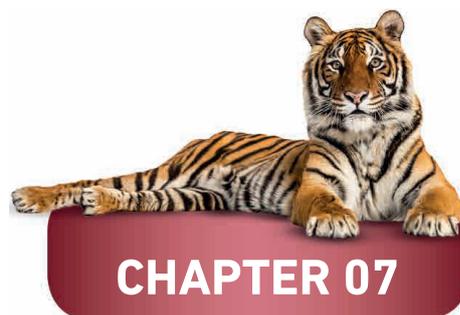
### 1.1.5.3 Threats

- (i) Proximity to Kolkata which is a major centre of smuggling of wildlife articles to Nepal, China and S.E. Asian countries.
- (ii) Mushrooming of large number of tourist lodges, increase in number of tourists.
- (iii) Presence of an international waterway route within the Reserve with vessels/cargo ships plying with loads of fly ash etc.
- (iv) Porous international border with Bangladesh makes the area vulnerable to timber honey smugglers, and poachers. Of late, alerts have been sounded for the extremists trying to sneak into the country using this route. Similarly there have been reports of Maoists also trying to increase their presence in these areas.
- (v) Global warming and rise in sea levels.
- (vi) Sundarban Tiger Reserve is extremely vulnerable to cyclonic surges and storms; the reason being:
  1. Coastal waters (shallow bathymetry extending tens of kilometre offshore);
  2. Convergence of the bay;
  3. High astronomical tides;
  4. Thickly populated low-lying islands;
  5. Favourable cyclone tracks impacting perpendicular to coastline;
  6. Innumerable inlets and river systems

(Mitra *et al.* 2011; Changes of selected hydrological parameters in Hooghly estuary)



# Management Strategies



## 1.1. CORE ZONE

### 7.1.1. Delineation of Critical Wildlife Habitats and Inviolable Areas

#### Critical Wildlife Habitats and Critical Tiger Habitat

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 provides for Critical Wildlife Habitats (CWH) to be notified under Section 4(2) provided the conditions given therein are satisfied. Also, subject to the caveat that the CWH from where the forest rights modified and villagers resettled may not be subsequently diverted for any other purpose by the State Government. Similarly, Section 38V subsection 4 of the Wildlife (Protection) Act 1972, amended up to 2006 provides for the creation of Core or Critical Tiger Habitat (CTH) based on defined ecological and biological criteria.

There are no habitations within the Tiger Reserve and as such there are no recorded rights in the area. Based on the given criteria the Critical Tiger Habitat CTH has been notified as per GO no. 6028-For Dt 18.12.07 (Details of the area see **Appendix 10**)

### 7.1.2. Zone and Theme Approaches to Management Strategies

For the convenience of management of the area it has been divided into different zones which have their own management objectives and strategies. Apart from this, common issues cutting across the area have been dealt in the theme plans.

#### 7.1.2.1. Zone Plans

The core area of the Sundarban Tiger Reserve can broadly be divided into the following zones for the purpose management.

1. Critical Tiger Habit Zone
2. Zone of International Boundary
3. Habitat Management Zone

**7.1.2.1.1 Core Zone or Critical Tiger Habitat:** This zone comprises of the entire area south of the Sajnekhali wildlife Sanctuary Range and Basirhat Ranges. This includes the Sundarban National Park having an area of 1330.12 sq km along with other adjacent compartments of Netidhopani(1-3), Chamta (1-3) Chandkhali (1-4 ) and Bagmara (1-3 ). Administratively the area is covered under the Ranges of National Park West and National Park East, having a total area of 1699.62 sq km

**Table 1: Critical Tiger Habitat**

SI No	Block	Compartment	Total Area (sq. km.)	Legal Status
1	Matla	1-4	176.36	NP
2	Chamta	1-3	96.32	RF
3	Chamta	4-8	124.37	NP
4	Chotahardi	1-3	175.67	NP
5	Gosaba	1-4	171.73	NP
6	Gona	1-3	139.03	NP
7	Bagmara	1	24.30	RF
8	Bagmara	2-8	269.63	NP
9	Mayadwip	1-5	273.36	NP
10	Netidhopani	1-3	93.00	RF
11	Chandkhali	1-4	115.91	RF
<b>Total</b>		<b>1699.62</b>		

**Objectives:**

1. To act as the “Sanctum Sanctorum” of the area.
2. To act as the “source” area for the tiger population within the Reserve.
3. To carry out strict protection regime within the area.
4. To carry out research and monitoring activities.

The Critical Tiger Habitat Zone shall be free from all external influences and act as the ‘sanctum sanctorum’ or the primitive gene pool of the area. The area shall also serve as the source population of the tigers, other principal faunal and floral species which can disperse to the adjacent areas. All activities except tourism on a limited scale shall be carried out in Netidhopani camp lying in Netidhopani 1 compartment (for educational purpose as World Heritage Monument is situated inside the camp ). A strict protection regime with intensive patrolling may be the main management intervention as the area is vulnerable to illicit timber felling, honey collection besides poaching of wild animals. Apart from protection, research and monitoring activities like population estimations, successional analysis, salinity changes, radio collaring and camera trapping studies etc may be carried out to understand the various ecological and biological processes.[Details of these are dealt in the chapters Research and Monitoring, Training and Wildlife health].

**7.1.2.1.2. Zone of International Boundary:** Indian Sundarbans on its eastern side shares the international border with Bangladesh and separated by Raimangal, Kalindi and Harinbhanga rivers. The compartments of buffer area lying in this zone is given in the table below:

SI No.	Compartment	Range	Area in Km <sup>2</sup>
1	Chandkhali-1	National Park East	62.84
2	Chandkhali-3	National Park East	37.26
3	Bagmara-1	National Park East	24.30
4	Bagmara-3	National Park East	41.81
5	Bagmara-4	National Park East	24.03
6	Bagmara-5	National Park East	80.54

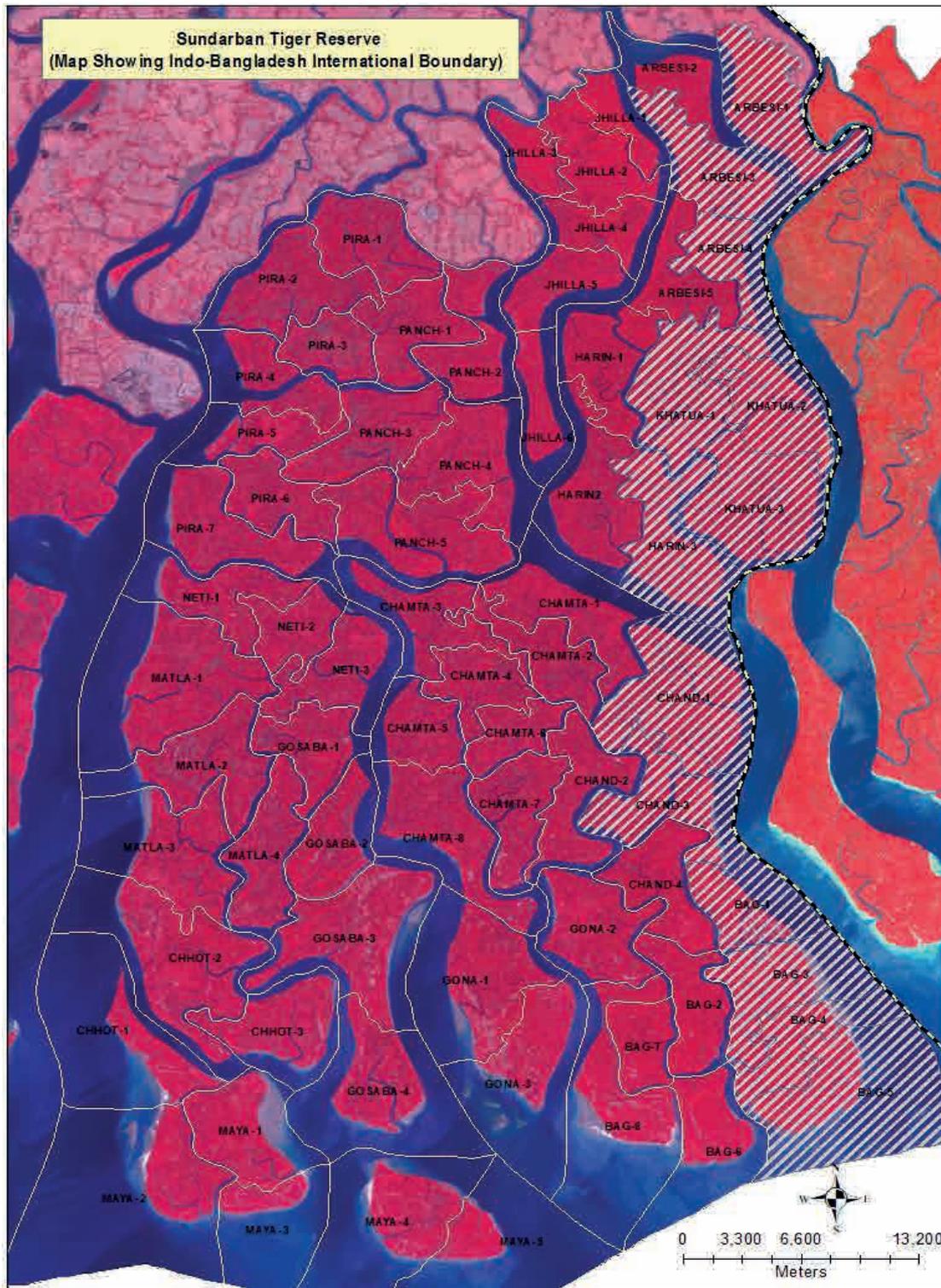
The porous border area makes the tiger reserve vulnerable to various illicit activities such as:

- a. Cattle and timber smuggling
- b. Illegal honey collection
- c. Illicit felling
- d. Poaching



**Management strategies for protection along the border areas:**

1. Joint patrolling is done with the Border Security Force (BSF)
2. The BSF has three BOPs along the border area which is active round the clock throughout the year
3. Every camp along the border area have been provided with high speed 4-cylinder boats and adequate arms and ammunitions and communication equipments.
4. Fair weather camps for patrolling during winter season for patrolling purpose



**7.1.2.1.3 Habitat Management Zone:** Sundarban Tiger Reserve is part of the largest compact patch of mangrove forest within the country. It harbours an extra ordinary array of floral and faunal diversity ranging from the Royal Bengal tiger, estuarine crocodile, olive ridley turtles to the extremely primitive mudskippers and horse shoe crabs. The habitat comprises 1680 sq.km of land and 905 sq.km of water i.e. 65% and 35% of the area respectively. The mangrove ecosystem by itself is extremely resilient however, it is facing many threats most of which are on account of human related activities on the upstream.

These rivers and rivulets frequently change course resulting in formation of new mud flats and erosion of existing stable banks. The high silt load in the river channel have also resulted in formation of new islands downstream. Siltation of river bed also results in frequent flooding and overflow of estuarine waters in human settlements which is borne out by satellite imageries of the area.

Similarly the habitat also faces destruction by illicit felling by miscreants and poaching of wild animals and illegal collection of honey. Tidal surges and cyclones which periodically ravage the area also cause destruction by way of uprooted trees etc.

[Details have been mentioned in the Disaster Management theme plan]

**Objectives:**

1. To conserve this pristine forest habitat from external biotic pressures like illicit felling, poaching, honey collection and fishing.
2. Raising plantation on blank and char land
3. To augment the availability of sweet water for animals in the Tiger Reserve.
4. To prevent soil erosion especially in catchment area through soil moisture works along with plantations.

**Problem in achieving these objectives:**

1. Increasing population pressure in the fringe areas where people have a high level of resource dependency.
2. Vacancies in the front line staff position
3. Lack of interagency coordination.

**Strategies:**

1. **Protection Management:** A sound protection strategy forms the backbone of the management of any Tiger Reserve. Sundarban Tiger Reserve also faces a number of challenges in the form of poaching, illicit felling, illegal fishing and honey collection. Of late, the area is increasingly being used for cattle smuggling.
2. **Water management:** Sweet water is a scarce resource in the Tiger Reserve. At present, water holes are dug up near camp locations only as past experience has shown that the water holes inside the forest away from camp areas are not only vulnerable to poaching but also serve as fresh water refilling points for illegal fishermen and honey collectors helping in prolonging their stay in the forest. As, the present strategy has worked well, it needs to be continued and fresh water holes only developed near newly developed camps only. It is also seen that these fresh water holes attract wildlife in the area and can double up as wildlife monitoring points. Fruit trees like Keora (*Sonneratia apetala*) and *Zizyphus* which are preferred by the wild animals especially deer and macaques can be planted near the sweet water ponds.

Similarly, as most of the camps also face acute shortage of sweet water they need to carry out water harvesting in order to conserve the same. The rooftops of the existing barracks should be used for harvesting of water and similar provision made in case of newly constructed barracks. Excess water should be drained off in a manner which serves to recharge the underground aquifer.

3. **Waste Management:** The Tiger Reserve has been declared as a 'No Plastic Zone' and the waste management should be carried out in consonance with this principle. Waste generated at the camps and that by the tourists visiting the

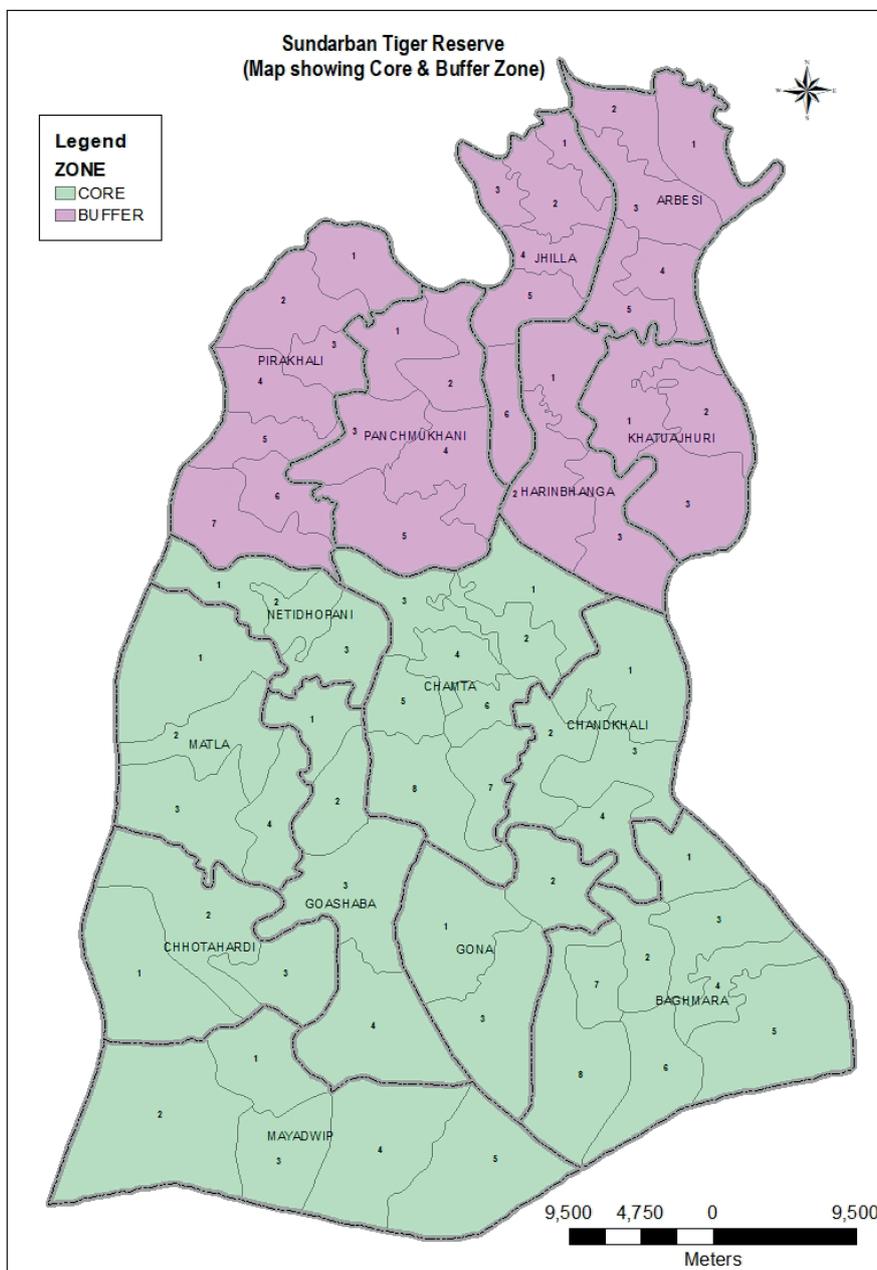


camps should be sorted out and that which can be recycled should be burnt with the help of incinerator and the one which cannot be recycled should be sent to Kolkata to be properly disposed of in landfills. Staff should be given proper training in waste management.

Of late, it has been seen that the pristine mangrove ecosystem is being threatened with the invasion of garbage in the form of plastics, pet bottles, thermocol plates which seem to be floating around the Reserve.

- 4. **Soil Moisture Conservation:** The catchment areas of the rivers have become denuded due to the rampant felling of trees for local use. Natural calamities like cyclones are also responsible for reduction in green cover. This has accelerated soil erosion and as a result downstream rivers are facing siltation of the river channels which is posing major navigation problem.

Plantations also need to be carried out on newly created char-lands. Soil moisture conservation measures shall be taken at spots mainly near protection camps most vulnerable to soil erosion. Mechanical structures like bamboo and sand bag piling along the earthen embankments or bamboo cribs with brick bats have proved to be very effective in combating erosion to some extent, may be taken up. Plantation activities shall be carried out at such places.



### 7.1.2.2 Theme Plans

The following themes have been identified for implementation in the Tiger Reserve:

1. Protection Management
2. Research and Monitoring
3. Disaster Management
4. Wildlife health Monitoring

#### 7.1.2.2.1 Protection Management

##### Objectives

1. To protect the tiger, its co predators and its prey species along with other floral and faunal components of this unique ecosystem against all biotic interference.
2. Upgrade and augment existing infrastructure like protection camps, patrolling boats, arms etc.
3. Developing a strong information network to prevent occurrence of wildlife crime.
4. Liasoning with other Government agencies like BSF and Coastal Police Station to ensure the territorial integrity of the area.
5. Checking the increased use for forest area for smuggling cattle to Bangladesh.

##### Problems in achieving these objectives:

1. Porous international border with Bangladesh from where smuggling of men and material is very easy.
2. Budgetary constraints and vacancy in frontline staff positions
3. Extremely poor fringe population with high degree of resource dependency.
4. Difficult terrain of sundarban landscape makes foot patrolling a difficult task. Most of the regions of sundarban are inaccessible and due to thick vegetation it almost makes impossible to patrol by foot. During summer and monsoon, most of the river channels are extremely turbulent so it becomes very risky and virtually impossible to cruise along the channels and desired area by foot patrolling.
5. Fewer number of camps with inadequate staff leading to few camps patrolling vast areas.
6. Lack of intelligence sharing and poor coordination between different agencies.
7. Most of the sea facing areas remains out of bounds due to extremely rough weather from March to September. (Pre-monsoon to post-monsoon period)

**7.1.2.2.2 Research and Monitoring:** Research and monitoring are effective tools for knowing more about an area as also testing/checking the efficacy of the existing strategies being followed. The mangrove ecosystem is one of the most biologically productive and taxonomically diverse biodiversity gene pool in the country. It exhibits enormous diversity on the basis of its genesis, geographical location, and hydrological regime. The structural complexity of the ecosystem lends to the presence of a number of ecological niches. Over the years the mangrove ecosystem is being affected by a number of factors like, upstream water pollution, increased off take of fish catch, illicit felling, illegal fishing and honey collection and poaching. The increased silt load in the river channels have been resulting in changed river courses.



High salinity levels especially in the western boundary of the Tiger Reserve have been correlated to declining status of Sundari trees in the tiger Reserve.

Other forms of flora and fauna especially endangered species like the estuarine crocodile, Irrawaddy and Gangetic Dolphins, also need to be monitored for their distribution, population size and kinds of threats faced. Similarly, vegetation plots could be laid down in different part of the Reserve for carrying out vegetation monitoring. The impacts of tourism which has come up in a big way in the area also needs to be studied. Detailed study needs to be carried out into the impacts of these activities to help the field managers in formulating sound policies and taking informed decisions based on scientific facts instead of reasoned guestimates.

Climate change which could lead to the rise the sea level rise which could endanger the very existence of the Tiger Reserve in the long run should be studied to find the factual position in this regard.

Though the area lends itself to undertaking research into a number of areas the following areas should be the areas of focus / or thrust areas for the management of the Reserve:

- Estimation of tiger densities, dispersal and ranging patterns
- Estimation of prey species especially spotted deer and wild boar populations
- Successional patterns in mangroves
- Change in river courses, erosion and accretion patterns in different parts of the Tiger Reserve.
- Studying the tidal movement and rise in sea waters especially in the context of global warming.

**7.1.2.2.3 Disaster Management:** Sundarban area has historically been prone to natural calamities like cyclones, tidal surges, earthquakes etc. Prominent among these, have been a huge surge in the Bay of Bengal in the year 1688 which took a toll of more than 60 thousand people in Sagar Island. In 1737, a severe cyclonic storm with wind speed 250 km/hr along with tidal thrust or surges of 13.0 m from msl and severe earthquake fully destroyed the human habitat and mangrove forest. Post independence the most disastrous cyclonic storm in this region was the one that occurred on 13<sup>th</sup> Nov, 1970 which caused thousands of deaths in Sundarban. The cyclone on 29<sup>th</sup> November, 1988 also had wind speed of 250 km/hr and had caused wide spread damage. The latest cyclone to wreak havoc in Sundarban was '**AILA**' which swept across Sundarban on 25<sup>th</sup> May, 2009 leaving thousands of people homeless and lakhs of hectares of farmland inundated thousands of cattle dead. The high waves accompanied by wind speeds 130-140 km/hr breached the river embankments causing large scale damage leaving people without any home or hearth. In most of these cases, the mangrove forests have acted as a natural barrier by absorbing the impact of the high speed winds and the high waves and breaking their impact thereby protecting the hinterland from the actual intensity of the cyclone. Though cyclones, floods, famines and earthquakes are natural phenomenon and occur on a regular basis advance planning can leave us in a better state of preparedness to handle such situations.

**Objectives:**

1. To be able to anticipate the disasters and have preparedness accordingly.
2. Capacity building of staff to deal with such scenarios.
3. To build supporting infrastructure needed to cope with such events.

**Problems in achieving these objectives:**

1. Most of the times the disasters occur suddenly and give very little chance of preparedness.
2. Remoteness from the mainland hinders the swift movement to and from the area.

3. Waterways are the only means of approaching the area.
4. Very few landing ports or jetties on the approach points/gateways to the area.
5. Unstable nature of soil that is prone to sudden subsidence due to river water dynamics.
6. The earthen embankments guarding against the flooding of river waters are extremely vulnerable in the face of rising water currents.

**Strategies:**

1. **Advance Warning System:** Cyclones can be predicted to a large extent due to recent advances in science and technology. The advance warning regarding the impending danger is to be broadcast through the R.T. system to all remote camps of the Tiger Reserve and through JFMC Committee to the fringe population.

Mobile R.T. handset to be provided to all watercrafts so that communication is possible in case of emergencies. Hooter system present in every camp to alert the patrolling staff of danger in the field.

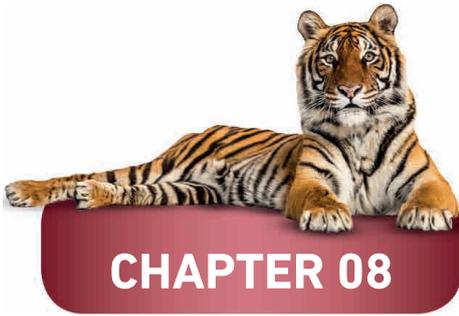
2. **Improving infrastructural facilities in the camps:**

- (i) Presence of an elevated area like roof tops for staff to take shelter in case of tidal surge and rise of water in the camps.
  - (ii) Sufficient number of search lights and batteries to be provided in each camp.
  - (iii) Sufficient number of life jackets and tarpaulins to be provided in each
  - (iv) Lofts created for storing of important documents, arms etc.
  - (v) First aid boxes to be provided at each camp.
  - (vi) Speed boats to be provided at all camp locations.
  - (vii) Roof water and spare water storage tanks to be provided at all camp locations
  - (viii) Height of the platform of tube well should be at least 4 to 5 feet above ground level to become effective even in natural calamities.
  - (ix) Brick pitching/bamboo piling of earthen embankment depending on fund position.
  - (x) All buildings to have piling work in the foundation to increased the stability and longevity of the structure.
3. Liaisoning with line departments namely BSF, Army, Police and District Administration to chalk out a disaster management strategy along with the role of different agencies.

**7.1.2.2.4 Wildlife health Monitoring:** There are no villages inside Sundarban Tiger Reserve area and the unique habitat of Sundarban Tiger Reserve makes it isolated from the fringe villages through river channels and creeks. Also scenario of cattle entering the forest area does not exist; hence there is no chance of spreading of infection to the wild animals. However, in case of animals rescued after straying into the villages, proper health monitoring is carried out by the veterinary officer following standard operating procedure. Standard protocols are followed in case of disposing animal carcass that surfaces through the river channels to and from the tiger reserve. As an added precautionary measure veterinary camps are organized in all of the 26 fringe villages of STR, throughout the year, aiming at the immunization of the cattle population in the fringe villages.



Gist of Work Done in the Veterinary Camps (20 Nos) at Bht, Sajnekhali & Npw Range in the Year 2017-2018													
Sl No	Range	Beat	Name of Jfmc	Date of Camp	Treatment					Vaccination			
					Cattle	Sheep/ Goat	Poultry Bird	Duck	Others	Total	Cattle	Sheep/ Goat	Total
1	BHT	Bagna	Mitrabari	01-Jan	136	293	1011	540	-	1980	97	98	195
2	BHT	Bagna	Kalidaspur	02-01-2018	152	327	1129	530	-	2138	98	93	191
3	BHT	Bagna	Bhulapara & Bagnapara	03-01-2018	209	256	1098	593		2156	93	89	182
4	BHT	Bagna	Adibasipara	04-01-2018	213	250	1452	551		2466	168	170	338
5	BHT	Jhingekhali	Hemnagar	05-01-2018	74	131	683	173	1	1062	49	98	147
6	BHT	Jhingekhali	Samsernagar	06-01-2018	189	587	1191	798		2765	146	97	243
7	SWLS	Duttar	Luxbagan	08-01-2018	151	206	505	183		1045	91	94	185
8	SWLS	Duttar	Lahiripur, Chargheri	09-01-2018	242	252	1394	347	1	2236	176	189	365
9	SWLS	Duttar	Lahiripur, Santigachi	10-01-2018	205	489	2260	659	1	3614	153	97	250
10	SWLS	Duttar	Tripligheri	11-01-2018	106	166	383	135		790	49	98	147
11	SWLS	Duttar	Rajatjubilee	12-01-2018	186	195	1151	536		2068	98	98	196
12	SWLS	Sajnekhali	Sonagaon	14-01-2018	195	235	1698	269	6	2403	160	170	330
13	SWLS	Sajnekhali	Jamespur	15-01-2018	187	264	1068	344		1863	130	99	229
14	SWLS	Sajnekhali	Dayapur	16-01-2018	162	157	831	223	3	1376	120	98	218
15	SWLS	Sajnekhali	Dulki	17-01-2018	221	193	848	168	24	1454	210	187	397
16	SWLS	Sajnekhali	Pakhirala	18-01-2018	176	212	1016	236	6	1646	160	170	330
17	NPW		Bali, Bijaynagar	21-02-2018	191	251	1137	167		1746	163	197	360
18	NPW		Amlamethi	22-02-2018	127	180	662	144	1	1114	109	140	249
19	NPW		Mathurakhanda	23-02-2018	194	429	898	116	13	1650	160	198	358
20	NPW		Mathurakhanda	24-02-2018	175	301	1401	118	3	1998	145	196	341
<b>TOTAL</b>	<b>3</b>	<b>4</b>	<b>20</b>		<b>3491</b>	<b>5374</b>	<b>21816</b>	<b>6830</b>	<b>59</b>	<b>37570</b>	<b>2575</b>	<b>2676</b>	<b>5251</b>



# Research, Monitoring and Training

## 8.1. RESEARCH PRIORITIES, MAIN PROJECTS AND IMPLEMENTATION

Research and monitoring are effective tools for knowing more about an area and also serve to provide an effective feedback regarding the efficacy of the existing strategies being followed. The mangrove ecosystem is one of the most biologically productive and taxonomically diverse biodiversity gene pool in the country. It exhibits enormous diversity on the basis of its genesis, geographical location, and hydrological regime. The structural complexity of the ecosystem lends to the presence of a number of ecological niches. The mangrove ecosystem is being affected by a number of factors like, upstream water pollution, increased off take of fish catch, illicit felling, illegal fishing and honey collection and poaching. The increased silt load in the river channels have been resulting in changed river courses. High salinity levels especially in the western boundary of the Tiger Reserve have been correlated to declining status of Sundari trees in the Tiger Reserve.

In Sundarban, due to inaccessibility and remoteness of the area, hardly any concrete data exists with regard to the actual range of tiger numbers, its ecology and behavior especially territoriality, its breeding biology and genetic diversity vis a vis other tiger populations of the country and these would make for an interesting study. Monitoring prey base of the tiger needs to be carried out on a priority basis so as to aid management decisions in event of low prey base as is often alleged.

Other forms of flora and fauna especially endangered species like the Irrawaddy and Gangetic Dolphins, also need to be monitored for their distribution population size and kinds of threats faced. Similarly, vegetation plots should be laid down in different part of the Reserve for carrying out vegetation monitoring.

Similarly, the impact of climate change on the sea level rise which could endanger the very existence of the Tiger Reserve in the long run should be studied to find the factual position in this regard.

On the whole, detailed scientific studies needs to be carried out on the above mentioned topics to help the field managers in formulating sound policies and taking informed decisions based on scientific facts instead of reasoned guesstimates.

Research activity requires dedicated personnel, adequate infrastructure and financial support. The Tiger Reserve management faced with a crunch of men and material resources by itself cannot spend the time required for carrying out the Research. Therefore, research studies should be carried out in collaboration with local universities, scientific institutions or NGO's of repute. However, all the research activity should be undertaken as per the management priority and in consultation and direct co supervision of the field managers. The outcome of these scientific investigations can help them refocus or fine tune their management interventions.



### 8.1.1. Strategies

1. The Research Range which has become moribund in the absence of a full time Research Officer (despite a sanctioned post), Range officer, beat officer and needs to be revitalised. It is in charge of the routine monitoring activities especially relating to monitoring of biodiversity i.e. fortnightly monitoring of wildlife, tiger monitoring, data collection on weather, tidal fluctuations, camera traps, salinity etc. along with compilation of the data collected.
2. Improved research methodology may be devised in terms of base line study of flora, fauna and conservation biology with the help of expert groups, NGOs and Academia with the requisite budgetary provisions regarding the matter.
3. Special studies related to marine and aquatic species of Sundarbans may also be devised with the help of expert groups, NGOs and Academia after making the requisite budgetary provisions regarding the matter.
4. Presently, all the Research proposals are cleared at the level of the Chief Wildlife Warden. Field level requirements and inputs may be taken into consideration before giving permission for the conducting of field based research. In this regard a Research Advisory Committee is proposed which shall vet all the Research Proposals before giving a final go ahead.

#### Constitution of Research Advisory Committee:

**A Research Advisory Committee shall be constituted with the following members:**

(i) The Chief Wildlife Warden, W.B.	Chairman
(ii) Director, Sundarban Biosphere Reserve	Member Secretary
(iii) Field Director, Sundarban Tiger Reserve	Member
(iv) Deputy field Director, Sundarban Tiger Reserve	Member
(v) Scientist, Calcutta University	Member
(vi) Scientist, BSI, ZSI	Member
(vii) Any other Scientist/Forest officials, NGO nominated by the Chief Wildlife Warden	Member/Special invitee

#### The Committee shall have the following Activities:

- (a) To finalize the selection/identification of relevant research based studies.
- (b) To review the progress of research activities carried out for the STR
- (c) Provide suggestion/recommendations for improvement and smooth functioning of the research activities.

The meeting should be arranged as per the requirement, but at least once in six months. The members would be eligible to get TA/DA and other facilities, decided by the Government from time to time.

#### Research Projects:

Though the area lends itself to undertaking research into a number of areas the following areas should be the focal / or thrust areas for the management of the Reserve:

- Estimation of tiger densities, dispersal and ranging patterns through radio collaring studies.
- Estimation of prey species especially spotted deer and wild boar populations.
- Successional patterns in mangroves
- Spatial distribution of 'Sundari' or *Heritiera fomes* with reference to the salinity regime in the Tiger Reserve.
- Straying of tiger in the village areas

- Impact of eco development works on villages and its linkages with conservation
- Ecotourism its impact on conservation awareness, local economy and the environment.
- Change in river courses, erosion and accretion patterns in different parts of the Tiger Reserve.
- Studying the sea level rise, and tidal movement especially in the context of global warming.

In addition to these a list of research which has already been conducted has been given in Appendix 12.

### 8.1.2. Monitoring Framework

Monitoring is one of the most effective methods of gauging the efficacy of a process or a management intervention along with this it also serves as a regulatory tool as well as a means of detecting incipient change. One of the outcomes of a good monitoring program is that it generates good baseline data. It has been seen that in most of our Protected Areas we lack good baseline data collected in a scientific manner which often results in decisions being taken in an adhoc and piecemeal manner.

In the Tiger Reserve the present system of monitoring involves data being collected in pre designated formats by the field staff. The different field camps are involved in collection of data related to the following:

- (i) Tiger sighting direct and indirect evidences on a day to day basis.
- (ii) Wildlife sighting on a daily basis.
- (iii) Protection related data collected on a daily basis. The monitoring of this data is carried in the form of *Protection Monitoring Protocol (PMP)* which reflects the duties performed by the field staff along with its outcome in the form of data generated with respect to the area where duties were carried out, number of night halts, number and nature of offence detected, etc has proved to be an effective tool for monitoring the protection regime. The same needs to be continued and monitored regularly and corrective action applied based on the basis of the monthly review meetings chaired by the Field Director. (Format of PMP see Annexure18)

To overcome the limitations of time dependency on RT network, errors and time consumptions in manual entry, possibilities of data manipulation and absence of real time data. Hence, in order overcome all these limitations E-patrol/ Smart patrolling was introduced in Sundarban Tiger Reserve in 2015.

In this new system every camp has been given a cell phone having an android operating system with a compatible mobile application. With the help of this application the frontline staffs are recording their every possible activity like patrolling, monitoring the condition of fences, night patrolling, offence detections, and wildlife sightings.

The real time patrolling data which has been well tabulated, analysed and synchronised into the main server database, can directly be monitored by the application installed in a compatible android cell phone of a senior official. In addition to that, the software allows arranging and/or comparing the reports on numerous strata, by providing various relevant filters.

### 8.1.3. Training Needs Assessment

Training or capacity building is an integral part of all the management activities and inputs and is invariably reflected in an increased efficiency or output. Training needs are different depending on the persons and activities involved. The staff posted in wildlife areas need to be well versed with the biodiversity values of the area along with different field signs. Towards this end staff which appear promising or with potential should be identified and capacity building carried out. The Park Management may ensure that the newly inducted staff undergoes wildlife training conducted by various Institutes in the State and outside. Officers and staff right up to the Range Officer level should be encouraged to undergo Diploma, Certificate and Capsule courses conducted by the Wildlife Institute of India, Dehradun. The information about the training and institute providing training is as following:



## 8.1.4. HRD Plan

Wildlife management is a specialized branch, which need special orientation, skill and knowledge. It requires men with high degree of motivation, dedication and skills in field craft. However, in most of our PA's we have an aging work force in the form of Forest Guards, Beat Officers and Range Officers and many of whom may not be very motivated to give their best efforts. Therefore, the Tiger Reserve management may systematically carry out capacity building through trainings along with a system of incentive to increase the skill sets and the motivation levels of the staff. The existing human resource at the disposal of the Tiger Reserve management needs to be given exposure to good efforts in other PA's can help develop motivation to achieve the goal to the same degree or higher also. Not only this, tremendous degree of confidence is also developed if the initiative done is appreciated by others. Therefore, it is nice to initiate effort to impart special training to all level of staff in various relevant fields. Technical assistance and guidance should be availed from the concerned experts as and when required.

### Training Calendar:

Sl No.	Type of Training	Designation/level of participants	Resource Person	Frequency
1.	Tanquilisation	FR, BO, FG, BS/BM	DFD, AFD	3 months
2.	Arms training	FR, BO, FG, BS/BM	State Police Academy	Yearly
3.	Mob control	FR, BO, FG, BS/BM	State Police Academy	Yearly
4.	First Aid	FR, BO, FG, BS/BM	Block Doctor	Yearly
5.	Hospitality training	FR, BO, FG dealing with tourists, tourist guides	From Hospitality industry	Yearly
6.	Law and related matters	FD, DFD, AFD, FR, BO, FG	APP and Judges	Yearly
7.	Computer	FD, DFD, AFD, FR, BO, Clerical staff	Professional from a training institute	Yearly
8.	Waste Management	Local lodge owners, boat operators, FR, BO	Expert from the concerned field	Yearly
9.	Radiocollaring and Monitoring	FD, DFD, AFD, FR, BO, FG	Experts from WII	Yearly
10.	Surveillance and intelligence gathering	DFD, AFD, FR, BO	Experts from CID	Yearly
11.	Tourism, interpretation and conservation awareness	DFD, AFD, FR, Tourist Guides	Local Experts	Yearly
12.	Livelihood options	FR, BO, JFMC members	Local Experts	Yearly
13.	JFMC account keeping	FR, JFMC members	Forest Range Officer	Yearly
14.	GPS and Smart Patrolling	FR, BO, FG, BS/BM	Local Experts	3 Months

### In addition to the above, the following are also proposed:

- (i) Study tours to other PA's to study their management activities and initiatives. The JFMC members also should be given exposure during these visits to see the ecocodevelopment activities being carried out in other areas.
- (ii) The Sundarbans is a contiguous forest between India and Bangladesh. Officials and staff should visit Bangladesh to study the management being carried out there.
- (iii) International study tours to gain exposure to the new initiatives being carried out elsewhere.
- (iv) Yearly workshops should be conducted to present the findings of the studies being carried out in Sundarbans by different departments like BSI, ZSI other institutions, NGO's which shall result in updation and exchange of ideas and help in keeping abreast with the latest information in the concerned field.

## 8.1.5. SPECIES RECOVERY PROGRAMME

Since the 1980's *ex situ* conservation program of olive ridley turtle (*Lepidochelys olivacea*), was fully operational in Sundarban Tiger Reserve, where eggs of the species were collected from the turtle pits and incubated at a controlled environment (at Sajnekhali). The hatchlings were subsequently released in the sea.

During the 1990s amongst the hatchlings of olive ridley turtles nine hatchlings of some other species were spotted and later these were identified as Northern River Terrapin (*Batagur baska*). By 2008, there were 12 individuals (7 males and 5 females). Thereafter a species recovery program is ongoing in this reserve with active assistance from Madras Crocodile Bank Trust and TSA. Unfortunately, one male was lost from the pond of Sajnekhali when cyclone *Aila* hit Sundarbans and adjoining areas. However, later in 2013, an adult female was received from Mollakhali.

### Objectives of the species recovery program of *Batagur baska* in Sundarban Tiger Reserve

The major objectives of the *species* recovery program of *Batagur baska* are:

- a. Initially, creating *ex situ* breeding conditions and favorable growth environment.
- b. Later, when the individuals ages to about two years and attains a body weight of about one kilogram, soft release would be done after adequate habitat survey. Soft release would be carried out by constructing temporary enclosures on the tertiary creeks at the release site in order to acclimatize the individuals to the natural conditions and as per the protocol for the monitoring of the released individuals, ultrasonic transmitter with temperature sensor would be fitted to them.

### Soft Release of *Batagur baska* in Sundarban Tiger Reserve:

During March 2014, selected river stretches were surveyed for soft release of the individuals. As per the protocol a temporary enclosure was constructed at the creek of Chamta khal. On 17/01/2016, 10 (six female and four males) juvenile *Batagur baska* were released at the creek of Chamta khal, fitted with ultrasonic transmitter with a temperature sensor.

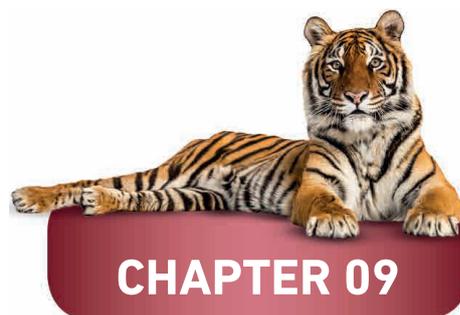
With the increase in number of individuals of Northern River Terrapin in *ex-situ* conditions at Sajnekhali, the Sunderban Tiger Reserve management with proper guidance from scientific experts, has decided to improve and add a few more objectives to the existing species recovery programme of the species *viz.*

- Deploying satellite tags on the released individuals thereby effectively monitoring their movements
- Secondly creating assurance colonies in different parts of Sundarban Tiger Reserve in order to avoid overcrowding at the adult pond at Sajnekhali and also to be prepared during natural calamities which might lead to the loss of these critically endangered species

### Breeding Status (*ex situ*) of *Batagur baska* in Sundarban Tiger Reserve

Yearling	No. of individuals	Male	Female	Unidentified	Remarks
2008	12	7	5		
2012	33	0	32	1	1 could not be captured and examined
2013	56	20	36		
2014	55	4	51	1	
2016	96				Sex of the individuals yet to be identified
2017	74				
<b>Total</b>	<b>326</b>				

# Tiger Population and Habitat Assessment



## 9.1 DAILY MONITORING AND FORECASTING

### 9.1.1 Tiger

Tiger is the flagship species in this mangrove ecosystem and the management focus is geared towards conservation and monitoring of the tiger and its habitat. Presently, an organized system of wildlife monitoring is operative in the Tiger Reserve, where information regarding the direct and indirect evidences of all the animals are recorded and the last ten days of a monthly is exclusively dedicated towards the monitoring of tiger (the information are recorded during routine patrolling). The data collected at the range level is collated and compiled at the Field Director's office and sent to National Tiger Conservation Authority (NTCA) and other state level officials. The present monitoring system needs to be continued, however, keeping in mind the unique conditions of the habitat which limits access to the entire forest area, e-patrolling data corresponding to wildlife sighting, offence detection, and patrolling are being used to generate relevant maps, thereby strengthening the protection strategies in the tiger reserve.

### 9.1.2 Radio collaring

The biology of the Sunderban tiger, its ranging or distribution patterns, presence or absence of territoriality have for long intrigued the field managers and wildlife biologists alike. The dense vegetation cover and limited access to the forest area on foot or otherwise necessitates the simultaneous tracking using a VHF antenna as well. A study of Radio Collaring should be carried out with scientific and technical inputs by the Wildlife Institute of India, Dehradun. A dedicated research personnel and staff shall be used for monitoring the radio collared animals. These might lead to valuable insights into the animal behaviour especially the movement patterns, which in turn might be useful in formulation of management strategies regarding straying of animals in localities.

**Table 1:** Details of Radio Collaring Operation in Sundarban Tiger Reserve

SI No	Date of Radio Collaring	Sex	Place of Trapping / Straying	Place of Release	Type of Collar	Results	Remark
1	05.12.07	Female	Trapped at Panchamukhani-3 of SWLS Range	Panchamukhani-3 of SWLS Range	GPS	Covered around 35 sq km area as evident from available reading	The collar functioned till April, 2008 ( <b>4 MONTHS ONLY</b> ). Sh. Qamar Qureshi of WII was present during collaring operation.
2	24.02.10	Female	Strayed out in Sonagaon village from Pirkhali – 2 compartment of SWLS Range	On same day at Netidhopani-2 of NP(W) Range, which is at around 65 km from straying site	Satellite	Travelled around 80km running distance	The collar found dropped on forest floor on 9 <sup>th</sup> April, 2010 ( <b>SIGNAL RECEIVED FOR 1.5 MONTHS ONLY</b> ). Dr. Parag Nigam of WII was present during collaring operation.

Contd.

SI No	Date of Radio Collaring	Sex	Place of Trapping / Straying	Place of Release	Type of Collar	Results	Remark
3	28.02.10	Female	Trapped at Pirkhali – 5 Of SWLS Range	On 1 <sup>st</sup> March Pirkhali – 7 of SWLS Range, just opposite to trapping site	Satellite	Travelled around 5 sq km area from release site	On 11.3.10, the collar was found dropped on forest floor at Pirkhali-6 ( <b>SIGNAL RECEIVED FOR 11 DAYS ONLY</b> ). Collaring done by STR.
4	20.03.10	Male	Trapped at Netidhopani – 1 Of NP(W) Range	On 21 <sup>st</sup> March Pirkhali – 7 of SWLS Range, just opposite to trapping site	Satellite	Travelled around 30 sq km area around release site	Last signal received from collar on 6 <sup>th</sup> April 2010 ( <b>17 DAYS ONLY</b> ); later the collar ceased functioning, though the tiger has been directly sighted afterwards by STR staff with the collar on its neck. Collaring done by STR.
5	22.05.10	Male	Strayed out in Kalidaspur Village from Jhilla – 3 compartment of Basirhat Range	On same day Near Khatuajhuri camp at Khatuajhuri – 1 compartment, approx 40 km from straying site	Satellite	Travelled around 70 km running distance from release site	Last signal received from collar on 5 <sup>th</sup> August, 2010 at Talpatti, Bangladesh ( <b>2.5 MONTHS ONLY</b> ). Afterwards no signal from was collar received nor any direct sightings of the animal was reported. Collaring done in presence of Dr YV Jhala, WII.
6	22.05.10	Male	Netidhopani – 1 Of NP(W) Range	Netidhopani – 1 Of NP(W) Range, at trapping site itself	Satellite (1 <sup>st</sup> case) & GPS (2 <sup>nd</sup> case)	Travelled around 30 sq km area in and around release site combining both operation	Signal received continuously till 02.10.10 ( <b>4 MONTHS ONLY</b> ). Then on 02.10.10, GPS based 2nd collar was fitted on the animal which emitted signal till 15 <sup>th</sup> December, 2010 ( <b>2 MONTHS ONLY</b> ). There after the 2 <sup>nd</sup> collar also ceased functioning. Both collaring operation were done in presence of Dr YV Jhala, WII.
7	15.08.14	Female	Pirkhali-I; beside Padmapukur	Netidhopani-I; beside Netidhopani camp	GPS-Satellite	Travelled a linear distance of 100km from the site of release	Collaring operation was done in presence of Dr Parag Nigam, WII.
8	29.01.2016	Female	Bali Khal; Tridibnagar under Matla Range	Released on 31.01.2016 at Chora-Mayadwip Khal at Gosaba-3 compartment	GPS-Satellite		Collaring operation was done in presence of Dr YV Jhala, WII.
9	25.01.2016	Female	Captured at Kishorimohanpur. Radiocollared at Jharkhali Camp	Released at Ajmalhari near Boni camp	GPS-Satellite	Ongoing Tracking by a research personnel from WII	Radiocollar functional Collaring operation was done in presence of Dr YV Jhala, WII.

### 9.1.3 Camera trapping

#### Method

The standard method of camera trapping in accordance with Capture-Recapture framework (Otis et al. 1978; Pollock et al. 1990) was followed to collect and analyse data.

#### Pre-field work

As Sundarbans ecosystem is subjected to tides twice a day with varying tide levels, there is high risk of the camera traps being inundated. The first step was to analyse the tidal fluctuation from the data available through tide tables (Survey of India, 2016).



A high resolution image of the study areas were procured and processed for its use in the reconnaissance survey and thereafter. The study areas were divided into grids of four sq. km each, so as to systematically divide the area and help the team plan during reconnaissance survey and also to decide on the sites and minimum distance between camera trap stations.

## Reconnaissance survey

Reconnaissance survey was carried out in different grids for potential camera trap locations. Geo-coordinates of the survey and suitable sites was recorded using a handheld Global Positioning System receiver (Garmin 72 H). These tracks and points were laid over gridded high-resolution image in Geographic Information System environment using MapInfo 8.5.

The grids were selected based on the following criteria: (i) tiger pugmarks (ii) comparatively high elevation areas unlikely to get submerged even during high tides and (iii) avoid excessive human disturbance.

## Data collection

Data was collected for 30 occasions (days) commencing from 4th December, 2015 and ended on 2nd January, 2016 in Sajnekhali Wildlife Sanctuary; 38 occasions (days) commencing from 8th January, 2016 and ended on 14th February, 2016 in National Park (West) Range; 38 occasions (days) commencing from 19th January, 2016 and ended on 25th February, 2016 in National Park (East) Range; 40 occasions (days), commencing from 3rd March, 2016 and ended on 11th April, 2016 in Basirhat Range and for 40 occasions (days) commencing from 10th March, 2016 and ended on 18th April, 2016 in 24 Parganas (South) Forest Division.

Cameras with heat-motion sensors were deployed to capture tigers and other fauna. The distance between two camera trap stations was kept at a minimum of 1 km to maximise the capture probability. At each station, two camera units were deployed between 40 and 50 cm height from the ground in such a way that both flanks of the animal are captured. The camera delay was minimised to ensure photo captures of tigresses with cubs in case such an event occurred. To maximise both tiger captures as well as recaptures, an olfactory lure was applied. All the camera trap stations at the Range were monitored periodically to check the status of camera traps and if required the height of camera trap was changed or comparatively high elevation sites within the same grid were selected. This was done due to the high water mark presence in the sampling session which may inundate camera trap units in the particular sites.

Every tiger captured in the camera traps was examined visually based on the stripe pattern on the flanks, limbs, forequarters and sometimes even tail of tiger, and also with Extract Compare V1.08 (Hiby 2009) software.

**Table 2:** Division wise details of Camera Trapping exercise in Sundarban Tiger Reserve 2015-16

Forest Division/ Range	Total area (sq. km)	Total grids of 4 sq. km each	Camera trap grids	Trapping area [sq. km] (Grid)	Session date (start)	Session date (end)	Total grid with tiger captures
24 Parganas (South) Forest Division	454	116	50	200	10.03.2016	18.04.2016	37
National Park (East) Range	850	155	60	240	19.01.2016	25.02.2016	23
National Park (West) Range	890	138	60	240	08.01.2016	14.02.2016	38
Sajnekhali Wildlife Sanctuary	430	103	60	240	04.12.2015	02.01.2016	27
Basirhat Range	466	94	44	176	03.03.2016	11.04.2016	16

**Table 3:** Demography of camera trapped tiger individuals in Sundarban Tiger Reserve

Sl. No.	Area	Tiger Individuals				
		Male	Female	Unidentified Sex	Cub	Total
1	24 Parganas (South) Forest Division	11	15	0	1	26
2	National Park (East) Range	2	12	0	0	14

Contd.

Sl. No.	Area	Tiger Individuals				
		Male	Female	Unidentified Sex	Cub	Total
3	National Park (West) Range	4	13	2	3	19
4	Sajnekhali Wildlife Sanctuary	1	8	2	0	11
5	Basirhat Range	3	6	2	0	11
<b>Total</b>		<b>21</b>	<b>54</b>	<b>6</b>	<b>4</b>	
<b>Grand Total</b>						<b>81</b>

## 9.1.4 Animal and Vegetation

### Prey species

Spotted deer and wild pig form the principal prey species of the tiger. Currently, they are monitored on a daily basis and the same recorded in the camp wildlife register. However, this data is only to highlight the presence and absence of the target species in a given area.

Since a healthy prey base is the primary prerequisite for a healthy tiger population proper scientific monitoring which is statistically robust is required for designing of the monitoring procedure. Help in this regard can be taken from the NGOs and other stakeholders. This needs to be carried out on a monthly basis. Based on the results obtained, proper management strategies can be designed.

### Aquatic Species

River channels and waterways harbour a wide variety faunal species. Prominent among these are the estuarine crocodile, gangetic and Irrawaddy dolphins. Due to remoteness and difficult terrain of Sundarban, no research on habitat and distribution studies of aquatic species has been done extensively. However there is a species recovery programme of critically endangered *Batagur baska* is ongoing in Sundarban Tiger Reserve.

### Vegetation

Since the 100mtsX100mts plots are very difficult to maintain in Sundarban and also hinders the movement of wildlife, therefore has been discontinued. It has been deemed that maintaining vegetation plots is not a viable methodology.

### Abiotic factors

Water marks to be created to measure changes in tidal amplitude and rain gauge and six thermometer to be installed in a few selected camps to monitor changes in rainfall, relative humidity respectively especially to monitor the weather related changes in the wake of global warming.

## 9.2 TIGER POPULATION ESTIMATION AND MONITORING FRAMEWORK

### 9.2.1 Phase I: Spatial mapping and monitoring of tigers, prey and habitat

For estimating the distribution, extent and relative abundances of tigers, other carnivores and ungulates data will be collected in simple formats on carnivore signs and ungulate sightings and on indices of human disturbance and habitat parameters. For this data collection, beat will be taken as a unit. All the concerned staffs must be adequately trained with the data collection protocol.



The detailed methodological approach for sampling carnivore signs, ungulate encounter rates, pellet/dung counts, habitat and anthropogenic pressures is as follows:

### 9.2.1.1 Sampling for Tiger, and other carnivore species direct and indirect evidences

- A beat will be considered as a sampling unit.
- Maximum area to be searched in the form of river based transects.
- Both signs i.e. indirect evidences and direct evidences need to be recorded. Tiger signs should be classified into the following categories 1) Pugmark trails, 2) Scats (Old: dry with hair and bones visible; Fresh: dry but intact with shiny surface; Very Fresh: soft, moist, and smelly, 3) Scrapes, 4) Scent marks (spray, rolling), 5) Rake marks on trunks, 6) Actual sighting, 7) Roaring (vocalization, 8) Kills (Predation on wild prey).
- Average length of a transect should be 10-15 km. It is important to record the distance covered and the time spent during each search separately (in the data sheet-1) and accurately. If time is spent resting or in other activities while conducting the search, this duration should be reported separately. If possible the GPS coordinate of the beginning point of each search path should be recorded.
- A brief description of the topography and forest type is to be recorded for each sign.
- In case of pugmark trails, each trail set is considered as one sign (not each pugmark as one sign). In case a tiger (or other carnivore) continues to walk along the mudflat for a long distance (say 1 km), then this should be considered as one sign, and a comment recorded in the remarks section of the data regarding distance covered by a pugmark trail of a single tiger.
- Tiger if encountered outside of the sampling route should also be recorded with GPS coordinates (if available) and with appropriate comments.
- Special emphasis should be given to sign of tigress and cubs, and any authentic evidence of tiger cubs (sightings of cubs, lactating tigress, tracks, etc.) obtained within the past twelve months should be mentioned in the data sheet.
- While sampling for tiger signs, record should also be kept for signs of any other carnivore that are encountered.
- The number of livestock that are killed by predators within the past three months needs to be recorded in the questionnaire following the data sheet.
- It is important to report data sincerely. It is likely that there may be reliable information that tiger is present in the beat being sampled, but no tiger signs are recorded during the intensive search survey. In such cases, mention should be made in the remarks column of the data sheets. However, failure in obtaining tiger sign from a beat is equally important as recording tiger signs and for appropriate analysis of this data the actual data should be reported.

### 9.2.1.2 Distance Sampling for Animal Densities

This protocol outlines a simple method for quantifying animal (chital, wild pig, rhesus macaque, otter, tiger, crocodile, dolphin, lesser adjutant stork, etc.) density in an area based on visual encounters during boat transects. The following procedure needs to be followed for data collection

- i. The boat transects need to be conducted in channels having a minimum width of 40 meters to a maximum width of 200 meters for a distance of minimum 5 kilometers and maximum 15 kilometers. Avoid sampling transects/khals when facing directly into rising or setting sun.
- ii. The GPS should be in track mode so as to record the entire transect (channel) sampled during the survey. This track should be saved and downloaded on to a computer at the end of the exercise.
- iii. During the exercise, only one side of the channel should be surveyed. Do not focus on the other bank which is not being surveyed as it might increase confusion and chances of missing individuals on the bank being surveyed.

- iv. The exercise should be conducted at such a time when the tidal conditions are ideal. Three hours AFTER the beginning of low tide and 3 hours FROM the beginning of high tide will provide a window of 6 hours when mudflats will remain exposed during which time sampling should be done under appropriate light conditions.
- v. The boat should move at 5 km/hour or slower so as to reduce the chances of missing any individual as well as minimizing noise which might scare the animals away.
- vi. Maintain the distance between the boat and the sampled bank at a constant of 20 to 30 meters.
- vii. Complete silence must be maintained during the survey and undue gesturing or shouting on spotting animals should be strictly forbidden.
- viii. Fill in the 'Census unit', 'Observers' names', 'Date', 'Forest Circle/Div', 'Range' (where the transect is being conducted), 'Forest Block & Comp', 'Khal name', 'Khal ID', 'Side of channel', 'Lunar date', 'Time of past lowest tide', 'Start time', 'Begin GPS' (in Degree, Minute, Second format) just when the survey is about to start.
- ix. When any animal is spotted, note the 'Time' - when it was spotted, 'Species', 'Total number of individuals including the young', 'Number of young', 'Mangrove type' – classified as 'Tall', 'Medium' and 'Small' depending upon the average mangrove height of more than 10 feet, 4-10 feet and 2-4 feet respectively. 'Bank type' depending on the average slope should be classified as 'Steep' (more than 60°), 'Medium' (30° to 60°) and 'Gentle' (less than 30°).
- x. If the animal is spotted from afar, then keep a mental note where it was first spotted by observing any nearby tree, log, creek etc. As the boat comes parallel to the 'landmark', record the GPS location (in Degree, Minute and Second format) and then use the range finder to record the perpendicular distances of the observer to water, grass patch (whenever present), upper bank (the upper bank is defined as the point from where the land flattens out into the forest), vegetation (the point where the mangrove forest starts) and the animal. Check the figure (Page no. 10) to avoid any confusion. All the readings must be recorded using the range finder and checked against visual estimates as often the laser can hit objects far or near other than the target and give wrong reading. If on pressing the button on the range finder once, the reading does not show up in the screen, keep on repeating the exercise till you get the correct distance. The GPS location and the perpendicular distances should be recorded where the animal was initially spotted and not the location where it has moved away after sighting it. In case of animals observed in side khals, perpendicular distance need to be recorded by navigating into these khals. If the side khal is non-navigable, in that case, the observation should not be recorded.
- xi. When a group of animals is seen, measurements should be taken for the centre of the group. An animal is considered to be a part of a group if its distance from its nearest neighbor is less than 30 meters.
- xii. If one observes animals on the other bank (the bank which is not being surveyed) then note the sighting in the remarks column only. Do not include it in the observation.
- xiii. In the end, note the 'End Time', 'End GPS' (in Degree, Minute, Second format), 'Total distance' travelled during the transect obtained from the track log of the GPS when the transect gets over.
- xiv. One could select the side (smaller) khals while conducting transects of big channels to maximize spatial coverage. In such cases, the following should be considered –
  - a) The 'Total distance' should include only the 'going inside the small khal' distance and not the distance covered while coming out of the same. Hence, start recording the distance while one starts the transect, continue till one has reached the last reachable point inside the smaller khal, stop recording while coming out and start recording again once one comes back to the junction of the bigger khal till the transect ends.
  - b) Select side channels only if they can be navigated for more than 500 metres.  
Ideally, on one's way back after the transect is complete, one should conduct the exercises of sign survey and sampling for vegetation and human disturbance on the same khal bank to save time. Whether one does the

same bank or opposite bank of the same khal or a different khal altogether for these exercises, one should always start with the transect for direct sighting so as to minimize a priori disturbance to the animals and increase detection.

### 9.2.1.3 Sampling for Animal and Human Sign Encounter Rates

To obtain data on presence, absence and intensity of use by chital, wild pig, rhesus macaque, otter, tiger, crocodile and humans, we shall quantify the relative abundance of their signs in an area. The following procedure need to be followed for data collection

- i. Surveys should be restricted in channels having an average width of 40-200 meters. During the exercise, only one side of the channel should be surveyed as it might increase confusion and chances of missing signs on the bank being surveyed. Be ever vigilant to detect signs as these could easily be missed if full attention is not given.
- ii. The exercise should be conducted at such a time when the tidal conditions are ideal. Three hours AFTER the beginning of low tide and 3 hours FROM the beginning of high tide should provide adequate time and exposed bank surface to detect the signs.
- iii. The boat should move at 5 km/hour or slower so as to reduce the chances of missing any sign.
- iv. Drive the boat as near to the bank as possible so as to detect and record all signs successfully.
- v. Fill in the "Census Unit", "Observers' names", "Date", "Forest Circle/Div", "Range" (where khal is being surveyed), "Forest Block & Comp", "Khal name", "Khal ID", "Side of channel", "Lunar date", "Time of past lowest tide", "Start time", "Begin GPS" (in Degree, Minute, Second format) just when the survey is about to start.
- vi. When any sign is detected, note the "Sl. No", "GPS Location" (in Degree, Minute, Second format), "Animal species/ Human sign", "Sign type" (pugmark/ hoof print/ foot print/ scat/ pellet/ direct sighting), "Mangrove type" – classified as "Tall", "Medium" and "Small" depending upon the average mangrove height of more than 10 feet, 4-10 feet and 2-4 feet respectively. "Bank type" specific to the sign location, should be classified as "Steep" (more than 60°), "Medium" (30° to 60°) and "Gentle" (less than 30°). Signs should be classified as "Very Fresh" when they seem less than 2 days old, "Fresh" when they seem 2-3 days old, "Old" when they seem more than 3 days old. Since accurate freshness categorization depends upon experienced individuals, such individuals should be more encouraged to carry out this exercise.
- vii. Whenever possible coordinates can be saved as waypoints on the GPS unit and subsequently entered on datasheets to save time.
- viii. If one observes signs/ animals on the other bank (the bank which is not being surveyed) then note the sighting on the remarks column only. Do not include it in the observation. Do not record signs on side channels if those channels are not being included during the particular survey.
- ix. In the end, note the "End Time", "End GPS (in Degree, Minute, Second format)", "Total distance" travelled during the survey obtained from the track log of the GPS when the transect gets over.
- x. In case of pugmark/hoof print/foot print trails each trail is considered as one sign (not each pugmark/hoof print/foot print unit). In case the animal/ human has walked along the channel bank for a long distance, then this is to be considered as one sign, and a comment should be recorded in the remarks section of the data regarding the distance covered by the trail of the single animal/human.
- xi. If side channels are considered during transects on big channels, conduct the sign survey on the way out of these smaller channels during the transect for direct sighting. The survey length (of one side) of the small/ side khal will be added to the total survey length.

### 9.2.1.4 Sampling for Vegetation and Human Disturbance

To quantify the habitat parameter and determine levels of human disturbance, sampling will be done along the same side of the channels used to record sign types at the same time. This form needs to be filled at every 15 minutes intervals while conducting the sign survey (when the boat is moving at 5 km/hr).

- i. Conduct this survey at the same time as you survey the channel side for signs (could be done on your way back after direct sighting exercise).
- ii. Fill in the 'Census unit', 'Date', 'Khal name' and 'Khal ID' just when the survey is about to start.
- iii. The different fields in the form should be recorded on a 10 metre radius semicircular plot, with the plot starting from the first line of vegetation. Refer to figure on page 24.
- iv. Once at the beginning, record the GPS location (in Degree, Minute, Second format) and consecutively coordinates should be recorded for every plot, note the 'Sl. No.', 'Mangrove type' – classified as 'Tall', 'Medium' and 'Small' depending upon the average mangrove height of more than 10 feet, 4-10 feet and 2-4 feet respectively. Give the local/ scientific names of the tree species in descending order of abundance. Write the percentage occupied in the plot by each of these abundant species, as well. Accordingly, follow the same for recording local/scientific names and percentages of grass/ herbs/ sedges including regenerating mangrove abundance (strata less than 2 feet height). The density of the vegetation should be recorded as 'Low' when one can see a chital sized object more than 20 meters clearly through the mangrove, 'Medium' when a chital sized object is barely visible at about 10 meters distance, 'High' when a chital sized object is barely visible at 5 meters distance into the mangrove. Record the perpendicular distance from the observer to the vegetation (grass patch, wherever present, otherwise treeline).
- v. If the vegetation is 50 metres away from the observer, record only the perpendicular distance from the observer to the vegetation and the density of the distant treeline as 'Low', 'Medium' and 'High' as per the above 'chital visibility' criterion.
- vi. Do not write about the vegetative attributes which lie beyond the plot even if they are different and visible from your boat.
- vii. At each plot, count the number of trees or palms cut or lopped.
- viii. Count the number of tourist/fishing boat, fishing nets and fishing poles in all directions as far as you can see.
- ix. At the end of the survey take a similar vegetation plot at the end GPS location.
- x. Do not forget to conduct the sign survey continuously and simultaneously as the vegetation and human disturbance sampling is being carried out.

### 9.2.2 Phase II: Spatial and attribute data

The spatial data that are likely to influence tiger occupancy of a landscape will be used for modeling in a GIS domain. The vegetation map, terrain model, night light satellite data, drainage, transportation network, forest cover, climate data, Normalised Difference Vegetation Index (NDVI), livestock abundance, human density, socio-economic parameters, etc will be used for modelling habitat condition and tiger occupancy. Beat-wise vegetation sampling will be done to generate broad vegetation map. Part of this component will be done in collaboration with Forest Survey of India and Survey of India. This modelling helped in determining current spatial distribution of tigers, potential habitats, threats to crucial linkages between occupied landscapes and conservation planning.

### 9.2.3 Phase III: Estimating the population of tigers and its prey

This will deal with the actual range of how many tigers and ungulates are there. Teams of researchers may be deployed for estimating tiger density and ungulate densities within stratified sampling units.



- 1. Tiger numbers:** After stratifying landscape into tiger sign abundance classes of high, medium, low and number tiger sign at the beat and larger spatial resolution (100 km<sup>2</sup>). In each of these strata, within a landscape, the actual tiger density in 3-5 replicates of sufficient size (100-200 km<sup>2</sup>) shall be estimated. Primarily dependent on remote camera traps to identify individual tigers based on stripe patterns, population estimates may be based on mark-recapture framework. These densities may be then extrapolated for the areas under various density classes within the landscape to arrive at a tiger population estimate.
- 2. Tiger prey:** Phase I of the protocol would be reporting encounter rates on line transects. To convert encounter rates to density, an estimate of the effective strip width of these transects would be essential. The effective strip width of a transect primarily depends on the visibility (vegetation and terrain type), ability to detect ungulates by different observers and animal behaviour response. Effective strip widths determined from the model and actual sighting of ungulates for different vegetation types. However ungulate response is likely to play an important role in disturbed area in determining effective strip width. The habitat and terrain specific effective stripe width can be determined by actual sampling and by modelling. These estimates of effective stripe width may be used for converting encounter rates of ungulates to density estimate by modelling detection probabilities.

### 9.2.3 Phase IV: Intensive monitoring of source populations

- 1. Photo registration of tigers:** Pictures of individual tigers obtained by camera traps or by regular cameras should be maintained in the form of a photo identity album. Records may be kept on the location, condition (breeding status, injury, etc) and associated tigers whenever a tiger is sighted. This can provide crude data on ranging patterns, demography and mortality.
- 2. Tiger pugmark and other signs:** Regular monitoring of tiger signs (pugmark tracings, plaster casts, etc) may be undertaken in every beat at a weekly interval with monthly compilation of data. Sign surveys and individual tiger monitoring may become a regular task for every guard. The monthly data may be mapped and maintained to analyse trends.
- 3. Monitoring by telemetry in select areas:** Use modern technology of VHF, GPS and satellite telemetry to study and monitor aspects of demography, metapopulation dynamics (dispersal, ranging patterns), mortality, predation ecology and behaviour. In all source populations, tiger abundance and density may be estimated using camera traps, digital images of pugmarks and/or DNA profile from non-invasive methods biannually.

## 9.3 HABITAT ASSESSMENT AND MONITORING FRAMEWORK

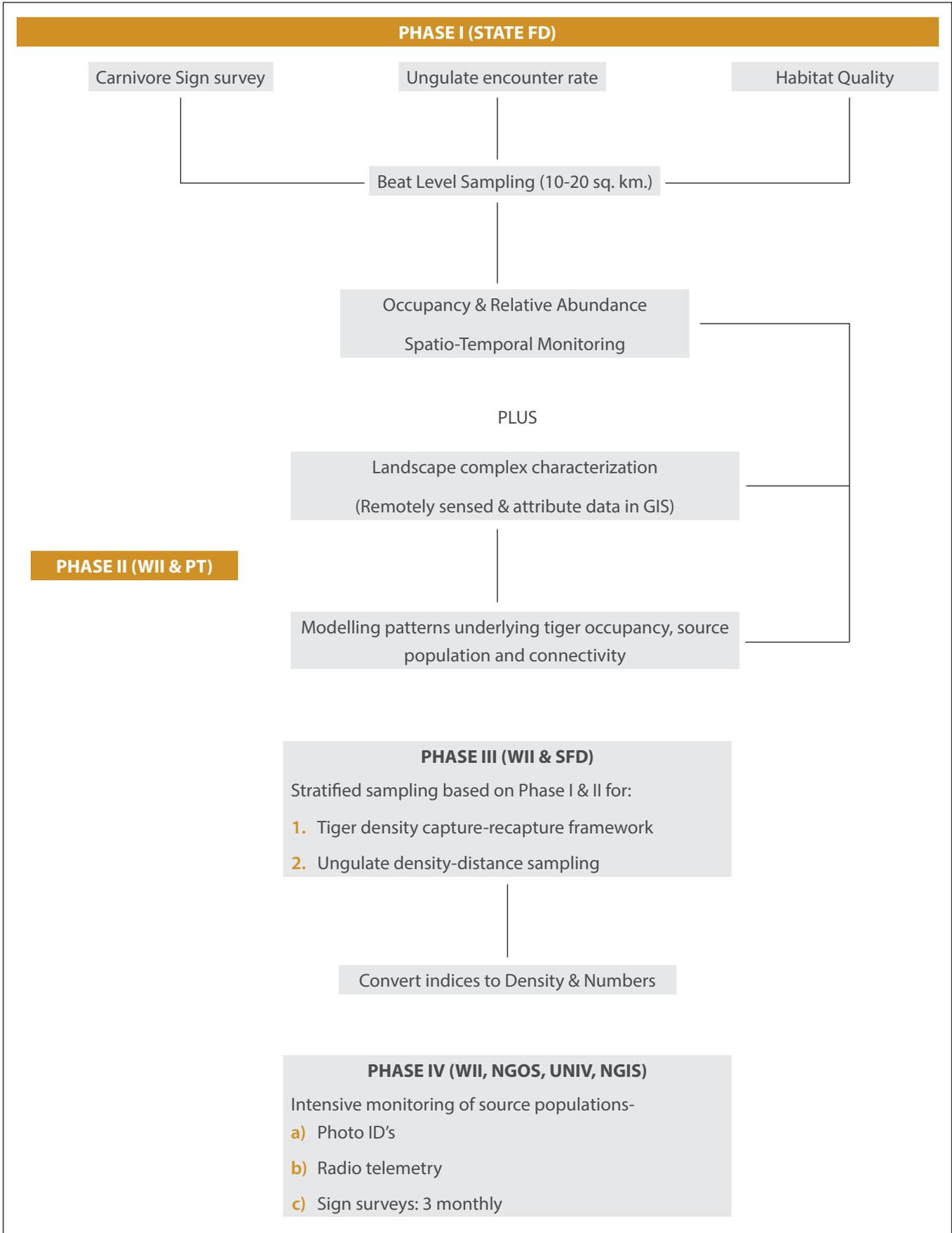
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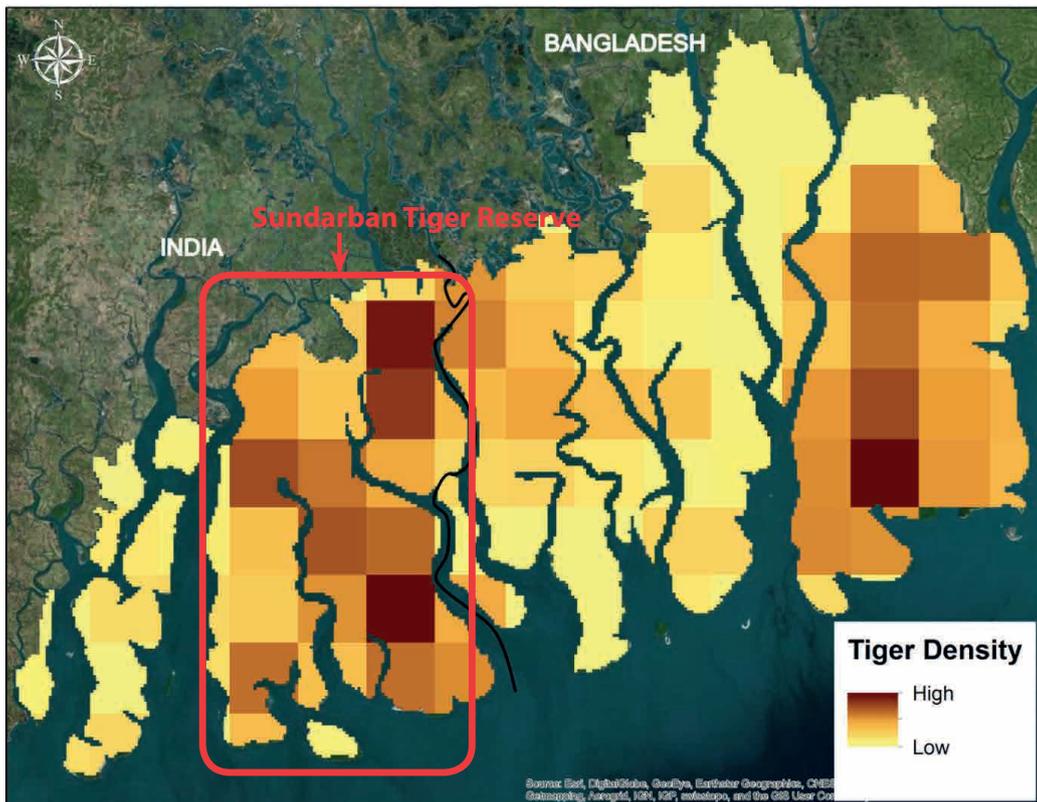
The data collected during Phase I for sampling for Vegetation, Human disturbance may be collated and put in GIS Domain. This can be correlated with tiger and prey base presence. Any change in the habitat can be monitored by serial data present in GIS Domain.

## 9.4. SPATIAL DATABASE DEVELOPMENT

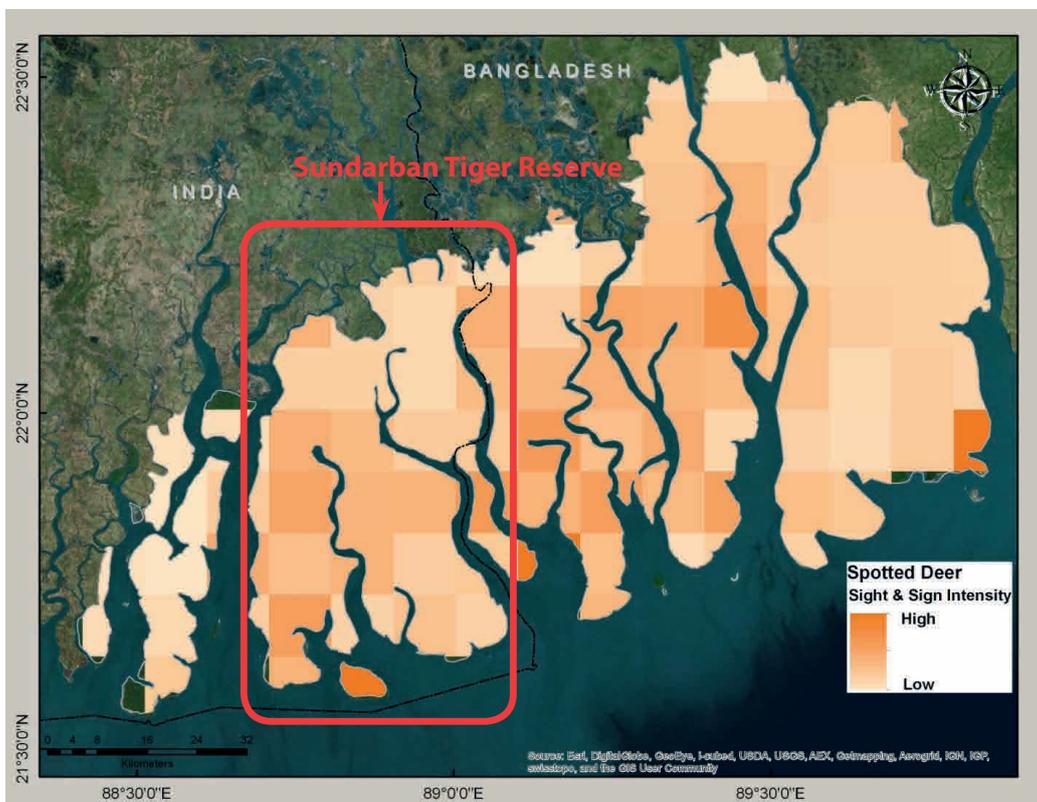
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The information on the encounter rates Tiger and its prey base obtained from the camera trapping exercise conducted as a part of All India Tiger Estimation, 2014, has been used to prepare maps in GIS Domain to get the spatial distribution of the key species of Sundarban Tiger Reserve. Maps of distribution of key species Sundarban Tiger Reserve is given below.





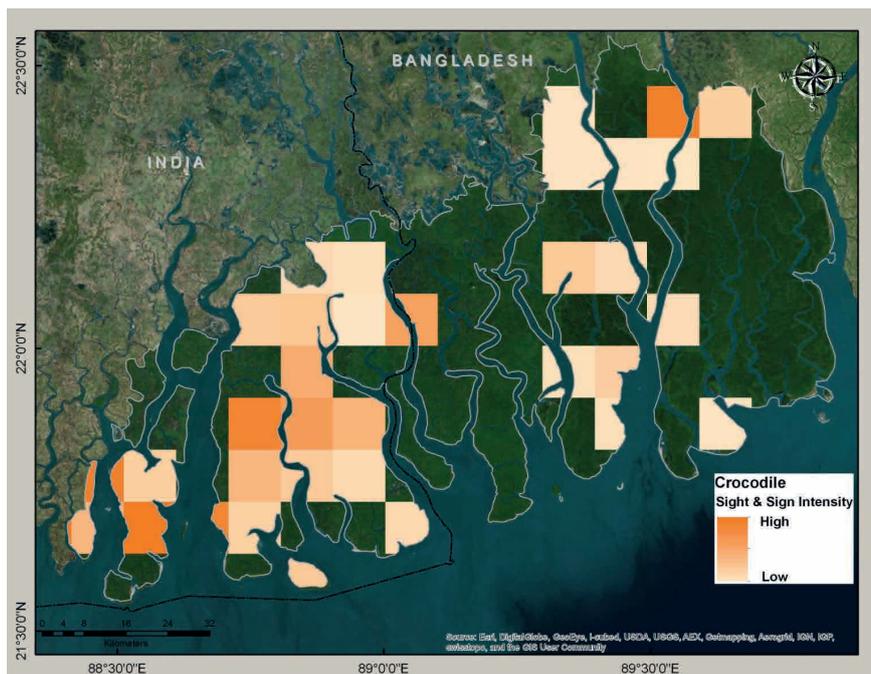
**Figure 1:** Tiger density across Sundarban obtained from camera trap based spatially explicit capture recapture and covariate based regression model (Jhala et al. 2016)



**Figure 2:** Intensity of spotted deer sign and sighting encounter rate across Sundarban (Status of tigers in the Sundarban landscape Bangladesh and India (Jhala et al. 2016)



**Figure 3:** Intensity of Wild pig sign and sighting encounter rate across Sundarban (Status of tigers in the Sundarban landscape Bangladesh and India (Jhala et al. 2016))

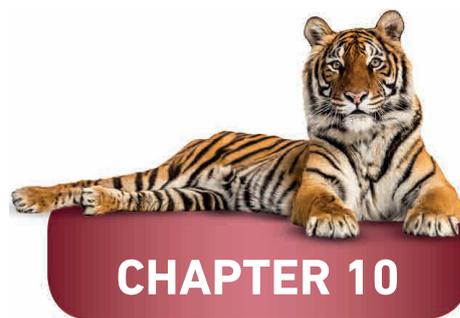


**Figure 4:** Intensity of Crocodile sign and sighting encounter rate across Sundarban (Status of tigers in the Sundarban landscape Bangladesh and India (Jhala et al. 2016))

#### 9.4. ANALYSES AND REPORTING FRAMEWORK

Data analysis is to be carried out by WII during monitoring tiger, co-predators prey base along with their habitat. Apart from this routine monitoring may be carried out as mentioned earlier and analysis of the data obtained done at the Divisional level with help from GIS cell. The results obtained to be used as a feedback based on which proper management interventions can be planned.

# Protection and Intelligence Gathering



Protection is the most vital management intervention being carried out in the Tiger Reserve. The entire status of the Reserve i.e. habitat integrity along with the well being of the fauna and flora depend on the kind of protection measures that are being taken there. Intelligence gathering is an important component of the protection strategy through which the protection can be made much more effective and can lead to prevention of untoward incidences.

## 10.1. OBJECTIVES

1. Conservation of the tiger, co predators and its prey species along with other floral and faunal assemblages of this unique ecosystem against biotic interferences.
2. Developing a strong information network to prevent occurrence of wildlife crime.
3. Upgrade and augment existing infrastructure like protection camps, arms, patrolling boats to result in more effective protection measures.

### 10.1.1. Problems in achieving these objectives

- a. Porous international border with Bangladesh from where smuggling of men and material is very easy.
- b. Extremely poor fringe population with high degree of resource dependency.
- c. Vacancy in frontline staff positions
- d. Difficult terrain and tendency of tiger to attack inside the forest makes foot patrolling a difficult task.
- e. Fewer number of camps with inadequate staff leading and large areas to be patrolled.

## 10.2. DEPLOYMENT OF NATIVE WORKFORCE

The pressure on the Tiger Reserve is enormous. International poachers, honey and timber smugglers usually enter and exit through porous international border along the eastern boundary. The southern side of the reserve is vulnerable to timber smuggling and fishing by huge fishing trawlers which try to trespass into the National Park area using it as a transit route to the sea. There have been incidences of them indulging in deer poaching and fishing. The northern fringe of the Reserve is densely populated and has a density of about 819 persons per sq. km. with little or no means of regular income especially in the lean season.

With a view to combat this biotic pressure a network of camp and floating check posts have been developed within the Tiger Reserve. Most of the camps are manned by a Beat Officer/ Forester along with Forest Guards in few locations. However as about 50% of the Group D staff posts are vacant there is an acute shortage of people for field patrolling and manning camps. Floating check post have been positioned at the most vulnerable spots and are headed by Head forest

Guards or forest guards along with the people from the JFMC are deployed to augment the staff strength. This also helps in creating goodwill as the locals also develop a stake in the conservation process. Besides they can also serve as eyes and ears of the Tiger Reserve management and can bring information from the village level to the management.

#### Existing sanctioned staff strength of Sundarban Tiger Reserve (as on 01/01/2019):

Sl. No.	Category of Post	Sanctioned Strength	Existing	Vacant	Audited Against	Existing G.O. No.
1.	CCF & FD	1	1	-	-	PCCF, WB's O.O. No.20-Misc/2001 dt. 18.05.2001
2.	DFD	1	1	-	-	-do-
3.	AFD	2	2	-	-	1234-For dt. 27.2.1974
4.	Research Officer	1	-	1	-	11343-For dt. 21.12.1976
5.	Lab. Asstt.	1	-	1	-	4253-For dt. 10.7.1978
6.	Veterinary Officer	1	1	-	-	1130-For/11B-22/88 dt.14.2.1991
7.	Head Clerk	1	1	-	-	G.O. No. 1683-F dt. 23.02.2009 & PCCF, WB's O.O. No. 147-50/PMC/09 dt. 30.6.09
8.	Accountant	1	1	-	-	PCCF, WB's Letter No.11062/ PMC/2E-212 dt. 15.09.97
9.	UDC	6	3	3	-	-do-
10.	PA	1	1	-	-	
11.	Clerk-cum-Typist	7	2	5	-	-do-
12.	Typist	1	-	1	-	5295-For/11B-41/80-I, dt. 21.7.84
13.	Forest Ranger	11	8	3	-	PCCF, WB's O.O. No. 20-Misc/2001 dt. 18.05.2001
14.	DR/Fr.	24	23	1	-	-do-
15.	Head Forest Guard	8	2	6	-	-do-
16.	Forest Guard	100	49	51	-	-do-
17.	Majhi	21	06	15	-	CCF/WB's O.O. No. 45/S, dt. 24.9.1975
18.	BoatMan	54	16	38	-	4192-For dt. 19.9.1981
19.	Forest Watcher	1	-	1	-	769-For dt. 9.2.1974
20.	Karmabandhu	1	1	-	-	5295-For/11B-41/80-I dt.21.7.1984
21.	Mali	1	1	-	-	769-For dt. 9.2.1974
22.	Driver	2	-	2	-	8815-For dt. 20.9.1976
23.	Chowkidar	2	1	1	-	769-For dt. 9.2.1974
24.	Karmasathi	2	-	2	-	769-For dt. 9.2.1974
25.	Peon	4	4	-	-	*Audited against PCCF, WB. G.O. No. 760-For dt. 9.2.1974 & 5295-For/11B-41-80-I dt. 21.7.1984
26.	Orderly	8	6	2	-	769-For dt. 9.2.1974 & 5926-For dt. 2.9.1977 & 2661-For dt. 27.4.1974
27.	Engine Driver	5	3	2	-	1170-For dt. 17.12.76 & 4128-For dt. 19.7.1980
28.	Sereng	3	2	1	-	4128-For dt. 17.09.80 & 4192-For dt. 19.09.1981
29.	Sukhani	2	-	2	-	1170-For dt. 17.12.76 & 4128-For dt. 19.07.1980
30.	OMG	3	1	2	-	-do-
31.	Laskar	8	1	7	-	-do-
	<b>Total</b>	284	134	150	-	Existing strength includes nos. Banashramik

## 10.3. PATROLLING STRATEGY INCLUDING JOINT PATROLLING

### 10.3.1 Tiger Cell

It may be a nodal centre to coordinate all protection, tiger straying, disaster management related issues and any other emergency situations. It may be headed by the Field Director who shall be assisted by the Deputy Field Director and



the Assistant Field Directors. The Range Officers of all four Territorial Ranges and the Range Officer Headquarter Range shall be members of the cell. Permanent invitees to the Tiger Cell may also include SP and DM of 24 Parganas North and South, BSF Commandant, BDO's of Canning, Basanti, Gosaba, Hingalganj, Block Level Medical Officer, Block Level Veterinary Officer. There may be monthly in house meetings which shall be chaired by the Field Director to review the field situation. Meetings with line agencies may be carried out on six monthly basis. The following activities may be performed by the Tiger Cell:

1. Monitoring protection scenario in the field and fine tuning protection strategy based on field conditions.
2. Monitoring the local village markets etc to detect trade of wildlife and timber related products.
3. Discuss information related to smuggling of cattle and other goods, poaching, illicit felling etc.
4. Coordinate all tiger straying, rescue and release operations.
5. Coordinate rescue and release of other wild animals.
6. It shall coordinate all rescue and relief operations in case of natural calamities like earth quakes, cyclones like Aila etc, and any other emergency.

### 10.3.2. Strike Force

As on date, Sundarban Tiger Reserve has not been allotted Tiger Protection Force which is operational in some of the Tiger Reserves in the country. There is one unit of SAP (Special Armed Police) posted in STR at Jhilla. This additional force is quite handy in conducting raids, carrying out patrolling and helping in tiger straying cases but needs replication in other ranges. Therefore, a special strike force or Tiger Protection Force is proposed for tackling emergency situations like tiger straying, village side raids, special patrolling drives against poaching, illicit felling, honey and cattle smuggling, especially against international smuggling. It may be a mixed force comprising both of forest officials and police force or retired army/ police officers and few local youth with good track record.

The Tiger Protection Force would be under the direct control of a Range Officer with his headquarters at Pakhiralaya. The Deputy Field Director of the Reserve may be made supervisory officer, who would ensure its proper functioning. There should be a schedule of patrolling prepared by Deputy Field Director and supervised by Assistant Field Director for every patrolling party of Tiger Protection Force. The Tiger Protection Force may be equipped with firearms and provided a watercraft and wireless system. Daily movement message may be sent to the Field Director's office at Canning to obtain appropriate instructions, especially in case of emergency.

#### Duties of the Tiger Protection Force:

- Patrolling along the international border, sea-facing area of National Park West and East Ranges along with the interdivisional boundary along the Matla river.
- Regular checking of nearby weekly markets, bus stops and railway stations also keep an eye to ascertain presence of wandering tribal poaching gangs.
- Assist in tiger straying cases.
- Intensive regular patrolling on highly sensitive paths.
- Carrying out raids.
- Regular watch on the movement of antisocial elements engaged in illegal fishing, felling, poaching, cattle smuggling activities etc to prevent crime occurrence.

### 10.3.3. Joint Patrolling

The tiger reserve shares boundary with Bangladesh on one side, fringe villages on the other and a territorial Division on the third side. A system of joint patrolling is proposed to strengthen the existing patrolling regime. The following should be carried out at regular intervals and based on the exigency of circumstances:

1. Inter Division joint patrolling: this is to be carried at an interval of two months each.
2. Patrolling with BSF along the border areas at regular interval.
3. Patrolling with the mobile force from headquarters in the vulnerable periods at regular intervals.
4. Improvised patrolling techniques through the application of modern equipments and modernized watercrafts
5. Engagement of JFMC members as wageearner to strengthen the protection measures till the problem of shortage of staffs is mitigated.

## 10.4 STRATEGY FOR PROTECTION AND COMMUNICATION

### 10.4.1. Protection camps

Presently there are 21 land based camp and 05 number of floating camps and checkpost for manning an area of 2585 Sq Km. An analysis of the location of these camps reveals that only 15 camps are present within the forest locations and the rest are concentrated at along the periphery. The table below shows the areas covered by the different protection camps:

**Area covered by Different Camps of STR ( Core Zone)**

SI No	Name of Range	Name of the Camp	Name of Block	Compartt. No.	Area covered (sq. km.)
1	National Park West Range	Netidhopani	Netidhopani	1-3	82.21
			Matla	1-3	160.82
			Gosaba	1	23.77
			<b>Total</b>		<b>266.8</b>
2	National Park West Range	Haldibari	Chottohardi 1, Goasaba 2 to 4 and Matla 4		248.36
3	National Park West Range	Kendo	<b>Mayadeep-1 to 5</b>		410.33
4	National Park East Range	Chamta	Chamta	1-8	231.37
5	National Park East Range	Chandkhali	Chandkhali	1-4	154.77
6	National Park East Range	Bagmara	Bagmara	1-8	310.89
			Gona	1-3	150.57
			<b>Total</b>		<b>461.46</b>

#### Camp Coverage:

On analysis of the Table No1 it is seen that the camps of National Park East and West Ranges are patrolling huge areas with Haldibari Beat covering an area of 248.36sq km. With limited number of staff and patrolling boats it is not possible to cover all the area at regular interval. Similarly areas of Netidhopani, Chamta and Bagmara camps with 266.8, 231.37, 461.46 sq km. respectively are exceptionally large resulting in insufficient area coverage in terms of frequency of visits as well as actual area covered.

#### New Protection Camps:

Therefore, it is proposed that the number of camps should be increased which of course is dependent on staff strength and budgetary support and water availability. In recent years, NTCAs has released funds for development of camps and watch towers at strategic locations so the limiting factor could be the manpower which can be addressed if a special



recruitment drive for group D staff is permitted by the Government. Proposed location of the new protection camps is as follows:

**New camps may be developed at the following locations:**

**(At Core Zone)**

SI No.	Name of Range	Camp location (Block and Compartment)	Jurisdiction	Justification
1	National Park (E) Range	Chamta-8	Chamta-7,8, Gona 1-3	This area is far from the existing Chamta Camp. Gona block is similarly less frequently covered by the Bagmara Camp
2	National Park (W) Range	Matla-2	Matla-2, 3, 4, Goasaba-2	This area is far away existing Netidhopani beat and partly from Haldibari beat

*Note: The Camp location is indicative as the actual location depends on the availability of water*

## 10.4.2 Management of Field Staff/Personnel

Frontline staff mainly forest guards, boat man, laskar, majhi, forester etc. are crucial to the protection of the Tiger Reserve. However more than considerable vacancy in these posts have lead to staff crunch leading to many of the camp being undermanned. To some extent this is being compensated by utilizing the services of people from the fringe areas mainly JFMCs.

As the area is remote the following incentives are proposed to improve efficiency in duty/ output of the staff.

### 10.4.2.1 Monetary rewards

Monetary rewards may be awarded to the entire patrolling team for detection/prevention of significant crime cases especially those pertaining to schedule I animals. Individual staff may also be given reward in case of exemplary performance of duty. Such rewards if linked to promotional opportunities may have a positive impact on staff morale. The amount of the reward should be fixed in consultation with the field level officers and CWLW of the state, and awarded at the time of state level function of Wildlife week, falling on 23rd December every year.

### 10.4.2.2. Special Allowance

Sundarban Tiger Reserve is a different ecosystem with difficult terrain conditions which are physically and mentally taxing on the staff. Presently the staff are getting the following allowances:

Rank of Staff	FG/BS	Beat Officer/Forester	Ranger
Project Tiger Allowance	700	900	1000
Sundarban Allowance	50	70	100
Ration Allowance	860	860	
Risk Allowance	400	400	500

These allowances are very paltry and do not provide any significant benefit as compared to the hardships faced by the staff. This can be given to the staff instead of the existing Project Allowance.

### 10.4.2.3. Training

It is extremely important for increasing the efficiency of the staff. Presently the State Govt. conducts a 6 month training for untrained Forest Guards in the state where they are made familiar with the overall forestry and wildlife activities being performed in the state. However, being posted in a Tiger Reserve in house trainings in wildlife crime prevention, law, tranquilization, arms, first aid etc involving specialist resource persons should be conducted from time to time to staff so as to be better equipped to perform the task at hand more effectively.

### 10.4.3. Communication

a) **Wireless:** There exists a well established network of wireless communication with one Control Room at Gosaba. The control room monitors round the clock activities in the field and the same is reported to the higher officials.

The Present RT timing are:

Station	Timing of RT Calls
Gosaba and other field Stations	6:00; 8:00; 10:30; 12:00*; 14:30; 16:30; 19:00; 20:30*; 22:00.

The wireless network has been functioning well and may be continued as such. All patrolling boats also need to be fitted with wireless sets. Also charging of batteries in the field is especially designed solar chargers need to be provided to all camps and patrolling boats.

**Patrolling-boats/Watercrafts:** The Tiger Reserve is a maze of rivers, creeks and islands and boats are the only means for carrying out patrolling duties. Presently, all the main land based camps have a larger 2 cylinder house boat for performing night halts in the field; and are also supported by smaller dingi boats which can go right inside small creeks which are otherwise inaccessible to larger boats as they require greater draft.

**Patrolling:** Protection is carried out by patrolling the area using watercrafts like launches, dingi boats and occasionally speed boats. Foot patrolling is also carried out but only selectively owing to the difficult nature of the terrain and since the tigers are prone to attack human beings entering the forest area, it is mainly carried out along the sea facing areas; areas with less under growth or on basis of specific information. Rivers in the Tiger Reserve experience tides on a daily basis. Due to this patrolling in narrow creeks is only possible during the high tide period i.e. when they are filled with water which drains back during low tide rendering it impossible to approach the creek by means of dingi boat. Also the tides are governed by the waxing and waning of the moon with maximum water rising and falling around new moon and full moon days. These periods of high tide are the time when the poachers, fishermen and timber smugglers enter the forest.

The staff duty therefore has to coincide with this lunar cycle to have the maximum efficacy. Also night halt/ patrolling at sensitive areas should be compulsorily followed. More number of tiger guards to be provided for the safety of the staff these are to be used during foot patrolling.

There must be a different schedule during different seasons, like monsoon patrolling summer season patrolling etc., which should be focused on specific problems during the period.

The Patrolling should be focused on following sensitive areas:

- Sweet water ponds
- 'Chataks' or open areas in the forest devoid of tree cover and are favoured by the ungulates. These areas are used by poachers for setting up snares.
- During honey season the eastern border is vulnerable due to people coming in to smuggle honey from Bangladesh.
- During rough weather (April-September) the sea facing areas.
- During winters the sea facing areas and the western and eastern borders.
- In addition, to the above the village hats/local markets.

#### Smart Patrolling:

a. **Use of specially designed app for patrolling:** To overcome the limitations of old practices of using pen, pencil and papers along with prolonged and time bound use of RT system. Main constraints were time dependency on RT network, errors and time consumptions in manual entry, possibilities of data manipulation and absence of real time data. Hence, in order overcome all these limitations E-patrol/Smart patrolling was introduced in Sundarban Tiger Reserve in 2015.



In this new system every camp has been given a cell phone having an android operating system with a compatible mobile application installed in it for monitoring and patrolling purpose. With the help of this application the frontline staffs are recording their every possible activity like patrolling, monitoring the condition of fences, night patrolling, offence detections, and wildlife sightings.

These recorded real time data will directly be going into main database. The real time patrolling data which has been well tabulated, analysed and synchronised into the main server database, can directly be monitored by the application installed in a compatible android cell phone of a senior official. In addition to that, the software allows arranging and/or comparing the reports on numerous strata, by providing various relevant filters.

- b. **Use of Unmanned Aerial Vehicle (UAV):** UAV or Drones has been introduced as a part of the Smart Patrolling initiative in Sundarban Tiger Reserve. These have proven a remarkably useful tool in patrolling those areas in the Tiger Reserve which are otherwise inaccessible. This tool has also proven useful in case of locating a strayed animal in a locality especially tiger. UAV are also being used to monitor an animal post release into the wild up to considerable distance inside the forest at close vicinity.

### Maintenance of Village Level Crime Dossier:

Wildlife Crime Dossier:

All the wildlife Crime especially these relating to Schedule I and part II of Schedule II species need to be compiled at the office of Field Director into a crime dossier. Similarly at the Range level Wildlife Crime Database register need to be opened which should contain the following details:

SI No	Range	POR/ UDOR/ COR	Year	Place of Crime	Species involved	Name and Address of accused	Photo of accused	Remarks
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In addition to the above the following are proposed to gear up Protection on the basis of data base of offenders along with GIS which should be applied for protection and crime management:

- Creation of a crime database in the **GIS domain** of the Tiger Reserve and adjoining forest Division. The crime data is to be overlaid on the map of the area using GPS coordinates. This will help in mapping out the vulnerable zones.
- Regular round the clock updating of the crime database from the field through **wireless** from **Patrolling Camps**.
- Updating the database with **surveillance information** like: **crime-history, criminal dossiers from local police, district and inter-district criminals, criminals operating on railways, wandering gangs, resident gangs**.
- **Monitoring** the movement of **'anti-poaching squads' (village patrol, road patrol, forest patrol)**.

Using the database to monitor pendency in Courts. This information may be sent to the head office on a monthly basis. This Dossier may serve as a guide for gathering more information related to the accused; fast tracking of court cases especially those related to Scheduled species and help further fine tuning the protection strategy by keeping track of habitual offenders, planning of raids, or increasing patrolling at vulnerable points. Based on this information Crime Maps may be generated of the Tiger Reserve depicting the crime area with date. Important cases to be followed up with the judiciary for conduction of a speedy trial and awarding of punishment to the accused.

The Park Management may also ensure that the staff remains trained and updated on the latest amendments to the concerning Acts, and for this purpose easy Bangla translation of the concerning Acts may be circulated down to the lowest level for a better understanding of the subject. Besides, periodic Legal Workshops and discussions may also be organized, involving resource persons from the judiciary and the police department to guide the staff in the proper investigation of forest offences, procedural norms, and to simplify the intricacies of the laws. The staff would be benefited by such arrangements, as these close interactions point out the various shortcomings/ mistakes in the entire procedure which render the cases weak, increasing the possibility of criminals going scot-free.

### **Monitoring of Protection Duties:**

Active supervision at all levels is required to ensure that patrolling is carried out in a proper manner in the field. The concerned Range officer, having jurisdiction over various camps, should regularly report in brief the duties performed to the AFD. The AFD in turn should monitor the patrolling schedules and actual field patrolling and should periodically report the same to Deputy Director and Field Director. Minimum number of night halts in the fields may be fixed. The higher authorities during their field visit should carry out surprise checks of the patrolling duties as also check the presence of staff in the field. They may also join some patrolling party to check the patrolling activities and provide the on spot knowledge with regard to the native fauna and flora.

At present, monitoring of the field performance is carried for all levels of field staff from Beat Officer/Forester, Forest Ranger, and AFD. This has been termed as **Protection Monitoring Protocol: (PMP)** (PMP formats see **Appendix 11**). Monitoring is carried out by means of actual field verification along with analysis of a series of forms which mention the details of the duties performed along with the night halts, offence detected etc. Based on the duties performed a duty map is generated, and on the basis of offence records of the past three months along with the intelligence reports and site vulnerability a sensitive area map is generated. This map is used by the patrolling staff to identify the weak spots and intensify the duties. This field performance is monitored by the Assistant Field Directors who visit all the field camps during a given month which is followed by visit of the Deputy Field Director. The Field Director holds a meeting almost every month to review the protection scenario in the field.

As the current system has been giving good results the same needs to be followed but it has to be insured that the current protocol should not become a form filling exercise rather it should serve as an index of the field condition which has to be verified by actual field visits.

The following registers i.e. Wildlife Register, Arms Registers, RT Register, Nylon net fencing register, Offence Register which are being maintained by all the camps need to be continued. These are also to be checked by the inspecting officers.

## **10.5. INTELLIGENCE GATHERING AND COORDINATION**

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### **10.5.1. Intelligence Gathering**

Intelligence gathering is a very important component of protection as it helps in the prevention of the crime or in tracking out the people involved in the crime and bringing them to book. All the territorial Range Officers may be encouraged to develop a network of local informers whose identity should be kept secret. There may be proper system of payment to informers. Local persons like shopkeeper, boatmen, and hoteliers may be identified and imparted basic training of wildlife crime detection so as to avail their services as and when required as informers.

Sensitizing the JFMC members through workshops and involving them in assisting the management through information related to wildlife crime. Introducing a system of incentives like monetary rewards / recognition in return for important information. Quantum of the reward to be as per discretion of the Field Director.

Owing to the poor network connectivity throughout Sundarban initiating a toll-free number for the JFMC to contact the management of the tiger reserve was not possible. Nevertheless, with the recent improvement in network connectivity in some areas of the tiger reserve, network service providers has been contacted for initiating a toll-free number, and shall be implemented shortly along with concerned staff.

### **10.5.2. Coordination**

Apart from the Forest Department other Government agencies involved in policing are BSF and State Police. Presently police stations are located at Gosaba, Chotto Mollakhali (the later is a coastal police station). BSF patrols the area along

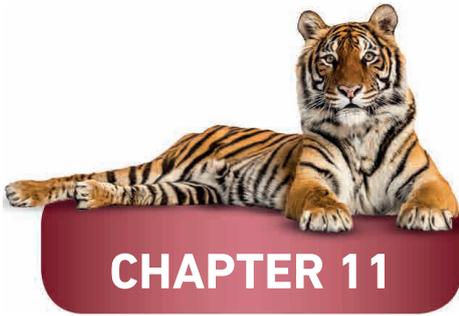


the international border and have established Joint camps with the Tiger Reserve one at Khatuajhuri and another at Bagna. Talks are on to establish another BSF camp at Bagmara. Apart from the land based camps BSF has a number of BOP's (Border Out Post) in the form of floating camps situated at Bharkunda, Chaya Kapura, and Raimongal rivers. The local BSF headquarters are at Samsernagar situated in the eastern fringe of the Tiger Reserve. The BSF has extremely good infrastructural support in the form of sophisticated arms and speed boats. These camps undertake periodic joint patrolling with the forest staff. Their presence adds to the confidence of the staff especially in remote locations like Bagmara.

Though there is staff level contact between these agencies; formal contact mechanism at the level of the Field Director needs to be institutionalized. Tripartite meeting between the F.D, Police and BSF may take place at quarterly interval staffs to review the crime against wildlife and be coordinated at the level of the Director, Biosphere Reserve. The exchange of crime dossiers may be carried out at range and thana level by concerning range officer. Relevant telephone numbers may be made available to both sides for passing on relevant information. Apart from this, meetings should also be held with the Director, Wildlife Crime Control Bureau (Eastern Region) to share information related to wildlife crime. The Bureau may be asked to act as a resource centre for capacity building of staff and officers in the field of wildlife crime.

In addition to this there should be meetings with line departments which should be coordinated through the Tiger Cell.





# MISCELLANEOUS ISSUES

## 11.1 WILDLIFE HEALTH MONITORING

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There is no scope of wildlife health monitoring in the core area.

## 11.2 MORTALITY SURVEY

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This should be carried out in the Tiger Reserve throughout the year. The field staff should prepare a register an details of mortality recorded in time along with the area, species, approximate age, probable causes of mortality. In all cases of Scheduled I species post mortem is to be carried. The Standard operating procedure for disposing the tiger/ leopard carcass/body parts as put forward by NTCA is given below:

1. **Title:** Standard Operating Procedure for disposing the tiger/ leopard carcass/ body parts.
2. **Subject:** Tiger death/seizure of body parts
3. **Reference:** Advisories of the Ministry of Environment & Forests/ Project Tiger/ NTCA on the subject (Advisory No: 1-60/89-WL I dated 04-11-1994 from the Addl. IGF (wildlife) Ministry of Environment and Forests)
4. **Purpose:** To ensure that the carcass/ body parts of tiger/ leopard are disposed of in a transparent manner to prevent any pilferage for illegal market.
5. **Short summary:** This Standard Operating Procedure (SOP) provides the basic, minimum steps which are required to be taken at the field level (tiger reserve or elsewhere) for disposing of tiger/leopard carcass/ body parts where carcass is available or the body parts have been seized.
6. **Scope:** The SOP applies to all forest field formations including tiger reserves besides other areas where the incident has occurred.
7. **Responsibilities:** The Field Director would be responsible in the case of a tiger reserve. For a protected area (National Park / Wildlife Sanctuary), the concerned protected area manager would be responsible. In the case of other areas (revenue land/conservation reserve/community reserve/village/township) the Wildlife Warden, as per the Wildlife (Protection) Act, 1972, or Divisional Forest Officer/ Deputy Conservator of Forests (under whose jurisdiction the area falls), would be responsible. The overall responsibility at the State level would rest with the Chief Wildlife Warden of the concerned State.
8. **Detailed instructions for the procedure to be followed for disposing of the tiger/ leopard carcass/ body part(s) where body part(s) / carcass is available**
  - (i) **At Scene of Crime (SoC) / Incident:** When carcass or parts available  
Follow the SOP issued by the NTCA on dealing with the tiger mortality/ seizure of body parts. Dispose of the carcass by incineration in the presence of the Field Director or an officer not below the rank of the Conservator of Forests besides the Post Mortem (PM) Team having representation from the civil society institution

While incinerating the carcass, the sequence must be photographed and video recorded. Before leaving the site, ensure that the whole carcass including bones are fully burnt.

After ensuring the complete incineration of the carcass, prepare a 'Panchnama (Memo) on disposal of the carcass, duly signed by the PM Team and officer incharge, and send a final report (Annexure-I) to the CWLW under intimation to the NTCA with supporting photographs/ documents.

**(ii) In case of seizure of body parts (Skin – dry or fresh/ bones/meat or other body parts):**

Follow the SOP issued by the NTCA on dealing with the tiger mortality/ seizure of body parts. In case of seizures of body parts, the same may be required as evidence for prosecution in the courts of law and hence in such situations do not dispose the same till the orders of the concerned court for such disposal are obtained.

Once orders have been obtained by the competent authority, dispose of the body part (s) by incineration in the presence of the Field Director or an officer not below the rank of the Conservator of Forests besides the Team (same as prescribed for the Post Mortem) having representation from a civil society institution

While incinerating the body parts, the sequence must be photographed and video recorded. Before leaving the site, ensure that the whole/ all body parts are fully burnt.

After ensuring the complete incineration of the body part (s), prepare a 'Panchnama' (Memo) on disposal of the body part (s), duly signed by the said Team and officer incharge, and send a final report (Annexure-I) to the CWLW under intimation to the NTCA with supporting photographs/ documents.

**(iii) In cases of seized stock of wildlife trophies obtained during seizure/ confiscation:**

All seized stock of wildlife trophies, where no case is pending in a Court of law, should be destroyed through incineration in the presence of the Field Director or an officer not below the rank of the Conservator of Forests besides a team (same as prescribed for the post mortem) having representation from a civil society institution.

While incinerating the body parts, the sequence must be photographed and video recorded. Before leaving the site, ensure that the whole/ all body parts are fully burnt.

After ensuring the complete incineration of the body part (s), prepare a 'Panchnama' (Memo) on disposal of the body part (s), duly signed by the said Team and officer incharge, and send a final report (Annexure-I) to the CWLW under intimation to the NTCA with supporting photographs/ documents.

The provisions of the Wildlife (Protection) Act, 1972 must be followed before destroying such stock.

## FINAL REPORT FORMAT

To be submitted for disposal of each case of tiger/ leopard carcass/ body part (s)/ trophy

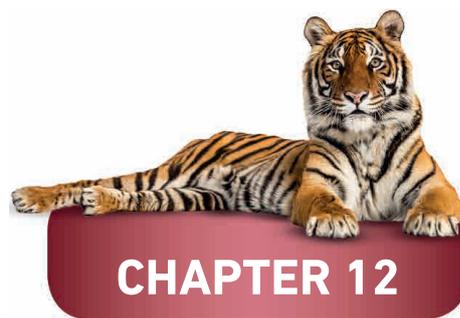
- 1 Name of Office
- 2 *Locational details of the mortality:* description, GPS, Compartment /Block/Range /Sub-Division/ Forest Division/ Tiger Reserve or place/ time
- 3 Date of Mortality/ carcass report
- 4 In case of seizure of body parts details indicating the status of carcass or seized material
- 5 Details of the person (staff/ Others) who reported the incident first: name/address/ contact details/ telephone numbers/e-mail
- 6 *For carcass:* Date, time and Place of Post Mortem (PM)
- 7 Details of PM Team (names/designation/ address/ contact)

- 8 Details of the missing body parts, if any
- 9 Cause of death as ascertained after the PM
- 11 Colour photographs of the carcass/ body part (s)- (close ups, indicating injury, if any ); details of comparison with camera trap photo data base
- 12 Cause of death: Natural/ Poaching
- 13 In case of poaching/ seizure of body parts:
  - i. further action taken/ proposed:
  - ii. attach colour photographs of the seized body part/s
  - iii. attach certification regarding species identity (for bone pieces/ meat/ other body parts which are not physically identifiable)
  - iv. action taken with respect to offenders/ suspects (if arrested)
  - v. status of Case/ complaint: number, date of filing the complaint, Sections of law, name of Court where filed
- 14 Panchnama/memo of disposal of Enclosed/ not-enclosed carcass/ body part (s)
- 15 Remarks if any
- 16 Signature of the Officer In-charge with name, designation, date and stamp

(SOP prepared with inputs from Field Officers of Tiger Reserves)



# Organization, Administration and Budget



## 12.1 STAFF DEPLOYMENT

At present the field staff is posted against the four territorial ranges. Each Range is further divided into beats and camps. The camps are located all over the Tiger Reserve and are manned by the field staff. The staff performs patrolling duty on a routine basis with exceptions occurring only in periods of rough weather (June to mid September). The staff in the field is to perform a minimum number of night halts and night patrolling as per the established protection protocol. One of the major factors hindering the actual field performance of the field staff is old age, multitude of diseases and an acute shortage of frontline staff amounting to a considerable number. To compensate for this shortfall fringe villagers from the JFMC's are taken to assist the staff in patrolling duties. In the vulnerable seasons like pre monsoon, post monsoons and the monsoon period special patrolling drives are carried out to nab the offenders. In these drives the routine patrolling teams are joined by the team from Headquarter.

The Headquarter team may also carry out surprise checks on patrolling and in field camps to ensure proper patrolling as well as the presence of the staff in the field. Special drives or joint patrolling is to be carried out with the BSF and the neighboring Division i.e. 24 Parganas South Division on the Eastern and Western borders respectively.

The camps stationed towards the border areas may be given more resources in the form of men and material. Periodic reshuffling of the staff is carried out but it may be carried in a more systematic manner i.e. after every three years, which is the maximum limit, the staff from the remote locations to be brought to the upper portions of the Reserve and vice versa.

In case of floating camp, the time limit is maximum 1 year. In addition it has to be ensured that the proper staff amenities are to be provided in all the camps. Like clean barrack/quarters, toilets, drinking water, fuel for cooking, first aid, light, mosquito nets etc. In addition field equipments like arms, binoculars, uniform, tapes, compass, field diaries etc are to be ensured. Proper health checkups and staff insurance should also be carried out from time to time.

## 12.2 TIGER STEERING COMMITTEE

As per the requirement of section 38 U of WPA. The process of constituting Tiger Steering Committee for ensuring, co-ordination, monitoring, protection and conservation of tiger, co-predators and prey animals is in progress.

## 12.3 TIGER CONSERVATION FOUNDATION

As per section 38 X of Wildlife (Protection) Amendment act 1972, the Sundarban Tiger Conservation Foundation for the Reserve has been established in order to facilitate and support management for conservation of tiger and biodiversity

and, to take initiatives in eco-development. It will act as a nodal body for the Tiger Reserve and help in recycling of the gate receipts, receipt of funds from donor agencies, coordinate research, awareness campaigns etc.

#### **1.4. CO-ORDINATION WITH LINE AGENCIES / DEPARTMENTS**

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Coordination with line departments is the need of the hour. The different problems and issues facing the Reserve are generally multi dimensional and often involve multiple agencies. In the absence of a formalized structure for coordination many of the issues remain lingering on for long periods thereby decreasing the overall efficiency of the management. In general, it is required to ensure a better protection, development of the area, conflict resolution and overall better management of the Tiger Reserve. Some of the key agencies with which better coordination may be there are Police, BSF, District administration and Judiciary. For the purpose of coordination the Tiger Cell has been designated as the nodal cell for coordination both within the Tiger Reserve and with other line departments. Similarly for the purpose of research coordination with different scientific institutions and bodies and universities may be carried out.

#### **12.5 FUND RAISING STRATEGIES**

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The main source of funding shall be the Government of India (NTCA) for developing of new infrastructure, ecodevelopment, awareness and the State Government for meeting the establishment costs and other recurring expenditure. Similarly, TCF is used for the to maintain and augment the existing infrastructure and facilities. Funds may also be raised from different donors through the Tiger Conservation Foundation.

#### **12.6 SCHEDULE OF OPERATIONS**

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Protection is the major activity in a tiger reserve, which goes on throughout the year. It is reinforced at different points in time within a year based on the threat perception. In addition to this water hole maintenance of the existing waterholes and maintenance of the nylon net fencing. Fencing checking is carried out twice daily on a regular basis.

#### **12.7 ACTIVITY BUDGET**

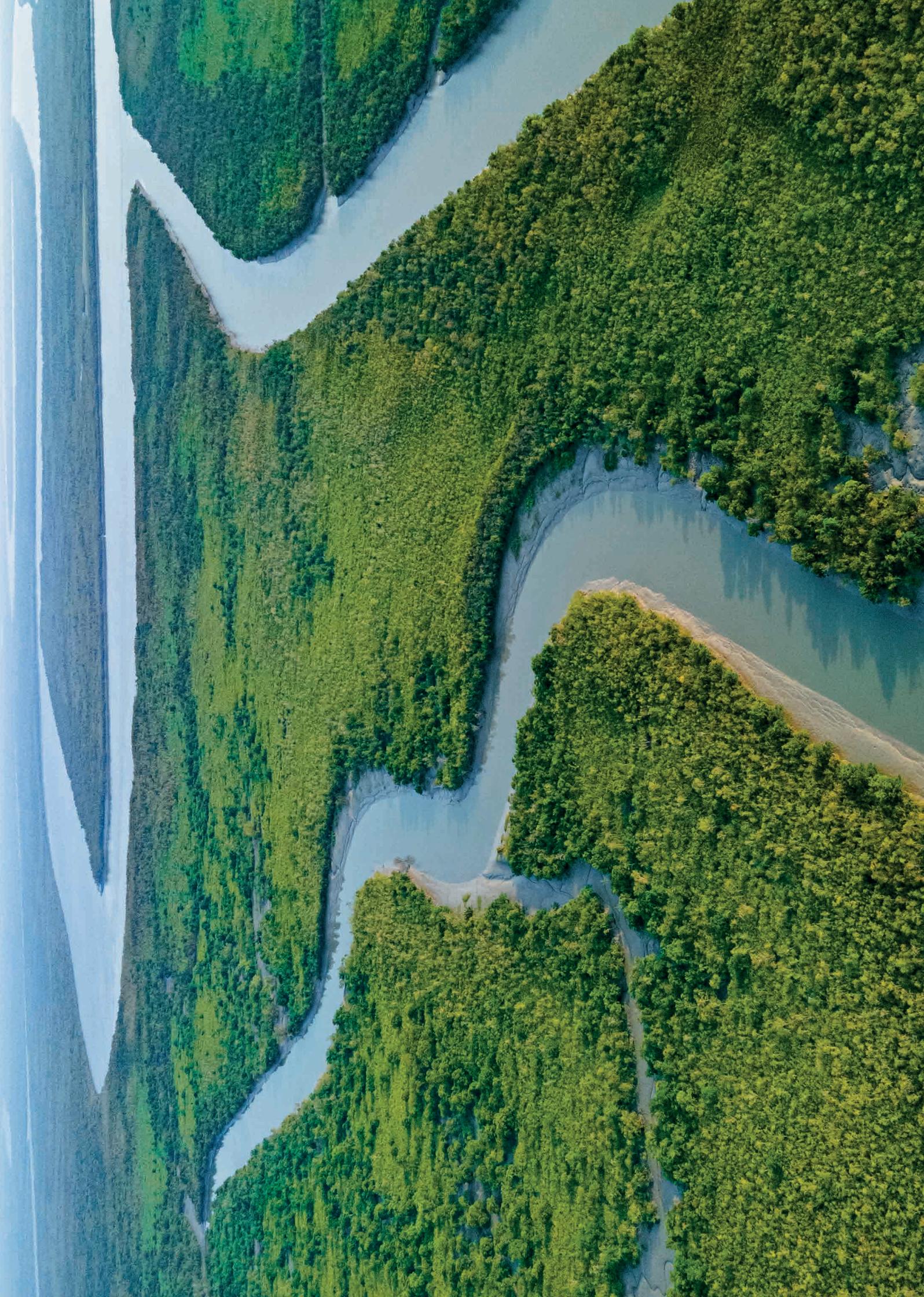
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All the activities to be carried out are mentioned in different chapters. Apart from patrolling there are very few activities which are being carried out throughout the year. The budget has both recurring and non recurring items of work including the item of works proposed in the Plan. Details are given in **Appendix 15**.

# **BUFFER AREA**

## **PART A**

### **Existing Situation**

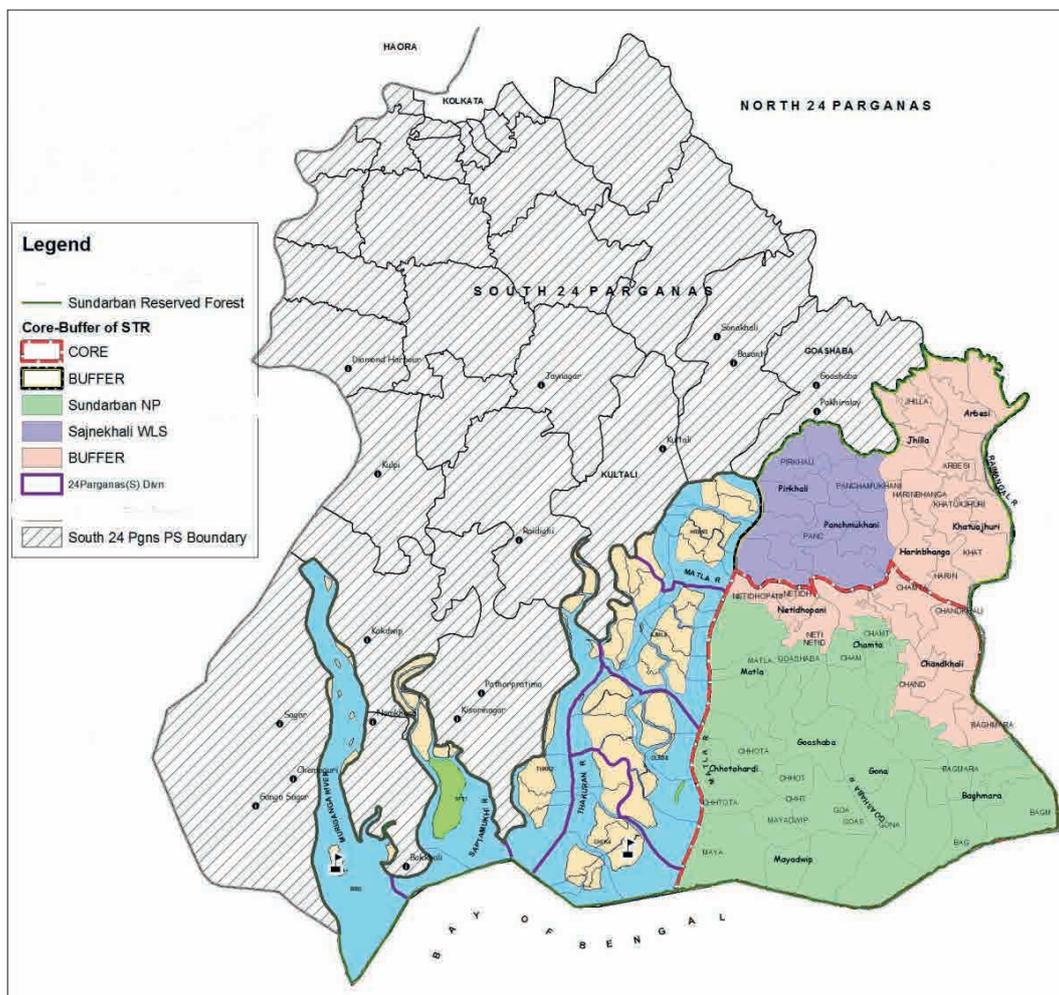


# Introduction of the Area



## CHAPTER 01

### 1.1. NAME, LOCATION, CONSTITUTION AND EXTENT



#### 1.1.1 Sundarban Tiger Reserve.

1.1.2 It is located in the State of West Bengal in the Districts of South 24-Parganas and North 24-Parganas. There are fringe villages all along the northern boundary of the Tiger Reserve. On the eastern boundary lies Bangladesh separated by the rivers Kalindi, Raimongal and Harinbhanga. On the western boundary lies the territorial Division of 24-Parganas South and towards the south lies Bay of Bengal.

**1.1.3** The Tiger Reserve comprises of an area of 2585 sq. km. The legal status of the Reserve is as follows: (Area Statement: **Appendix 1**).

(i) Sajnekhali Wildlife Sanctuary	362.40 sq. km.
(ii) The Sundarban National Park	1330.10 sq. km.
(iii) Reserve Forest	892.43 sq. km.

Administratively the area is divided into four territorial ranges namely:

- (i) Sajnekhali Wildlife Sanctuary Range has an area of 432.86 sq. km. of which 362.40 sq. km. is the notified sanctuary area (Notification see **Appendix 2**). It is situated to the north-west of the Tiger Reserve.
- (ii) The Bashirhat Range, which lies to the north-east of the Tiger Reserve and shares the common boundary with Bangladesh. It has an area of 452.44 sq. km.
- (iii) The National Park East Range having an area of 809.56 sq. km. of which 533.03 sq. km. is the National Park area. (Notification see **Appendix 3**). An area of 124.40 sq. km. (Chamta 4-8) within the core area is preserved as primitive zone to act as gene pool. Lying in the south-east it shares the eastern border with Bangladesh, which is separated by the river Harinbhanga. The southern boundary is formed by the Bay of Bengal.
- (iv) The National Park West Range lies in the south-west of the Tiger Reserve and has an area of 890.06 sq. km. of which 797.06 sq. km. is the National Park area. It is separated on the western border by rivers Matla and Bidya from the adjacent Forest Division of 24-Parganas South. The southern boundary is formed by the Bay of Bengal.

**1.1.4** Sundarbans lies a little south of Tropic of Cancer between the latitudes 21°31' and 22°31' North and longitude 88°10' and 89°51' East.

## 1.1 APPROACH AND ACCESS

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The Headquarters of Sundarban Tiger Reserve is located at Canning Town, South 24-Parganas District and is connected by broad gauge Railway line with Sealdah South Suburban station, which is 46 km. from Canning. The Reserve can be approached by road from Kolkata upto embarkment points at Sonakhali, Godkhali, Dhamakhali and Jharkhali. From these points, the Reserve is approachable by waterway only. The Reserve can also be approached from Basirhat and Hasnabad under North 24-Parganas District. There are numerous train and bus services upto Canning and Hasnabad and bus services upto Dhamakhali, *i.e.* (80 km. from Kolkata), Sonakhali (90 km. from Kolkata), and Gadkhali (120 km. from Kolkata). However, inside the Reserve the only means of transport are service launches and ferry boats, which take people to both places of tourist interest and to different inhabited villages located on the fringes of the Reserve. Kolkata is the nearest major city well connected through air and rail.

## 1.2 KEY BENEFITS OF THE SITE AT

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### Local level

- The mangrove forests act as a natural shelter belt and protect the hinterland from storms, cyclones, tidal surges, sea water seepage and intrusion.
- The mangroves serve as nurseries to shell fish and fin-fishes and sustain the coastal fisheries of the entire eastern coast.



## Regional/State level

- The mangrove forests trap debris and silt and stabilise the near shore environment. Certain mangrove species also act as bio-filters as they have been found to bio-accumulate heavy metals. They filter ground-water and storm-water runoff which often contains harmful pesticides. They recharge the ground-water by collecting rain-water and slowly releasing it to the underground reservoir.

## National Level

- It constitutes over 60% of the total mangrove forest area in the entire country and has 90% of the total Indian mangrove species.
- There are 140 plant species under 59 families and 101 genera have been reported from the entire Biosphere region by Naskar *et al.* These comprise of true mangroves or major elements, minor elements of mangroves or and mangrove associates, back mangrove trees and shrubs, non-halophytic, non-mangrove associates in the area, halophytic herbs, shrubs, and weeds and epiphytic and parasitic plants.
- It is known as a kingfisher's paradise as out of the 12 species of kingfishers found in the country eight species are found here.
- Inaccessibility and absence of human habitation provides a pristine habitat for the biodiversity within the Tiger Reserve

## Global Level

- The Sundarbans has been classified as a Tiger Conservation Landscape of global priority, as it is the only mangrove habitat (along with Bangladesh), which supports a significant tiger population.
- The Tiger Reserve is home to a large number of endangered and globally threatened species like the fishing cat (*Prionailurus viverrinus*), Gangetic (*Platanista gangetica*) and Irrawaddy Dolphin (*Oracella brevirostris*), King cobra (*Ophiophagus hannah*), water monitor lizard (*Varanus salvator*) etc.
- It harbours the population of the Northern river terrapin (*Batagur baska*), in captive breeding facility in the Tiger Reserve, which was once believed to be extinct.
- It is the nesting ground for marine turtles like Olive ridley (*Lepidochelys olivacea*), Green sea turtle (*Chelonia mydas*) and Hawksbill turtle (*Eretmochelys imbricata*).
- A number of heronries are formed here during monsoon, which harbour large bird populations, which come and breed here. Also, during the winters it is home for Trans- Himalayan migratory birds. Goliath heron (*Ardea goliath*) is another important bird is found in the area.
- Two species of horse shoe crabs (which are considered as living fossils as they are thought to be more than 400 million years old), *i.e.* *Tachypleus gigas* and *Carcinoscorpius rotundicauda* out of the four species found in the world are found here.

## 1.3 GEOLOGY, ROCK AND SOIL

The deltaic region of South Bengal is covered solely by the quaternary sediments carried and deposited by the river Ganges (Hooghly), Matla and Bidyadhari river courses. (Fox C S. 1938). Geologically there are two major groups of deposits (GSI, 1974) are found here:

- Quaternary:** Recent to sub-recent ie Newer alluvium. Consist of sand, silt, clay and pebbles.
- Pleistocene:** Older Alluvium. The pleistocene deposits comprise of clay, silt, kankar and boulders (assorted), which are locally cemented. These are characteristically coloured as reddish brown on the exposed surface.

The Sundarbans delta is the largest prograding delta of the globe. The formations of different lithologic units of deltaic deposition in this system took place at major shifts of strand lines. The high strand shoreline was far west 2,15,000 years back, a strandline change took place 82000 years back and the present deposition of detritus formed since last 6000 years of stable phase. There is general slope towards south as well as west to east. The upper 100 m. layer is composed of thick clay with occasional clay balls. There occurs an unconsolidated sediment at 137 to 152 m. depth composed of sand, silt and clay and gravels of varying colours. This serves as boundary of upper aquifer. At about 350 m. level there lies a second aquifer of potable water. The whole sediment is composed mainly of montmorillonitic, which is very sticky. They are derived from the basic and semi-acidic rocks like Dolerite, Gneiss and Mica schists lying within the course of Ganga flow. Soil salinity reaches upto 3%. Older the sediments, higher is the salinity within Tiger Reserve area.

The Sundarbans saline soils are considered to cause higher plant mortality and the white salt encrustations are very often visible on the soil surface. The salinity rises to the maximum in the middle of May and decreases on the onset of monsoon. The salt contents are of mostly chlorides and sulphates of sodium, magnesium and calcium, though bicarbonates are also present in traces. The subsoil layer remains under reduced condition along with mottles of different sized dark coloured horizons. The soil is slightly acidic to alkaline, pH ranges between 5.4 and 8.5 in reaction. Salinity rises with the age of the sediment, older the sediment, higher is the salinity within the Tiger Reserve area. pH has been reported by the Management Plan of STR – 2000-2010 (Anon, 2001) to be as low as 6.9 in case of *Excoecaria - Ceriops* association and as high as 9.7 in case of *Rhizophora - Bruguiera* association. In submerged condition and with higher salinity, the decomposirate of the organic matter is less as the bacterial population in those areas are generally poor. The organic matter decomposition in these tidal zones are carried out by some facultative and obligate anaerobic bacteria. Mangroves, usually have a low decomposition rate of root biomass relative to root production, which results in the accumulation of organic matter in the soil.

The average elevation varies from 5.8 m. to 6.1 m. above msl with several low-lying depressions.

## 1.4 HYDROLOGY AND WATER SOURCES

### 1.4.1 River systems

A close network of rivers, channels and creeks intersects the whole area, which has resulted in formation of innumerable flat islands. These are submerged completely during high spring tides and partially during ordinary high tides. The main rivers in and around the Reserve area are Matla, Bidya, Gomdi, Goasaba, Gona, Jhilla, Kapura, Raimangal, Harinbhanga and Kalindi. The existing large rivers running north to south are the remnants of the old courses of the Ganga. During the 16<sup>th</sup> - 18<sup>th</sup> Century the Bengal basin was affected by a neo-tectonic movement by way of which an easterly tilt came along a hinge zone, *i.e.* from Sagar to north of the district of Malda, West Bengal, and then gradually curving towards Dhaka, Bangladesh. As a result of the trend of surface elevation contours ENE-WSW, the present course of Ganges, which used to flow along the course of Tamralipta till 12<sup>th</sup> Century A.D., started flowing along the river Padma within Bangladesh leaving Hooghly as a mere tidal channel. Even till the early eighties the tidal effect of Hooghly could be felt upto 281 km. upstream upto Nabadwip in the district of Nadia, West Bengal. During this period the Matla and Bidyadhari river system formed innumerable network of creeks between Ganges and Padma, however, these river systems got completely cut off from sweet-water source and are presently fed by the back-waters of sea.

During the rains the Raimangal receives an overflow of the Ganga through the Ichhamati, which connects them. All the rivers receive a considerable quantity of local drainage. The rivers Matla, Saptamukhi and Thakuran lying on the Western side of the Reserve have practically no connection with their original parent stream and are now creeks of the sea. These are highly brackish all the year round in comparison with the Hooghly and the Raimangal. The Hooghly is fed mainly by the Rupnarayan and is also connected with the Ganga through the Jalangi and the Bhagirathi. But the estuary of the Hooghly remains brackish even during the rains on account of its great width. With the coming up of Farakka Barrage



sweet-water flow in Hooghly has increased and is now brackish below Diamond Harbour. The sources of all the rivers in the western Sundarbans are being progressively silted up leaving hardly any passage for fresh-water, with the result that the rivers are getting more brackish and shallow year after year.

## 1.4.2 Climate

Although the tract is situated south of the Tropic of Cancer, the temperature is equable due to its proximity to the sea. It receives good amounts of rainfall and is humid for most parts of the year. The summer extends from the middle of March to the middle of June and the winter extends from December to February. The climate is more equable in the areas covered by forest than in the neighboring cleared areas. The monsoon starts usually between the middle of June and lasts up to the middle of September. This is followed by autumn lasts from middle of September to November. Overall, the rough weather lasts from 15<sup>th</sup> March to 15<sup>th</sup> September and the fair-weather prevails between middle of September to middle of March.

Every year, 4-5 cyclonic storms are common. Locally known as '*Kaalbaisakhi*', these are of common occurrence in the lower Ganga delta during mid-March – mid-June and occasionally during October–November. During cyclones and storms, the sea or the river-water rises up much more than what it normally rises. The accompanying winds impart it with much force with which the waves dash against the surrounding areas. The funnel shape of the Bay of Bengal in the lower part of the Gangetic delta, poses the most serious threat, from the surges, driven by storm waves (Fosberg, 1971). The role of Sundarbans forest vegetation for reducing and breaking the impact of these cyclonic waves has been documented time and again.

## 1.4.3 Rainfall

The average annual rainfall of the Sundarbans Tiger Reserve is reported to be 1920.30 mm. **Relative Humidity:**

The average humidity is just over 80 per cent and is more or less uniform throughout the year. During the months of January and February dense ground mists occur in the early morning.

## 1.1.5 Tidal Amplitude

In the Sundarbans high-tides and ebb-tides occur twice daily and the current changes its direction every six hours. The spring tides, which occur at the vernal equinox (March-April), produce the maximum rise and fall, as there is very little current in the rivers during this time. The tidal effect is felt in the rivers far inland beyond forest areas. The tidal current passes from west to east, so the change of tide is earlier in the west than in the east.

The velocity of the tidal current increases in the northern part of the tract where the rivers are narrow and the maximum rise and fall occur where the speed is the highest. Near the sea coast the average rise and fall is about 2.15 m. While a south wind prolongs the period of the flow, a north wind shortens the same. The maximum and minimum tides recorded at Sagar Island (west part of Sundarbans) are given below:

Maximum	5.68 mtrs.
Minimum	0.96 mtrs.

However, as a rule, the flood tide in estuarine system lasts more than the ebb-tides. In the resulting effect, unless there is excess river energy from upstream flush, the decantation of traction load sediments takes place. Thus, these backwater channels are getting silted up day by day. With the change in seasons, tidal interactions in the estuarine system in and around the Indian Sundarbans also change (Pillay, 1958). During the monsoon months, the effect of flood tide is more or less countered and nullified by freshets and there is a strong predominance of ebb-tide. The strength of flood tide over ebb-tide is at a minimum during the post-monsoon season. Conversely, during the pre-monsoon season, the effect of flood tide is considerably stronger than that of the ebb-tide.

## 2.2.5. Water Supply

Cultivation in Sundarbans is solely dependent on rainwater. The fishermen, honey collectors and woodcutters carry large earthen pots for carrying their ration of sweet waters whenever they go to the field. There is acute scarcity of water in the islands of Gosaba, Bidya, Choto Mollakhali, Kumirmari and Samsernagar. A deep tubewell (nearly 300 m. deep) has been sunk at Bidya station and is the primary source of water for all touring launches and few camps where there is no source of drinking water. In addition, this point also regularly supplies drinking water to the West Bengal Tourist Development Corporation's Tourist Lodge at Sajnekhali and other line Departments though on a case to case basis. At present, there are deep tube wells at Jhila-1, Haldi, Dobanki, Khatuajhuri, Harinbhanga, Bagmara, Sudhanyakhali, Netidhopani, and Chamta camps. Among the camps Sajnekhali and Pakhiralaya and Lahiripur along with floating camps, in the Western sector source water from Bidya and Jhingekhali along with the floating camps in the Eastern sector is supplied with drinking water which is sourced from Jhilla and Bagna as till date deep tube well boring has been unsuccessful in these sites. Most of these field camps have fresh water ponds and recently, rain water harvesting has been carried out at Sajnekhali, Pakhiralaya, Jhingekhali and Lahiripur where rain water is collected and stored in large overground and underground tanks. This has given encouraging results and shall be replicated in other camps as well.

In addition to these, sweet water ponds have also been dug for wild animals. These serve as monitoring points for wildlife also. Tanks are generally dug down to the layer of impervious sodic clay. Rainwater collects therein and is subsequently bailed out. By such repeated washing with rain water in about three years a tank becomes sweet. Sweet water in small quantity can sometimes be obtained by digging holes on beach sands. The temporary layers of sweet water float on heavier saline waters as a geomorphologic phenomenon.

Presently these wildlife ponds are there in all major camps like Sajnekhali, Sudhanyakhali, Dobanki, Jhingekhali, Khatuajhuri, Haldibari. Few years back a number of such ponds had been dug up all over the Tiger Reserve to serve as a source of water for the wild animals.

**Table 1:** List of Water-holes (Sweet-Water Pond) in sundarban Tiger Reserve

Sl. No.	Range	Beat	No. of Ponds	Compartment	Name of Pond	
1	Sajnekhali Wildlife Sanctuary	Sajnekhali	4 Nos.	Pirkhali – 1 (2 Nos.) Panchamukhani-3 (1 No.) Panchamukhani-5 (1 No.)	Sajnekhali Padmapukur Sudhanyakhali Choragazi Panchamukhani Khal Site	
		-do-	Dobanki	2 Nos.	Pirkhali – 5 (1 No.) Pirkhali – 6 (1 No.)	Dobanki Camp side Deulbharani Pond
		-do-	Duttar	3 Nos.	Jhilla – 4 (2 Nos.) Jhilla – 5 (1 No.)	Bijoybharani, Bhajjhora Choto Bhajjhora
2	National Park (W)	Haldibari	6 Nos.	Gosaba-2 (1 No.) Matla-4 (1 No.) Gosaba-3 (2 Nos.) Mayadwip-1 (1 No.) Chotohardi-3 (1 No.)		
			Netidhopani	6 Nos.	Matla-2 (1 No.) Matla-3 (1 No.) Gosaba-1 (1 No.) Netidhopani-1 (2 Nos.) Netidhopani-2 (1 No.)	
3	National Park (E)	Chamta	5 Nos.	Chamta-4 (1 No.) Chamta-4 (1 No.) Chamta-6 (1 No.) Chandkhali-3 (1 No.) Chandkhali-3 (1 No.)	Out side of the camp Chandraduani Chotodhuya Bakultala Chandkhali Bharani	
			Baghmara	4 Nos.	Baghmara-4 (1 No.) Baghmara-3 (1 No.) Baghmara-5 (1 No.) Gona-2 (1 No.)	Gona Bhurkunda Gorankathi Baghmara Khal Site Gona Khejurtala

*Contd.*



Sl. No.	Range	Beat	No. of Ponds	Compartment	Name of Pond
4	Basirhat	Jhingakhali	5 Nos.	Arbesi-1 (1 No.) Arbesi-2 (1 No.) Arbesi-3 (1 No.) Arbesi-4 (1 No.) Arbesi-5 (1 No.)	Outside of Office Compound Outside of Office Compound Jhilla Burirdabri Junction Outside of Burirdabri Camp Kaukhali/Gabboni
	Basirhat	Khatuajhuri	2 Nos.	Khatuajhuri-1 (1 No.) Khatuajhuri-2 (1 No.)	Tushkhali Khal Side North Chara South Chara Junction
		Harinbhanga	4 Nos.	Harinbhanga-1 (1 No.) Harinbhanga-1 (1 No.) Harinbhanga-3 (1 No.) Harinbhanga-1(1no)	Balkhali/Jhill side Cherakarikhali Jhilla Junction Baraharikhali Out side of Harikhali camp
		Jhilla	2 Nos.	Jhilla-3 (1 No.) Jhilla-2 (1 No.)	Kaksa Chilmari

## 1.6 VEGETATION TYPES

Mangroves and mangrove associates constitute the dominant vegetation type of the area. These salt loving plants which are found throughout the tropical and subtropical regions of the world have been variously categorized by different authors. Mac Nae (1968) has designated the total mangrove ecosystem as 'mangal' and the intertidal plant assemblage as 'mangroves'. Tomlinson (1985) has categorised them into i) major elements of mangroves, ii) minor elements of mangroves, iii) back mangroves or mangrove associates. These are highly productive ecosystems with productivity about 20 times that of the average oceanic ecosystem. These are detritus based ecosystems unlike others which are plankton based. The detritus supplied by this ecosystem triggers the growth of planktonic community in the water. This is then fed upon by zooplanktons and juveniles of finfish and shellfish.

The Sundarban forests have been variously classified by different authors. These include:

1. Prain (1903) divided the entire Sundarbans (Sundribans) into three zones, namely— (i) southern coastal strip and south-western part consisting of mangrove species; (ii) central zones of *Heritiera fomes*; and (iii) north-eastern part of Savannah type vegetation. The Indian Sundarbans falls in the first category. Tensley and Chipp (1926) found that certain conditions of soil make the development of the climatic climax permanently impossible and vegetation ultimately developed on such soil is best considered as an *edaphic climax*. Troupe (1926) shared this view and stated that edaphic forest formations are well represented in India and among the most obvious examples, which may be mentioned, are the mangrove and tidal forests of the littoral region.
2. Curtis (1933) also divided the Sundarbans into three mangrove forest types, these being (i) freshwater forest; (ii) moderately salt-water forest; and (iii) salt-water forest.
3. Champion (1936) classified the tidal forests under primary seral type of moist tropical seral formations and did not regard the mangrove as a climax or pre-climax forest types. He divided the forests of the Sundarbans region into mangrove forests consisting of (i) low mangrove forest; (ii) salt-water *Heritiera fomes* forest and (iii) freshwater *Heritiera fomes* forest. The Indian Sundarbans falls under categories (i) and (ii) while the Sundarbans forest in Bangladesh are at large considered to be representative of category (iii).
4. Champion and Seth (1968) later made one of the most comprehensive assessments of the vegetation communities of the Indian Sundarbans. They divided the forest into categories based on broad characteristics of physiognomy and structure. These communities were defined irrespective of physiographic, edaphic or biotic factors.

Champion and Seth (1968) were of the opinion that some communities were clearly associated with a definite site factor, which differed appreciably from the surrounding areas.

According to Champion and Seth's classification falls under sub-group 4B Tidal Swamp forests with sub-divisions mentioned below:

**(i) Mangrove Scrub: 4B/TS<sub>1</sub>**

*Ceriops*, *Avicennia alba*, *Aegialitis rotundifolia*, *Excoecaria agallocha*, *Phoenix paludosa* (drier ground).

Along the edge of tidal waterways and sheltered muddy coast. Dense forest with average height 3-6 mts. Few species and markedly gregarious, all evergreen with leathery leaves. Vivipary seen. Common in Western Sundarban.

**(ii) Mangrove Forest: 4B/TS<sub>2</sub>**

*Rhizophora*, *Kandelia candel*, *Avicennia alba*, *Excoecaria agallocha*, *Ceriops decandra*, *Ceriops tagal*, *Bruguiera* sp, *Xylocarpus granatum*, *Sonneratia apetala*.

Found on mud banks of delta streams and near sea-face where accretion is in progress. An evergreen forest of moderate height. Tidal mud permanently wet with salt- water and submerged with every tide. Stilt roots and vivipary seen.

**(iii) Salt-water Mixed Forest: 4B/TS<sub>3</sub>**

*Heritiera fomes*, *Excoecaria agallocha*, *Ceriops decandra*, *Xylocarpus mekongensis*, *Avicennia officinalis*, *Aegialitis rotundifolia* (near sea-face).

*Nypa fruticans* relatively uncommon. Fairly dense forest, more than the fresh-water type but not as high. Rarely over 20 mts. Trees do not attain girth. Ground flooded every tide with brackish water. Less silt deposition than fresh-water type. Less humus, soil stiffer, clayey liable to crack extensively when exposed. Bigger river deltas.

**(iv) Brackish-water Mixed Forest:**

**4B/TS<sub>4</sub>** *Heritiera fomes*, *Sonneratia apetala*, *Acanthus ilicifolius*, *Xylocarpus mekongensis*, *Bruguiera* sp, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Ceriops decandra*, *Phoenix paludosa* (high land), *Acanthus ilicifolius*, *Hibiscus tiliaceus*, *Nypa fruticans* (fringing banks).

In the larger deltas, notably of the Ganges. High forests over 33 mts., stilt roots rarely met but pneumatophores present. Forest is flooded for some portion each day the water never very salty and very fresh during rainy season or slightly brackish. Good amounts of fresh silt deposition.

**(v) Palm Swamp Type: 4B/E<sub>1</sub>**

*Phoenix paludosa*.

Seen on drier areas within salt-water mangrove scrub or forest. Forest area is partly flooded for some part of the day.

- Blasco (1975) identified the following 5 species compositions in his classification: (i) back mangroves (euryhaline zone), found on the river bank; (ii) dense mangrove consisting of many species of plants; (iii) tall, dense trees of *Heritiera fomes* with primary associate *Excoecaria agallocha*; (iv) brackish-water of mixed *Heritiera fomes* forests with *Rhizophora* species over a very limited area; (v) palm swamps consisting of pure *Phoenix paludosa*.
- According to Blasco (1975) and Champion and Seth (1968) had not considered the anthropogenic and biotic factors for spatial zonation. On the other hand Sidhu (1960) pointed out that as a result of constant biotic interference species of *Acanthus* and *Avicennia* may be generally pioneers.



7. Naskar and Guha Bakshi (1982) grouped this forest into five major zones as— (i) sea-face of beach forest; (ii) formative island flora; (iii) flora of reclaimed land and low lying area; (iv) flora of river banks and (v) swamp forest. The first category is dominated by xerophytic plants due to the dryness of the soil and numerous sand dunes. The flora of the formative islands consists mainly of *Porteresia coarctata*, *Salicornia brachiata*, *Suaeda maritima*, *S. nudiflora*, *Phragmites vallatoria* (*P. karka*), *Acanthus ilicifolius* and a few tree species such as *Avicennia*, *Sonneratia* and *Excoecaria*. The reclaimed land and low lying areas are dominated by mesophytic flora while the last two zones are dominated by halophytic mangrove species.
- As per Naskar et al (2010) the total plant species are grouped into 59 families, and 101 genera and 140 species. These comprise of true mangroves or major elements, minor elements of mangroves or and mangrove associates, back mangrove trees and shrubs, non-halophytic non-mangrove associates in the area, halophytic herbs, shrubs, and weeds and epiphytic and parasitic plants. Among the important mangrove families are Rhizophoraceae, Avicenniaceae, Meliaceae, Sonneratiaceae, Sterculiaceae, Myrsinaceae etc. The list of Mangrove and associated species has been given in **Appendix 4**

### Characteristic Features of Mangrove Flora:

Mangrove plants are salt-loving or halophytic plants, which show numerous modifications and adaptations in order to survive in the anoxic, waterlogged saline soils. Few of these are given below:

- There exists extensive lateral root system for a proper anchorage against diurnal tidal inundation/scouring, eg. *Excoecaria* sp.
- Supporting roots like stilt roots or prop roots, root buttress are formed in species like *Rhizophora*, *Xylocarpus*. Vertical knee roots from horizontal lateral roots are given out by species like *Lumnitzera*, *Bruguiera gymnorrhiza*, *Kandelia candel* etc.
- As the lateral roots get submerged due to tidal movement and do to get oxygen breathing roots or 'pneumatophores' have been developed. These roots grow above the earth surface and contain pores called as lenticels through which gaseous exchange occurs. In addition to pneumatophores even the stilt roots contain lenticels as seen in the case of *Rhizophora mucronata*.
- *Excoecaria agallocha* shows perforated burr formation on its stem in more inundated areas, to facilitate gaseous exchange.
- To counter the excess saline conditions outside the plant cells exert very high osmotic pressure in order to draw water from outside salt solution. It has been seen that the cell sap is rich in organic electrolyte in case of *Rhizophora* sp. and inorganic electrolyte in case of *Suaeda* sp.
- The leaves are normally thick and often contains salt excretory channels to deposit crystals and waxes of various composition on leaves. Salt hairs on leaves of *Porteresia coarctata* bursts to excrete salt. *Avicennia alba*, *Acanthus ilicifolius*, *Aegialitis rotundifolia*, *Aegiceras corniculatum* also show salt excretory mechanisms.
- Mangrove leaves have sunken stomata to prevent water loss.
- The fruits of *Rhizophora*, *Bruguiera* etc. germinate right on the tree and fall like a dart on the mud flats to get anchored against tidal inundation. This phenomenon is called as 'Vivipary' and is an adaptation unique to mangrove plants.

These mangroves have also started manifesting quaint adaptations (being out of normal domain), as in case of *Avicennia* species which never throws stilt roots and is an outer estuarine species but, when found in the mid-estuarine creeks at the foreshore gives rise to stilt pneumatophores in order to combat the higher velocity and undermining effect of water. Both stilt roots and normal pneumatophores of *Avicennia* are histologically alike and contain chlorophyll unlike other stilt rooted mangroves. The species like *Excoecaria agallocha* (an inner estuarine species) which normally does not

have pneumatophore or stilt root, give rise to perforated 'Burr' formations on the lower stem in order to ensure gaseous exchanges at places where tidal amplitude is more severe, *i.e.* like the mid-estuarine environment. Thus the mangroves of Indian Sundarbans exhibit a unique pattern of species movement setting the whole consociation in a dynamic state of phyto-plasma, overlapping the normal estuarine modes and developing resultant adaptational abnormalities.

### Succession:

Naskar and Guha Bakshi (1987) worked extensively on the succession of mangrove flora. They identified five ecological succession of the Sundarbans swamp based mainly on tidal magnitude, *viz.*—

- **Phase I:** Swampy Mangrove or Intertidal Mangrove Zones
- **Phase II:** Tidal Mangrove
- **Phase III:** True Mangrove Decline
- **Phase IV:** colonisation of non littoral species
- **Phase V:** xerophytic non-mangrove and dry evergreen forest

The mangrove forest is a very dynamic eco-system. It is in continuous state of erosion and accretion leading to subsidence or erosion of existing banks and appearance of new lands and mud flats. Mangrove succession starts with the appearance of the pioneer species locally known as dhani ghas or *Porteresia coarctata* on the newly arisen mud flats. With the passage of time this grass species traps the propagules of *Avicennia* and *Sonneratia* sp., which come up well in freshly silted and firm mudflats. Once the land gets consolidated Goran or *Ceriops* sp. and Genwa or *Excoecaria agallocha* comes and colonises the area. *Phoenix paludosa* considered as the climax species which comes up on high lands and forms gregarious growth.

However, not all areas of the forest contain plant growth. There are some saline blanks, which have been identified with the help of satellite imageries, some of which are saucer and some inverted saucer shaped. These blanks are high lands where water does not reach even during full tides. However, extent of such blanks is very limited. The blanks are generally devoid of any vegetation, but some of these blanks show the signs of primary succession and others contain either scrubby growth of *Ceriops decandra* or scanty growth of *Excoecaria agallocha* (Genwa), *Phoenix paludosa* (Hental).

The central section of mangrove patch of the Sundarbans delta between rivers Thakuran and Harinbhanga is typified, by the accelerated geomorphic action of ingressing back waters, which does not get any upstream resistance of sweet-water. This has resulted in movement of plant association within outer, inner and mid-estuaries.

In general, the northern boundary and new depositions are characterised by Bain (*Avicennia marina*, *A. alba*, *A. officinalis*) flanked by foreshore grassland of *Porteresia coarctata*. Bain is gradually replaced by Genwa (*Excoecaria agallocha*) and then Goran (*Ceriop decandra*). About 70% of the area is covered with Genwa-Goran association. There are, however, southern and eastern associations of Garjan (*Rhizophora apiculata*, *R. mucronata*), Kankra (*Bruguiera sexangula*, *B. gymnorhiza*, *B. cylindrica*, and *B. parviflora*) and patches of Sundari (*Heritiera fomes*)–Genwa–Goran. Pure 'Hental' (*Phoenix paludosa*) forests exists on relatively high lands. These hental forests are considered as the climax vegetation. *Xylocarpus granatum* and *X. mekongensis* are distributed through out the forests. *Nypa* palm swamp are common on central, eastern and southern portions, along side creeks and rivers having soft mud deposition. The sea-facing areas have *Excoecaria* sp., *Lumnitzera racemosa*, *Saccharum*, *Derris indica*, *Thespesia populnea*, *Ipomea pes caprae* etc.

*Heritiera fomes*, which was once found throughout the area has over the years become confined to the eastern and southern sector. This shift in distribution has been attributed to the gradual reduction of sweet water into the system as the river sources have been cut of from their origin owing to siltation and are purely arms of the sea. Thereby, leading to an overall increase in the salinity regime.



### **Mangrove species preferred by Wildlife:**

The species most favoured by the herbivores is Keora (*Sonneretia* spp.) whose fruits and leaves are preferred alike by Cheetal and *Rhesus macaque*. Pangas fish has been found to eat Keora fruits. Apart from this, fresh shoots of Hental is browsed by Cheetal and hental fruits are preferred by birds and macaques. Bain and Genwa are also browsed quite often by the herbivores. Succulent tips of dhani ghas growing on newly colonised mud flat have also been seen to attract cheetal groups.

## **1.7 WILD FAUNA AND HABITATS**

### **1.1.1 Historical Perspective**

A detailed account of the wildlife, which was once present in the area is given in the **Hunter's Statistical Account of Sundarbans (1878)**. Some excerpts of which are reproduced below:

"Tigers, leopards, rhinoceros, wild buffaloes, wild hogs, wild cats, bara singa or large deer, spotted deer, hog deer, barking deer, porcupines, otters, and monkeys are the principal varieties of wild animals found in the Sundarbans. Tigers are very numerous, and their ravages form one of the obstacles to the extension of cultivation.

The serpents found in the Sundarbans are the boa constrictor, cobra-di-capello or gokhura, kuriat, sankhachur or saltwater snake, gosap and green viper.

THE BIRDS of the Sundarbans comprise the following: Adjutants of two kinds, viz. *Ardea gigantia*, and the Marabout adjutant–vultures, kites, hawks, owls, mainas, doves, green pigeons, parrots, parroquets, jungle-fowl, woodpeckers, sandpipers, egrets, waders, large and small spoonbills, pelicans, storks, paddy birds of several kinds, herons, snipe, crows, several varieties of kingfishers, divers, hornbills, jays, orioles, teal, seagulls, curlew, Indian pheasants, waterfowl, reedbirds, plovers, partridges, and a great variety of wild geese and ducks.

FISH abound in nearly all the rivers. Porpoises and crocodiles (commonly called alligators) abound, but the latter are less numerous than they were twenty years ago.

Sharks, also, are by no means uncommon in the larger streams and estuaries. No trade is carried on in wild beast skins, with the exception of the skins and horns of the spotted deer, which are sold for a trifle, and to a very small extent"

However, over a period of time we have lost a number of animals due to ecological changes, habitat degradation, and related anthropogenic activities. Some of the animals, which were once present but have been lost include:

The animals that once existed in Sundarbans and have become extinct over a period of time include:

- 1. Javan Rhinoceros (*Rhinoceros sondaicus*):** Remains of this animal were found in pond excavations in upper layers collected in 1870, displayed in Indian Museum, Calcutta. According to **Gupta (1964)** the last reports of evidences proving the presence of the Javan Rhinoceros in the Sundarban mangals dates back to the year the year 1888. In April 2000, skeletal remains of *R. sondaicus* were found 2.7 meters below the surface by the side Mollakhali island under Gosaba P.S.
- 2. Wild Buffalo (*Bubalis arnee*):** The wild buffalo roamed about in the Sundarbans till 1885 and died out by the end of the 19<sup>th</sup> Century. According to **Gupta (1964)** the last reports of evidences proving the presence of Wild Buffalo in the Sundarbans mangroves dates back to 1890. On 3<sup>rd</sup> March, 2001, some bones were recovered from Netidhopani (Compartment 1) within the Sundarbans Tiger Reserve, which was badly eroded by recent storms. The bones were sent to ZSI for identification and were identified as the bones of Wild Buffalo.
- 3. Swamp Deer (*Cervus duvaucelli*):** This animal existed in good numbers till the earlier part of the present century. Probably got extinct by 1930.

4. **Barking Deer (*Muntiacus muntjak*):** Barking deer used to exist in the southern portion of the Sundarbans, even upto 1976. It was seen in Halliday Island and Bulcherry area.
5. **Hog deer (*Axis porcinus*):** It was reported from Sundarbans till 1945.

Over the years, excavations have yielded evidence of the presence of these animals in the area. In the recent past, fossil of *Rhinoceros sondaicus* have been collected from Bakkhali. Fossils of sweet-water tortoise and jaws of Gharial (*Gavialis gangeticus*) were found in the excavations of Dumdum near Kolkata along with stumps of Sundari (*Heritiera* spp.) and fruits of *Derris* and *Ceriops*. Sweet-water enabled the survival of Javan Rhino, water buffalo and swamp deer within mangrove forests of Sundarbans until the last Century.

#### **The Current Status:**

Mangrove fauna in general, is found to occur in both the terrestrial and the aquatic ecosystems. These areas can be differentiated as littoral or supra-littoral forests, inter-tidal mudflat and estuary. The littoral or supralittoral (*i.e.* areas beyond the high tide) forest biome is typically a terrestrial environment, which includes both aerial and arboreal forms and the soil inhabitants. The intertidal (region between high and low tide) mudflats are essentially semi-terrestrial or semi-aquatic habitat supporting mainly the soil forms and the benthos. While the other faunal components in the mudflat and estuary can broadly be divided into zoo-plankton, nekton and benthos. Several species of crustaceans and larvae of fishes form the main component of the zoo-plankton in this region. The pattern of distribution of animals in mangrove eco-system is influenced by the substratum, salinity, tidal amplitude, vegetation, light, temperature etc.

#### **LITTORAL OR SUPRALITTORAL FOREST FAUNA**

The supra-littoral forest habitat includes area where water may or may not reach at all and is essentially densely covered with halophytes. It offers forest floor, roots, stems, branches and leaves of trees as the abode. Mangrove forests here are inhabited by terrestrial animal communities. They may occupy tree or ground or both. Most of the mangrove animal communities should distinct zonation in relation to tidal height, but the tree fauna exhibit vertical zonation in the vegetation.

#### **The Arboreal Community:**

Animals under this community include both aerial and arboreal forms. The upper canopy of mangrove trees is the home of birds, bats, monkeys and insects. But such as the *Pigmy pipistrella*, *Pipistrellus mimes* can be found flying on the onset of evening inside the Tiger Reserve areas. The *Rhesus macaque*, *Macaca mulatta* the only species of primate occurring in the Sundarban is well-distributed in the entire forest. They are often found feeding on Keora trees (*Sonneratia apetala*) but are also well adapted to crab eating. It is interesting to note that the herds of deer follow the troops or Rhesus Monkey from one Keora tree to another in search of leaves what the monkeys drop from the trees tops in course of their feeding; the deer also get advance information about the movement of the tiger from the monkey's call. The wild boars are seen burrowing beneath the roots of *Ceriops*, Hental for roots and tubers. Mammals, reptiles, birds etc. are also seen inhabiting cavities of *Sonneratia*.

Many species of birds build their nests in the mangrove trees. Herons, Egrets, Cormorants and Darters enjoy roosting in colonies on the tall trees of Bain, Sundari and Genwa. The *Sonneratia* tree is especially preferred by parakeets and woodpeckers, many snakes, water monitors and even otters have been seen living in the hollows of this tree. Several species of birds use trunk, branches and aerial roots of mangrove as observation posts for feeding on fishes, molluscs, crustaceans and aquatic insects.

Honey bee, *i.e.* *Apis dorsata* is responsible for pollination in about 80% of the mangrove species thereby plays a very important ecological role in the mangrove forests. These bees are known to build their honeycomb inside the forest in large numbers. Yearly more that 20 tonnes of honey is produced by the bees in the entire Sundarbans area. About 39%



of honey are produced from *Excoecaria agallocha* (Genwa), 16% from *Avicennia species* (Bain), 11% from *Ceriops species* (Goran), 10% from *Rhizophora species* (Garjan) and only 24% from the rest of the plants. *Phoenix, Excoecaria* (Hental-Genwa) association is thought to be the ideal sites for honey comb formation.

### Terrestrial/Aquatic Community:

#### Mammals:

The terrestrial mangrove eco-system in Sundarbans is the domain of the Royal Bengal Tiger, *Panthera tigris tigris*, which is at the apex of the food chain. It leads an almost amphibious life and is an excellent swimmer. It has been seen to cross rivers as wide as 2 km. at a stretch. It has adapted itself nicely to this difficult terrain which is characterized by sharp pneumatophores, muddy substratum, innumerable rivers and creeks with tidal rhythm, variable salinity and lack of freshwater source. The principal prey species of the tiger are spotted deer, wild boar, and *Rhesus macaque* who also swim across the streams and water channels. In addition, it also feeds upon fish, crab and water monitor. In one instance, a post-mortem of a dead animal revealed the presence of a Monocellate cobra and a King cobra from the stomach of the animal. This is only one of the very few recorded instances of tigers eating King cobras. The man-eating trait of Sundarban tigers have become almost a legend in Bengal and elsewhere. It is considered that man-eating propensity of tiger in this area is an acquired trait over a period of generations given the harsh surrounding conditions. It has been noticed that in the last 10 years apart from one case where the tiger had accidentally killed a girl all the deaths have occurred inside the forest. This peculiarity in the tiger behavior has been explained by various experts that within the forest area, *i.e.* their habitat, they consider all moving objects as their prey. It is generally believed that the tigers in this mangrove forest do not have territories due to the obliteration of urination marks by the tidal waters. However, this is yet to be borne out by scientific facts. Recent data from radiocollared tigers reveals that the animals are using specific areas possibly indicating territoriality.

Though the tigers may breed at any time of the year but in Sundarban it has been observed that the mating season starts in winter and continue up to March - April. During this period, males often fight with each other but there has never been any report of fatal fights in Sundarban. General gestation period of tiger is 95 to 110 days. In Sundarban the litter size of 1 to 2 is very common and rarely three or more cubs have been sighted. Usually cubs stay with their mother upto 2 to 3 years but in Sundarban it is seen that they are separated by the time they are two years old approximately. Generally, inter-cub interval of tigress is approximately three years but not much observation has been made regarding Sundarban tigers due to difficult terrain and their man-eating propensity. Occasionally, up to five tigers have been sighted together in Sundarbans. This could be a case of the sub-adults with the male and female.

Based on the preliminary results of the radio telemetry studies in Bangladesh Sundarban (Barlow,2008) documented home range sizes for two adult females of between 12 and 15 sq. km. Also, studies conducted on the skulls of Bangladesh Sundarbans tigers (Barlow, 2008) found that it is significantly different craniometrically from all other currently defined subspecies, both in terms of size and shape. This distinction was most notable for male tigers, which tend to have more variable morphology than females. This findings add to previous work on tiger craniometrics that found substantial differences between the mainland and Sunda island. As per Mukherjee, general osteological study of selected long bones of Sundarbans tiger reveals that different parameters of all bones are somewhat lesser than corresponding long bones of Indian tigers of other region such as tiger of Project Tiger Melghat, Amaravati. Skull size of Sundarbans tiger is lesser than that of Melghat tigers. (Pandit, 1994)

Apart from the tiger, the secondary predators are mainly the fishing cats (*Felis viverrina*) and to small extent the jungle cat. They feed on small birds, snakes, fish etc. Among other ground dwelling fauna are Spotted Deer (*Axis axis*), wild boar, (*Sus scrofa*). The wild boars feed on underground tubers but also relish dead fishes, prawns, crabs, molluscs and sea turtle eggs. The Spotted Deer preferably browse on leaves, twigs and fruits of Keora (*Sonneratia apetala*) 'Bain' (*Avicennia officinalis*) and Genwa (*Excoecaria agallocha*).

The cetaceans like Gangetic Dolphin (*Platinista gangetica*) and the Irrawaddy Dolphin (*Orcella brevirostris*) are frequently found in the eastern side particularly in rivers like the Raimongal, Goasaba, Matla and the sea-facing areas. The Black Finless Porpoise (*Necmeris phoceanoides*) is also found in rivers near the estuary. Detail list of fauna is given in **Appendix 5**.

### **Reptiles:**

The estuarine crocodile (*Crocodylus porosus*) is the top-most predator in the aquatic eco-system. Apart from the estuarine crocodile, the water monitor lizard (*Varanus salvator*), which reaching upto 2.4 mtr. in length, can be frequently found within the Reserve. The sea-facing beach of the Reserve forms a nesting ground for olive ridley sea turtle (*Lepidochelys olivacea*), which come to lay eggs on the sandy beaches of the Tiger Reserve. The egg laying is sporadic and takes place mainly during December to March. The water monitors are the greatest predators of their eggs and hatchlings along with wild boars, terns and sea gulls. The endangered River Terrapin (*Batagur baska*) also uses the beaches as their nesting ground. The Mechua beach in Bagmara block is an important nesting ground for such terrapin. Dr A.K. Mukherjee of ZSI has recorded other coastal soft-shell turtle (*Pelochels bibroni*), Bengal eyed terrapin (*Morenia ocellata*) and three keeled terrapin (*Geomyda tricarinata*) from the area. Occasional reports of presence of green sea turtle (*Chelonia mydas*) and Hawksbill turtle (*Eritmochelys imbricata*) have also been received.

Since the 1980's ex situ conservation program was started and eggs of the turtles were collected from turtle pits and incubated at Sajnekhali. The hatchlings were subsequently released in the sea. This practice has been subsequently discontinued and now in situ conservation of the turtle is carried out on the beaches. The egg pits are surrounded by wire meshes to prevent the eggs from being destroyed by the wild boars and water monitor lizards. After hatching the wire mesh is removed and the hatchlings move out into the sea. Similarly, an ex situ conservation program for the estuarine crocodiles is going on at Bhagbatpur. The crocodiles reared here are released into the tidal waters. This is an ongoing program.

Around 53 species of snakes are found in the area. Prominent among the poisonous are the king cobra, monocellate cobra, banded krait, Russell's viper, common krait. The python, chequered keelback, dhaman, green whip snake, ornamental snake, and several other species constitute the non-venomous snakes. The tidal creeks also harbour Homalopsid snakes adapted to living in water, the most common being the *Cerberus rhynchops* or dog-faced water snake. Snake bite cases are very common in the fringe villages between July and October, especially due to cobra and krait. Detail list is given in **Appendix 6**.

### **Avifauna:**

There are over 200 species of birds, which have been recorded from the area as per the bird surveys conducted in the area. These include a large number of migrants from the higher latitudes that visit the area in winter. During the monsoons heronaries develop in Arbesi and Jhilla block. Common birds found in the area include herons, egrets, darters, spoonbills, cormorants and storks etc., which come out and nest in the area. Earlier there was a heronry around Sajnekhali covering 1.5 sq. k.m. area, which used to develop from June to end of September. However, this nesting ground suffered intense damage during the cyclone of 1988 and is no more active.

The bird species, which are most abundant in the Sundarbans Tiger Reserve include the Common Sandpiper, Indian Ringed Dove, Whimbrel, Tailorbird, Black-capped Kingfisher, Jungle Myna, Rose-ringed Parakeet, Large Egret, Bronzed Drongo, White-collared Kingfisher, Mag-pie Robin, Pond Heron, Common Iora, and Red-vented bulbul.

The mangrove is also known as the kingfishers paradise with 8 species out of 12 species of kingfishers found throughout the country are found here. Apart from these, few of the birds found in the area are Large and median egret, brahminy kite, white bellied sea eagle, lesser adjutant stork, osprey, Goliath heron, whiskered tern, brown winged gull, whimbrel, common sandpaper, jungle myna, rose ringed parakeet etc. A detailed list is given in **Appendix 7**.



### Aquatic Community:

Aquatic habitat has not yet been studied in full details. However, some works have been done by ZSI. The most interesting is the formation of Phytoplankton in the shallow clear water of the tidal creeks receiving enough sunlight for a luxuriant growth. The phytoplanktons are the sources of augmentation of oxygen content in the water. This influx, however, is checked by the zoo-plankton particularly by the shrimp population, which invade mangrove estuary during the semi-larval stage to adult stage. The zoo-plankton consumes the phytoplankton and diminishes the oxygen content and the whole equilibrium is also controlled by the seasonal salinity of the creeks. The total catch fish diminishes to a minimum during the highest salinity as has been recorded by Chakraborty and Chaudhury. The micro-organisms, like *Noctuluca*, dinoflagellates produce bioluminescence during winter night particularly near the sea-face and entire atmosphere turns into a fairy land.

### Fishes, Crabs etc:

A wide and varied assortments of fishes, molluscs, crabs and prawns inhabit the estuaries. The mangrove leaves, which decompose slowly, offer food and shelter for the larval shrimps and they migrate from the sea to the mangrove estuary for attaining maturity. Even the snappers or mullets depend very much on the mangroves. Mulletts like Bhetki and Bhangor constitute the main form the edible fishes in the area. The studies of fish made by Shri Chaudhury and Chakrabarty also reveal that *Pangasius pangasius*, i.e. Pangas fish is the primary heterotrophy, which often swallow full keora fruit. The amphibious mud skipper fish such as *Periophthalmus* and *Boleopathalmus* arouse considerable interest. The former creeps up the trees with the rising water level. Among the crustaceans, the one-armed fiddler crab (*Uca* species) often shows off to his mate with the colourful arm. They have diurnal clock inside which regulates their colour change along with tides. Another interesting crab is the *Clibanarius padavensis* (deMan), i.e. Hermit crabs occupying gastropod shells of genus *Telescopium*, *Nerita*, *Cerithidea* or *Semifusus*, apart from the edible crab *Scylla serrata*, there are 11 species of crabs found within the creek waters. Amongst which ghost crab and patal chingri (*Thalacina anomala*) are important ones. Marine borer like *Teredo* often causes concern to the watercrafts.

There are two species of trilobite, viz. *Tachepleursgygus* and *Carcinoscropius rotundicauda* commonly known as Horse shoe crab or king crab. King crabs are now protected owing to its ability or high sensitivity to bacterial endotoxins. The cell lysates obtained from the blue blood of the species is widely used for estimation of bacterial endotoxin. They have hardly changed in 400 million years are also called living fossils. They visit Sundarbans during pre monsoon season (March to June) when the salinity reaches its peak. During this season they are found mating in mangrove creeks and mudflats. They are often killed by people owing to the belief that they can cure arthritis.

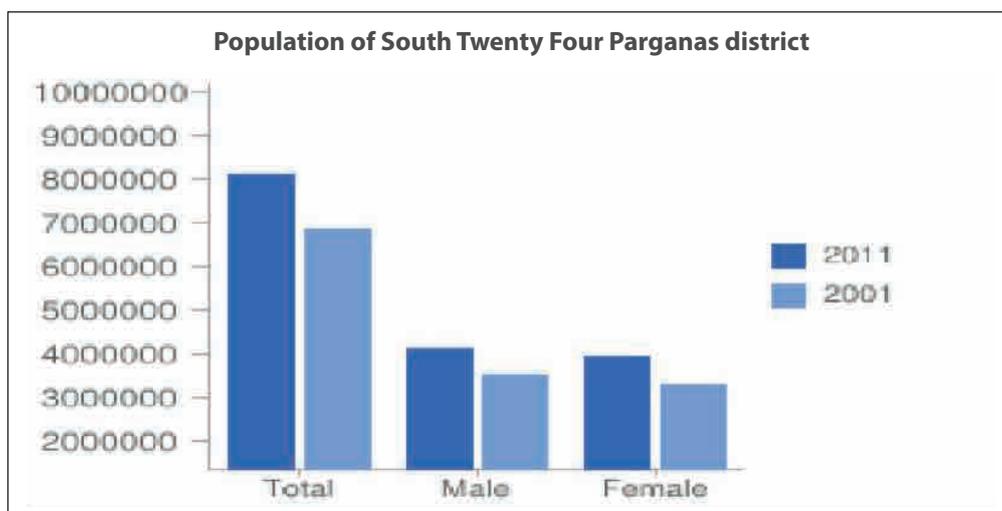
The fish fauna of the estuarine waters in and around the Sundarbans have been classified into residents and transients (migrants). The residents include *Mugil parsia*, *M. tade*, *Polynemus paradiseus*, *Polydactylus indicus*, *Otolithoides biauritus*, *Lates calcarifer*, *Hilsa toil*, *Arius jella*, *Harpodon nehereus*, *Ilisha elongata*, *Pama pama*, *Sillaginopsis panijus* etc. The transient or migratory fish which enter the estuary for a short time mainly to spawn include *Tenualosa ilisha*, *Pangasius pangasius* and *Polydactylus indicus* etc.

The sharks and rays found in Sundarban include the Ganges shark (*Glyphus gangeticus*), Small toothed saw fish (*Pristis microdon*), Pointed saw fish (*Anoxypristis cuspidate*), and white spotted shovel nosed guitar fish (*Rhynchobatus djiddensis*) all of which are Schedule-I species in the Wildlife (Protection) Act, 1972. In addition to these, the following are also found— *Rhinobatus granulates*, *Himantura alcockii*, *Rhinoptera javanica*, *Sphryna zygaena* etc.

Detailed list of fishes and crabs species recorded so far in the area is given in **Appendix 8**.

## 1.7 MAJOR CONSPICUOUS CHANGES IN THE HABITAT SINCE INCEPTION

1. Exponential increase in the fringe human population leading to increased pressure on the natural sources.



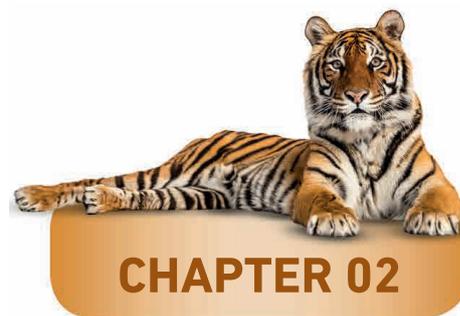
Description	2011	2001
Population	81.62 Lakhs	69.07 Lakhs
Actual Population	8,161,961	6,906,689
Male	4,173,778	3,564,993
Female	3,988,183	3,341,696
Population Growth	18.17%	20.85%
Area Sq. Km	9,960	9,960
Density/km2	819	693
Proportion to West Bengal Population	8.94%	8.61%
Sex Ratio (Per 1000)	956	937
Child Sex Ratio (0-6 Age)	963	964
Total Child Population (0-6 Age)	1,025,679	1,050,120
Male Population (0-6 Age)	522,552	534,626
Female Population (0-6 Age)	503,127	515,494

2. Due to siltation in the upper reaches of the river as a result of which there is no fresh-water inflow into the system. The rivers now are just extended arms of the sea. This change has been reflected in the gradual reduction of the Sundari trees, which are now mostly confined only in the Southern and Eastern sector.
3. Many of the upstream rivers have silted up which is becoming a problem in the navigation of watercrafts.
4. Largescale silting up of the Shakunkhali khal in Bashirhat range. It is hardly 2-3 mts. wide at a few places. It poses a threat of encroachment in the coming future.
5. A continuous cycle of erosion and deposition has led to decrease in the area of certain blocks and compartments and increase in the area of others. The accretion is more in the southern blocks and erosion more in the northern side.





# Status of Tiger and Co-Predators



## 2.1. DISTRIBUTIONS

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Tigers are found throughout the area. This has been evident by the direct and indirect evidences like pugmarks and scat as observed by the field staff, researchers, etc. While patrolling and monitoring in and around the area. This has also been carried out by the All India Tiger Estimation exercise which was completed in December, 2018. Apart from the tiger, the other co predator on land is the fishing cat. It is very difficult to sight the animal however the widespread presence of the animal has been confirmed through camera trap captures throughout the Tiger Reserve. In the aquatic system the estuarine crocodile is the topmost predator. It is also distributed all over the Sundarban landscape.

## 2.2 ABUNDANCE STATUS

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Though all of these animals are present throughout the area as is seen in the daily wildlife monitoring programs and also in the All India predator and prey monitoring exercise. According to these the tigers are fairly abundant. However, the status of the fishing cat and estuarine crocodile cannot be commented on pertaining to the dearth of adequate data. There have been no dedicated surveys for determining the population of these especially the estuarine crocodile.

## 2.3 PREY–PREDATOR RELATIONSHIP

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The tiger is the top-most predator in the terrestrial ecosystem. Its principal prey species are Spotted Deer, Wild Boar and Rhesus macaque. The analysis of the 113 scats reveals the presence of eight prey species with a high prevalence of the medium sized ungulates, viz. the deer and wild boar. This is because large sized ungulates have long become extinct from this eco-system. Together with deer and wild boar there are a lot more species in the form of Rhesus monkey, water monitors, different species of turtles, fish and crabs upon which the Sundarbans tiger feeds. This diversity in food habits has enabled the tiger to adapt to the adverse environment of Sundarbans.

The Sundarbans tiger have also acquired notoriety of being man-eaters. However, they have not ventured out to kill humans in the village area. Water Monitor is formidable predator for the nesting birds and Olive ridley turtles. The crocodiles which feed on aquatic animals and predator fishes in turn help to increase the population of edible fish.

## 2.4 ASSESSMENT OF THREATS

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There are many threats both to the ecosystem and the fauna inhabiting the area. First is the destruction of habitat by the local communities having a natural resource dependency. Poaching is another threat as the spotted deer and wild boar were traditionally eaten by the locals especially on festive occasions. In addition to these, destruction of habitat by upstream effluents, soil erosion also poses serious threat to the area. Destruction of seeds of various fish in the process

of catching tiger prawn seeds is also one of the major threats, which shall have an adverse effect in maintenance of ecological balance in the area on account of elimination of different species of fauna. It has been calculated that with every single tiger prawn seed, 46.7 other prawn seeds, 4.1 fingerlings of fishes and 0.3 other aquatic fauna (crustaceans and annelids) get trapped and most of them do not survive later on.

All these have been dealt in detail in the proposed management.

### Distribution of Tiger in Sundarban

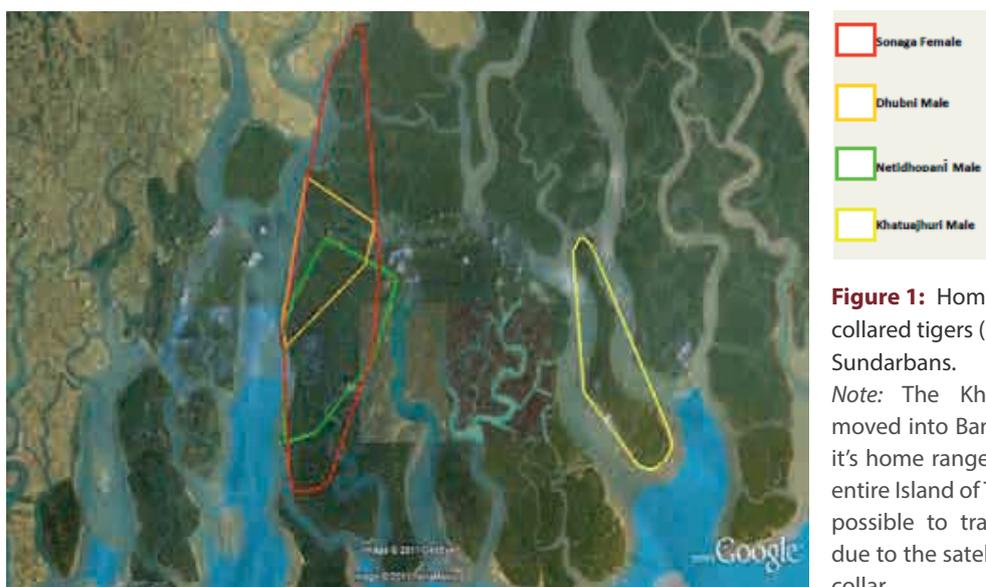
#### All India Tiger Monitoring exercise 2010

In 2010 camera trapping has been done in only few points on experimental basis.

Due to the unique and hostile habitat of the Sundarbans the methodology used across India (Phase I) for monitoring tigers and their prey could not be applied. We adapted the methodology to suit the environment of the Sundarbans. Since it was not possible to walk in the mangrove forests for recording tiger sign encounter rates due to lack of proper animal trails as well as the ever present threat of tiger attack, we used tidal channel searches across the Sundarbans to record sign and animal encounter rates. One hundred and twenty-six boat transects with an effort of 1163 kms were sampled across the entire tiger reserve. A similar approach has also been used in the Bangladesh Sundarbans as well (Barlow et al. 2008). The sign intensity data across the Sundarbans constituted the Phase I data set. We then used a combination of satellite-telemetry and camera traps to estimate home range size, population and density of tigers (Phase III).

#### Collaring of Tigers

A total of five tigers, 2 adult females and 3 adult males were tagged with satellite radio collars as a part of an on-going study on the Sundarbans tigers. The tigers were trapped in cages using bait and were anesthetized using 3 mg/kg Ketamine and 1.5 mg/kg Xylazene (Kreeger, 1996) administered intra muscularly using a blowpipe. The satellite collars (VECTRONIX GPS Plus) weighed less than 1.5 % of the body weight of the tigers. The collars were programmed to provide GPS fixes every 30 minutes during phases of intensive sampling and later remotely reprogrammed to provide five GPS fixes per day to conserve battery power. Locations of tigers were analysed with ArcView v3.3 software (ESRI, Redlands, California) and Animal Movement extension v1.1 (Hooge and Eichenlaub 1997), to construct Minimum Convex Polygon (MCP) (Mohr and Stumpf 1966) and Fixed Kernel (FK) (Worton 1989) home ranges. Activity time periods, frequency of crossing water channels of various widths, and distances moved within a day were also computed



**Figure 1:** Home ranges of collared tigers (n = 4) in the Sundarbans.  
*Note:* The Khatuajhuri tiger moved into Bangladesh and its home range covered the entire Island of Talpati. It was possible to track this tiger due to the satellite link of its collar.

**Table 1:** Home Ranges of Radio-collared Tigers (n = 4)

Individuals	Total Fixes	95% Fixed kernel (km <sup>2</sup> )	100% MCP (km <sup>2</sup> )
Sonaga Female	454	474.9	335.8
Netidhopani Male	680	116	207.1
Dhubni Male	122	75.3	92.9
Khatuajhuri Male	929	156.3	120.5
Average		205.6	189.1
SE		45.6	54.6

Due to the difficulty of walking in the mangrove forests and locating game trails for setting camera traps, camera traps had to be deployed in a systematic grid based approach used across India. Instead, camera traps were set up at strategic locations, near fresh and brackish water ponds, using attractants to lure tigers to our camera stations. Fishing nets were used to orient the approaching tigers to get proper flank photographs for uniquely identifying each tiger from its stripe patterns. Estimation of tiger population has been done in a mark re-capture framework with closed population estimators in an area of about 200 km<sup>2</sup>. This setup allowed us to estimate population size reliably. But due to the small number of camera stations (12) and uneven geographical spread of camera traps, it was not possible to obtain a reliable estimate of mean maximum distance (MMDM) moved by recaptured tigers nor use the spatially explicit models (Efford *et al.* 2009) effectively. Models estimating effective trapping area attempt to estimate home range radius either by estimating MMDM or through centers of activity, in the case of the Sundarbans we had direct estimates of home ranges based on telemetry data. Therefore used home range radius from 95% fixed kernel area estimates of tiger home ranges were used as a buffer to the camera trap polygon for estimating effectively trapped area. The telemetry data suggested that though tigers do cross wide channels, crossing of channels >1 km in width was rare. Therefore a habitat mask was used wherein channels >1km in width were considered barriers to movement over the short term duration of the camera trapping exercise.

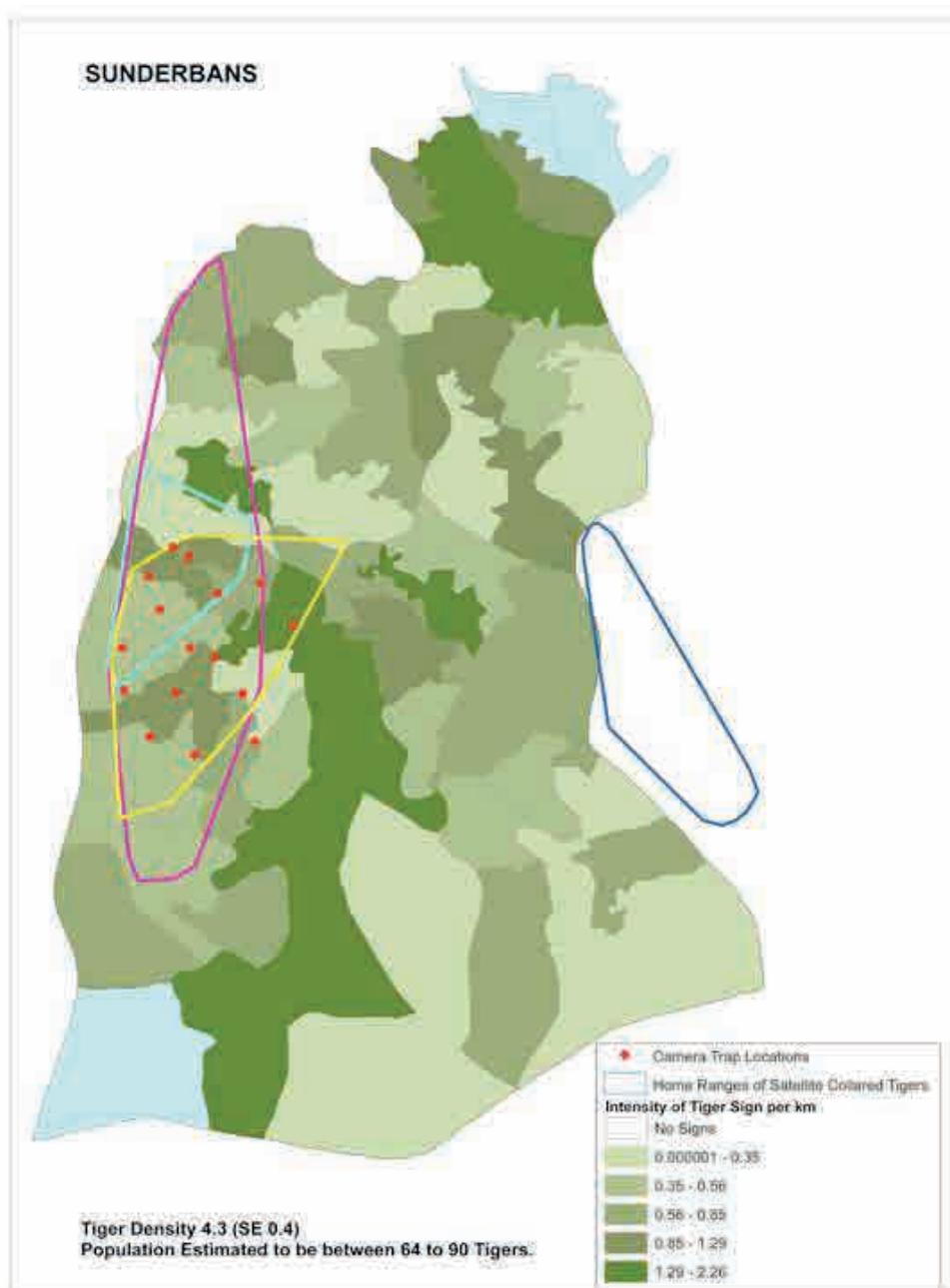
Ten adult tigers and two cubs were photo-captured. The best model selected by CAPTURE was model Mh (incorporating individual heterogeneity) and the population estimate was 11 (se 3) tigers. The home range radius of four satellite-radio tagged tigers was 6 km and was used to calculate the buffer width around the camera trapped polygon, giving an area of 438 km<sup>2</sup>. After applying a habitat mask bounded by channels >1 km the effectively camera trapped area was 257 km<sup>2</sup>. Tiger density was computed to be 4.3 (se 0.3) tiger per 100 km<sup>2</sup>.



**Figure 2:** Map showing the camera trapped study area with (A) Camera Trapped area buffered by the Home Range Radius; (B) Habitat mask defined by channels > 1km width; (C) Effectively camera trapped area (257 km<sup>2</sup>)

Since tiger occupied area of the Sundarbans Tiger Reserve was 1645 km<sup>2</sup> and the tiger signs were found throughout this area with a similar variation across the Tiger Reserve as found within the camera trapped area, it would be possible to extrapolate this tiger density across the reserve without much loss of accuracy. Ideally, 2-4 additional camera trap replicate areas need to be sampled and additional data from radio collared tigers are needed to provide more accurate and precise estimates of tiger density. But till these are obtained, this first quantitative assessment estimates the number of tigers to be around 70 (64 to 90) tigers for the Sundarbans Tiger Reserve (in 1645 km<sup>2</sup>).

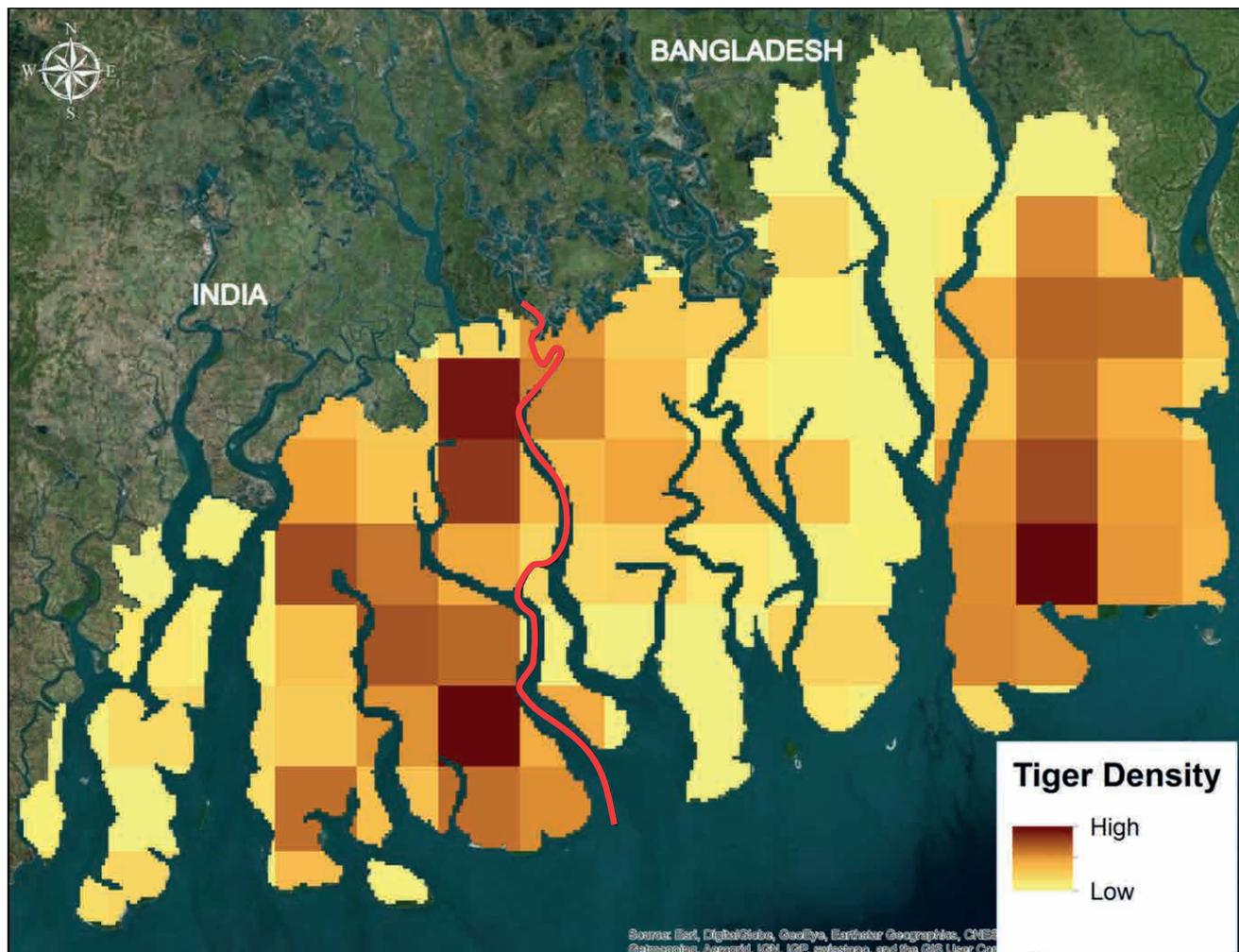
The Principal Chief Conservator of Forests has communicated to NTCA through their letter No. DO No. 12119/CS/2M-22/09(Pt.II) Dated 30-03-2011, that they were not satisfied with the methodology used for population estimation of the Sundarbans tigers. Further refinement in methodology, involvement of other institutions is needed and mention must be made that the 2010 estimate is subject to further study and by better methodology.



**Figure 3:** Map showing Tiger occupancy, home ranges of radio-collared tigers and camera trapped area in the Sundarban Tiger Reserve.

### All India Tiger Monitoring exercise 2014

The information on the encounter rates Tiger and its prey base obtained from the camera trapping exercise conducted as a part of All India Tiger Estimation, 2014, has been used to prepare maps in GIS Domain to get the spatial distribution of the key species of Sundarban Tiger Reserve. Maps of distribution of key species Sundarban Tiger Reserve is given below.



**Figure 4:** Tiger density across Sundarban obtained from camera trap based spatially explicit capture recapture and covariate based regression model (Jhala et al. 2016)

#### Distribution of tigers within tiger reserve according to 2014 census:

Name	No. of days sampled	No. of camera locations	No. of individuals captured (Mt+1)	Bounding polygon area (sq. km.)	Model with lowest AIC values in secr	Density (SE) in tigers/100 sq.km.	g0 estimate (SE)	$\sigma$ (SE) estimate in km.
Block IV(Basirhat)	31	56	14	325.4	D(.)g0(bk) $\sigma(.)$	3.43(0.99)	0.01 (0.003)	3.07 (0.41)
Block V (Ramganga)	36	30	5	228.76	D(.)g0(.) $\sigma(.)$	1.57(0.74)	0.01 (0.004)	9.06 (1.87)
Block VI (East)	31	60	20	485.45	D(.)g0(bk) $\sigma(.)$	3.77 (1.03)	0.003 (0.001)	5.84 (1.17)
Block VII (West)	32	76	14	420.33	D(.)g0(bk) $\sigma(h2)$	3.15(0.88)	0.04 (0.007)	$\sigma_1 = 1.89 (0.21)$ , $\sigma_2 = 4.24 (0.43)$ , pmix = 0.71 (0.10)
Block VIII (Sajnekhali)	23	40	14	188.51	D(.)g0(bk) $\sigma(h2)$	4.79(1.31)	0.04 (0.007)	$\sigma_1 = 1.89 (0.21)$ , $\sigma_2 = 4.24 (0.43)$

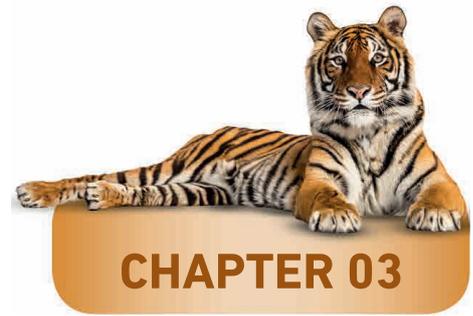
**Minimum Number of Tigers Captured During Camera trapping Exercise, 2012-13 onwards, in Sundarban Landscape**

Year	Minimum No. of Adult Individual	Minimum No. of cubs	Total	Remarks
2012-13	89	2	91	Survey carried out in the entire Sundarban Landscape in collaboration with WWF
2013-14	62	–	62	Based on All India Tiger Estimation Report, 2014. Survey Carried out at Sundarban Tiger Reserve Division and Ramganga Range of 24 Parganas (South) Forest Division
2014-15	31	7	38	Survey carried out at 24 Parganas (South) Forest Division and Basirhat Range of Sundarban Tiger Reserve Division, in collaboration with WWF
2015-16	81	4	85	Survey carried out in the entire Sundarban Landscape in collaboration with WWF
2016-17	87	4	91	Survey carried out in the entire Sundarban Landscape

**CAMERA TRAPPING EXERCISE IN SUNDARBAN TIGER RESERVE**



# History of Past Management and Present Practices



## 3.1 CONSERVATION AND FOREST MANAGEMENT HISTORY

Between 321-226 BC the Mauryan Empire created a Department of Forest Products headed by an official called a “*kupyadhyaksta*”. This department supervised the use of eight forest divisions called “*gaja-vanas*” or “elephant forests”, classified with respect to their intended use: (1) religious, (2) supply of general forest produce, (3) grazing for royal elephants, (4) royal hunting ground and (5) public hunting ground. The Sundarbans was part of the Angireya-vana, which included forests from North and South Bengal (Farooque 1997; Iftekhar and Islam 2004a). New regulations were enacted during the Gupta dynasty (320-415 AD), after which forest management declined and extensive tracts of land were cleared for agriculture (Farooque 1997). From 1204-1575, the Sundarbans was ruled by the Indo-Turkish sultans. During this period, land reclamation was catalyzed by Islamic holy men called “*pirs*”, including Khan Jahan, Mubarra Ghazi, Zindah Gazi, Mehr Ali and Umar Shar.

During the Mughal Empire, which reigned from 1575 to 1765, newly reclaimed land was encompassed into management. This land was catalogued as administrative units called “*pargana*”, recognized as capable of producing revenue. The first *pargana* in the Sundarbans area (Ambarabad, 175 square miles) was established in 1734. From the 15th to 18th Centuries, the administration of the Sundarbans became increasingly complex, with plots of land “*ta’alluq*” owned by “*ta’allug-dar*”. The *ta’allug-dar* let out subplots for clearing, and supplied revenue to “*zamindars*”, who passed on a portion of their earnings to the government.

This land tenure system continued to develop when the East India Company took over administration of the 24 parganas area, and then into the period of formal British colonial rule, which started in 1757. The British conducted the first survey of the Sundarbans from 1769 to 1773, took over rights to the area in 1828, and started leasing out land for further clearance in 1830. The rate of forest clearance then increased until the formulation of the Forest Act in 1855. At one stage, reclamation grants were suspended and the forest was leased to the Port Canning Company, but this decision was later revoked because the company treated the traditional forest users badly.

The first management plan for the Sundarbans, formulated in 1871, was designed to regulate harvesting of *sundri*. Under the earlier recommendation of a Conservator of Forests in Burma, and in line with the Forest Act of 1855, some parts of the Sundarbans were declared as reserved forest in 1878. The boundary of the protected area has been subsequently re-plotted several times in response to an ever shrinking forest. The most comprehensive plan, in the early 1900s, delineated the Sundarbans into management units called compartments, to be periodically harvested and monitored by a complex system that relied upon estimation of tree composition and standing crop in each area (Curtis 1933).

After gaining independence from the British rule in 1947, and administration of the Sundarbans was split between India and East Pakistan. Bangladesh was subsequently created in 1971 after a war of independence with Pakistan. A series of management plans subsequently evolved to update the harvesting strategies of an increasing number of forest

products (Heinig 1892; Lloyd 1904; Trafford 1911; Curtis 1933; Choudhury 1937; Roy Chaudhary 1948, Lahiri 1973 and the Field Directors subsequently.

The whole area in 24-Parganas District was declared first as protected forests following the efforts of Mr. A.L.Home, DCF, Dr. Schlich and Sir Richard Temple by a notification dated 7th December 1878 and the boundaries of the remaining protected forests were fixed by the notification No.4457-For dated 9th April 1926. The protected forests in the Basirhat Sub-Division of the District (the present Basirhat Range in Tiger Reserve area) were constituted as Reserve Forests as per Govt. Notification No. 15340-For. dated 9th August, 1928. Due to fresh colonization in the Mahisani and Patibania islands a further exclusion was made from the above mentioned protected forests under notification Nos. 1024-For. dated the 20th August, 1935 and 5174-For. dated the 2nd May, 1939. The residual protected forests (Namkhana Range) were finally declared as Reserved Forests under notification No. 7737-For., dated the 29th May, 1943, with the result that the whole of the existing forests of the Division is now reserved. The Indian Forest Act 1927 prohibits or otherwise restricts the carrying of guns, cattle grazing, tree cutting, removal of forest produce, or land clearance. Within the reserved forest there are neither villages nor any agricultural land. There is one sanctuary within the Tiger Reserve area viz., ‘**Sajnekhali Wildlife Sanctuary**’ covering an area of 362.335 sq. k.m. vide notification No.5396-For., dated 24.6.76 and the ‘**Sundarbans National Park**’ covering an area of 1330.10 sq. k.m. This was finally declared as a National Park u/s 35(3) of Indian Wild Life (Protection) Act, 1972 vide Govt. Notification No. 2867-For, dated 4,5.1984. Considering the importance of this biogeographic region of Bengalian River Forests, the National Park area of Sundarban Tiger Reserve had been included in the list of the World Heritage Sites in 1985. The whole Sundarban region including the protected area of Sundarban Tiger Reserve was declared as Biosphere Reserve on 29th March, 1989 with the broad objective of:

1. Conservation of its ecosystem and the genetic diversities.
2. Promotion of basic and applied research works and its monitoring.
3. Dissemination of experience for education and training.

### 3.1.1 Past System of Management of Forests

Management practices of the forests in Sundarbans evolved with the increasing pressure on the Sundarbans for meeting the demand for agricultural land and forest produces. The settlements started more than 200 years ago with clearing of forests and construction of embankments to stop the ingress of tidal water. The population, inspite of problems of communication, shortage of drinking water, irrigation facilities and maintenance of embankments and dykes kept on growing. The Working and or Management Plans of the Sundarbans reflect the change in management objectives with the increase of population pressure in these area, because of the changed mindset wherein the forest were not thought to be an inexhaustible resource. With the gradual change in quality of the forest along with the steady decrease in area, led the conservationists to realise the conservation values of these mangrove forests and consecutive Management Plans/ Schemes put restriction and regulation for the use of the forest products.

The current Management plan from 2000 to 2010 is the third Management Plan written for the area. The changes in the observations and objectives of the previous Working/ Management Plans/ Schemes have been analysed below:

Sl. No.	Period	Working/ Management Plan/Scheme	Observations	Prescriptions
1.	1863-1869	Dr. Brandis (Anon., 1952)	Forests are valuable resource for revenue generation by the Government.	The Port Canning Land Reclamation and Rehabilitation Private Company was given the lease to collected toll from 24 forest blocks from the forest produce.
2.	1871-1872	A. L. Home (Anon., 1952)	Forests were dense, impenetrable and with undergrowth primarily of <i>Cerriops</i> . Each square mile of forest could produce 700 quintals of serviceable timber.	Government took over the lease in 1869 and started collecting the revenue from the forest produce.

Contd.



Sl. No.	Period	Working/ Management Plan/Scheme	Observations	Prescriptions
3.	1873-1874	Sir R. Temple & Dr. S. Schlich (Anon., 1952)	Forests had 40 different species of trees and herbs. <i>Heritiera fomes</i> the most economically valuable species was confined to the north - eastern corner and in the areas farthest from the sea. Forests adjoining rivers got depleted and no good quality forest remained due to unregulated felling.	<i>Heritiera fomes</i> required protection and in 1878 forests were declared protected. In 1879 a Forest Division was established for the protection of forest.
4.	1893-1903	Heining (1893)	Indiscriminate felling was depleting the forest with <i>Heritiera fomes</i> being the most affected species, especially in the present Bangladesh areas due to relatively high population pressure.	The Annual Coups were established in Bangladesh part of Sundarbans. Felling girth limit of <i>Heritiera fomes</i> was restricted to > 90 cm.
5.	1903-1908	Lloyd's Working Scheme (Anon., 1952)	Forests were found to be under increased anthropogenic pressure, for which stringent transportation rules and silviculture practices need to be implemented.	Rules were prescribed for felling of <i>Heritiera fomes</i> , <i>Sonneratia</i> spp. and <i>Xylocarpus mekongensis</i> in 24 Parganas District. Staff strength was increased and patrolling was intensified.
6.	1906-1912	Farrington's Working Scheme (Anon., 1952)	Forests were found to be under increased anthropogenic pressure, for which stringent transportation rules and silviculture practices need to be implemented.	Felling girth for <i>Heritiera fomes</i> was raised to 105 cm and Government Hammer marks were prescribed prior to felling. In the 24 Parganas District the felling of <i>Amoora sp.</i> , <i>Bruguiera sp.</i> , <i>Heritiera fomes</i> , <i>Sonneratia</i> spp. and <i>Xylocarpus mekongensis</i> were prohibited. The rules to control the transport of forest produce was introduced vide Notification No.- 2821-For, 8 <sup>th</sup> November, 1906.
7.	1912-1932	Trafford's Working Plan (1912)	A single Management Practice cannot be applicable for the entire Sundarbans. Based on salinity 2 circles as western with more salinity (Indian part) and eastern with less salinity having fresh water (Bangladesh part) required to be designated.	In the western circle the felling girth were restricted for <i>Amoora sp.</i> (60 cm), <i>Bruguiera sp.</i> (60 cm), <i>Heritiera fomes</i> (105 cm), <i>Sonneratia</i> spp. (120 cm) and <i>Xylocarpus mekongensis</i> (60 cm). In both the circles 5 felling blocks were laid which were to be worked on rotation for extraction of fuel.
8.	1930-1959	Curtis, 1933	The forest of Basirhat range was already declared as Reserve Forest by Government Notification for scientific conservation. So the rest of Sundarbans located west of Matla river required stringent legal control against illegal felling. The growth pattern of species was found to be zone specific. The Forest Administration required decentralization and delegation of powers.	The forest in the west of Matla river was declared as Reserve Forest in 1946, viz., 2 Ranges - Basirhat, and Western and 3 Working Circles were established. The felling series were fixed based on species requirement, viz., 40 yrs for <i>Avicennia</i> spp. and 20 yrs for <i>Sonneratia</i> spp. The felling girth for different species were fixed based on the block in which they were found. For meeting the fuel requirement felling of <i>Ceriops tagal</i> , <i>C. decandra</i> and <i>Aegiceras majus</i> were allowed.
9.	1937-1951	Chaudhuri, S. Working Scheme (Anon., 1952)	Silviculture system of the forest had to be Block specific.	The forests were felled as per Selection - cum - Thinning Silviculture System. The yield was fixed by area on a felling cycle of 20 years. Only 2 felling series were created in the Indian Part of Sundarbans - at Basirhat and Namkhana. Fuel woods and leaves of <i>Nypa fruticans</i> collection were allowed.
10.	1949-1959	Roy Chowdhury (Anon., 1952) Working Plan (The First Working Plan for 24 Parganas Forest Division, Southern Circle)	Ongoing Silviculture system needed change since the forest during that time was observed to be of poor stock and growth and demand for quite a number of species had increased manifold. Many gaps were noticed in the natural forest areas.	The forests were worked under Selection - cum - Improvement Felling System. Felling cycle was still 20 years and the area for felling was about 30,000 hectares, which was spread over 5 felling series. The exploitable DBH were fixed at - <i>Avicennia</i> spp. (12.5 cm), <i>Bruguiera</i> spp. (15 cm), <i>Excoecaria agallocha</i> (10 cm), <i>Heritiera fomes</i> (7.5 cm), <i>Xylocarpus granatum</i> (12.5), <i>X. mekongensis</i> (15 cm) and <i>Sonneratia</i> spp. (23.5 - 45.5 cm). Artificial regeneration and stocking were initiated.

Contd.

Sl. No.	Period	Working/ Management Plan/Scheme	Observations	Prescriptions
11.	1959-1973	Annual Working Schemes	Forests were under great pressure leading to habitat degradation of tiger. The problems accelerated due to Refugee Rehabilitation after partition of Sundarbans and 2 wars of 1965 and 1971.	The felling cycle continued to be of 20 years. Natural regeneration was encouraged. Revenue collection and transportation of timber was streamlined.
12.	1973-1979	1 <sup>st</sup> Management Plan Lahiri, R. K., (1973)	The loss of habitat of tigers was identified to be the most important leading to the destruction of the total ecosystem. Holistic treatment approach towards the conservation of the ecosystem was identified as priority area.	Project Tiger was launched in 1973 in the eastern parts of Matla river in an area 2,585 sq. km. The principle objective was to preserve the habitat of the wildlife to achieve optimum level of population of tiger and its prey base and along with other floral and faunal associations. Digging of fresh water ponds started.
13.	1979-1985	Annual Plans of Operation for the STR (by Field Director, STR)	Holistic approach towards the conservation of the ecosystem continued to remain the focal issue. It was identified that scientific research is needed to reduce tiger - human conflicts. Tiger and prey base poaching and habitat degradation continued alarmingly but poaching of crocodile and water monitor reduced to a large extent.	<i>Phoenix</i> permit was discontinued in 1980, felling was restricted in buffer areas, electric dummies were introduced in 1983 to study the human attacking behavior of the tiger. Farm bred crocodiles were released in the STR areas from 1984 onwards for restocking the crocodile population. Salinity studies along with climate monitoring were taken up.
14.	1986-1995 (extended till 2000)	2 <sup>nd</sup> Management Plan (by Field Director, STR)	Tiger - Human conflicts along with habitat degradation was identified as the main management problem. Scientific research specific to Sundarbans conditions was identified as a tool to tackle the problem along with intensive protection works. Afforestation with mangrove species was identified as a possible method for soil conservation and fulfilling the needs of the villagers. Afforestation in the village land with non mangrove species was identified as a solution for meeting the fodder and fuel requirements of the people. JFM was identified as an important management tool. Increasing pressure on forest demanded intensification of protection works. Eco tourism was identified as an important tool for management.	Human face masks were introduced in 1987. Felling had been restricted strictly in buffer areas in Khatuajhuri, Arbesi, Harinbhanga and Jhilla blocks. From 1991 - 1992 coupe working was restricted to fair weather conditions and rough weather coupe was discontinued. Annual prescriptions for felling of 1000 ha. Large scale afforestation with the mangrove species in the forest areas and mud flats and with non mangrove species in human habitation areas were taken up. Broadening participation from local people and NGO's, eco-development works were taken up which were need based and ecologically viable. JFMC's and JFMC's were formed in 1996. Surface camps were constructed in Dobanki and Chamta.
15.	2000-2010	3 <sup>rd</sup> Management Plan (by Field Director, STR)	GIS was identified as a management tool. The need for research, capacity building of staff and local people was identified. Emphasis was given on scientific research and ecological monitoring. Cross border problems were found to be a hindrance towards the management of this vulnerable ecosystem.	GIS data were updated, interpreted and were ultimately used in tackling management problems. Surface camps started functioning in Dobanki, Chamta and Khatuajhuri. Ecotourism facilities were developed in Dobanki and Burirdabri. Collaborative programs were taken up with a focus on common management policy with Bangladesh. Though this Plan also provided for felling of 1000 ha annually however, coupe felling was stopped from 2000 onwards.

SL No.	Management Aspect	Work Done
1	Protection	1. Construction of new protection camps at Kaksa (earlier a floating camp at Basirhat), Samsernagar Camp (Basirhat Range), Kendo Camp (National Park West Range), Chandkhali Camp (National Park East) 2. Developing Infrastructure of the existing protection camps: Electric connection at camps (SWLS) and Jhingekhali (Basirhat range); Construction of wireless control tower and its maintenance all over STR; Installation of Solar power plants including solar electrification system all over STR; Construction of raised tube-well and deep tubewell all over STR; Construction of Staff Barrack along with approach path at Rampura Range, Netidhopani (NPW range), Kanksa (BHT range), Chamta (NPE), Chandkhali (NPE); Construction of Jetty at Kanksa (BHT), Dobanki (SWLS), Gosaba (NPE), Chandkhali (NPE), Harikhali and Jhila (BHT); Construction of Watch Towers at Netidhopani and Sajnekhali, renovation at Haldibari
2	Human Wildlife Conflict Management	Maintenance of the existing nylon net fencing along the interface of forest and the fringe villages
3	Wildlife Management	Excavation of Sweet water ponds at Basirhat, Sajnekhali Wildlife Sanctuary Range, National Park West and National Park East Range

Table showing the work done as per the prescription of the previous TCP (2012-13 to 2016-17)

### 3.1.2 Harvesting of Timber and Firewood

Since inception of the Project Tiger scheme in 1973, the core area of the Tiger Reserve has been kept free from harvesting of timber, fuel-wood etc. Prior to that in areas falling within the present core area the forests were worked with the yield being regulated by area. Till 1994, there used to be two felling coupe operations, one in fair weather and another in rough weather. Since 1994, there has been only one coupe during fair weather that is from October to March. The yield calculation was done on the basis of area for annual operation of coupes and was not based on the mean annual increment of the crop. Average production of timber and fuel-wood was very high viz-a-vis the rest of the area. During the year 1981-82 when regular coupes were laid out in accordance with the prescription of first Management Plan of Sundarban Tiger Reserve, the annual yield on the basis of area was calculated as 2,930 ha. in the First Management Plan of Sundarban Tiger Reserve and in the Revised Management Plan, the yield was fixed at 2,484 ha. Yield of timber and fuel-wood from annual coupes since 1985-86 is given in the **Appendix 9**.

#### 3.1.2.1 Analysis of Felling Coupes in the STR

The Third Working Plan (Curtis, 1931) that divided Sundarban Forests into two felling series (Harinbhanga and Haldi felling series) pertains to the period between 1930-59 prior to the declaration of tiger reserve. The general felling cycle was fixed at 40 years, but for Keora (*Sonneratia*) and Bain (*Avicennia*) it was reduced to 20 years. Fellings were confined to the principal annual coupes only for the supply of timber and fuel. The exploitable diameters of Sundri, Genwa, Pasur, Dhundal, Kankra and Bain were fixed differently for different blocks to provide for the variations in the rates of growth in the blocks. All over the area mature and unsound trees were allowed to be removed from the annual coupes. Unregulated fellings were allowed in the coupe for Goran (*Ceriops decandra*), Math-Goran (*Ceriops tagal*), Singra (*Cynometra iripa*), Khalsi (*Aegiceras corniculatum*), Kirpa (*Lumnitzera racemosa*) and Tora (*Aegialitis rotundifolia*).

However in the working schemes of Chaudhuri from 1937-1941 (Anon., 1952) the entire forest division of 24 Parganas district were put under one working circle of the Selection cum Thinning system. The yield was fixed by area on a felling cycle of 20 years. The exploitable sizes of sundri, genwa, pasur, dhundal, keora, kankra and bain were fixed in Bashirhat felling series. The scheme appears to have worked satisfactorily. From the old records it is found that from 1963 to 74-75 the average area felled/year was 2500 ha to 3000 ha in Harinbhanga, Gona, Panchmukhani, Khatuajhuri, Bagmara, Chamta, Chandkhali, Mayadwip - 1 and 3 compartments. Felling was also done in Harinbhanga, Khatuajhuri, Arbesi and Jhilla compartments. From 1974-75 to 84-85 the area of felling were mainly confined to Arbesi, Jhilla, Netidhopani, Chandkhali, Harinbhanga and Khatuajhuri blocks but the major felling area was restricted to the buffer areas of STR. The total area of felling in 1975 - 76 was 15,913.01 ha which was the highest area in the last four decades.

Followed by felling area in the year 1974 -75 that was 9724.80 ha. However from 1985-86 to 1999-2000 the felling was restricted strictly to buffer area that is Khatuajhuri, Harinbhanga and Arbesi blocks. The felling area also was limited to 1000 ha from 1991-1992 onwards. It appears that over the period of time the emphasis was given on the habitat improvement and to preservation of the fodder species like Keora and timber species like Pasur, Dhundul, Kankra and Sundari which were dwindling fast. As per MOE&F, GOI Correspondence No.9-89/FCE, 01.03.2000 (Anon., 2001) felling is subject to prescription chalked out by the Ministry which incorporates estimation of felled volume and checks against over exploitation and maintenance of sample plots for gathering data on growth and bio-diversity including the assured regeneration in the felled area. **The timber coupes were all together stopped from the year 2000 onwards.**

### 3.1.3 Extraction of Non-timber Forest Produce

Honey, Bees-wax, Golpata, Hental etc. are the minor forest produces which were usually collected by the outsiders annually during the short periods for which permit were issued. Golpata collection has however, been stopped since 1978. Extraction of Hental had also been gradually reduced and discontinued since 1991. Presently, only honey collection is permitted in the buffer area. Permits are given to collect honey at a fixed tariff per kg. which is fixed in consultation with the West Bengal Forest Development Corporation Ltd. to whom all the collected honey is finally handed over. Previously, the crude honey used to be supplied to 24-Parganas Division for filtering and processing in their unit but subsequently since 1995-96 the processing unit has been transferred to West Bengal Forest Development Corporation for processing of crude honey and its marketing.

### 3.1.4 Fishing

Since creation of Sundarban Tiger Reserve fishing is not allowed in the core area. Buffer zone except Sajnekhali Wildlife Sanctuary is open for fishing in case of registered permit-holders. However, a number of fishermen and crab collectors try to enter the restricted area for fish and crab collection.

## 3.2 PROTECTION OF TIGER, ITS PREY AND HABITAT

The northern boundary of Sundarban Tiger Reserve is constituted by the fringe villages where a large portion of the human population is dependent upon fishing. More than 50% of the population is land less and belongs to weaker section of the society having a high natural resource dependency. The Sundarban Tiger Reserve has a common boundary of approximately 20 km with the Bangladesh Sundarbans. This boundary is very porous and there is periodic intrusion by Bangladeshi Nationals who indulge in timber smuggling, poaching of tigers, deer and other animals. The southern side of Sundarbans opens up in the Bay of Bengal.

Presently, protection is carried out by means of patrolling the area using watercrafts which include dingi boats, mechanized boats, speed boats and launches. Patrolling is carried out regularly both at day and night and by the field staff and officers. Apart from this field based camps are located at strategic points both inside the forest and in the fringe areas. These camps are both land based and floating. These floating camps are mobile in nature and have their designated area of operation. The entire area is well connected by means of RT network. There are RT(wireless) sets at all camps in addition the patrolling teams also have mobile RT handsets. The staff is also equipped with firearms. Foot patrolling is restricted to certain areas owing to staff safety issues. Tiger guards have been provided to all field staff for wearing at the time of foot patrolling.



In addition to the above tiger monitoring is carried out in the last fortnight of every month. This gives an indication of the tiger movement in the area. Wildlife monitoring is a part of the everyday patrolling duties where the staff records the wildlife sightings which are then compiled on a monthly basis.

From time to time raids are also carried out in the neighbouring villages based on secret information. Joint patrolling with the neighbouring Division and BSF also form part of the security drill.

### Daily Tiger Monitoring data entry format

**Sundarban Tiger Reserve  
Tiger Monitoring Report  
(From.....To.....)**

Sl No.	Date	Time	Whether seen or not		Whether roared or not		Whether fresh pugmark or not		Location (including Block No.)	Name of Range (including Beat/ Camp)	By whom Seen/ Detected	Remarks, if any
			Adult	Cub			Adult	Cub				

Year 2017								
Division	Month	Direct Sighting		Pugmark		Roared	Strayed	Detected By
		Adult	Cub	Adult	Cub			
	January	18	2	94	0	2	0	Staff
	February	14	0	35	0	2	0	Staff
	March	5	0	36	0	1	0	Staff
	April	15	0	26	0	0	0	Staff
Sundarban	May	21	0	43	0	0	0	Staff
Tiger	June	16	0	18	0	1	0	Staff
Reserve	July	9	0	13	0	3	0	Staff
	August	9	0	27	0	2	0	Staff
	September	6	0	34	0	0	0	Staff
	October	11	1	43	0	5	0	Staff
	November	19	0	95	0	3	0	Staff
	December	28	0	116	0	2	0	Staff
	<b>Total</b>	171	3	580	0	21	0	



Sundarban is a unique landscape and the zone of influence is restricted due to the presence of various river channels and creeks. Also there are no villages inside the Tiger Reserve. So, there are neither any encroachment nor any enclave villages and the problems associated with this Reserve. There was only one illegal settlement in the Jhilla block known as Marichjhapi, which was removed in 1975-76 by the special police operation. Most of the people living in these fringe villages who come under direct zone of influence are from the weaker section of the society and majority of them are land less labourers. Most of the area falls under Choto Mollakhali coastal PS and under Gosaba P.S. The entire length of this interface zone is about 65 km. These villages are situated under direct zone of influence and within 5 km from the boundary of the Reserve area.

SI No	Block	Compartment	Area(in square km)	Legal Status
1	Arbesi	1-2	84.04	RF
2	Jhila	1-5	95.367	RF
3	Panchamukhani	1-2	52.298	RF
4	Pirkhali	1-2,4-5	113.029	RF

Agriculture is the mainstay of the economy with 75% of the human population directly or indirectly depending on it. The agricultural land holdings are mostly small and marginal. Paddy is the main crop and is planted as aman( June – Oct), boro(Dec-mid March) and aus (mid March –May) crops in winter, rains and summer respectively. Apart from paddy lentils, chillies, vegetables, and water melons are also grown in the area. Chemical fertilisers are used indiscriminately and these are washed off as surface runoff into the mangrove ecosystem. The agriculture is mainly rain fed. Few years back only one crop was taken by the villagers in the absence of proper irrigation facilities. However, over the years the forest department has re excavated a number of irrigation canals and sweet water ponds which act as water harvesting structures and have enabled the farmers to take at least two crops instead of one. Each such irrigation channel or canal ie one km long has been estimated to irrigate an area of 25-30 ha. Also, in winters it is seen that strayed out tigers often take shelter in the uncut paddy fields.

Ecotourism is another industry which is coming up quite rapidly in the area. The unique mangrove tiger land of Sundarban criss-crossed by a network of streams and creeks is always fascinating to the visitors for its scenic beauty and thrill of sighting the “Royal Bengal Tiger”. Since inception of Tiger Reserve, craze for visit to Sundarban gradually increased and these had been sharp rise in the tourist flow in Sundarbans. No. of tourists who have visited Sundarbans in last ten years has risen exponentially. In view of the interest of tourists, Department of tourism, Govt. of West Bengal has set up a tourist lodge at Sajnekhali to provide accommodation facilities for the tourists. In May 1996, Zillaparishad 24-Parganas (North) has created accommodation facilities at Hemnagar close to the northern boundary of Sundarban Tiger Reserve keeping tourists interest in mind. The Zilla Parishad of 24-Parganas (S) has also developed an accommodation facility at Pakhiralaya opposite to Sajnekhali to cater to the needs of the tourists.

In the last couple of years, a large number of tourist lodges have come up on the boundary of the Tiger Reserve in the absence of any guideline restricting these constructions. Most of these lodges are located in Gosaba and Satjelia islands. Most of these lodges have no means of proper garbage and sewage disposal. Most of the garbage is dumped in open pits on the side of the river banks. During high tides much of this non degradable waste is transported by the tidal waters into the mangrove ecosystem.

The entry of the tourists is however, restricted only within the specified ecotourism zone on realization of entry fees. Traditionally the Tiger Reserve is open for tourists throughout the year because it does not disrupt the breeding of animals and there are no issues of movement of boats along the creeks. Entry within the core area which is also a National Park is strictly prohibited for the outsiders except for scientific research and Officials on duty with, prior permission of Chief Wildlife Warden and/ Field Director. Apart from this there are no major industries in the area.



**Figure 1:** Map showing the zone of Influence of STR

**INDEX**

- International Boundary
- District Boundary
- Block Boundary
- Village/Mouza Boundary (with J.L.No)
- \* Block HQ
- Other Road
- Embankment Cum Road

**Built Up Area**

- Rural Settlement

**Agricultural Land**

- Single Crop
- More Than One Crop (Kharif-subject to Flood / Water logging)
- Aquaculture

**Forest**

- Notified Forest Area (As per SOI Toposheet 1970's)
- Mangrove-Dense
- Mangrove-Open
- Plantation (Mangrove)
- Mud Flat within Forest Boundary
- Aquaculture within Forest Boundary

**Wetlands**

- Mud Flat

**Waterbodies**

- River
- Stream/Canal

**LAND USE MAP OF STR AND ADJOINING VILLAGES**

NORTH 24 PARGANAS DISTRICT



### 3.5 RESEARCH, MONITORING AND WILDLIFE HEALTH

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The Sundarban mangrove eco-system provides conditions for collection of uninterrupted research data for interdisciplinary research programme involving natural and social sciences. The zones of lesser interference provide scope for monitoring the changes in both physical as well as biological components. However, research is one of the weak areas of the Sundarban Tiger Reserve.

Among the studies carried out are the preliminary floral survey had been conducted jointly by Sundarban Tiger Reserve and Botanical Survey of India which has set up a research station at Canning. For study of edaphic changes in Sundarban area, Soil Saline Research Institute has also established a station at Canning. Hatching of Olive Ridley turtle and Northern river terrapin which was done at Sajnekhali in the past has been stopped and in its place in situ conservation is being carried out. Under Biosphere programme a research sub-committee has also been formed which co-ordinates and monitors the research activities relating to Sundarbans by all the Institutes, Organisations, Government Departments and Universities.

Outside the Tiger Reserve also, there are a number of institutions which are engaged in carrying out studies on the mangrove ecosystem. These include a station of Central Inland Fisheries Institute station at Kakdwip on the western side. An estuarine crocodile breeding centre at Bhagabatpur where artificial hatching of estuarine crocodile and Olive Ridley Turtle has been standardized since 1976. A research laboratory at Namkhana which facilitates researchers and scholars in their field study. Lothian island Sanctuary which is an representative area of the entire mangrove ecosystem has been used for carrying out studies on biodiversity of the area.

Though, there is a research unit in Sundarban Tiger Reserve which in the past was active and from time to time carried out different activities related to monitoring of salinity and seasonal variation, artificial hatching and breeding biology of River Terrapin and Olive Ridley turtle, factors associated with man eating and tiger straying, estimate of population of major faunal spp. including tiger and its prey-base, local migration of tiger and other major fauna, change of vegetation-consociation, as well as nature of migration of avifauna. At present, the Range has been lying vacant in the absence of a designated Research Officer and a dedicated research Range Officer. Details of the different research carried out have been given in.

#### List of Research Activities in Sundarban Tiger Reserve

- 1874 On two new species of Heriteria
- 1893 Blind Root Suckers of Sundarbans
- 1958 Symposium on Mangrove Vegetation
- 1960 The genus Bruguiera in the Sundribans
- 1963 The Genus Phoenix Linn. In India.
- 1963 On the Distribution, structure and ontogeny of stone cells in *Avicennia officinalis*.
- 1965 Sundarbans
- 1972 Some Observations on the Macrovegetation in and around Bheris of Sundarbans, West Bengal.
- 1974 Main Characteristics of Indian Mangrove
- 1975 The Mangrove of India
- 1976 A Note on the Halophytes in India.
- 1978 Mangroves of Sundarbans, India
- 1979 The Genus Bruguiera Lamk. (Rhizophoraceae) in India.





**Figure 2:** The Core or the Critical Tiger Habitat of the Tiger Reserve has been identified as the zone of lesser interference

- 1981 Photosynthesis in Mangroves.
- 1981 Structural Variability and Biomass Production of Mangroves in Lothian Island of Sundarbans, India.
- 1982 Sundarbans the World Famous Mangrove Forests of the Districts 24 Parganas in West Bengal (India)
- 1983 Halophytes and their Unique Adaptations on the Sundarbans Mangrove Swamps in India
- 1983 An Eco-Taxonomical Studies of the Typical Halophytic Flora of Sundarbans in the District 24 pgs, West Bengal with Special Reference to their Socio-Economic Impact.
- 1983 Comparative Studies of Stomata in some Halophytes, Cultivated Rice and Rice Mutants in Relation to Salt Resistance
- 1984 Potentiality of compost made of leaves of the plant *Avicennia officinalis* and straw mulch for coastal pond fertilization.
- 1984 Importance of Mangroves - Raw Material Function and Role in Environment.
- 1984 Mangrove wealth of Indian Sundarbans - Utilisation and Conservation.
- 1985 Litter Production in Mangrove Forests. Lothian Island, Sundarbans, West Bengal.
- 1986 Preliminary Studies of Artificial Regeneration Of Mangrove Forests in Sundarbans, West Bengal.
- 1986 Adaptations in Mangroves of Sundarbans.
- 1986 Role of *Avicennia L.* Plantation on the Brackish Water Fisheries with Special Reference to Their Taxonomy and Ecological Note in the Tidal Mangrove Forests of Sundarbans.
- 1986 On the Verge of Extinction of Some Important Mangrove Species from the Sundarbans Delta in West Bengal
- 1986 Some observations on Abnormal Adaptations of Mangrove in Indian Sundarbans
- 1986 Comparative Study of Mangrove of Sundarbans and that of the Mahanadi Delta in eastern India.
- 1987 Mangrove Ecology of the Sundarbans Delta in West Bengal and its Role on the Brackishwater Fisheries.
- 1987 Sundarbans Mangroves of India-A Study on Conservation Status.
- 1987 Sundarbans Mangroves Biomass Productivity and Resources Utilisation on Mangroves- An in Depth Study.
- 1988 Maintenance of Leaf Temperature and the Optimisation of Carbon Gain in Relation to Water Loss in A Tropical Mangrove Forest.
- 1988 Economic Potentialities of the Tidal Mangrove Forests of Sundarbans in India
- 1988 Ecological Studies of the Mangrove Flora of Bhagabatpur (Sunderbans)
- 1990 Pollen Morphology of Some Mangrove Plants of Sundarbans, West Bengal.
- 1990 Mangrove Litter Production in a Tidal Creek of Lothian Island of Sundarbans, India.
- 1990 Artificial Regeneration of *Sonneratia apetala* (Buch-Ham) in Sundarbans, West Bengal.
- 1991 Productivity of Grass *Porteresia coarctata* in Mangrove Forest of Sundarbans.
- 1991 Succession of the different Species of *Sonneratia L f.* in the Sundarbans Mangrove Ecosystems.
- 1991 Aerial Seedling in Mangrove Swamps.
- 1991 Mangrove Ecosystems in the Indian Sub-Continent with Special Reference to the Sundarbans, W.B.
- 1991 Biomass Production of Mangrove Plantation in Sundarbans, West Bengal (India) - A Case Study.
- 1991 Studies on the Size, Viability and Germination of Seeds of Sundri (*Heritiera fomes Buch. - Ham.*)
- 1992 Mangrove Afforestation in the Sundarbans
- 1993 Morphology of Stomata and Leaf hairs of Some Halophytes from Sundarbans, West Bengal.



- 1993 Strategies for Plant Adaptation in Saline Habitats -I : Foliar Anatomical Changes
- 1994 Chemical-Induced Rooting in Hypocotyls of *Rhizophora mucronata*.
- 1994 Rooting of Stem Cuttings of *Avicennia officinalis* Linn. and *Avicennia alba* Bl. A Tool for Afforestation of banks in Mangrove Forest.
- 1994 Preliminary Observation on Control of Slumping through Mangrove Afforestation at Nayachara, West Bengal (India) - A Case Study.
- 1994 Mangroves of the Sundarbans
- 1995 Metabolic Changes during Rooting in Stem Cutting of Five Mangrove Species.
- 1995 Soil based Recommendations for Mangrove Plantations in Sundarbans, West Bengal.
- 1995 Leaf Anatomy and Chlorophyll Estimates in Some Mangroves.
- 1995 Vegetative Propagation through Air-Layering in Two Species of Mangroves.
- 1995 On Distributional Record of *Scyphiphora hydrophyllacea* Gaertn.f. and *Atalantia correa* M. Roem. from the Intertidal Mangrove Forests of the Indian Sundarbans
- 1995 Vegetation Analysis of Restored and Natural Mangrove Forest in Sagar Island, Sundarbans, East Coast of India.
- 1995 Structural Characteristics of Vessel Elements in Stems of Some Mangroves
- 1996 Anatomy of Leaves of Some Mangroves and Their Associates from Sundarbans, West Bengal.
- 1996 Effect of Plant Growth Regulators on Rooting of *Heritiera fomes* Buch.-Ham.
- 1996 Economic Importance of the Dominant Mangrove Family Rhizophoraceae from the Sundarban Delta of 24-Parganas Districts, West Bengal.
- 1997 Development of Stomata and Leaf Hair in Some Mangroves.
- 1997 Investigation on Seedling Development, vis-a-vis, Plantation of *Heritiera fomes* Buch.-Ham. Beyond the Intertidal Non-Saline Zones
- 1997 Some Fish Poisonous Plants from the Sundarbans Mangrove Ecosystem
- 1997 Sundarban Mangrove Environment
- 1997 Sundri mortality in Sundarbans.
- 1997 Reproductive Biology of Three Mangrove Plant Species.
- 1998 Studies on the Mangroves Patch at Subarnarekha River Mouth of Orissa State.
- 1999 Mangroves and Other Phanerogams Growing at Nayachar, Haldia, Midnapore, West Bengal
- 1999 Scope and Possibilities of Test Tube Mangrove Forests by Tissue Culture.
- 1999 An Adaptive Feature of Some Mangroves of Sundarbans, West Bengal.
- 1999 Major Inorganic Elements in the Leaves of Some Mangroves from Sundarbans (West Bengal) and Bhitarkanika (Orissa) - A Comparative Approach.
- 1999 Structural Characteristics of Vessel Elements in Stems of Some Mangroves of Sundarbans with Special Reference to Habitat.
- 1999 Ecodynamics and Importance of Mangroves in Sustaining the Coastal Fisheries and Aquatic Biodiversity.
- 1999 Status of the Mangroves in Indian Sundarbans - In the Perspectives of India and World Mangals.
- 1999 Mangrove Ecosystems in the Indian Sub-Continent
- 1999 The Sundarbans Mangrove Forests in India and their Ecological Stresses

- 1999 Floral Diversity of Mangal of the Indian Sundarbans - Highlighting Distribution and Status of the Different Mangrove Species
- 1999 Physiography of Mangrove Swamps - A study in the Sundarbans (West Bengal Portion).
- 1999 Salinity Induced Changes in Growth and Mineral Constituents of *Acanthus ilicifolius* L. A Halophyte.
- 1999 Nutrient Status of Different Mangrove Species and Different Mangrove Zones of the Indian Sundarbans
- 1999 Studies on the Utilities of Saline Resistant Wild-Rice, *Porteresia coarctata* (Roxb.) Takeoka from the Newly Silted up River Flats of Indian Sundarbans
- 1999 Medicinal Values of Sundarbans Mangrove Flora
- 1999 Toe Line Mangrove Plantation for Protection of Earthen Embankment of Sundarbans
- 1999 Phenological Studies of Tropical Mangrove - A Case Study in Indian Sundarbans
- 1999 A Comparative Study on the Mangroves and Associated Flora in the Ganga Delta (Sundarbans) and Bay Islands (Andaman and Nicobar)
- 2000 Morpho-anatomical Studies of *Phoenix paludosa* in Relation to its Halophytic Adaptation in the Indian Sundarbans
- 2000 Rooting Response in Stem Cuttings from Five Species of Mangrove Trees: Effect of Auxins and Enzyme Activities.
- 2000 A New Approach of Nitrogen Fixation and Uptake in Mangrove Ecosystem.
- 2001 Seedling Morphology of Some Mangroves of Sundarbans, India : A Taxonomic Approach.
- 2001 Observation on A Mangrove Palm.
- 2001 Photosynthesis and Water-Use Efficiency of Some mangroves from Sundarbans, India.
- 2002 On the Ontogeny of Stomata and Glandular Hairs in Some Indian Mangroves.
- 2002 Checklist of Mangrove Associated Species in the Indian Sundarbans
- 2002 Biology of *Nypa fruticans* (Thunb.) Wurmb. - An Endangered mangrove Palm of Sundarbans, India
- 2002 Why are mangroves degrading?
- 2002 Arbuscular Mycorrhizal relations of mangrove plant community at the Ganges river estuary in India
- 2003 Vegetative Propagation of *Aegiceras corniculatum*, A Tree Mangrove: Biochemical and Anatomical Basis of Adventitious Rooting
- 2003 Seed Structure and Germination Pattern of Some Indian mangroves with Taxonomic Relevance.
- 2003 Mangroves as Cash Crops.
- 2003 Estimation of Osmotic Potential and Free Amino Acids in Some Mangrove of the Sundarbans, India.
- 2004 Advances in Mangrove Research : Soil-Plant-Climate Interactions in Mangroves.
- 2005 Photosynthesis and Water-Use Characteristics in Indian Mangroves.
- 2005 Relation of leaf micromorphology with photosynthesis and water efflux in some Indian mangroves
- 2006 Biodiversity and its conservation in the Sundarban Mangrove Ecosystem
- 2007 Volume of Abstracts
- 2007 Effects of Root Exudates of Two Mangrove Species on in vitro Spore Germination and Hyphal Growth of *Glomus mosseae*.
- 2015 Studies on selected families of Hymenoptera of Sundarban Biosphere Reserve by Zoological Survey of India
- 2015 Study of Creek Systems and shoreline changes of Western Sunderbans by Geological Survey of India



- 2016 A pilot study on Ecology of Goliath heron in the inter-tidal landscape of Sundarban by Nature Environment & Wildlife Society
- 2017 Ethnographic Research on marginalized people in Sundarbans in relation to their livelihood and sociology by Department of Anthropology, London School of Economics
- 2017 Sawfishes in the Sundarbans by M.Sc. Dissertation project by Ms. Poriyankar Chakraborty
- 2017 Integrated approach to prioritize tiger habitat management interventions and establish linkages with the community for integrated conservation and development in Indian Sundarbans by WWF
- 2017 Prey base estimation methodology development by WWF
- 2017 Rationalizing BLC and fishery stock assessment in permissible areas of Sundarban Biosphere Reserve by WWF

The need for research has been acknowledged and a policy with clear objectives has been set out which gives priorities to research work which directly contribute towards improvement of management.

Wildlife health monitoring is not carried out on a routine basis. However, all the cases where wild animals are captured or rescued they are treated and checked for diseases before being released back into the wild. Similarly, in case of the dead animals post mortem is carried out to know the actual cause of death. This is routinely carried out in the tiger Reserve. In case of the captive deer it was seen that there were cases of parasitic infections including that of tuberculosis which were treated by the Veterinary doctor of the Tiger Reserve. In addition to the above vaccination camps are conducted in the fringe villages to prevent outbreak of diseases.

### 3.6. NATURE EDUCATION AND INTERPRETATION

One of the stated goals of the management of the Tiger Reserve has been to promote ecotourism with a view to encourage nature education, interpretation thereby creating nature awareness for tiger and mangrove conservation. In addition it has also been the endeavour of the Tiger Reserve to enlist support and collaboration from voluntary organisations/associations in awareness building and participatory management for evolving effective conservation strategy.

Sundarban Tiger Reserve is one of the oldest Tiger Reserves in the country and only tiger bearing mangrove ecosystem in the country. It harbours one of the largest stand alone populations of tiger in the entire country. From an average of 30,000 tourists the number has risen to over one lakh in the past couple of years. Unlike other Protected Areas which are closed for tourists in the rainy season Sundarban is open for tourists throughout the year. Though the main tourist period is from October to mid February after which the weather gets rough due to the onset of the cyclonic storms.

The wildlife tourism is primarily organised by the West Bengal Tourism Development Corporation Limited (WBTDCL) and the private tour operators. There is a tourist lodge having 29 double bedded rooms and one dormitory. The WBTDCL Ltd. arranges for conducted tour through its launches M V Madhukar and M V Chitrankha and M.V Sarbojaya. The private tour operators organise the trips to Sundarbans from Gadkhali, Canning/Basanti, Hasnabad and Dhamakhali.

Tourists permits are issued from Head Quarter Range in Canning, Sajnekhali, Sonakhali, Gosaba, and Bagna in Basirhat Range. The tourists are allowed to cruise through the rivers in the designated tourist area. This restricts the visibility upto the river banks only thereby impacting the sighting probability of the wild animals. The tidal movement, coupled with thick mangrove vegetation further restricts sighting of the animals. This results in poor visitor satisfaction. Further,

unrestricted movement of water crafts add to the pollution of the river system by way of oil spills and dumping of waste materials. The use of plastics has been banned inside the PA but visitors do throw plastics cups, plates, wrappers etc in the river outside the Tiger Reserve and these enter the PA with the tide. Although, there had been development in tourism facilities outside the PA in last five years, but there is yet no mechanism to regulate tourism development activities.

The tourism here is a highly regulated one due to difficult terrain of Sundarban. The tourists are not allowed to walk on the land except in some designated places where proper protection, measures have been provided. Presently, tourists visit Sajnekhali, Sudhanyakhali, Dobanki, Netidhopani, Burirdabri and Jhingekhali. The Tourist circuit is more active on the western side of the Reserve. The cage path at Burirdabri, which passes through the section of the vegetation and walk through the cage path, is a thrilling experience and so is the canopy walk at Dobanki.

In the year 1997, a Mangrove Interpretation Centre was opened at Sajnekhali with an objective of priming the visitor about the floral and faunal values of the area. An audio visual centre was also established as part of the unit for organising film shows related to wildlife and the mangrove ecosystem in particular to the visiting tourists. Recently, the Interpretation Centre has been remodelled to include new aspects and concepts being used in the management of the Tiger Reserve. In addition to this, there are a number of tourist guides who are stationed in Sajnekhali and accompany the different watercrafts carrying tourists. These guides besides interpreting the biodiversity values of the area also act as eyes and ears of the management and help in enforcing the rules in the area.

A number of pamphlets on the birds, biodiversity and general management are also sold to the tourists from Sajnekhali. Boards containing information regarding the birds, common mangroves etc are also there in different tourist sites which help enhance the learning experience of the common visitor. Feedback forms are also taken from visitors to improve their experience through valid suggestions.

Study tours of school children to the Tiger Reserve is done with an aim of creating goodwill ambassadors for the area. The Tiger Reserve also organises essay competitions, street plays, Sit and draw competition during wildlife week, Aranya saptah etc where the field officers directly interact with the masses and spread the conservation message.

### 3.7 ADMINISTRATION AND ORGANISATION

The Tiger Reserve is headed by the Field Director who is in charge of the overall administration of the area. He is assisted by the Deputy Field Director and two Assistant Field Directors. The entire area has been divided into 4 (four) territorial and 8 (eight) functional Ranges. The Territorial Ranges include Basirhat Range, Sajnekhali Wildlife Sanctuary Range, National Park (West) Range and National Park (East) Range. These 4 Territorial Ranges have 17 Territorial Beats/ Stations. Basirhat Range has two revenue stations viz. Jhingakhali and Bagna and Sajnekhali Wildlife Sanctuary Range has one revenue stations namely Sajnekhali. National Park (East) range has one revenue station namely Sonakhali revenue station and Headquarter Range has also one revenue station at Canning. Nomenclature of revenue station is legacy of old erstwhile Khulna Division when the forests were being managed for the sole purpose of revenue collection. It is proposed that revenue station should be converted into territorial beat jurisdiction with DR/Fr in charge as Beat Officer instead of Station Officer. Apart from the land based camps/stations there are a number of floating camps at strategic locations. The sanctioned staff pattern for managing this huge area is given in **Appendix 14**

#### A. Territorial Ranges in the Sundarbans Tiger Reserve:

1. **Basirhat Range:** With its headquarters at Jhilla it covers an area of 452.26 sq. km. and has 5 Beats, viz., Bagna, Jhingekhali, Khatuajhuri and Harinbhanga. Recently the Burirdabri camp has also been upgraded into a beat.

- (i) **Bagna:** It was the headquarter prior to development of the Jhilla camp. It has an jurisdiction of Jhilla 1, 2 and 3 Compartments. The total area of the Beat is 52.58 sq. km. It was originally a revenue station, which



was re-designated as Territorial Beat. Main works of this Beat are protection of forest including collection of revenue for honey collection, and fishing. This also includes afforestation works and works related with eco-development. This beat is susceptible to illegal fishing, illegal collection of tiger prawn seeds and poaching etc., because it lies in the vicinity of highly populated fringe villages. Bagna Beat has 2 floating camps ie Chilmari, Kankmari and one new land base Satellite camp at Kanksa, which previously was a floating camp. Being close to International Border this camp is prone to trans-border problems like illegal entry of Bangladeshi nationals for felling poaching, tiger prawn seedling collection etc. The staff of this camp are mainly engaged in protection works. There are nine JFMC's under its jurisdiction and it carries out the JFM works in these areas.

- (ii) **Jhilla:** It is the new headquarter of the Bashirhat Range. This land based camp was developed with a view of being in close proximity of the forest. It houses the office of the Range Officer, Attached Officer and the beat officer Bagna beat along with other Staff. The State Armed Police also stay in one of the Barracks within the Jhilla campus. A mangrove nursery has also been developed here. It also looks after the area covered by the Bagna Beat. It is also involved in the maintenance of the nylon net fencing along Jhilla 1 forest area.
 

In addition to Jhilla camp there are two floating and one satellite camps which patrol Jhilla block. These are

  - a. **Chilmari Floating Camp:** it looks after Jhilla 1 and 2 compartments.
  - b. **Kankmari Floating Camp:** it looks after Jhilla 3 and 4 compartments.
- (iii) **Kanksa Satellite Camp:** This is a newly constructed land base camp in 2016-17 in place of the existing floating camp, it looks after Jhilla 2 and 3 compartments
- (iv) **Jhingekhali:** This Beat has Headquarters in Jhingekhali and Arbesi 1, 2 compartments covering an area of about 84.03 sq. km. under its jurisdiction. This Beat was earlier a revenue station and was later re-designated as a Territorial Beat. It is the most disturbed Beat of STR with reference to forest and wildlife protection. The main works of this Beat are protection, which also includes afforestation and eco-development works. The area of this Beat is susceptible Tiger straying which has been a major problem of this Beat since long. This has been accentuated by the silting up of the Shakunkhali khal which separates this beat from the adjoining forest area with the distance between the forest boundary and the village side as less as 2-3 metres. This also makes it vulnerable to illegal fishing, illegal tiger prawn collection and poaching etc. It is also a tourist spot with a watch tower and a sweet water pond on the forest side along with observation lines. The beat has three JFM Committees under its jurisdiction. It is involved in carrying JFM activities in these areas. Besides this it is also responsible for maintenance of the nylon net fencing along the forest area from Jhingekhali to Kalindi river.
- (v) **Samshernagar Satellite Camp:-This was a floating camp till 2016 and upgraded to a Land base Satellite camp at Arbesi -1.** It patrols over Arbesi 1. It is also involved in the maintenance of the nylon net fencing along Arbesi 1 forest area. Regular activities of the camp is controlled by the beat officer of Jhingekhali Beat. Strategically the location of the camp is a very important because of proximity of Bangladesh Border.
- (vi) **Burirdabri:** This was a camp till recently and has been upgraded to a beat. It patrols over Arbesi 3, 4 and 5 having an area of 66.43 sq km. It has interface with the international border with Bangladesh. It is a well known tourist spot with the cage trail and a watch tower overlooking the Bangladesh border.
- (vii) **Khatuajhuri:** The beat was created in the year 2001. The Headquarter of this Beat is in Khatuajhuri and its jurisdiction lies in Khatuajhuri 1, 2 and 3 compartments covering an area of 132.40 sq km. The works for construction of this Beat was started in the year 2001 because of its strategic location and proximity to International Border. The main works of this Beat is to tackle trans-border problems and honey collection operations and a little bit of eco tourism. This Beat has a sweet water pond, as well.
- (viii) **Harinbhanga/Harikhali:** Activities of the beat previously was controlled by Beat is in Bagna and its jurisdiction is in Harinbhanga 1, 2 and 3 compartments covering an area of 116.86 sq.km. This Beat was earlier a Patrolling

Unit, which was later re-designated as a Beat. The main work of this Beat is protection works. Recently, a new campus was developed for this beat which was now upgraded to a beat and a Beat Officer is in the charge of it.

2. **Sajnakhali Wildlife Sanctuary Range:** It is a territorial range, its headquarter is at Pakhiralaya and covers an area of 432.92 sq. km of which 362.60 sq. km is a notified Wildlife Sanctuary. It has 3 beats namely Sajnakhali, Dattar, and Dobanki. Apart from these fixed camps another camp is at **Sudhanyakhali** which is also a famous tourist spot with a watch tower from where tigers are frequently sighted. It also has **three floating camps mainly Sadak khali, Tentultala and Pirkhali camps**. The Sajnakhali Mobile Patrolling Party (MPP) also doubles up as a floating camp. Sajnakhali range has a huge area of interface with the fringe villages. This range also has the major work of tourism management other than normal protection works.
  - (i) **Sajnakhali:** Sajnakhali beat has its headquarters in Sajnakhali and covers an area of 43.81 sq. km. and has jurisdiction over Pirkhali 1 and 3 compartments. This beat was earlier a revenue station, which was later re-designated as a beat. The main works of this beat are protection of the forest and wildlife including collection of revenue from honey collectors and fishermen. The works also include that of afforestation and eco-development. This beat has a surface camp in Sudhanyakhali, which covers the jurisdiction of 32.98 sq. km. in Pirkhali 2. Sudhanyakhali is a tourist spot with the watchtower, mangrove park and sweet water pond. There is huge pressure during tourism season on the surface camp but in the lean period this camp does the protection works of Pirkhali 2. It also maintains the nylon net fencing along the village forest interface.
  - (ii) **Dattar:** The head quarter of Dattar beat is in Dattar village besides the Dattar river. The total area of this beat is 96.85 sq. km. with its jurisdiction in Panchmukhani 2 and Jhilla 4, 5 and 6 compartments. This beat was also a revenue station earlier and later was re-designated as a beat. The beat covers a very disturbed area with a big zone of interface. The main works of this beat are protection works related to illegal fishing, illegal collection of tiger prawn seedlings and poaching etc. The works also include eco-development and afforestation. It has four JFMC's under its jurisdiction and carry out ecodevelopment activities there. Also it is responsible for maintenance of the nylon net fencing from Sadak khali camp to Duttar river. It also looks after nylon net fencing along the forest village interface.
  - (iii) **Dobanki:** This beat camp which is very strategically located in Dobanki was established in the year 2000. The area of Dobanki beat is 108.94 sq. km. and has its jurisdiction in Pirkhali 4, 5, 6 and 7 compartments. The main work in this beat is to protect the vulnerable forest. It is also a major tourist point with a watch tower and an elevated canopy walk which gives the tourists a feel of the mangrove forest.
  - (iv) **Sajnakhali Mobile Patrolling Party( Chayan):** The head quarters of this beat is in Sajnakhali. This beat covers an area of 124.37 sq. km. and has its jurisdiction in Panchmukhani 3, 4 and 5 compartments. The main work of this beat is protection of forest and wild life for the entire SWLS range. This beat is primarily used to act as strike force after collection of information from intelligence networks and perform tiger straying duties.
  - (v) **Sarakkhali Floating Camp:** it has jurisdiction of Panchmukhani 1 and covers an area of 25.97 sq. km. Sarakkhali patrolling camp is situated in a very sensitive zone and deals with problems of illegal fishing, illegal collection of tiger prawn seedlings and poaching and in case of tiger straying. It has six JFMC's under its jurisdiction and carry out ecodevelopment activities there. Also it is responsible for maintenance of the nylon net fencing upto Sadak khali camp.
  - (vi) **Tentultala Floating Camp:** is a fixed floating camp which secures the Tentultala khal from the entry of illegal fishermen, crab collectors and poachers.
  - (vii) **Pirkhali Floating Camp:** is a fixed floating camp which secures the Pirkhali khal from the entry of illegal fishermen, crab collectors and poachers.
3. **National Park (East) Range:** It is a territorial range with its head quarters in Gosaba. The head quarters of National Park (East) Range has main control of Radio Transmitter system (RT CONTROL) for Sundarban Tiger Reserve. The

area of this range is 809.46 sq. km. This range has three beats namely Sonakhali and Chamta and Bagmara under its jurisdiction. Earlier Mechua floating camp used to perform the duties in fair weather time in place of the present Baghmara camp.

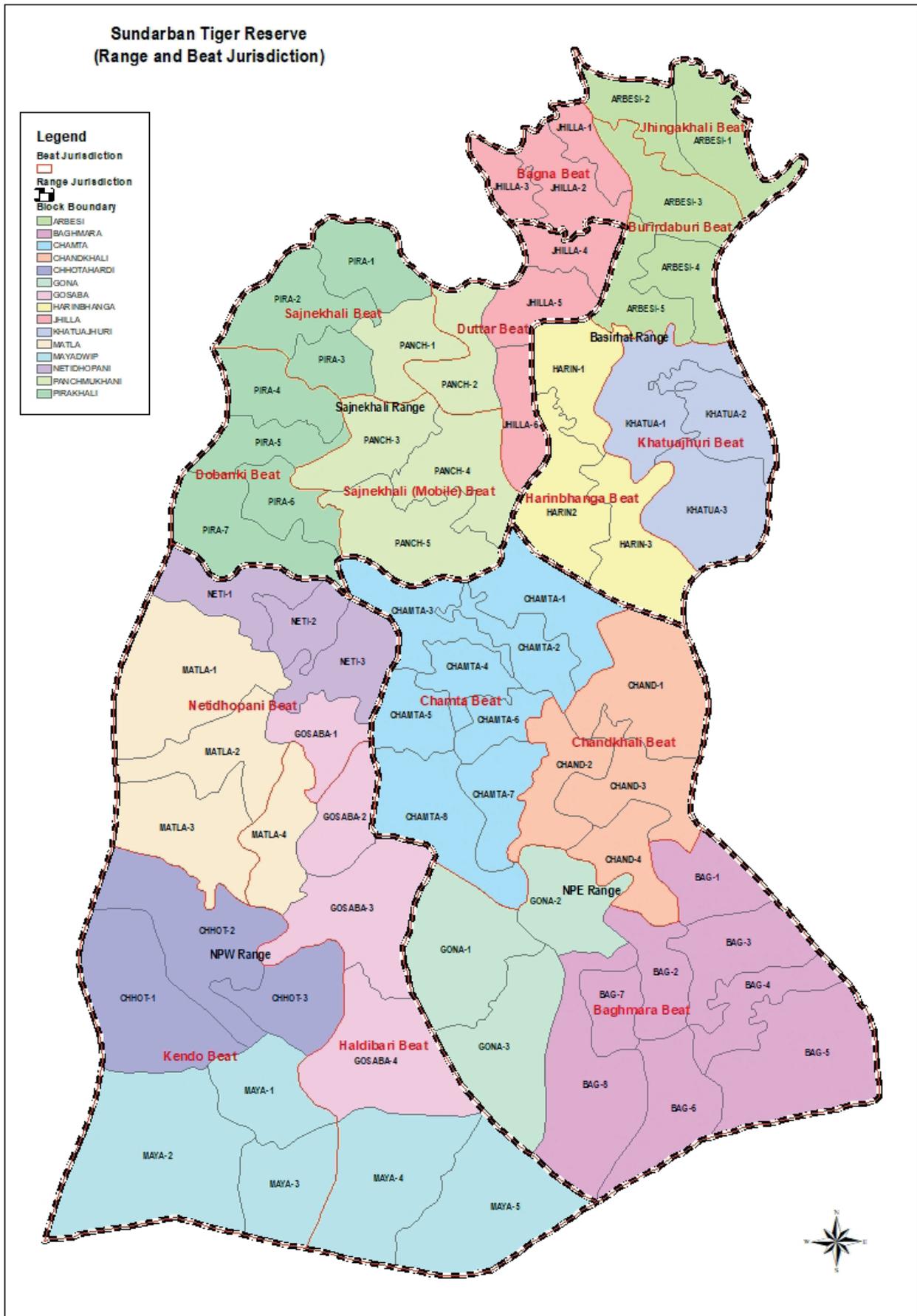
- (i) **Sonakhali:** The head quarters of this beat are at Sonakhali and it is a gateway point for the Reserve. The beat has a tourist permit-issuing centre at Sonakhali. The works of this beat includes spreading of awareness regarding nature conservation, rescue of wild animals, coordination of joint patrolling operations, and promoting social forestry in the fringe villages. However, with the gradual silting up of the Hogal river and development of a good road network upto Gadkhali this point has lost its importance. In the coming future an office shall be opened up at Gadkhali the new gateway to Sundarban.
  - (ii) **Chamta:** The head quarters of this beat are at Chamta. It was earlier a patrolling camp and started functioning as beat from 2001 after construction of Chamta Beat Camp. This beat has an area of about 231.37 sq. km. and its jurisdiction is in Chamta 1 to 8 and Chamta 1-8 forms part of the National Park area. The location of this beat is very important in view of protection aspects. The main works of this beat is protection of forest and wild life. This is very vulnerable to intrusion from Bangladesh especially during the honey season and the fair weather coupe operations in Bangladesh.
  - (iii) **Bagmara:** This land based camp which started functioning in the year 2009 in place of the earlier floating camp of Mechua and looks after an area of about 432.95 sq. km. The jurisdiction of this beat is in Bagmara 1 to 8 and Gona 1, 2 and 3 compartments. Bagmara 2-8 and Gona 1-3 also form part of the National Park. The primary work of this camp is protection of forest and wild life including the protection of Olive ridley turtles which lay eggs on the sandy beaches of the National Park.
  - (iv) **Chandkhali:-** This land base camp which started functioning in the year 2013. The jurisdiction of the beat Chandkhali 1 to 4 compartments and look after area of about 154.77 sq. km. This is very vulnerable to intrusion from Bangladesh especially during the honey season and the fair weather coupe operations in Bangladesh.
  - (v) **Mechua Floating Camp:** This is fair weather camp which is present in the field from Late October to end of March after which the weather turns rough. It secures the Mechua khal which is an important route used by fishermen and illegal timber collection from the beache. It also looks after the adjacent area of Baghmara- 6 and 8 compartments
4. **National Park (West) Range:** It is a territorial range with its head quarters in Bidya and has an area of 890.08 sq. km. It has three beats namely Netidhopani, Bidya Head Quarter and Haldibari.
- (i) **Bidya Head Quarter:** The head quarters of this beat is at Bidya and it has overlapping jurisdiction over Pirkhali 2 compartment with SWLS range because of its proximity to the forest. The main works of this beat is the protection of forest and wild life. The beat has a sensitive zone and main works of this beat are protection works related to illegal fishing, illegal collection of tiger prawn seedlings and poaching etc. It has five JFMC under its jurisdiction and carries out eco-development and afforestation works in the JFMC areas. This beat also looks after the nylon net fencing maintenance along Pirkhlali 2 and tiger straying incidences. There is a deep tubewell in Bidya and this water station supplies the sweet water for Sajnakhali Wild Life Sanctuary Range and to the tourist lodge. Many of the watercrafts especially the launches take water from here before venturing out into the field.
  - (ii) **Netidhopani:** The head quarter of this beat is at Netidhopani with an area of 266.66 sq. km. in its jurisdiction in Netidhopani 1, 2, 3 and Matla 1, 2, 3 and Goasaba 1 compartments. Netidhopani 2,3 and Matla 1-3, Goasaba 1 are all part of the National Park. Its primary work is to protect the forest and the wild life. It also has a watchtower and sweet water pond in its head quarters and is a favourite tourist spot. There is huge pressure of tourists during the peak period of tourism.

- (iii) **Haldibari:** The head quarters of this beat is at Haldibari with an area of 328.53 sq. km. with its jurisdiction in Chottohardi 1, Goasaba 2 to 4 and Matla 4 compartments. The entire area falls under the National Park. Its primary work is to protect the Forest and the Wild life. Before constructions of Chamta, Dobanki and Khatuajhuri camps, this camp was the only permanent surface camp inside the forest area in the entire Sundarban Tiger Reserve. It also has sea facing beaches and the staff is also involved in the protection of Olive ridley turtles which lay eggs in its jurisdiction.
- (iv) **Kendo Camp:** This camp development has started in 2009 and it was functional since 2012. This camp has been developed as a substitute for the Arabhanga floating camp which was looking after the area over 272.12 sq. Km covering Mayadwip block 1-5 compartments and Chotohardi block 2-3 compartment. The entire area falls under the National Park. This area is illegally used by trawlers to venture out into the deep seas. Many times they have also been found illegally fishing within the Tiger Reserve.
- (v) **Havate Floating Camp:** This is fair weather camp which is present in the field from Late October to mid April after which the weather turns rough. It secures the Havate khal which is an important route used by fishermen and other illegal entrants into the Reserve. It also looks after the adjacent area of Matla 2 and 3 compartments.

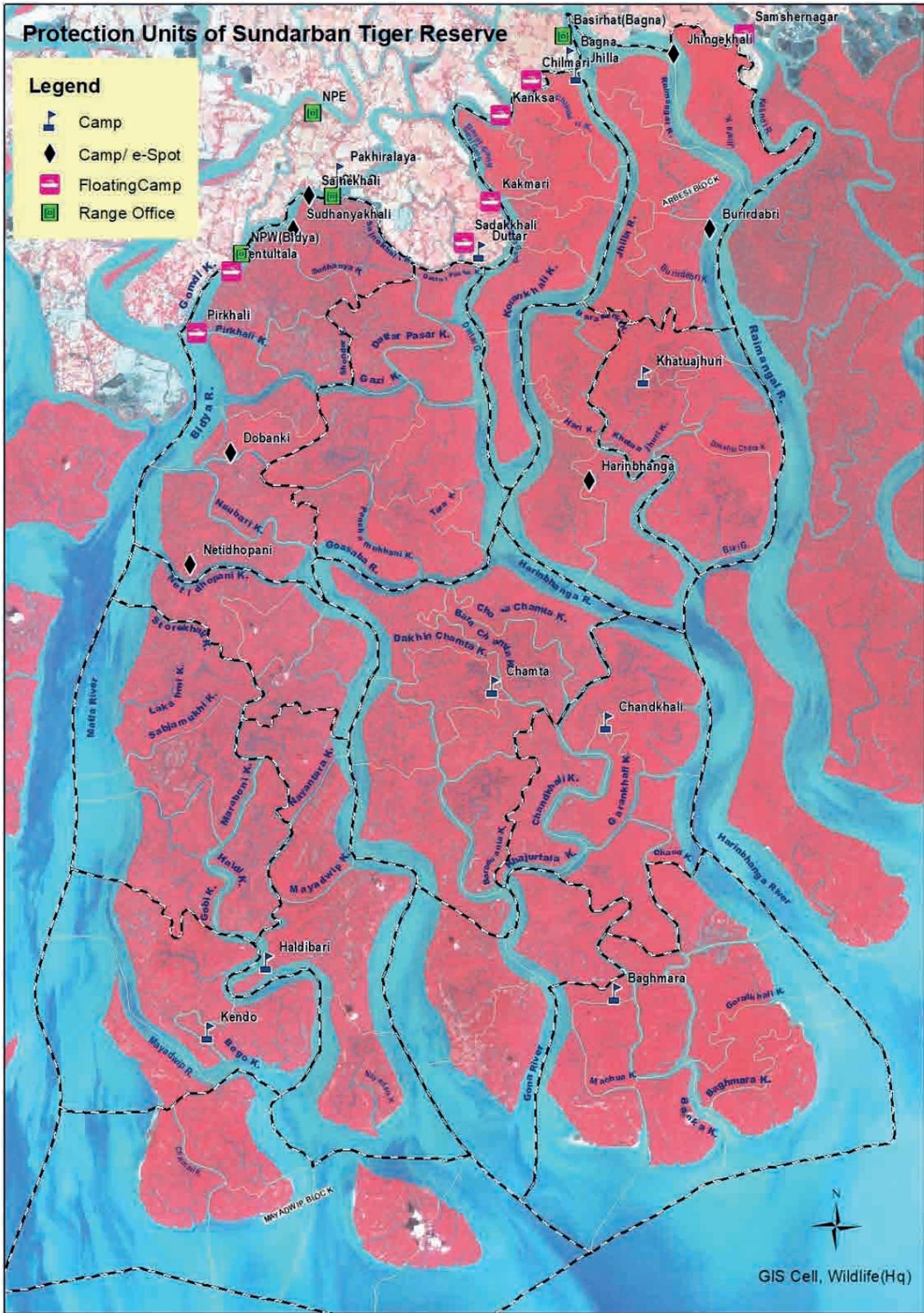
## **B. Functional Ranges in the Sundarban Tiger Reserve:**

1. **Rampura Mobile Range:** It's a functional range and its head quarters is at Rampura under the district of 24 Parganas (N) situated on the other side of Dhamakhali, which is also a gateway-point for the STR. It has two beats namely Rampura Head quarter and Rampura MPP under it. The range has its jurisdiction all over the forest area of Basirhat Range and main works is to augment the protection works of Basirhat Range.
  - (i) **Rampura Head Quarter:** It was a primary a revenue station which collected the revenue for the felling coupes. Presently it assists in the protection duties and eco-development works in the fringe villages.
  - (ii) **Rampura MPP:** The main work of this mobile and floating patrol camp is to augment the protection works of Basirhat range.
2. **Eco-tourism Range:** It is a functional range with its headquarters at Sajnakhali. The main works of this range is related to tourism management including maintenance of Mangrove Interpretation Centre at Sajnakhali. This range also has a tourist permit issuing centre at Sajnakhali.
3. **AFR has been redesignated as the Head Quarter Range:** It is a functional range with its headquarters at Canning. The main works of this range is to issue license/ permits to the tourists, fishermen, honey collectors and timber merchants. This range also works in the field of intelligence network collection and looks after the works of protection outside the TR areas. It has two beats under its jurisdiction namely Head Quarter beat and Head Quarter MPP.
  - (i) **Head-Quarter Beat:** It was earlier a revenue station and now mainly looks after the works of issue of permits / license etc. It also works in the field of protection and animal rescue operations.
  - (ii) **Head-Quarter MPP:** It is a mobile and floating patrol camp with its head quarter at Canning and its jurisdiction is all over the TR. The main works of the beat is to augment the protection works for the entire STR.
4. **Basanti Mobile:** This is a functional range with its head quarters at Basanti. This Range is not working because of shortage of staff and other paraphernalia support, like boats, arms, etc.
5. **Land and Law Cell:** It is a functional range with its head quarters at Canning. The main works of this cell is related with legal matters and court cases.
6. **Research Range:** It is a functional range with its head quarters at Canning. The main works of this range is to undertake research works related to the field of the tiger conservation. This has been lying moribund in the absence of a permanent Research Officer.





**Figure 3:** Territorial Ranges of Sundarban Tiger Reserve



**Figure 3:** Map Showing Protection Camps, Floating Camps, Range offices Sundarban Tiger Reserve

# Production Sectors In the Landscape



## 4.1 FORESTRY

The neighbouring 24 Parganas South forest Divisions is separated from the Tiger Reserve by the Matla River. This river is a part of the inter division corridor as the tigers occasionally swim across. There are tigers on both sides. The management of the area is more or less similar to the Tiger Reserve with no coupe or timber operation activity taking place. All the activities of South 24 Parganas Division are guided by their approved Working Plan. However, it has a much larger interface with the villages and there is heavy pressure on the forest areas for natural resource like fish, fuel wood, timber and honey etc. As a result of which, the overall habitat quality has gone down. It has been seen that boats having fishing permits of that Division illegally enter and fish in the Tiger Reserve. Many of the poachers also inhabit the fringe areas of the forest Division but operate in the Tiger Reserve. It is proposed that to improve better coordination and cooperation between both the Divisions meetings should be held at the level of the DFO and the DFD at an interval of two months to sort out all pending issues. Information sharing especially with regards to criminals operating in the areas and strategies as joint raid program can also be thought of. Joint patrolling operations once in two months are also proposed especially in the border areas and along the sea facing areas. Since the staff of the Tiger Reserve have a much more orientation towards conservation it is proposed that there should be exchange visits between staff of the two Divisions wherein the wildlife techniques like tranquilization and other field craft being utilized in the field shall be shared. Recently a proposal has been made to incorporate the adjacent portion of South 24 Pargana Division under CATS.

## 4.2 AGRICULTURE

It is the mainstay of the rural economy in the area. Earlier only one crop was taken in the absence of suitable irrigation facilities. However, with the increase in the number of re-excavated irrigation channels have led to the people to take multiple crops. Most of the land holding are small and the overall yield is less.

Sl. No	Name of Crops	Name of Varieties		
1.	Paddy	i. Local* Dudheswar, Dadsal, Bashkathi, Chabukchari, Lunishree	ii. HYV IET-4786, SS-1, Rajendra Masuri, CR-1017, MTU 7029, MTU 1010, DRR-42	iii. Hybrid Arize Gold- 6444
2.	Maize		Deacan 1, Ganga 1	
3.	Kalai		Kalindi, Sarada	
4.	Arhar		PUAS 120	
5.	Wheat		PBW 343	
6.	Potato		Kufri, Chandramukhi, Jyoti	
7.	Mustard		B-9, B-54	

### Tiger Bearing Ranges of Indian Sundarbans

#### Legend

- 24PgnS Division
- Sundarban Tiger Reserve
- Range Boundary

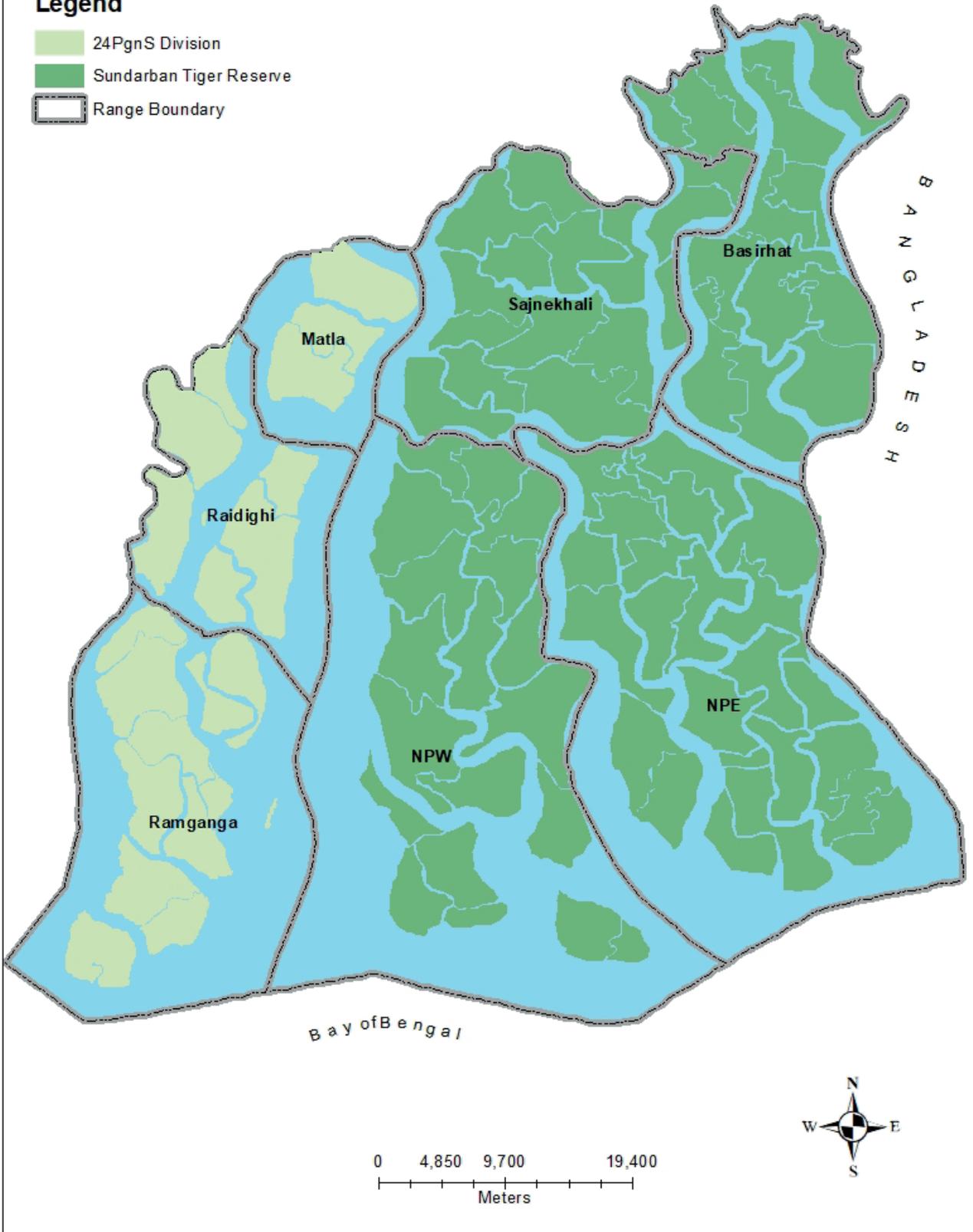


Figure 1: Tiger bearing ranges of Sundarbans

Sl. No	Name of Crops	Name of Varieties		
8	Til		Roma	
9.	Moong	Chaitali	Samrat, Sonali	
10.	Lentil		Ranjan	
11,	Gram		Mahamay 1, Mahamay 2	
12.	Pea			
13.	Khesari		B-1 (Nirmal), Ratan	
14.	Ground Nut		JL 24	
15.	Sunflower		PAC-36	

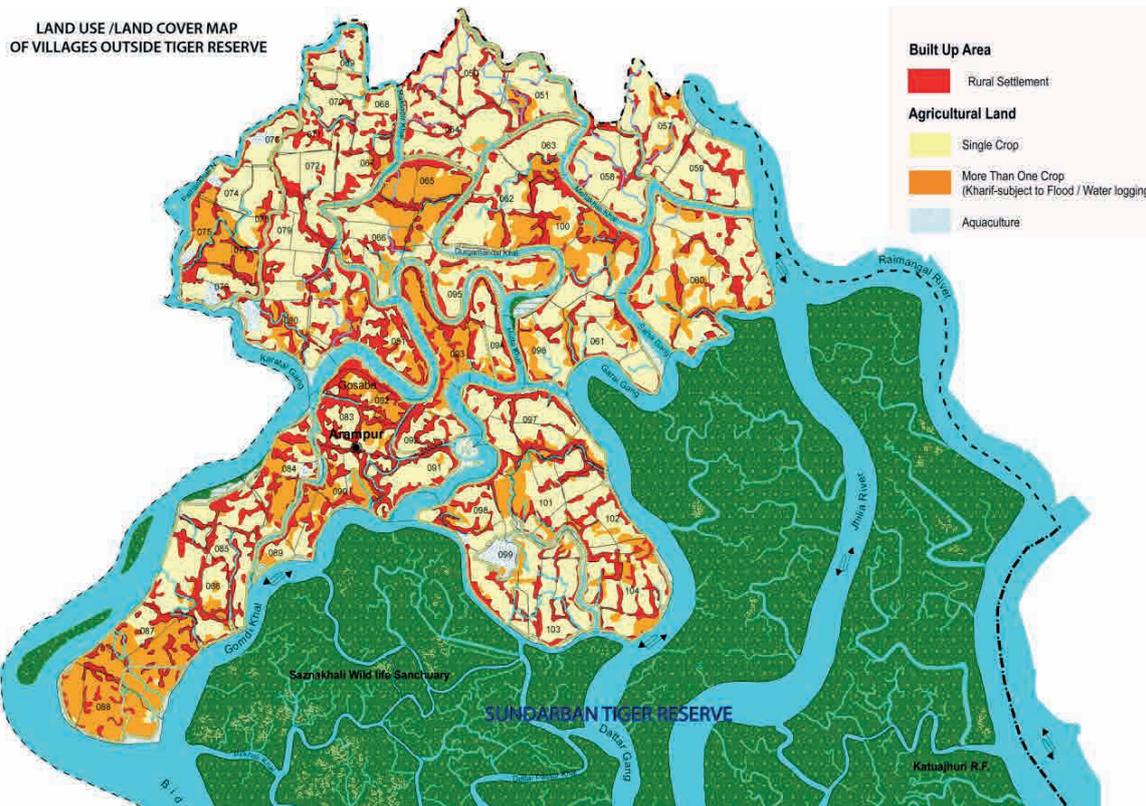
### Dominant Varieties of Cultivated Major Crop (Crop Wise)

#### A) Percentage & Area (in Ha.) Hyv.; Hybrid & Local During Kharif/Rabi

Crops Area (ha)		2015-16		2016-17		2017-18		Average	
		%	Area (ha)	%	Area (ha)	%	Area (ha)	%	
Aus	HYV	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Hybrid	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Local	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Aman	HYV	16345	74.2448331	18540	84.2153077	19230	87.3495344	54115	81.9365584
	Hybrid	2	0.00908471	2	0.00908471	1.78	0.0080854	5.78	0.00875161
	Local	5668	25.7460822	3473	15.7756075	2786.78	12.658551	11927.78	18.0600802
Boro	HYV	1390	89.677419	1369.5	88.354839	1353.5	87.3225806	4113	88.4516129
	Hybrid	172	11.0967742	193	12.4516129	205	13.2258065	570	12.2580645
	Local	12	0.77419355	12.5	0.80645161	8.5	0.5483871	33	0.70967742

#### b) No. of GP with Cultivated Area/ irrigated Area / Cropping Intensity

Sl. No.	GP	Geographical Area (Ha)	Cultivated Area (Ha)	Net Irrigated Area	Draught Prone Area (ha)	Flood Prone Area (Ha)	Gross Cropped Area (ha)	Net Cropped Area (ha)	Cropping Intensity
1	Satjelia	2804.25	1842.40	125.82	Nil	14.02	1793.02	1785.06	139.00
2	Amtali	2854.20	1875.22	128.06	Nil	14.27	1824.95	1816.86	139.00
3	Lahiripur	3055.87	2007.72	137.11	Nil	15.28	1953.90	1945.23	139.00
4	RT Nagar	3830.80	2516.85	171.88	Nil	19.15	2449.38	2438.52	139.00
5	Shambhunagar	1976.32	1298.45	88.67	Nil	9.88	1263.65	1258.04	139.00
6	Bipradaspur	2789.71	1832.85	125.17	Nil	13.95	1783.72	1775.81	139.00
7	Bally 2	3545.82	2329.61	159.09	Nil	17.73	2267.17	2257.11	139.00
8	Rangabelia	4597.51	3020.58	206.28	Nil	22.99	2939.61	2926.57	139.00
9	Kumirmari	2110.89	1386.86	94.71	Nil	10.55	1349.69	1343.70	139.00
10	CM khali	2906.17	1909.36	130.39	Nil	14.53	1858.19	1849.94	139.00
11	Kachukhali	3060.56	2010.80	137.32	Nil	15.30	1956.90	1948.22	139.00
12	Pathankhali	1799.43	1182.23	80.74	Nil	9.00	1150.54	1145.44	139.00
13	Gosaba	2001.54	1315.02	89.80	Nil	10.01	1279.77	1274.09	139.00
14	Bally 1	1791.56	1177.06	80.38	Nil	8.96	1145.51	1140.43	139.00
<b>GRAND TOTAL</b>		<b>39124.62</b>	<b>25705.00</b>	<b>1755.41</b>	<b>Nil</b>	<b>195.62</b>	<b>25016.00</b>	<b>24905.00</b>	<b>139.00</b>



### 4.3 INTEGRATED DEVELOPMENT THROUGH THE DISTRICT ADMINISTRATION

The District administration is involved in the planning and development of the entire area. The execution of most of the district level schemes is being carried out through the panchayats. Details has been dealt in Chapter-8.

### 4.4 TOURISM

The Tourism Department conducts guided tours in the area. It has its own watercrafts and a Tourist Lodge at Sajnekhali. Besides the Department a number of private players have entered the area. They have built up a number of tourist lodges and resorts right at the periphery of the Reserve. These are mainly concentrated in Gosaba and Satjelia islands. A number of local tour operators have also mushroomed. They pay local boats and ferry tourists from one tourist spot to the another. The offshoot of increased tourism is felt by way crowding at the tourist spots, garbage floating in the river channels and creeks, increase in noise and water pollution.

#### 4.4.1 Tourists Visiting The Area

YEAR	No. of Tourists (per entry point) [including Crew Member]												TOTAL
	Indian						Foreigner						
	Canning (Hqr. Range)	Sonakhali (NP(E) Range)	Sajnekhali(ET Range)	Basirfat Range	Gosaba Range	Total	Canning (Hqr. Range)	Sonakhali (NP(E) Range)	Sajnekhali(ET Range)	Basirhat Range	Gosaba Range	Total	
2003-04	9,380	749	32,909	2,030	-	59,225	-	339	297	-	-	636	<b>59,861</b>
2004-05	11,208	1,665	31,376	2,337	-	51,032	16	350	697	-	-	1,063	<b>52,095</b>
2005-06	13,633	2,081	39,200	5,303	-	63,158	-	286	463	-	-	749	<b>63,907</b>
2006-07	15,691	2,771	58,406	4,654	-	86,908	-	447	1,218	-	-	1,665	<b>88,573</b>

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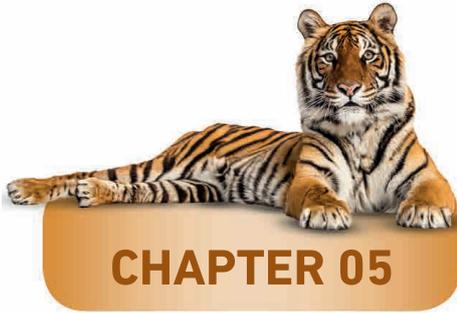
YEAR	No. of Tourists (per entry point) [including Crew Member]												TOTAL
	Indian						Foreigner						
	Canning (Hqr. Range)	Sonakhali [NPE] Range	Sajnekhali(ET Range)	Basirfat Range	Gosaba Range	Total	Canning (Hqr. Range)	Sonakhali [NPE] Range	Sajnekhali(ET Range)	Basirhat Range	Gosaba Range	Total	
2007-08	15,926	10,279	55,472	3,037	-	84,714	54	551	1,476	-	-	2,081	<b>86,795</b>
2008-09	18,949	16,147	79,029	3,599	-	1,17,724	52	1,136	1,581	2	-	2,771	<b>1,20,495</b>
2009-10	11,371	13,973	44,849	4,893	11,887	86,973	19	333	2,431	8	76	2,867	<b>89,840</b>
2010-11	5,250	21,280	58,460	2,493	4,098	91,581	145	197	2,411	-	248	3,001	<b>94,582</b>
2011-12	7,166	28,448	79,393	5,060	4,079	<b>1,24,146</b>	197	174	2,827	4	216	<b>3,418</b>	<b>1,27,564</b>
2012-13	6242	31253	90956	11081	0	<b>1,39,532</b>	102	96	3255	8	0	<b>3,461</b>	<b>1,42,993</b>
2013-14	2811	30945	95398	24965	0	<b>1,54,119</b>	123	157	3316	42	0	<b>3,638</b>	<b>1,57,757</b>
2014-15	1964	31894	121387	15226	0	<b>1,70,471</b>	156	129	3479	21	0	<b>3785</b>	<b>1,74,256</b>
2015-16	939	27553	136703	17231	0	<b>1,82,426</b>	74	56	3322	14	0	<b>3466</b>	<b>1,85,892</b>
2016-17	253	12,064	164648	22990	0	<b>1,99,955</b>	50	50	3376	11	0	<b>3487</b>	<b>2,03,442</b>
2017-18	497	20,582	1,72,864	25,866	0	<b>2,19,809</b>	32	39	3,128	4	0	<b>3,203</b>	<b>2,23,012</b>

## 4.5 FISHERIES

Since Sundarban Tiger Reserve is interspersed with creeks and water bodies which falls under the protected area therefore it comes under the sole jurisdiction of the forest department. Fishing is closed in the buffer area for three months and entirely restricted in the core area. The Fisheries Department regulates the fishing outside the Tiger Reserve area. They issue Marine Licenses to trawlers who go out to fish in the deep seas.

*Note:* There are no industries, irrigation projects etc. inside the Tiger Reserve area.





# Land-use Patterns and Conservation Issues

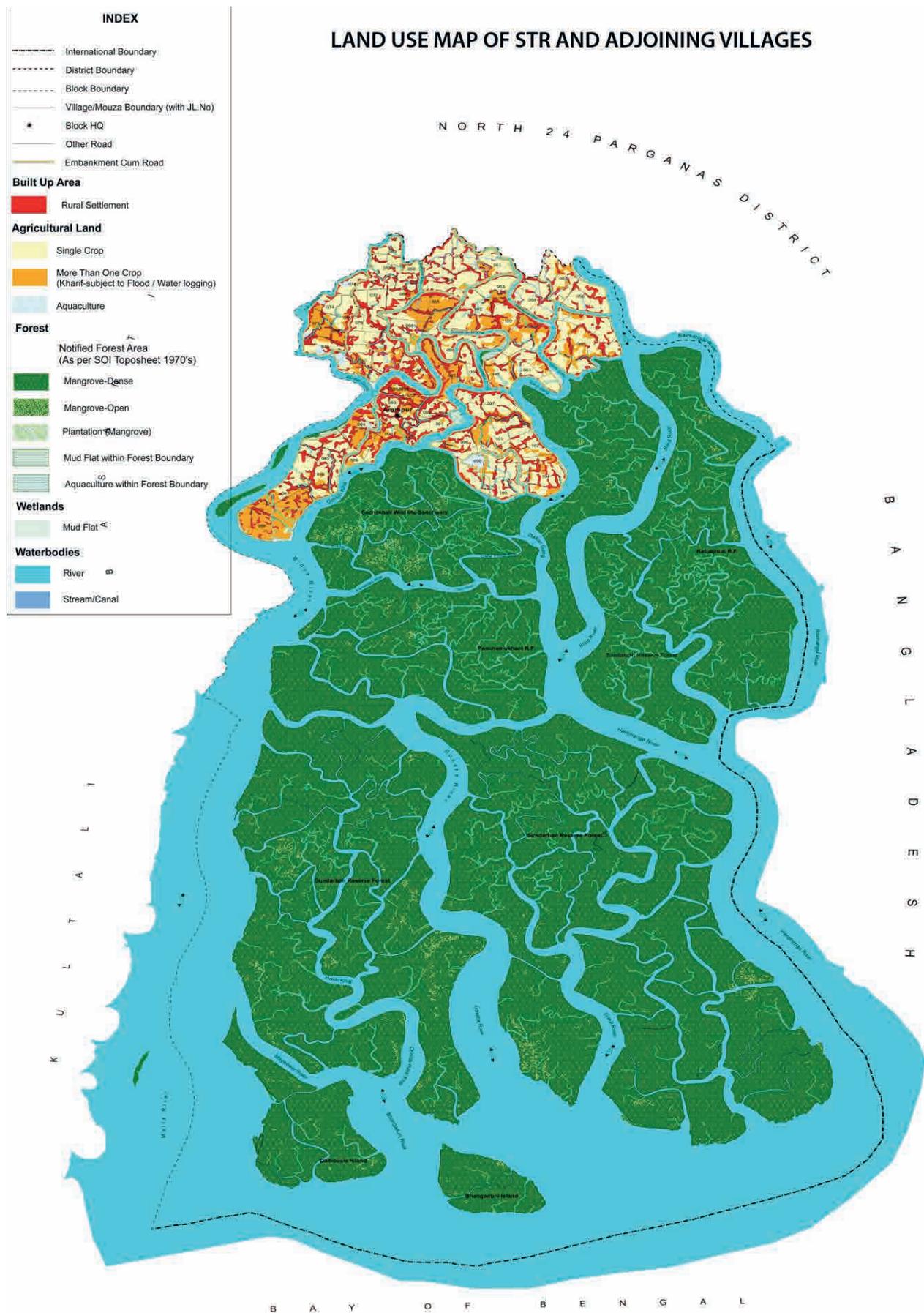
## 5.1 LAND-USE CLASSIFICATION

The erstwhile mangrove in the intertidal zone which falls south of imaginary line called Dampier and Hodges line have been partly reclaimed for cultivation and agriculture. All the reclaimed area lies on the northern side of the Reserve. The total mangrove area below the Dampier and Hodges line is 9630 sq. k.m. comprising 102 islands out of these 52 are inhabited where agriculture is being carried out and the rest 48 islands measuring 4262 sq.k.m. comprising of the Reserve Forest area which includes both the forests under 24-Parganas (South) Division and Sundarban Tiger Reserve. In the reclaimed area, tidal flow is checked by construction of embankments. The total length of embankment protecting the reclaimed land is approximately 3500 kms. Since the reclamation was started before the completion of siltation process therefore, most of the reclaimed lands are below the high tide level thus making them vulnerable during the cyclones. Many times there are frequent breaches in the embankments which causes enormous damage to the villages. The reclaimed land yield only a single crop as agriculture is rainfed. The major fringe villages are (West to East) Mathurakhand, Amlamethi, Satyanarayanpur, Bally, Bijoyanagar, Sonagaon, Pakhrala, Dulki, Dayapur, Enpur, Jamespur, Rajatjubilee, Lahiripur, Chorgheri, Santigachi, Imlibari, Bhuruliapara, Mitrabari, Hentalbari, Adibasipara, Bagnapara, Kalitala, Shamshernagar, Hemnagar etc. Apart from agriculture aqua-culture farms and brick kilns have also come up on these reclaimed lands. Of late, tourism is coming up in a big way in the fringe area bordering the Reserve.

## 5.2 SOCIO-ECONOMIC PROFILE OF THE VILLAGES

The fringe villages have a high percentage of socially backward groups like Scheduled Castes 32% and Scheduled Tribes 12%. The level of literacy as well as per capita income is much lower in Sundarbans than in other parts of West Bengal. The tribal population here is the descendent of the group of tribes of Chottanagpur, who were brought here for clearing the areas for human settlement during the 19<sup>th</sup> century. In the absence of any major industry in the area the vocation can be divided as cultivators 26.5%, agricultural labour 47%, household worker 1.5% and others 25% which include fishermen, crab collectors, honey collectors etc. Majority of the farmers fall under the category of small and marginal farmers (the detailed table is given below). Village rich mainly invest in agricultural land and commercial fishing, by engaging the poor fishermen to earn high profits. Moneylenders also abound in the villages. They give advances to fishermen and honey collectors in return of which they take all the fish catch and honey collected from the fishermen/honey collectors for a pittance. Most of the villagers also have cattle population, which are reared not for milk supply but to fulfill their protein requirements. Most of the cattle is stall fed or is left out in the local fields and the Tiger Reserve doesn't have grazing problems due to village cattle as is seen in other parts of the country. Prawn fishery has become a very popular trade by regulating the tidal water flow inside low lying fields and farm land outside the Reserve.

The infrastructure in the villages is poorly developed with hardly any metalled roads. The kutchha roads become very slippery during the rains making it very difficult to walk there. There is no electricity in the area. The wood gassifier plant



**Figure 1:** Data source-Map and details obtained from Department of Agriculture, West Bengal

at Gosaba having capacity of 500 KW was established in 1996-97 by the West Bengal Renewable Energy Development Authority (WBREDA) and supplies electricity to some parts of the Gosaba island. Though, the demand for the raw material is met from the wood growing in the local areas, still it faces a perpetual shortfall in supply of wood. The rest of the area is steeped in darkness. Individually some of the families have availed of subsidy by WBREDA to get solar lights installed in the village. Mode of communication in this area is mainly country boats and mechanized boats and the speed of which is regulated by the movement of the tidal currents. Concrete jetties which are boarding and disembarking points for people boarding watercraft are few and far between and at many places still brick block jetties are used to board boats. Primary health centres and schools are also not adequate. The local markets are called 'haats' and are organized once a week where the villagers come from far of places to buy and sell agricultural and other produce.

District Primary										
District	Total-Rural/ Urban	Area in Km Square	No of Household	Total population (including institutional and houseless population)			Population in the age-group 0-6			
				Persons	Males	Females	Persons	Males	Females	
Goasaba	Total	296.73	58,197	2,46,598	1,25,910	1,20,688	27,841	14,057	13,784	
	Rural	296.73	58,197	2,46,598	1,25,910	1,20,688	27,841	14,057	13,784	
	Urban	0								

Census Abstract										
District	Total-Rural/ Urban	Scheduled Caste Population			Scheduled Tribe Population			Literates		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Goasaba	Total	1,54,584	79,318	75,266	23,343	11,766	11,577	1,72,781	96,642	76,139
	Rural	1,54,584	79,318	75,266	23,343	11,766	11,577	1,72,781	96,642	76,139
	Urban	0								

District Primary- Industrial Category										
District	Total-Rural/ Urban	Total Workers			Main Workers			Cultivators		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Goasaba	Total	1,10,996	75,816	35,180	50,994	43,720	7,274	14,425	12,962	1,463
	Rural	1,10,996	75,816	35,180	50,994	43,720	7,274	14,425	12,962	1,463
	Urban	0								

Census Abstract of Main Workers										
District	Total-Rural/ Urban	Agricultural Labourers			Household Industry workers			Other Workers		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Goasaba	Total	23,194	20,408	2,786	1,178	774	404	12,197	9,576	2,621
	Rural	23,194	20,408	2,786	1,178	774	404	12,197	9,576	2,621
	Urban	0								



District Primary- Industrial Category										
District	Total-Rural/ Urban	Marginal Workers			Cultivators			Agricultural Labourers		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Goasaba	Total	60,002	32,096	2 7,906	7,489	4,934	2,555	36,917	21,369	15,548
	Rural	60,002	32,096	2 7,906	7,489	4,934	2,555	36,917	21,369	15,548
	Urban	0								

Census Abstract of Marginal Workers										
District	Total-Rural/ Urban	Household Industry workers			Other Workers			Non Workers		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
Goasaba	Total	3,749	762	2,987	1 1,847	5,031	6,816	1,35,602	50,094	85,508
	Rural	3,749	762	2,987	1 1,847	5,031	6,816	1,35,602	50,094	85,508
	Urban	0								

## 5.3 RESOURCE DEPENDENCE OF THE VILLAGES

The lack of industries coupled with high population density has led to a high level of resource dependency. Dire poverty is the primary reason for people venturing into the forests braving risks like the man-eating tigers other fierce animals, frequent cyclones and storms. Every year some of these people who enter the forest fall prey to the tiger. They enter the mangrove forests for fishing, honey and fuel-wood collection. However, many miscreants often take the guise of fishermen and enter the forests with the intention of poaching and felling of timber species. Though in the past people would enter the forest for collection of golpata and hental leaves which are used for thatching. These practices have since been discontinued.

### 5.3.1 Fuel wood and Timber Collection

The people in many border areas especially the eastern sector used to enter the Tiger Reserve to collect fuel wood and at times timber species also. The main species collected were *Ceriops decandra* locally called as Goran. The sticks from these trees were used for fencing purpose and thicker ones for posts of houses. In addition to these *Avicennia* sp which also has high calorific value were also cut. Most of the mangroves have little timber value except *Xylocarpus* and *Heritiera* sp. Presently these activities has been totally stopped inside the tiger reserve.

In Arbesi Block under Jhingakhali beat of Basirhat Range, due to the silting up of the demarcating khal called the Shakunkhali and during low tide the forest and village side are separated by a distance of only 2-3 metres at some places. Although a nylon net fencing separates the forest from the village area all along Arbesi 1, there is a tendency of the people to cut the net to gain entry into the forest. This often leads to man animal conflict scenarios.

### 5.3.2 Fishing

Fishermen enter into the STR area for fishing after getting permits from the office of Sundarban Tiger Reserve. These permits are given for a specific time and area as mentioned in the permit. These permits are issued against registered Boat License Certificates or BLC's. Presently in Sundarban Tiger Reserve there are about 923 Boat Licence Certificates or the Fishing Permits, out of which three fourth are active and one fourth are lying inactive due to various administrative and technical reasons. However some irregularities have been noticed like the fishermen usually extend their period of stay in the forest area and try to enter non permitted areas.

### Range wise details of Fishing Permits (BLC's)

SI No.	Name of the Range	Active BLCs (Nos.)	Cancelled BLCs* (Nos.)	Total (Nos.)
1.	Basirhat Range	191	77	268
2.	Sajnekhali Wildlife Sanctuary	308	119	427
3.	Head Quarter Range	194	11	205
		693	207	923**

Note: 23 nos. RPT fishing BLCs have been temporarily suspended.

\* Vide letter no 2186/FD/2M-16

### 5.3.3 Tiger Prawn Seed Collection

This livelihood is has been heavily discouraged due its negative impact on the ecosystem. Presently only a handful of people are involved in this.

List of aquatic fauna trapped in tiger prawn seeds collecting net is as follows:

Fish species	Prawn Species	Crabs
Setipinna phasa,	Penacus indicus	Scylla serrata
Setipima taty	Metapenaeus sp	
Coilia reynaldi	Macrobractium rosenbergi	
Lates calcarifer	Palaemoides styliferu	
Daysciaena albida		
Cynoglossu lingua		
Scatophaizus argus		
Strongylura strongylur		
Sillaginopsis panijus		
Chirocentrus dorab		
Lira pursia		
Anguila bengalensis		
Terapon jarbua		
Ponadasys argenteus		
Epinephelus taurina		
Lutjanhus johni		

### 5.3.4 Honey Collection

Rock bees (*Apis dorsata*) from the Himalayas visit the Sundarbans forest every year. Most of the mangrove flowers are highly nectar bearing. This attracts the rock bee to visit Sundarbans during summer months which is the main flowering season. Flowering starts with the bloom of *Aegiceras corniculatum* during end of March and is followed by the flowering of *Acanthus ilicifolius*, *Avicennia spp.*, *Sonneratia apetala*, *Rhizophora spp.* This continues for two months during April and May. The density of honey depends on the number of salt - excretory glands available on the tree. The Khalsi (*Aegicras corniculatum*) having 19 glands per sq mm. gives the best honey. As rock-bees are migratory so the experiment of setting up apiaries has failed. The honey from Khalsi is considered to be the best in quality. The Goran produces the maximum and the minimum is obtained by Gnewa. It has been found that Gnewa bears about 39% of honey comb and Bain 16%, Garan 11%, Garjan 10% and others bear only 24%. The ideal site for construction of hive would be Hental-Gnewa combination forests.

Honey Collection is a very important activity in Sundarbans. A lot of people are involved in honey collection which is facilitated by the Forest Department. The collection of honey begins from the month of *Chaitra* (March-April) and



continues for about two to three months. This is the time when most of Sundarban flora is in full blossom. Permits are issued to the honey collectors after the minimum support price is decided by a joint meeting of the Sundarban Tiger Reserve management and West Bengal Forest Development Corporation. Each permit allows 6 - 10 people enter the forest areas. During this period, fishing is stopped. Floating camps are put up with armed staff equipped with RT sets, speed boats etc. are placed in different places in Sajnakhali, Tarakhali and in Gabbani to keep a watch and ward over the entire activity and to attend to the emergencies like tiger attack, snake bite etc.

Honey collectors are locally called "Moulis". There are two types of "Moulis" - the 'Kande' mouli are the experienced ones, whereas the 'hata' moulis are the inexperienced ones. Honey collectors enter the forest and look out for honey bees and once they find a bee they follow its trail and enter the forest in search of honey combs. Before entering the forest, blessings are sought from local spiritual/religious leaders and offerings are made to forest deities such as *Banbibi*, *Dakshin Rai*, and *Badi Ghazi Khan*. Local shaman called "gunin", as well as other local spiritual leaders, supply blessed pieces of red cloth and other charms to keep villagers safe during their trip to the forest. *Gunins* accompany some user groups, particularly honey collectors, for the entire duration of their trip. In these cases, the *gunin* will ensure that the group adheres to a range of practices that show respect to the forest spirits, and will also use various incantations to make an area safe. Mostly experienced people go to the same area and tree in search of the honey comb every year. The honey combs are mainly found in Bain (*Avicennia spp.*), Garan (*Ceriops spp.*), Genwa (*Excoecaria sp.*), Dhundul (*Xylocarpus granatum*), Keora (*Sonneratia spp.*), Garjan (*Rhizophora sp.*) and Sundari (*Heritiera sp.*). On detecting a honey comb the honey collectors smoke out the bees using torches of Phoenix leaves called as 'Bolen' (bunch of leaves). They take care not to damage the eggs, larva and etc found in the comb. The honey collectors come back to the same comb after fifteen days and again cut them. The second time the yield is normally 60% that of the first time. One of the drawbacks of Sundarban honey is that it contains more moisture than honey obtained from other areas due to which it ferments quickly.

### 6.3.5 Threat to Poaching

Many species like tiger, deer, wild boar, water monitor and Olive Ridley turtles are vulnerable to poaching. Poachers in Sundarbans use many techniques like nylon rope traps, steel wire traps, gun shots, poisoning etc. to poach the target animals. There are clandestine local markets for deer and boar meat. Olive Ridley turtles are also poached by fishermen because of their meat.

#### Poaching Cases in Sundarban Tiger Reserve

Year	Name of Animal	Number
2003-2004	Spotted Deer	1
	Olive Ridley Turtle	1
2004-2005	Wild Boar	1
2005-2006	Spotted Deer	2
2006-2007	Wild Boar	4
2007-2008	Spotted Deer	4
2008-2009	Tiger	1
2009-2010	Spotted Deer	3 (POR cases have been lodged after arresting the accused)
2010-2011	NIL	NIL
2011-2012	Jungle cat	1 No. (Accused arrested & POR drawn)
2012-2013	Spotted Deer	1 (Accused arrested & POR initiated)
2013-2014	NIL	N.A.
2014-2015	Wild Boar	1 No. (Accused arrested & POR drawn)
	Spotted Deer	POR drawn
2015-16	Spotted Deer	2 Nos. (Accused arrested & POR drawn)
2016-17	NIL	NA
2017-18	NIL	NA

## 5.4 HUMAN-WILDLIFE CONFLICTS

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Human wildlife conflict has been recorded in this area from time immemorial. This is borne out by the old accounts of Sundarbans. One such account by Hunter(1878) shows the extent of conflict present.

“Tigers are very numerous, and their ravages form one of the obstacles to the extension of cultivation. They often commit terrible havoc among the cattle, sometimes on the husbandman or his family. The depredations of a single fierce tiger have frequently forced an advanced colony of clearers to abandon their land, and allow it to relapse into jungle. Mr. Westland relates that there was one great man-eater, whom the whole District was perpetually hearing about, in 1868. Hardly a week passed without one or two people being carried off by him, and his face and appearance were perfectly well known. He had apparently a charmed life. One day he came on board an Englishman’s boat, and coolly walked off with one or two of his oarsmen. The Englishman fired a blunderbuss at him, but it burst, and injured the shooter, while the tiger got off unscathed. On another occasion the tiger passed within a few yards of a gentleman, who fired at him, but again the beast escaped. This pest was finally killed by Mr Morrell of Morrellganj. Either this or another tiger contracted a habit of attacking boats passing through a certain khal near Morrellganj, and made the passage so dangerous, that the route was for a time given up. Rewards for the destruction of wild animals in the Sundarbans are paid from the treasury of the District to which the particular tract belong; but no information exists showing the separate rewards paid for the destruction of wild animals in the Sundarbans or of the annual loss of life caused by them. Porpoises and crocodiles (commonly called alligators) abound, but the latter are less numerous than they were twenty years ago. They are still, however, very destructive in the more populous parts of the Sundarbans, at the setting in of the hot weather. Colonel Gastrel states that, after the beginning of March, it is not safe to bathe in or take water from the streams, except at places specially protected by palisades of bamboos or wooden stakes. Even this precaution sometimes fails. Instances have been frequently known of crocodiles entering within the palisades from the landside during the night. In the morning, the first notice of the hidden danger is the struggles and shrieks of some unfortunate woman, seized and dragged under water by the reptile. Sharks, also, are by no means uncommon in the larger streams and estuaries.”

This piece of history tells us that the main conflict existed between the people and the tiger which started with the reclamation of the mangroves. This is despite the fact that the tiger is revered and is worshiped irrespective of caste and religion as “Dakhin Roy”, “Shah Jungali” throughout Sundarbans. It has been seen that, the conflict has also been recorded albeit to a lesser extent with other animals like crocodiles and snakes.

### 1.1.1. Human-Wildlife Conflict Outside the Forest

#### 5.4.1.1 Tiger Straying

The straying of tiger into the fringe villages outside the mangrove forest has been a very common phenomenon in the Sundarban Tiger Reserve. It is the main reason for conflict with the local villagers who perceive it as a serious threat to their livelihood due to the entry of the animal into their human habitation on the forest fringe. It has been seen that in the last 20 years apart from one occasion i.e in the year 2005 where a girl who came face to face with the tiger was injured and later succumbed to her injuries, there have been no case of human depredation by tigers in the village areas. The animosity of the villagers stems from the fact that many a times during such forays the tiger kills livestock which results in economic loss to the villagers besides creation of fear psychosis in the area. The people use to attack the animal because they are penalized by the field staff for theft/illegal activities like collection of fish, timber and small wood from the prohibited areas. So, the people take opportunity to assault the staff and at times even killing of the strayed out animal. The last such incidence was in the year 2001 where the villagers prevented the forest staff from reaching the spot where the tiger had strayed out in Pakhiralaya area. They killed the animal which then cut into pieces and thrown into the river. The case is sub judice in court.



A number of reasons have been attributed to the straying phenomenon. These include:

- Tigers in Sundarbans stray into the neighbouring villages because they are situated in the reclaimed forest land and in some places the boundary between the forest and agriculture land is no longer distinct with either silting up of the river channel separating (as in case of Arbesi 1 forest bordering Samsernagar, Kalitala ) them or the village side mudflat being covered by mangrove trees and resembling a forest area( as in case of Rajat jubilee). In the former case the tiger can easily walk across the river to catch the easy prey of cattle and goat just across the forest separated by hardly 6-10 feet.
- Tigresses sometimes come out of the forest to give birth inside the paddy field to possibly avoid danger from other males.
- Old aged, diseased and disabled tigers like the ones with broken tooth is another cause of straying because it is difficult to hunt the prey in the forest with such disabilities and they find it easy to prey on domestic cattle.
- Many a time's transients and sub adults looking to establish territory also stray out possibly driven out by the dominant males.
- A number of people also attribute the tiger straying to insufficient prey base. However, this is not backed by any scientific evidence.

It has been noticed that on many occasions the animals go back on their own but, at other times the Tiger Reserve management has to step in to rescue the animal. The area is thoroughly combed. The staff and local villagers try to drive out the animal back to the forest by using drums, crackers, torches etc. Night patrolling along the forest fringe is arranged and local people and the staff patrol the area with torches, generators are also pressed into service to illuminate the affected area. In case these methods are not successful then the animal is captured by trapping or chemical immobilization.

### Abstract of Tiger Straying & Live Stock Killed

Year	Range	No. of Tiger	No. of Livestock
		Straying Incidences	killed
2011-12	BHT	03	2
	SWLS	12	10
	NPW	02	NIL
2012-13	BHT	03	NIL
	SWLS	09	07
	NPW	NIL	NIL
2013-14	BHT	02	NIL
	SWLS	NIL	NIL
	NPW	NIL	NIL
2014-15	BHT	NIL	NIL
	SWLS	2	05
	NPW	NIL	NIL
2015-16	BHT	NIL	NIL
	SWLS	NIL	NIL
	NPW	NIL	NIL
2016-2017	BHT	NIL	NIL
	SWLS		
	NPW		
2017-2018	BHT	NIL	NIL
	SWLS		
	NPW		
2018-2019	BHT	NIL	NIL
	SWLS		
	NPW		

#### 5.4.1.2 Conflict with Crocodiles

The crocodiles are known to attack and kill people by dragging them into the water. Most of these cases have been reported when the people were bathing in the river waters. People who are engaged in tiger prawn seed collection by dragging the nets along the water have also fallen prey to these estuarine crocodiles inhabiting the tidal waters. Shark bites have also been reported in the same connection.

#### 5.4.1.3 Conflict with Snakes

The District of 24 Parganas South has the high probability of snake bites in the entire State. These bites are mostly caused by common Krait and Cobra which are found in the locality. Lack of proper information regarding the handling of snake bite cases coupled with poor medicare facilities result in high casualties. A number of NGO's have been working in this area to increase awareness about the same.

#### 5.4.2 Human-Wildlife Conflict within the Forest Areas

Inside the forest the behaviour of the animal is completely different. It is known to kill fishermen and honey collectors who venture out into the forests. This has been found from old records in Sundarbans of both Bangladesh and India that maximum attacks by tigers on human beings have been on honey collectors, who venture deep inside the forest areas in search of bee-hives. Honey collectors smoke out the bees using the leaves of *Nypa* and *Phoenix* which creates smoke and disturbs the animal and its habitat. Honey collectors become the easy prey of the tiger as many a times the members of collecting group get isolated because of very dense and impenetrable nature of the forest.



Fishermen and crab collectors are vulnerable to attack by the tiger. In this case, the tiger-human conflicts usually occurs in small creeks where the fishermen especially crab collectors enter for fishing/crab collection. During earlier times, when felling coupes were in operation there are records of tigers attacking both the forest staff and the labourers working in the coupes. Sometime prawn seed collectors are also attacked by the tiger in the forest areas.

#### Persons killed by Tiger and crocodile in Sundarban Tiger Reserve (Financial year-wise)

2011-12					
SI No	Date	Name of person with details (age, sex, address etc.)	Place of incidence	Killed or Injured	By which species
1	24.08.2011	Sukumar Bairagi, male, Sonaga	Chhotohardi-2 under NP(W) Range	Killed	Tiger
2	22.11.2011	Nikhil Mandal	Panchamukhani-5 under SWLS range	Killed	Tiger
3	07.12.2011	Nirapada Mandal	Panchamukhani-4 under SWLS Range	Killed	Tiger

2012-13					
SI No	Date	Name of person with details (age, sex, address etc.)	Place of incidence	Killed or Injured	By which species
1	30/06/12	Smt. Basanti Mondal w/o Basudev Mondal of Uttarbhangra Vill	Melmelia River	Killed	Crocodile
2	27/04/12	Sri Krishnapad Munda s/o Jatin Munda of Kumirmari	Arbesi-3 Comptt.	Killed	Tiger
3	20/06/12	Smt. Kalyani Mondal w/o Dinendra Mondal		Killed	Tiger
4	09/12/12	Sri Bistupada Gayen s/o Lt. Haripada Gayen of Lahiripur, SB Coastal PS	Tero banki side khal	Killed	Tiger
5	20/04/12	Sri Robin Sardar s/o Kalipada Sardar of Shyamnagar, PS- Kultali	Panchmukhani-3 Comptt.	Killed	Tiger
6	24/07/12	Sri Haru Mondal s/o Haladhar Mondal of Vill-Hingalganj (Dakshinpara), PO+PS-Hingalganj,	Pirkhali-6 Comptt.	Killed	Tiger
7	23/09/12	Sri Sushil Sardar s/o Lakshan Sardar of Rajatjubilee, SB Coastal PS	Pirkhali-5 Comptt.	Killed	Tiger
8	23/10/12	Sri Joseph Bairagi (Male- 55 Yrs.), Vill: Dulki, PS: Gosaba, S-24 Parganas	Dulki river side char	Injured	Tiger

2013-14					
SI No	Date	Name of person with details (age, sex, address etc.)	Place of incidence	Killed or Injured	By which species
1	17/6/13	Biswajit Mandal S/O of Adhar, Vill +PO-Luxbagan, PS-Sundarban Coastat	Pirkhali/6(SJF/208/13-14	Killed Dead body recovered	Tiger
2	6/8/13	Bhola sindhu mandal s/o late Haladhar Vill-Bidhan Colony po-chargheri ps-sundarban coastal	Pirkhali/6(sjf/55)	Killed Dead body recovered	Tiger
3	30/10/13	Somedh mistry s/o ratikanta Nehru palli, jharkhali/4 no po-jharkhali bazaar ps-basanti	Panchamukhani/4(cJF-66)	Killed Dead body not recovered	Tiger
4	7/11/13	Harendra mandal s/o-late jatin hentalbari, po-kalidaspur, ps-sundarbancoastal	Panchamukhani/4(SJF-260)	Killed Dead body not recovered	Tiger
5	18/11/13	Ujjal majumdar s/o-late Ratikanta satyanarayanpur ps-gosaba	Pirkhali/5(sjf/106)	Killed Dead body not recovered	Tiger
6	29/12/13	Kuddus molla s/o-siddiki molla vill+po-moukhali, ps-jibantala	Pirkhali/7(cgf/04)	Injured body recovered admitted at hospital and died on 4/1/14	Tiger
7	29/1/14	Sujit mandal s/o-late atikay vill+po-chargheri ps-sundarban coastal	Panchamukhani/5(SJF-140	Killed Dead body not recovered	Tiger

2014-15					
SI No.	Date	Name of person with details (age, sex, address etc.)	Place of incidence	Killed or Injured	By which species
1	06/05/2014	Kalpna Mandal W/O Pashupati Mandal, Vill-Rajatjublee, ps-sundarban coastal	Panchamukhani -1	Killed Dead body not recovered	Tiger
2	26/06/2014	Rambha Mandal, W/O- Shyamapada Mandal. Gobindapur, Mollakhali	Gobindapur	killed	Crocodile
3	19/07/2014	Susanta Mandal, S/O-Sanjay Vill-Kaikhali +PO-Kaikhali Ashram, PS-Kultali	Pirkhali/7(CJF/285/14-15	Killed Dead body not recovered	Tiger
4	25/07/2014	Sontosh Mandal s/o late Abhiram Vill-PO-Jamespur ps-sundarban coastal	Panchmukhani-1(CJF/77/14-15	Killed Dead body not recovered	Tiger
5	08/08/2014	Bhagabati Mandal, W/O-Sunil Vill+PO- dayapur PS-sundarban coastal	Jhilla-5 (SJF/250/2014-15)	Killed Dead body not recovered	Tiger
6	21/08/2014	Sekhar Biswas S/O- Ananta, Village-Bali, PS- sundarban coastal	Pirkhali-2	Killed Dead body not recovered	Tiger
7	24/08/2014	Sanjay Mandal, S/O-Lt Anukul, Vill-Deulbari, PS-Kultali	Jhilla-5(CJF/289/14-15)	Killed Dead body not recovered	Tiger
8	5/10/2014	Mrityunjoy Halder, S/O Sri Haridas Halder, Vill-Purba Gopalganj, PS- Kultali, South 24 parganas	Pirkhali-VI	Killed Dead Body found	Tiger
9	18/10/2014	Sishir Das, S/O Sudhir Biswas, Vill-Laskarpur, PO-Jahrkhali, PS-Basanti, South 24 Parganas	Pirkhali-VI	Killed Dead Body found	Tiger
10	20/10/2014	Sri Ramprasad Mondal, S/O Naren Mondal Vill.P.O-Pakhirala, PS-Gosaba	Pirkhali-I	Killed Dead Body Recovered	Tiger
11	23/12/2014	Sri Satish Mondal, S/O Late Satyacharamn Mondal, Vill+PO-Jamespur, PS-S.B.Coastal	Pirkhali-6 (S./F-36 of 2014-15)	Killed Dead Body Found	Tiger
12	12/01/2015	Tarapada Mistry, S/o Lt. Chandi Charan Mistry, Vill+PO-Bijoy Nagar, PS-Gosaba, South 24 Parganas	Pirkhali-III (CG/F/26 of 2014-15)	Killed Dead Body Found	Tiger
13	24/01/2015	Srinibas Sarkar, S/o Lt. Jatin Sarkar, Vill+PO-Dayapur, PS-S.B.Coastal, Choto Mallakhli, South 24 Parganas	Pirkhali-I (S./F/28 of 2014-15)	Killed Dead Body not Found	Tiger
14	23/11/2014	Denesh Mondal, S/o Dhananjoy Mondal, Vill-Rajatjubilee, PS-Coastal, South 24 Parganas	Pirkhali-III (S.J.f-134 of 2014-15)	Injured	Tiger
15	20/02/2015	Sukumar Biswas, S/o Lt KHapu Blswas, Vill-Ruihia Majhespara, P.O-Patulia, PS-Khardaha, North 24 Pargans	Panchamukhali-IV (SJ/F/254 of 2014-15)	Killed Dead Body Found	Tiger
16	25/03/2015	Amal Mondal, S/o Lt. Bishtu Pada Mondal Vill- Emilibari, S.B. Coastal, South 24 Parganas	Panchamukhni-III (SJ/F/ 295 of 2014-15 )	Killed Dead Body Not Found	Tiger

2015-16					
SI No.	Date	Name of person with details (age, sex, address etc.)	Place of incidence	Killed or Injured	By which species
01	22/09/2015	Late, Asit Mondal, Age – 32 Years, Sex – Male S/o, Sachin Mondal, Vill & PO – Jaharclolony, PS – SB Coastal, Dist – 24 PGS (South).	Panchomukhani – IV. B LC No, 15578/156, Dated, 27/06/2015 & SJ/F – 134 of 2015-6.	Killed Dead body not recovered.	Tiger
02	10/10/2015	Late, Arjun Sardar, Age- 35 Years, Sex – Male, S/o, Late, Jagendra Sardar, Vill – Tipligheri, PO – Sadhupur, PS – SB Coastal, Chottomollakali, Dist – 24 PGS (South )	Pirkhali – 3 Compartments. BLC, No. 15581/156 & Reg. No. SJ/F – 71 of 2015-16.	Killed Dead body not recovered.	Tiger
03	10/10/2015	Late, Anath Bandhu Kayel, Age -50Years, Sex – Male, S/o, Haripada Kayel, Vill & PO – Anandapur, PS – SB Coastal, Dist – 24 PGS (South)	Panchomukhani – V. BLC No, 15520/156, Dated, 26/06/2015. SJ/F – 284 of 2015-16.	Killed Dead body not recovered.	Tiger

Contd.



2015-16					
SI No.	Date	Name of person with details (age, sex, address etc.)	Place of incidence	Killed or Injured	By which species
04	09/11/2015	Late, Nikhilesh Mandal, Age – Nil, Sex – Male, S/o, Late, Monmotha Mandal, Vill & PO – Santigachi, PS – SB Coastal, Dist – 24 PGS (South )	Pirkhali VI. BLC, No, 39447/395, dated, 25/06/15 & Reg. No, SJ/F – 26 of 2015-16.	Body recovered	Tiger
05	11/11/2015	Late, Sahadat Gazi, Age – 41 Years, Sex – Male, S/o, Late, Haziruddin Gazi, Vill & PO – Birajnagar, PS – Gosaba, PS – Gosaba, Dist – 24 PGS (South)	Pirkhali – III BLC No, 15574/156, Dated, 27/06/2015.Reg, No. SJ/F – 136 of 2015-16.	Killed Dead body not recovered.	Tiger
06	09/12/2015	Late, Srikanta Barkandaj, Age – 45 Years, Sex – Male, S/o, Late, Joydeep Barkanda, Vill – Hetalbari, PO – Kalidaspur, PS – SB Coastal, Dist – 24 PGS (South )	Panchomukhali – V. BLC No, 15522/156, Dated, 26/06/20156 & SJ/F No, 154 of 2015-16.	Body recovered	Tiger
07	19/12/2015	Late, Monoranjan Mandal, Age – 45 Years, Sex – Male, S/o, Late, Kalipada Mandal, Vill & PO – Kumirmari, PS – SB Coastal, Dist – 24 PGS (South)	Zilla – VI. BLC No, 47493/475, Dated, 27/06/2015. Reg No, RP/F – 16 of 2015-16.	Body recovered	Tiger
08	08/02/2016.	Late, Subal Jaddar, Sex – Male, S/o, Late, Basanta Jaddar, Vill – Mitrabari, PS – SB Coastal, Dist – 24 PGS (South )	Panchomukhali – III. Reg No, BN/F – 115 of 2015-16.	Body recovered	Tiger
09	08/03/2016	Late, Parech Ch. Mandal, Age – 49 Years, Sex – Male, S/o, Late, Bijoy Mandal, Vill & PO – Jemaspur, PS – SB Coastal, Dist – 24 PGS (South )	Pirkhali – I. BLC No, CG/F – 13 of 2015-16. 795144/7952, dated, 29/03/16.	Body recovered	Tiger
10	25/03/2016	Late, Mukta Mandal, Age – 35 Years, Sex – Male, S/o, Nitai Mandal, Vill & PO – Kalinagar, PS – Sandeshkajli, Dist – 24 PGS (South )	Panchomukhali – III. BLC No. 217517/2176 date, 14/03/2016. SJ/F – 174 of 2015-16.	Killed Dead body not recovered.	Tiger

## 5.5 INPUTS OF LINE AGENCIES/OTHER DEPARTMENTS

A number of line Departments and NGO's are active in the area. In the year 1979 the Government of West Bengal created a separate ministry called as the Sundarban Affairs Department to give impetus to the development works in the area. The Department constituted the Sundarban Development Board with representatives from a number of line departments including the forest. The board carries out development works in the area like plantations, jetty construction, organising health camps, construction of brick paths, providing drinking water, solar street lights etc. The work is executed mainly with the help of NGO's. However, it has been seen that no substantial development has occurred in the area and more so in the fringe area.

In addition to the above the Irrigation department is responsible for the maintenance of the earthen embankments of over 3500 km. This is an onerous task and it is seen that the bunds are not maintained properly possibly due to paucity of funds. This was borne out when there was large scale breaching in the embankments following cyclone Aila.

The agriculture department is involved in extension activities and they also distributed some paddy seeds for sowing in the aftermath of Aila.

The police presence is through their Police Stations at Gosaba and Choto Mollakhali (for South 24 Parganas) and Hingalgunj (for North 24 Parganas area). The Choto Mollakhali coastal PS which was established in February 2009. Prior to its establishment the Gosaba GP was looking after the entire area. However now the jurisdiction has been divided with the Gosaba PS looking after Bali I GP, Bali II GP, Pakhiralaya GP and Rangabelia GP. The Choto Mollakhali coastal PS

looking after the entire Tiger Reserve and in addition Chotomollakhali GP, Kumirmari GP, Satjelia GP, Lahiripur GP, Amtali GP, Radhanagar GP and Taranagar GP. The last three do not fall under the designated zone of influence of the Tiger Reserve. The Hingalgunj PS looks after the Jogeshganj GP and Kalitala GP areas. All the offence cases occurring within the Tiger Reserve are booked with coastal PS. The police stations also render assistance at times especially to control the mobs during the tiger straying incidences and in village raids.

The District administration is represented by the BDO at the block level. He coordinates all the development works which are executed by the Panchayats at the village level. A number of NGO's are also involved in the development works in the area working on private funding or working on the behalf of different departments. They have made a positive impact especially in case of SHG formation, health care development through mobile medical camps. A few leading NGO's active here are Rangabelia society which involves local women on a large scale to develop and market local handicrafts like batik. They also package and sell Sundarban honey and are involved in conducting medical camps. The SHIS or Southern Health Improvement Society is very well known in the area for working in the health sector. WWF is also involved in capacity building of the fringe people. They have tried to introduce people to commercial cultivation of tiger prawn seedlings, artificial crab fattening etc. But have met with limited success. The different schemes are discussed in subsequent chapters (Chapter 9). Apart from this a number of local NGO's are also active in the region. A list of local NGO's is given below:

#### List of NGOs in Sundarban Tiger Reserve

SI No.	Name	SI No.	Name
01.	WWF-India, (State Office), Kolkata	11	Sabuj Kalyan Unnayan Samity, Sonakhali
02.	WWF-Sundarban Development Programme	12	Anwasha for Science, Gosaba
03.	Nature Environment & Wildlife Society (NEWS), Kolkata	13	Southern Health Improvement Society(SHIS), Bhargar
04	Institute of Climbers & Nature Lovers, Dayapur, Dist. 24-PGS(S)	14	Gabindapur Palli Unnayan Samity, Chotomollakhali
05	Sundarban Environment & Eco-development Society (SEEDS), Kolkata	15	Udayan Sangha, Baghajatin, Kolkata
06	Tagore Society of Rural Development, Gosaba	16	Bharat Sevashram Sangha, Kolkata
07	Bally Nature & Wildlife Conservation Society, Bally	17	Wildlife Conservation Trust, Mumbai
08	Canning Juktibadi Sanskritik Sanstha, Canning	18	Sanctuary India, Kolkata/Mumbai
09	Rupayan --- a branch of Narendrapur Ramkrishna Mission, Gosaba	19	Society for Heritage and Ecological Researches (SHER)
10	Sundarban Unnayan Niketan, Sonakhali		

Overall, it is felt that the eco development work carried by the Tiger Reserve in the fringe areas has been better in terms of both the quality and quantity

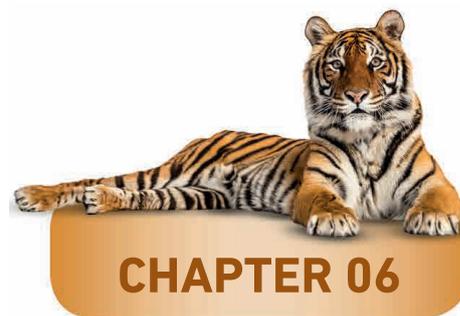
# **BUFFER AREA**

## **PART B**

### **Proposed Management**



# Vision, Goal, Objectives and Problems



## 6.1. BUFFER ZONE

### 6.1.1. Vision

Conservation of viable populations of the tiger, its co predator and prey species, along with all other floral and faunal assemblages of this unique mangrove ecosystem and also manage eco-tourism and other anthropogenic activities pertaining to fishing, crab collection and honey collection.

Note: There are no villages inside the boundary of the Tiger Reserve

### 6.1.2. Management Goals

For buffer zone: The area to serve as a sink for the wildlife population dispersing out from the core. Local communities shall be made partners in conservation by strengthening the alternative livelihood approach with an aim of reducing the natural resource dependency.

### 6.1.3 Management Objectives

1. To strengthen the alternate livelihood approaches by carrying out eco-development activities in the fringe villages so as to elicit the support of the local communities for conservation.
- 2 To stress on reciprocal commitments from the local stakeholders who are recipients of benefits from the eco development activities with regards to conservation of the habitat integrity of the area.
- 3 To act as a nodal agency to coordinate the activities of the various governmental and non governmental agencies working for the development of the area.
- 4 To mitigate the man animal conflict through active management interventions along with cooperation from the local stakeholders.
- 5 To promote ecotourism in a planned manner to generate awareness

### 6.1.4. Problems in Achieving Objectives

There are a multitude of problems being faced in the area which pose a challenge in achieving the desired management goals and objectives. These are listed below:

1. A porous international boundary with Bangladesh which makes the area vulnerable to international poachers, timber and honey smugglers.
2. Inadequate staff strength in the frontline staff category is another challenge for protection.

3. Poor infrastructure due to difficult landscape
4. The forest on the northern and western fringes is surrounded by human habitations with very high population density. The poor socio-economic condition of the people with low literacy levels, absence of proper skill sets, and lack of employment opportunities in the absence of any industries leads to a high degree of natural resource dependency for both sustenance and livelihood.
5. Absence of a research officer despite a sanctioned post has adversely impacted research related activities.
6. High tourist influx leads to overcrowding at the limited tourist spots.
7. Large scale pollution especially due to improper disposal of solid wastes.
8. Unstable nature of land poses a major challenge especially in creation and maintenance of infrastructure like buildings and jetties which become vulnerable due to sudden incidences of soil erosion and subsidence of land.
9. Corrosive nature of sea breeze and saline water also pose threat to infrastructure like fences, boats, iron based doors, windows, grills etc leading to very high maintenance costs.
10. Siltation in most of the rivers creeks and channels pose a major threat to navigation of water crafts.
11. Natural calamities like cyclones 'Sidr' and 'Aila' which have resulted in large scale destruction of property and life especially by damaging houses and flooding arable land with saline water also caused large scale damage to many of the protection camps.
12. Climate change is a worldwide phenomenon has resulted in changed weather patterns leading to few but more intense cyclonic storms; delayed rainfall, flooding at many places and even rise in sea water level over a period of time. This poses a long term threat to the very existence of Tiger Reserve.
13. Absence of drinking water at most of the places creates a hindrance in the development of protection camps at many desired locations.
14. Presence of an international waterway which passes along the boundary of S.T.R and is used by vessels carrying fly ash etc may poses an ecological hazard in the event of any mishap by way of sinking of the vessel.

### **6.1.5. Strength – Weakness – Opportunities – Limitations (SWOT) Analysis**

#### **Strength:**

1. Absence of any villages/settlements in the Tiger Reserve.
2. One of the largest stand alone tiger populations in the country. Inaccessible nature of forest acts as a natural barrier.
3. Ecological contiguity of habitat (mangrove forests) on both sides of the area i.e. Bangladesh Sundarbans on the East, adjoining forest Division 24 Parganas South on the West.
4. Extremely rich in biodiversity especially populations of many threatened animals like horse shoe crabs, Irrawaddy and Gangetic dolphins, olive ridley turtles, king cobra etc.
5. Largest contiguous patch of mangrove forest (along with Bangladesh) in the world and constitutes 60% of the total mangrove forest area in the country.
6. A World Heritage Site and a globally recognized Biosphere Reserve.
7. Compact and dense nature of forest acts as a natural shelter belt and protect the hinterland especially Kolkata and its surrounding areas from natural calamities like tidal surges and cyclones.
8. The mangrove ecosystem is highly productive, self sustaining and with a high regenerative capacity and serves as nursery for the finfish and shellfish. It also serves as the source population for the entire eastern coast fisheries.
9. Appreciable levels of conservation awareness among the masses.
10. Presence of staff trained in tranquillisation in all the vulnerable forest camps at the fringes who can effectively deal with the any tiger straying emergency.



## Weakness

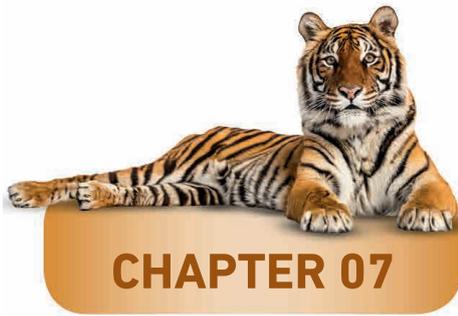
1. High population density coupled with poor socio- economic condition of people living in the fringe areas due to lack of industries and proper infrastructure leading to high resource dependence.
2. Considerable vacancy in frontline staff positions and difficulty to work in a remote terrain.
3. Absence of drinking water at most of the places.
4. Lack of proper research and monitoring of ecological processes and population dynamics of key species.
5. Inadequate interagency coordination and lack of proper intelligence sharing.
6. High influx of tourist.

## Opportunities:

1. High tiger densities given the extremely good quality habitat with good prey base if, proper protection is provided.
2. Potential increase in the fish production if, regulated properly by restriction on fishing during breeding time, no. of people fishing in the area, along with the types of fishing net used.
3. Excellent scope for carrying out research and monitoring studies especially those related to climate change, radio-telemetry studies on the tiger to study its ranging pattern territory and breeding biology.
4. Preserving the world's largest contiguous mangrove forest in the world and the largest mangrove area in the country.
5. Scope for raising conservation awareness among the fringe populations and tourist visiting the area.

## Threats:

1. Porous international border with Bangladesh makes the area vulnerable to timber and honey smugglers, and poachers. Of late, alerts have been sounded for the extremists trying to sneak into the country using this route. Similarly there have been reports of Maoists also trying to increase their presence in these areas.
2. Increase in the natural resource dependency of the fringe villages in the aftermath of cyclone Aila which rendered large number of arable tracts of land unfit for agriculture due to inundation by saline water.
3. Mushrooming of large number of tourist lodges, increase in number of tourists.
4. Presence of an international waterway within the Reserve with vessels/cargo ships plying with loads of fly ash etc.
5. Siltation of river channels.
6. Upstream river pollution due to the effluent discharge from Kolkata to different channels eventually reaching Sundarbans has negative impacts such as eutrophication of estuaries. Increasing nutrients availability introduces an instability into mangrove forests that lowers their resilience to environmental variability. The instability arises because nutrients, particularly nitrogen, stimulate growth of shoots relative to roots, thereby enhancing productivity during favourable periods but increasing vulnerability to water stress during drought. Enhanced instability with coastal eutrophication has far reaching consequences for many aspects of mangrove ecosystem function under contemporary and future climate conditions (Manna et al. 2010; Dynamics of Sundarban estuarine ecosystem: eutrophication induced threat to mangroves
7. Global warming and rise in sea levels is a looming threat.
8. The area is prone to cyclonic surges and storms.
9. Increased cattle smuggling to Bangladesh using the forest area makes the wildlife of Sundarban Tiger Reserve vulnerable to disease which might spread from the smuggled cattle.



# Management Strategies

## 7.1. BUFFER ZONE

### 7.1.1. Delineation of Buffer Area

The buffer area lies towards the north of the Critical Tiger Habitat and comprises an area of 885.27 sq km. It comprises of the Sajnekhali Wildlife Sanctuary having an area of 362.40 sq km and the adjoining Bashirhat Range having an area of 452.44 sq km. In addition to this, 70.43 sq km which administratively falls under the Wildlife Sanctuary Range also constitutes part of the buffer area. The buffer area has been officially notified vide Department of Forests No. 10054-For./FR/01/IIM-28/2007 Dt: 24.12.2009 (**Appendix 10**)

### 7.1.2. Zone and Theme Approaches to Management Strategies

For the convenience of management of the Tiger Reserve, it has been divided into different zones which have their own management objectives and strategies. Apart from this, common issues cutting across the area have been dealt in the theme plans.

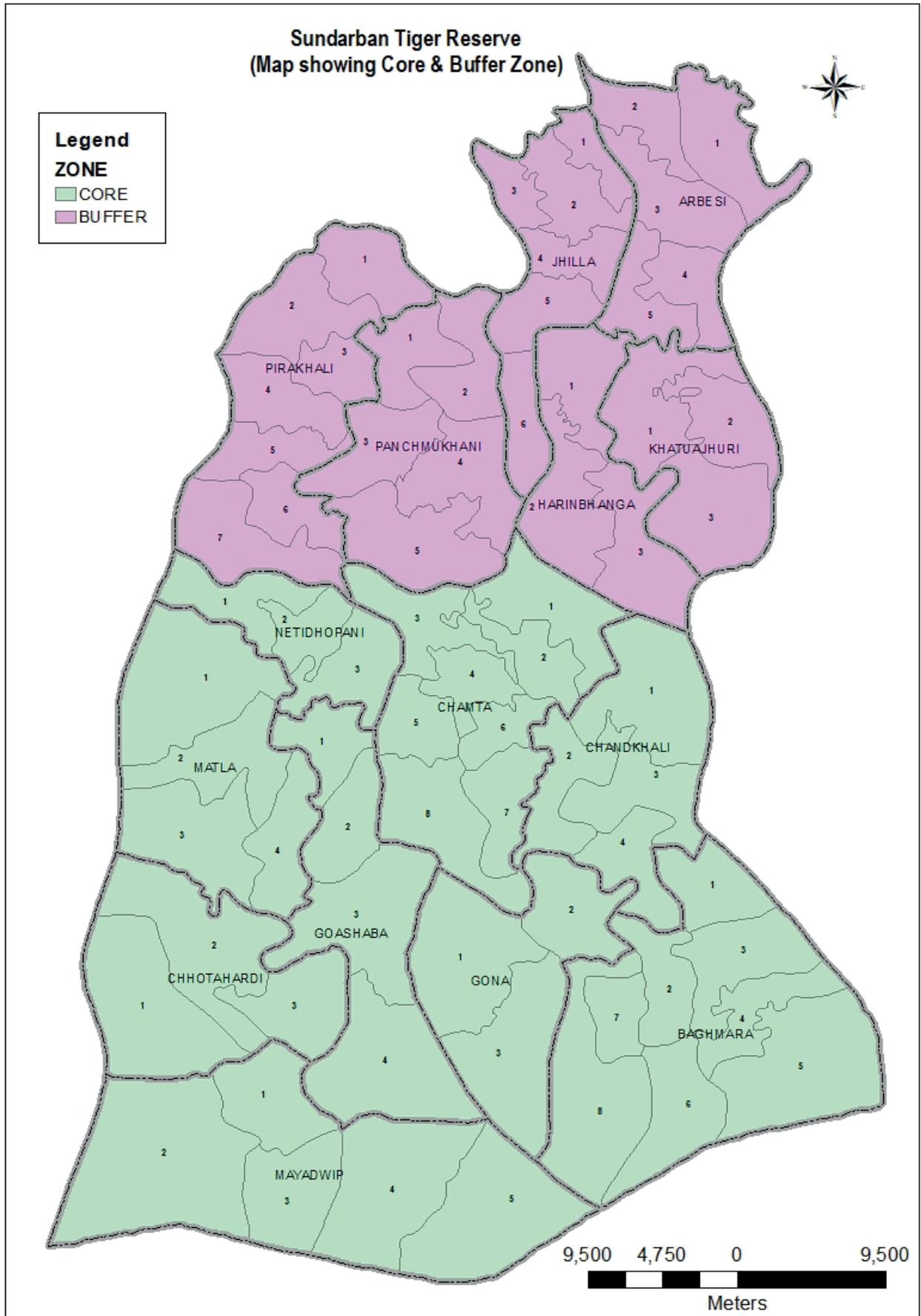
#### 7.1.2.1. Zone Plans

The buffer area of the Sundarban Tiger Reserve can broadly be divided into the following zones for the purpose management.

1. Sustainable natural resource use zone
2. Eco-tourism Zone
3. Eco-development Zone
4. Zone of International Boundary
5. Habitat Management Zone

**7.1.2.1.1. Sustainable Natural Resource Use Zone:** This zone lying towards the north east of the Tiger Reserve comprises of the following block and compartments.

SI No.	Block	Compartment	Area (sq. km.)	Legal Status
1	Arbesi	1-5	150.48	RF
2	Jhilla	1-6	123.14	RF
3	Khatuajhuri	1-3	132.24	RF
4	Harinbhanga	1-3	116.91	RF
<b>Total</b>			<b>522.77</b>	



**Figure 1:** Map showing the core and buffer zone of Sundarban Tiger Reserve



**Figure 2:** Map showing the buffer area demarcated as Zone of Influence, which is sustainable natural resource use zone.

### Objectives:

1. To allow regulated resource use in the area.
2. To mitigate man animal conflict in the area.

This area lying on the north-east side of the Tiger Reserve shall be open to regulated fishing and honey collection, as these resources help the people in the peripheral villages to sustain their living. In addition the area has a good scope for eco-tourism activities. The area is prone to high frequency of tiger straying. The forest department is trying to generate viable alternate livelihood options for the local people in order to reduce the dependency on the natural resources. Details of these activities shall be discussed in the corresponding theme plans.

**7.1.2.1.1.1 Sustainable Natural Resource-Use Management:** At present natural resource use is permitted in the designated Multiple Use Area comprising of 522.77 sq. km. Presently, the Tiger Reserve management allows fishing against valid permits known as Boat License Certificates (BLC's). Apart from fishing seasonal honey collection is also allowed in the months when fishing is closed (due to breeding period of the fishes).

### Objectives:

1. Streamlining the process of mutation of the existing BLC's.
2. Gradual reduction in the dependency of the fringe communities on the natural resource use.
3. To regulate the resource use in a manner to help attain long term sustainability.

### Strategies:

1. **Fishing:** Fishing is allowed against a permit called as BLC or the Boat License Certificate which is non-transferable and renewed annually. As per records, 923 number of BLC have been issued in Sundarban Tiger Reserve of which at present approximately three fourth are active and the rest one fourth are inactive. Fishing is closed for a period of 3 months from April – June which is the spawning time of the fishes. Mechanized fishing boats are not allowed within the Tiger Reserve. A typical fishing party consists of the BLC owner and 6-8 co-fishermen or 2-3 co-fishermen in case of crabs collectors.

Fishing trawlers and mechanized boats occasionally enter the Tiger Reserve. The trawlers have occasionally been found to be using the Tiger Reserve as a transit route to the sea where they carry out their fishing. Mechanized fishing boats from the adjacent Forest Division i.e. 24-Parganas (South) also enter the Tiger Reserve area with the intention of fishing in the core area. Trawler movement may be permitted on humanitarian grounds only in case of rough weather but not as a rule. Mechanized fishing boats should not be allowed in the Tiger Reserve and all illegal entries be dealt with as per the provisions of IFA, 1927 and Wildlife (Protection) Act, 1972 amended up to date.

2. **Honey collection:** The period in which the Tiger Reserve is closed for fishing coincides with that of the honey collection i.e. April-May. Most of the fishermen double up as honey collectors during this period. Though, there are traditional honey collectors locally called as 'mouley' also who come to the Tiger Reserve from far off places to collect honey. Over all 800-1000 people are engaged in this collection process.

The West Bengal Forest Development Corporation which is the main buyer of honey fixes the yearly targets in consultation with the Forest Department. Based on these targets the Ranges distribute the permits with individual targets and timelines. Honey collection involves a lot of risk considering the tendency of the tiger to attack inside the forest, and accidents occur almost on yearly basis even though the Tiger Reserves does the Janata Insurance Policy for these honey collectors.

The number of people who depend on it are also not substantial. This activity should be gradually discontinued and the honey collectors may be trained in other vocational skills like apiary boxes, aquaculture etc.

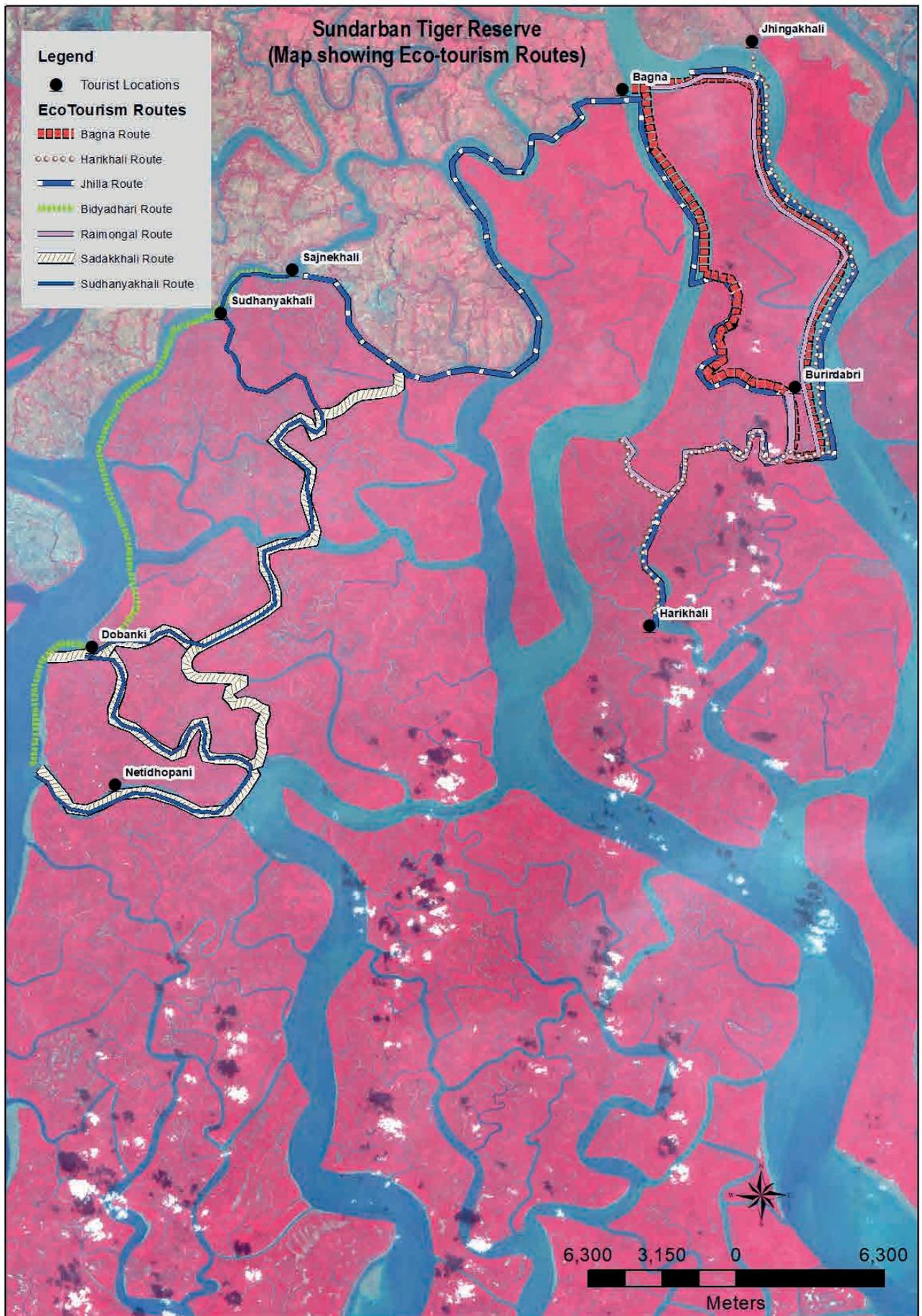
Following alternate livelihood activities to be taken up by dovetailing the similar schemes of other departments so that the meaningful impact can be achieved.

- Carpentry
- Diesel generator set repairing
- Training as electrician
- Plumbing works
- Hospitality management training
- Mobile repairing
- Masonry
- Solar light repairing
- Tailoring
- Embroidery
- Pisciculture
- Ornamental fish culture
- Apiculture
- Honey processing
- Brown rice production
- *Gamchaa* making
- Incense stick making
- Poultry farming
- Goat rearing
- Pig rearing

**7.1.2.1.2. Eco-Tourism Zone:** With the vision of spreading awareness among the common masses the selected area of buffer areas has been chosen as ecotourism zone.

The following blocks and compartments are part of this zone.

SI No.	Block	Compartment	Area (sq. km.)	Legal Status
1	Pirkhali	1-7	199.73	WLS
2	Panchmukhani	1-3	88.98	WLS
3	Arbesi	1-5	140.38	RF
4	Jhilla	1-4	83.29	RF
5	Khatuajhuri	1	43.21	RF
6	Harinbhanga	1	32.67	RF
7	Netidhopani	1	30.5	RF
	<b>Total</b>		<b>618.76</b>	



## THE EXISTING TOURIST ROUTES CIRCUITS

Presently the entry in the ecotourism zone of Sundarban Tiger Reserve is restricted through Sajnekhali and Bagna only. All watercrafts must report to Sajnekhali or Bagna and thereafter may take any of the following routes. The routes being used currently are:

### **ROUTE CIRCUIT NO. 1: Sudhanyakhali Route**

**Description of the route:** Enter Sundarban Tiger Reserve – Sajnekhali- Sudhanyakhali- Sundarkhali- Choragazikhali- Dobanki Exit OR proceed to – Naubanki- Deulbharani- Goasaba- Netidhopani- Exit Sundarban Tiger Reserve.



**Route circuit No. 2: Jhilla Route**

**Description of the route:** Enter Sundarban Tiger Reserve via Sajnekhali – Sadakkhali- Dutter – Jhilla- Harikhali/ Balkhali- Khatuajhuri- Burirdabri camp – Burirdabri khal- Jhila- Raimangal-EXIT Sundarban Tiger Reserve



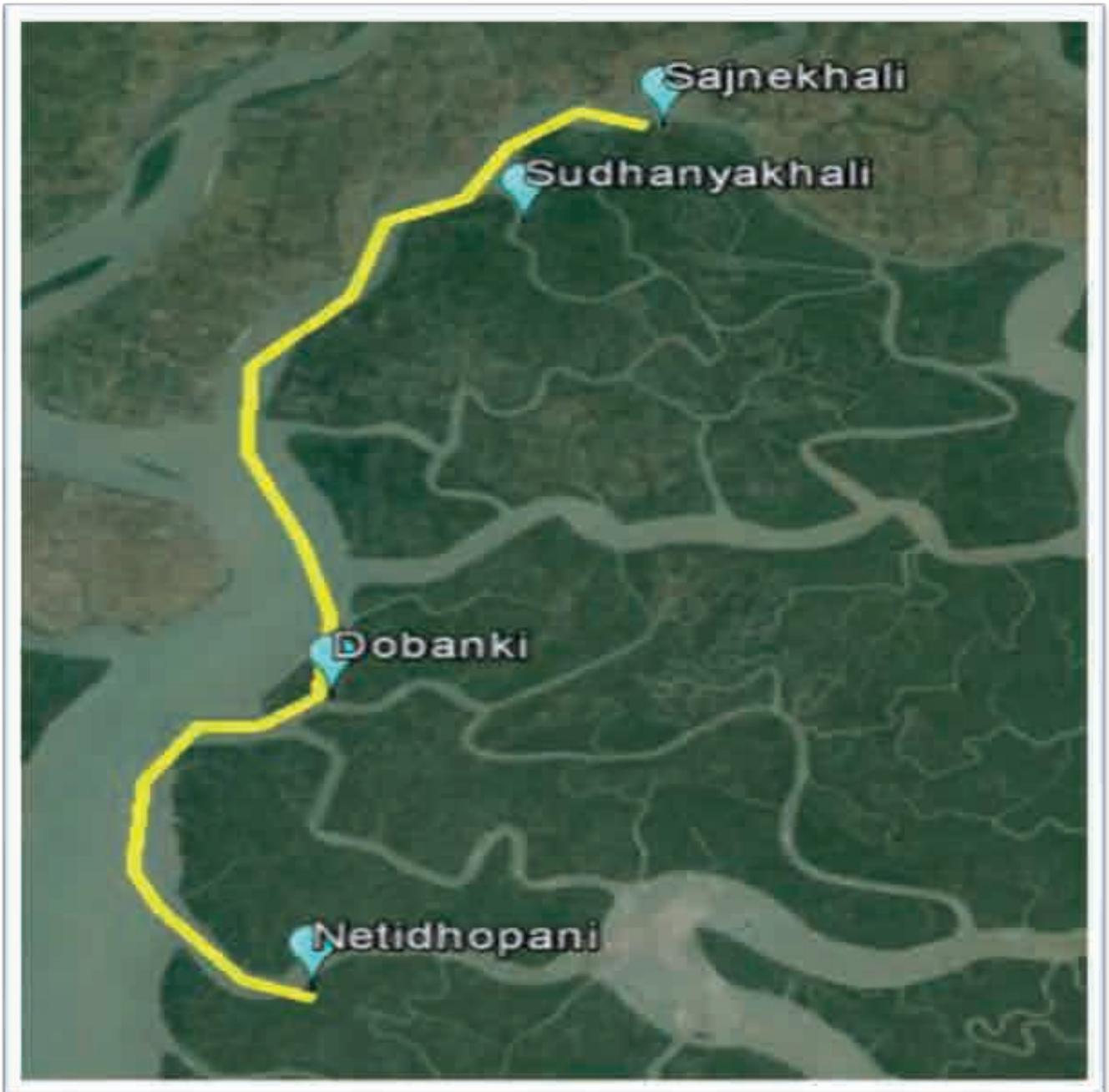
**Route circuit No. 3: Sadakkhali Route**

**Description of the route:** Enter Sundarban Tiger Reserve via Sajnekhali – Sadakkhali- Sudhanyakhali khal – Sundarkhali – Ghazikhali- Dobanki- EXIT or to Naubanki – Deulbharani - Goasaba – Netidopani and EXIT Sundarban Tiger Reserve



**Route circuit No. 4: Bidyadhari Route**

**Description of the route:** Enter Sundarban Tiger Reserve via Sajnekhali – Bidya river- Dobanki -Netidhopani and EXIT Sundarban Tiger Reserve



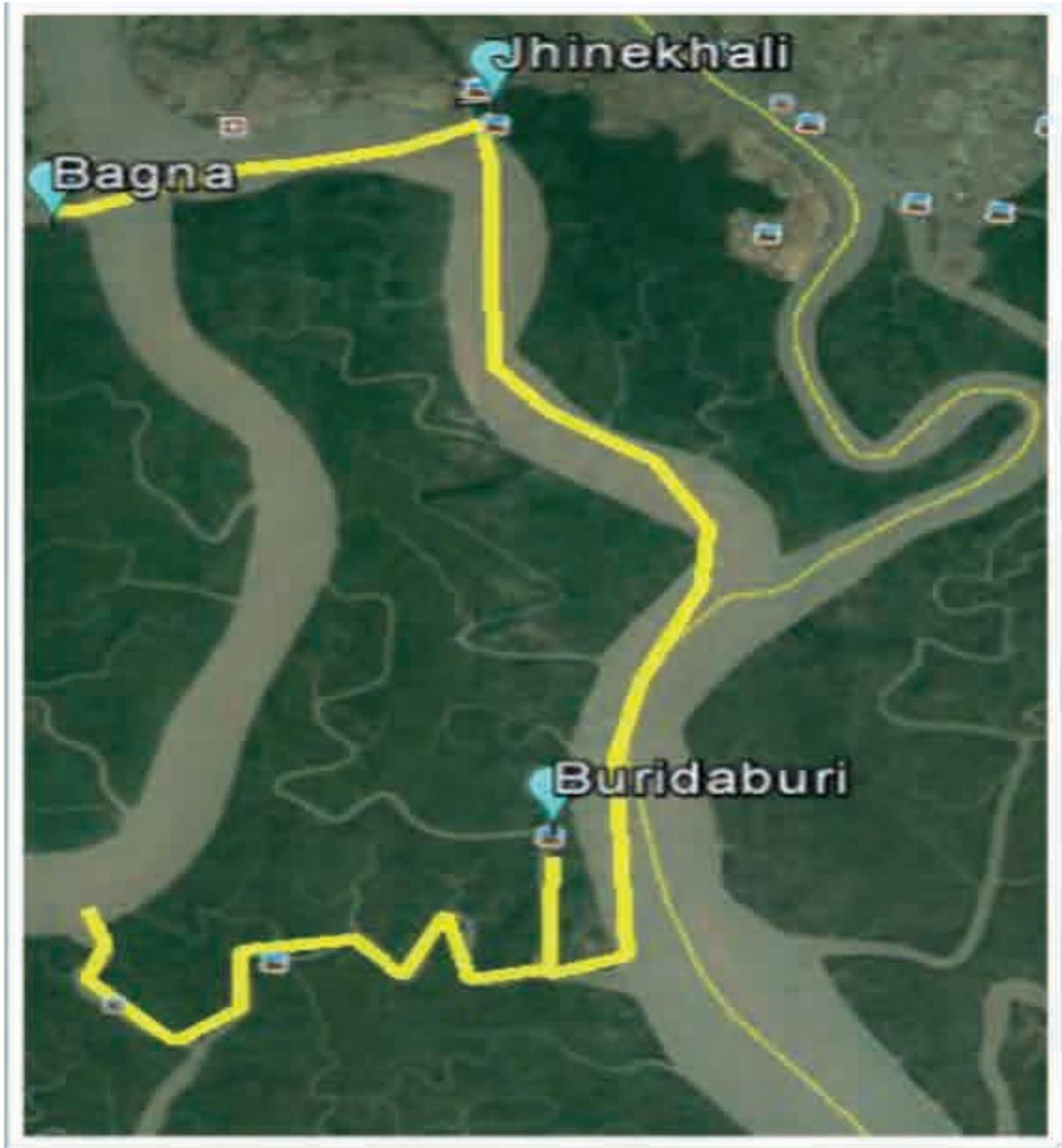
**Route circuit No. 5: Bagna Route:**

**Description of the route:** Enter Sundarban Tiger Reserve via Bagna – Jhilla – Burirdabri khal - Burirdabri camp – Balkhali- Raimangal- EXIT Sundarban Tiger Reserve



**Route circuit No. 6: Raimangal Route**

**Description of the route:** Enter Sundarban Tiger Reserve via Bagna – Jhingekhali – Raimongal- Burirdabri complex – Khatuajhuri – Balkhali-Raimongal-EXIT Sundarban Tiger Reserve



**Route circuit No. 7: Harikhal Route**

**Description of the route:** Enter Sundarban Tiger Reserve via Bagna – Jhingekhali Raimongal- Burirdabri complex - Gabbani khali- Khatuajhuri khal- Harikhal- Exit-Bolkhali –Jhlla.



**Objectives:**

1. To promote eco-tourism and allied activities to help boost the local economy.
2. To create conservation awareness among the masses.
3. To showcase the wonderful natural heritage of the area.

4. Forging partnership with the local communities and thereby developing their stakes in the conservation process.
5. Enhance the visitor experience to the area by suitable interpretation.
6. Carry out low impact eco-tourism.
7. To check the unregulated flow of tourists to the Tiger Reserve.

Over the years ecotourism activities in the area have multiplied manifold. This has been accompanied by mushrooming of new lodges, resorts, hotels catering to all categories of tourists. This increase has led to problems like waste disposal, water pollution and overcrowding of tourist places etc. Eco-tourism has to be regulated based on the carrying capacity of the area and ways and means devised to address all the accompanying issues.

#### **Problein Achieving the Objectives:**

1. Limited access to the forest areas on foot only in camps
2. Visibility in the forests is limited to areas along the bank and to the exposed mud flats during low tides. Thick undergrowth and cyclical tidal rhythms often interfere with the visibility often leading to poor sightings resulting in low visitor satisfaction.
3. Watercraft which are the only means of transport are often old and not compliant with pollution standards.
4. Limited number of tourist spots catering to large number of tourists.
5. No proper place / policy for garbage and sewage disposal.

#### **Strategies:**

**Determination of Carrying Capacity:** The tourists visiting the Tiger Reserve has been growing at an exponential pace. In the last five years the number of tourists visiting the Reserve has almost doubled. Presently the total number of visitors annually visiting the Reserve is presently close to two lakh. At present, there are only seven sites which are open to the tourists visiting the area. The tourist numbers need to be worked out on basis of the carrying capacity of the area. Also, these sites are located at two extreme ends i.e. the north western and the north eastern corner. Travelling from one end to another is time taking so visitors with less time at hand are not able to visit the Cage Trail at Burirdabri as well as canopy walk in Dobaki, which is a unique experience and needs to be replicated. An important step in this direction would be to identify circuits and limit the number of boats/ launches to a number arrived at basis of carrying capacity and other management considerations so as to control the number of tourists at tourist spots. Towards this end, the existing tour operators extended their area of operations to include the tourist destinations of the neighbouring 24 Parganas Division and also towards the eastern part of the Reserve. The Department can play a facilitating role in this regard.

#### **Carrying Capacity as per NTCA Guidelines:**

Estimation of visitor carrying capacity as per Guidelines for preparation of Tiger Conservation plan (issued by NTCA) is as following:

- (a) **Physical Carrying Capacity (PCC):** This is the “maximum number of visitors that can physically fit into a defined space, over a particular time”. It is expressed as:

$$PCC = A \times V/a \times RF$$

Where, A = available area for public use

$V/a = \text{one visitor} / M2$

$R_f = \text{rotation factor (number of visits per day)}$

In order to measure the PCC the following criteria must be taken into account:

- The number of watercraft that can dock at the jetty at a given time.
- The maximum number of visitors a site can hold at a given time.

Though, the Tiger Reserve is open throughout the year the maximum number of visitors are concentrated in the months of October–February. Therefore, these two periods need to be treated differently.

- Total length of was calculated to be 370 km.
- The minimum distance to be maintained between 2 boats is 200 m.
- At least four hour is required for one single visit and the Tiger Reserve is open for 10 hours daily. Thus the rotation factor ( $R_f$ ) is calculated to be:

$$R_f = 10/4 = 2.5$$

$$\text{Physical Carrying Capacity (PCC)} = 370 \text{ km.} \times 5 \text{ vehicles / km.} \times 2.5 = 4625 \text{ visits/day}$$

**(b) Real Carrying Capacity (RCC):** RCC is the maximum permissible number of visits to a site, once the “reductive factors” (corrective) derived from the particular characteristics of the site have been applied to the PCC. These “reductive factors” (corrective) are based on biophysical, environmental, ecological, social and management variables.

$$RCC = PCC - C_{f1} - C_{f2} \text{ ----- } C_{fn}$$

Where  $C_f$  is a corrective factor expressed as a percentage. Thus, the formula for calculating RCC is:

$$RCC = PCC \times 100 - C_{f1}/100 \times 100 - C_{f2}/100 \times \dots \dots \dots 100 - C_{fn}/100$$

Corrective Factors are “site-specific”, and are expressed in percentage as below:

$$C_f = MI \times 100/Mt$$

where:  $C_f$  = corrective factor;  $MI$  = limiting magnitude of the variable

$Mt$  = total magnitude of the variable

**(i) Creek erosion:** Here is the susceptibility of the site is taken into account.

Total road length = 370 km. ( $Mt$ )

Medium erosion sink = 40 km. (weighting factor: 2)

High erosion risk = 60 km. (weighting factor: 3)

$$MI = 40 \times 2 + 60 \times 3 = 80 + 180 = 260 \text{ km.}$$

$$Mt = 370 \text{ km.}$$

$$C_{fe} = 260/370 \times 100 = 70.27 \text{ or } 70\%$$

**(ii) Disturbance to Wildlife:** Here, species which are prone to disturbance owing to visitation are considered. In Sundarban Tiger Reserve the two major species prone to the disturbance due to boats are tigers and estuarine crocodiles. The limiting months were considered in accordance to the breeding season of the concerned species.

$$\text{Corrector Factor (Cf)} = \text{limiting months / year} \times 100$$

12 months / year



### Corrective Factor for Tiger

$$Cf w1 = 3/12 \times 100 = 25\%$$

### Corrective Factor for Estuarine crocodile

$$Cf w2 = 2/12 \times 100 = 16.67\%$$

Overall corrective factor for disturbance of wildlife in Sundarban Tiger Reserve = Cf w = Cf1 + Cf2 = 25 + 16.67 = 41.67 or 42%

- (iii) Over crowding of Boats: The overcrowding of boats is limited to only four months of year. There the correction factor  $Cf_b = \text{Limiting months/year}/\text{total months/year} \times 100 = 4/12 \times 100 = 33.33\%$  or 34%

Thus, the RCC =  $4625 \times 100 - 70/100 \times 100 - 42/100 \times 100 - 34/100 = 531.13$  or 531 boat units (two cylinder boats)/day

Note: 1 launch  $\equiv$  2.56 boat unit,  $\equiv$  (maximum 42 nos launch)

6 cylinder boat  $\equiv$  1.8 boat unit  $\equiv$  (maximum 116 nos boats)

4 cylinder boat  $\equiv$  1.4 boat unit  $\equiv$  (maximum 149 nos boats)

- (c) **Effective Permissible Carrying Capacity (ECC):** ECC is the maximum number of visitors that a site can sustain, given the management capacity (MC) available. ECC is obtained by multiplying the real carrying capacity (RCC) with the management capacity (MC). MC is defined as the sum of conditions that PA administration requires if it is to carry out its functions at the optimum level. Limitations in management like lack of staff and infrastructure limit the RCC.

For Sundarban Tiger Reserve, owing to the paucity of staff the MC is around 40%. Hence, EPCC =  $531 \times 0.40 = 212.4$  or 212 two cylinder boats which is equivalent to 151 four cylinder boats; 118 six cylinder boats and 88 launches.

During peak season (winter months), the staff strength may be increased (only 10%) by deploying "special duty" personnel, and this would enhance the EPCC to 233 two cylinder boats per day.

Only 13 number of boats are given permission for Netidhopani. Tourism zone are identified in the Sanctuary and buffer area allowed by CWLW, WB following the guideline of NTCA. Tourist area is concentrated in the parts of buffer area and core area is totally exempted). Here also to be mentioned that no tourist are allowed on the land except camps. Hence, virtually there is no disturbance on the wildlife.

**7.1.2.1.3. Eco-development Zone:** This zone shall lie in the fringe area of the Tiger Reserve and extend up to 2 km radially outwards (towards the hinterland). As per the Joint Forest management guidelines Joint Forest management Committees have been formed in areas those adjoining the Reserve Forest and the Wildlife Sanctuary area. Presently there are 26 JFMCs falling under the jurisdiction of the following territorial Ranges:

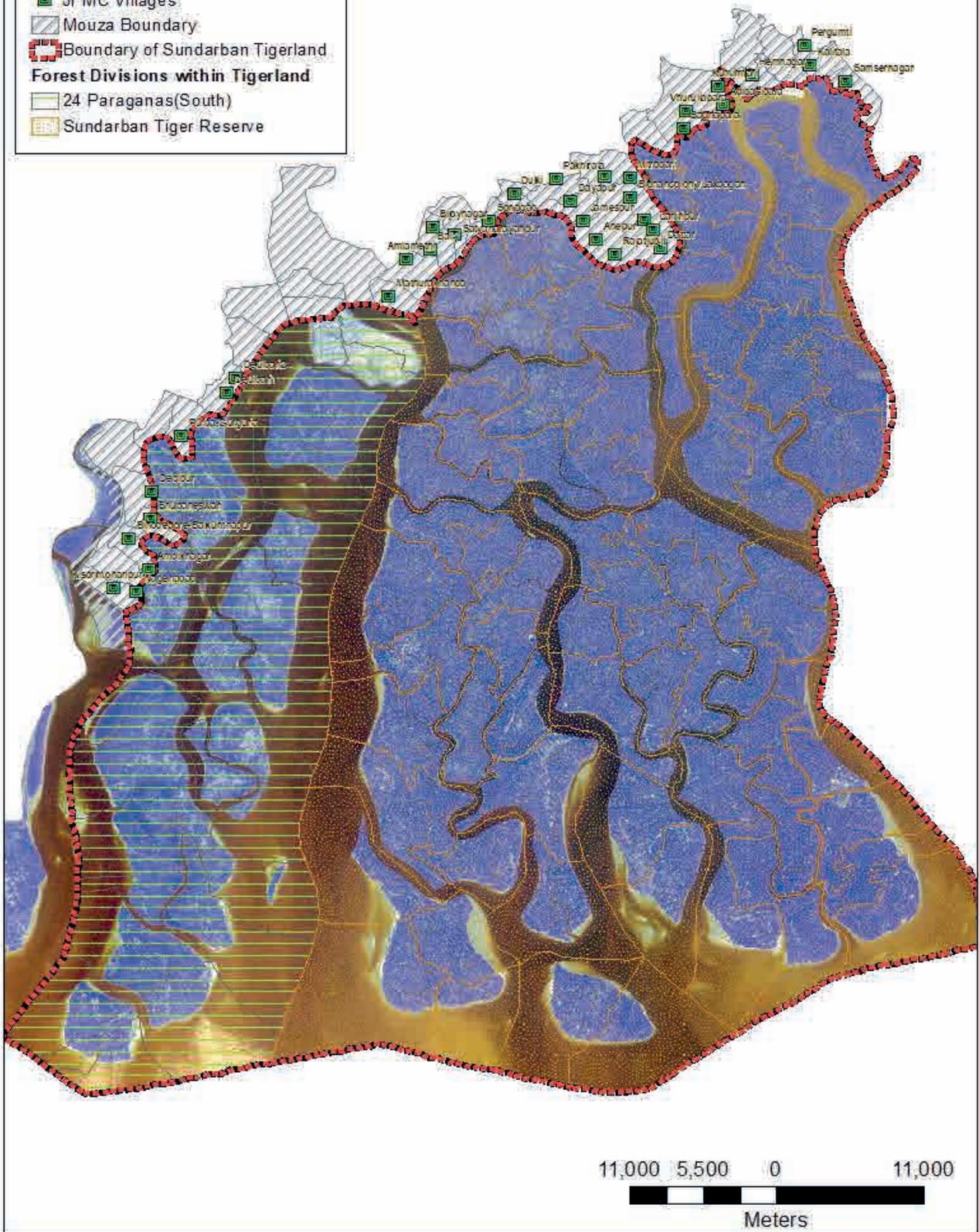
The people residing in fringe areas have extremely poor socio economic condition and show a great degree of dependency on the natural resource. The objective of eco-development in the fringe area is to reduce the dependency of the local people through capacity building and facilitating Alternate Livelihood practices, SHG formation and carrying out individual and community based activities.

SI No.	Name of Range	No. of JFMC
1	National Park West	5 JFMC
2	Sajnekhali Wildlife Sanctuary	9 JFMC
3	Basirhat	12 JFMC

### Sundarban Tigerland (Map showing JFMC Villages)

#### Legend

- JFMC Villages
- Mouza Boundary
- Boundary of Sundarban Tigerland
- Forest Divisions within Tigerland**
- 24 Paraganas(South)
- Sundarban Tiger Reserve



**Figure:** Map Showing JFMC villages

**7.1.2.1.4. Zone of International Boundary** Indian Sundarbans on its eastern side shares the international border with Bangladesh and separated by Raimangal, Kalindi and Harinbhanga rivers. The compartments of buffer area lying in this zone is given in the table below:

Sl No.	Compartment	Range	Area in Km <sup>2</sup>
1	Arbeshi- 1	Basirhat	41.79
2	Arbeshi- 3	Basirhat	20.82
3	Arbeshi- 4	Basirhat	21.61
4	Khatuajhuri-1	Basirhat	47.17
5	Khatuajhuri-2	Basirhat	33.69
6	Khatuajhuri-3	Basirhat	51.60

The porous border area makes the tiger reserve vulnerable to various illicit activities such as:

- a. Cattle and timber smuggling
- b. Illegal honey collection
- c. Illicit felling
- d. Poaching

Management strategies for protection along the border areas:

1. Joint patrolling is done with the Border Security Force (BSF)
2. The BSF has three BOPs along the border area which is active round the clock throughout the year
3. Every camp along the border area have been provided with high speed 4-cylinder boats and adequate arms and ammunitions and communication equipments.
4. Fair weather camps for patrolling during winter season for patrolling purpose

**7.1.2.1.5 Habitat Management Zone:** Sundarban Tiger Reserve is part of the largest compact patch of mangrove forest within the country. It harbours an extra ordinary array of floral and faunal diversity ranging from the Royal Bengal tiger, estuarine crocodile, Olive ridley turtles to the extremely primitive mudskippers and horse shoe crabs. The habitat comprises of 65% land and 35% water respectively. The mangrove ecosystem by itself is extremely resilient however, it is facing many threats most of which are on account of anthropogenic activities on the upstream. The rivers which drain into the ecosystem are the worst affected. It is seen that most of river sources especially in the western part of the Tiger Reserve are progressively getting silted up, leaving hardly any passage for ingress of fresh water, and as a result they are becoming highly brackish and shallow year after year.

These rivers and rivulets frequently change course resulting in formation of new mud flats and erosion of existing stable banks. The high silt load in the river channel have also resulted in formation of new islands downstream. Siltation of river bed also results in frequent flooding and overflow of estuarine waters in human settlements which is borne out by satellite imageries of the area.

The habitat is also threatened by pollution in and around the Tiger Reserve, especially due to tanneries, other small scale industries originating upstream in the northern part of the district. In the last 3-4 years, a large number of tourist lodges have come up in the area. This is a direct off shoot of the increased influx of tourists in the area. In the absence of any proper policy in place to check/regulate the number of tourists in the area shall lead to increased pressure on the mangrove ecosystem with impacts like, improper waste disposal, overcrowding, sound and water pollution. The wastes and effluents generated by the eco-tourism activities are all washed into the mangrove ecosystem.

Similarly the habitat also faces destruction by illicit felling by miscreants and poaching of wild animals and illegal collection of honey. Tidal surges and cyclones which periodically ravage the area also cause destruction by way of

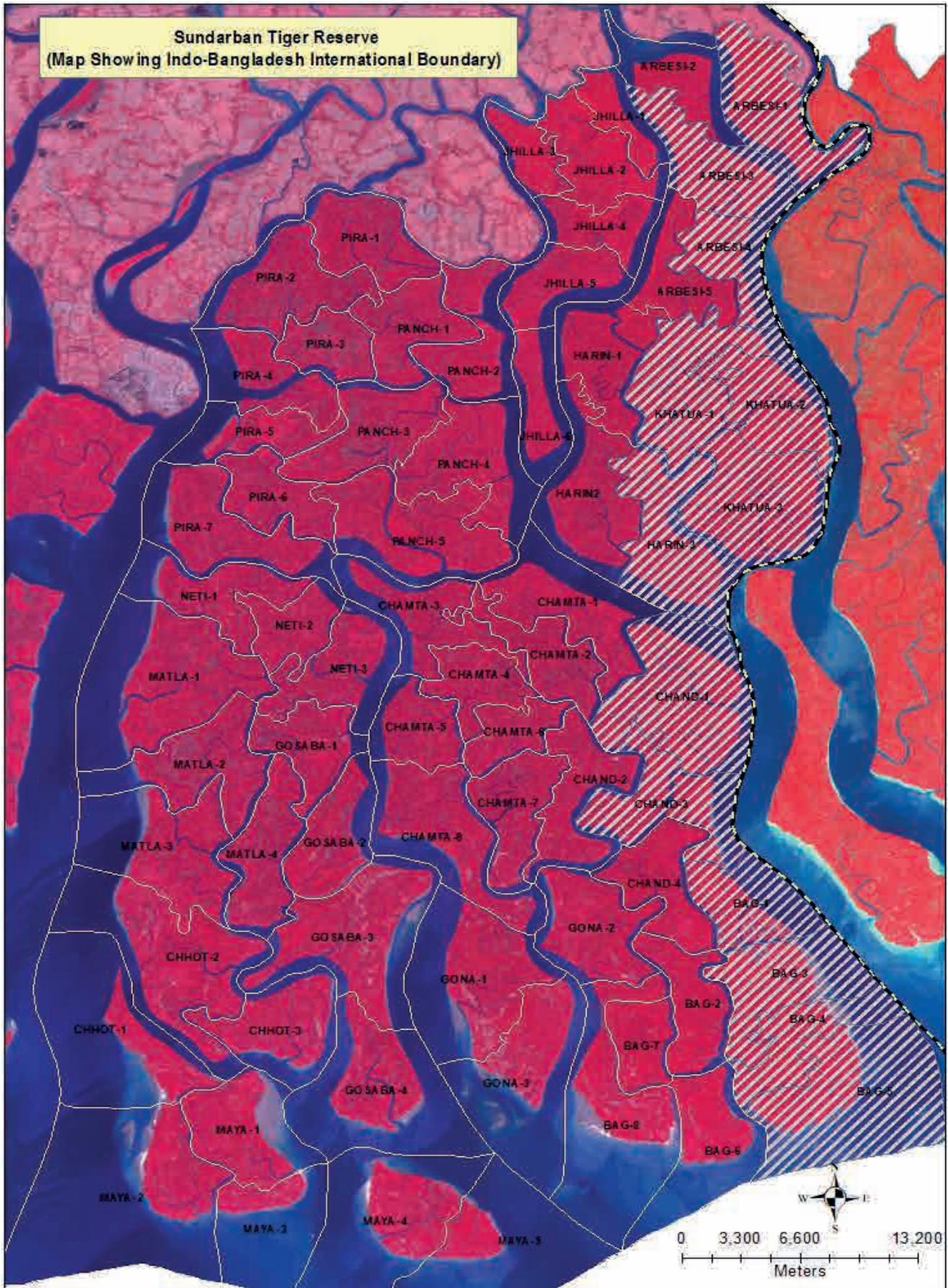


Fig: Map of STR showing the international boundary with Bangladesh

uprooted trees etc. Of late post semi super cyclone 'Aila' there has been an increase in the number of people illegally entering the Tiger Reserve for fishing.

The habitat also faces threat from the sinking/capsizing of the trawlers carrying fly ash to Bangladesh along the international waterway route.

#### **Objectives:**

1. To conserve this pristine forest habitat from external biotic pressures like illicit felling, poaching, honey collection and fishing.
2. To augment the availability of sweet water for animals in the Tiger Reserve.
3. To prevent soil erosion especially in catchment area through soil moisture works along with plantations.
4. To control pollution caused to water bodies by watercrafts, industries like tourism, tanneries etc.
5. To provide alternate source of fuel wood to the villagers through their own community woodlots.

#### **Problem in Achieving these Objectives:**

1. Increasing population pressure in the fringe areas where people have a high level of resource dependency.
2. Deforestation occurring at a rapid rate upstream especially in the catchment area.
3. Vacancies in the front line staff position
4. Large number of disparate stakeholders and government agencies involved.
5. Absence of any clear cut policy for regulating the mushrooming of the tourist lodges in the fringes of the Tiger Reserve.
6. Lack of jurisdiction over the polluting area/source
7. Lack of interagency coordination.

#### **Strategies:**

1. **Protection Management:** A sound protection strategy forms the backbone of the management of any Tiger Reserve. Sundarban Tiger Reserve also faces a number of challenges in the form of poaching, illicit felling, illegal fishing and honey collection. Of late, the area is increasingly being used for cattle smuggling.

In view of these serious challenges the protection of the Tiger Reserve has always remained the priority area for the management. The emphasis has been to improve and augment the existing infrastructure, and liaise with other Government agencies like the BSF and the Coastal Police to protect the area.

2. **Water Management:** Sweet water is a scarce resource in the Tiger Reserve. At present, water holes are dug up near camp locations only as past experience has shown that the water holes inside the forest away from camp areas are not only vulnerable to poaching but also serve as fresh water refilling points for illegal fishermen and honey collectors helping in prolonging their stay in the forest. As, the present strategy has worked well, it needs to be continued and fresh water holes only developed near newly created camps only. It is also seen that these fresh water holes attract wildlife in the area and can double up as wildlife monitoring points. Fruit trees like Keora (*Sonneratia apetala*) and *Zizyphus* which are preferred by the wild animals especially deer and macaques can be planted near the sweet water ponds.

Similarly, as most of the camps also face acute shortage of sweet water they need to carry out water harvesting in order to conserve the same. The rooftops of the existing barracks should be used for harvesting of water and similar provision made in case of newly constructed barracks. Excess water should be drained off in a manner which serves to recharge the underground aquifer.

In addition to make arrangement for sweet water in the fringe areas both for the staffs in protection camps and also for the fringe dwellers, the study of increased salinity of water due to attenuation of fresh water in the rivers and

creeks in view of this TCP tenure(5 Years) continuous studies to be incorporated with the help of NGOs, Academia and Expert groups. The outcome, if any, coming out of that study should be properly implemented so as to conserve the Mangrove Eco System.

3. **Waste Management:** The Tiger Reserve has been declared as a 'No Plastic Zone' vide West Bengal Pollution Control Board order no 1833A-35-89/2001 Dt 3.09.01 and the waste management should be carried out in consonance with this principle.

Of late, it has been seen that the pristine mangrove ecosystem is being threatened with the invasion of garbage in the form of plastics, pet bottles, thermocol plates which seem to be floating around the Reserve. Conservation awareness generated among the tourists regarding the issue and strict fine imposed on tourists/watercrafts for littering or throwing garbage within the Tiger Reserve.

A comprehensive waste disposal policy needs to be worked out with all concerned stakeholders promoting as much recycling through segregation of wastes along with identification of areas which can act as landfills. The help of other government departments as well as local elected bodies and NGO's working in the area may also be taken in this regard.

- (a) **Segregation of Waste:** Most of the solid waste generated to be segregated into biodegradable and non-biodegradable components at the point of collection.
- (b) Processing of Waste:
- (i) Degradable waste can be composted at designated areas.
  - (ii) Non-biodegradable waste which can be recycled to be sold off.
  - (iii) Waste which cannot be sold be burnt using special incinerators.
  - (iv) The waste which cannot be burnt buried inside pits.

This should be done for every village and co-ordinated through the JFM Committees. The Committees to identify the land for garbage vat, composting areas and landfill. The garbage which can be recycled sold off to nearby cities and the money received from selling of garbage to be put in community fund and set aside especially for garbage management.

A special Anti plastic drive is carried out through out the year with the help of local NGOs, stakeholders of boat and hotels.

4. **Pollution Management:** River channels and waterways which constitute 35% of the area is mainly polluted by watercrafts, households, chemical fertilizers, pesticides and industries. The latter like leather, industry are located upstream but their effluents are discharged directly into the rivers flowing into Sundarban. This is creating an adverse impact on the aquatic flora and fauna in the area. The water crafts which ply both within the Tiger Reserve (Tourism Zone) and surroundings areas are powered by old engines which create a lot of sound and water pollution (the water used to cool the engine is discharged into the river, which often contains oil, grease and mobil). Garbage is also dumped into the river by the tourist boats, lodges and households often the garbage left on the open river side is washed away into the river by the tides.

Meeting to be carried out with the concerned stake holders especially boat owners and allied Government agencies like State Pollution Control Board to arrive at some meaningful solution. The media may be involved to make the civil society aware about the threats being posed by the polluting industries. At the same time, the boat owners to be encouraged to convert to silencer fitted boats having new less polluting engines (new technology should be encouraged). They can be encouraged to form cooperatives after which they can avail loan facilities to change/upgrade the engine. All the boats which are to ply in the Tiger Reserve should be certified by marine authorities as being water worthy and pollution norms compliant. System of incentive/disincentive to be built into the system with boats not complying with the pollution standards denied entry into the Reserve. A check should also be placed on the number of boats entering the Tiger Reserve.



5. **Soil Moisture Conservation:** The catchment areas of the rivers have become denuded due to the rampant felling of trees for local use. This has accelerated soil erosion and as a result downstream rivers are facing siltation of the river channels which is posing major navigation problem. To counter this problem people need to be encouraged to grow trees mainly fruit bearing and avenue trees so that the green cover increases and the problem of soil erosion is also checked apart from meeting up the small wood requirement of the people. Occasions like Van Mahotsav can be used to raise awareness regarding the issue and also for distribution of plant seedlings.

Plantations of *Avicennia* spp and *Bruguiera gymnorrhiza* are created on *char*-lands on the village side to stabilize the *chars* or mudflats. Mangroves are otherwise very resilient species and in the absence of any disturbance come up very fast to colonize any barren land. However most of these plantations are susceptible to grazing and destruction by the villagers themselves who may chop them illicitly or they get killed due to dragging of nets.

Soil moisture conservation measures may be taken at spots mainly near protection camps most vulnerable to soil erosion. Mechanical structures like bamboo and sand bag piling along the earthen embankments or bamboo cribs with brick bats have proved to be very effective in combating erosion to some extent may be taken up. Plantation activities may be carried out at such places.

6. **Prey base management:** In the past, prey (Spotted deer) augmentation had been carried out in Sudarban Tiger Reserve a couple of times 2003 and 2012-13.

### Augmentation of Spotted Deer during the year 2003 in STR:

#### Source Location from where the deer individuals were translocated:

- a. Salt Lake Deer Park
- b. Bidisha, erstwhile Midnapore
- c. Ramakrishna Mission, Rahara

#### Total number of individual translocated: 28

**Location of Enclosure for acclimatization to the local habitat:** Dobanki Herbivore Acclimatization Centre; Beat: Dobanki; Range: Sajnekhali Wildlife Sanctuary

#### Duration of captivity of the translocated individuals at the acclimatization facility:

Five years (2003-2008).

**Note:** By June 2008 the herd size of the translocated deer increased from 28 individuals to 47 individuals (Male: 11; Female: 21; Fawn and yearlings: 15). These individuals were later released into the wild by November 2008.

Details of the augmentation programme of spotted deer during the year 2012-13 is given below:

Augmentation of Spotted Deer during the year 2012-13 in STR:

#### Source Location from where the deer individuals were translocated:

Bibhuti Bhusan Wildlife Sanctuary, 24 Parganas (N)

#### Total number of individual translocated: 33

**Location of Enclosure for acclimatization to the local habitat:** Dobanki Herbivore Acclimatization Centre; Beat: Dobanki; Range: Sajnekhali Wildlife Sanctuary

#### Duration of captivity of the translocated individuals at the acclimatization facility:

12 months (January-December, 2012)

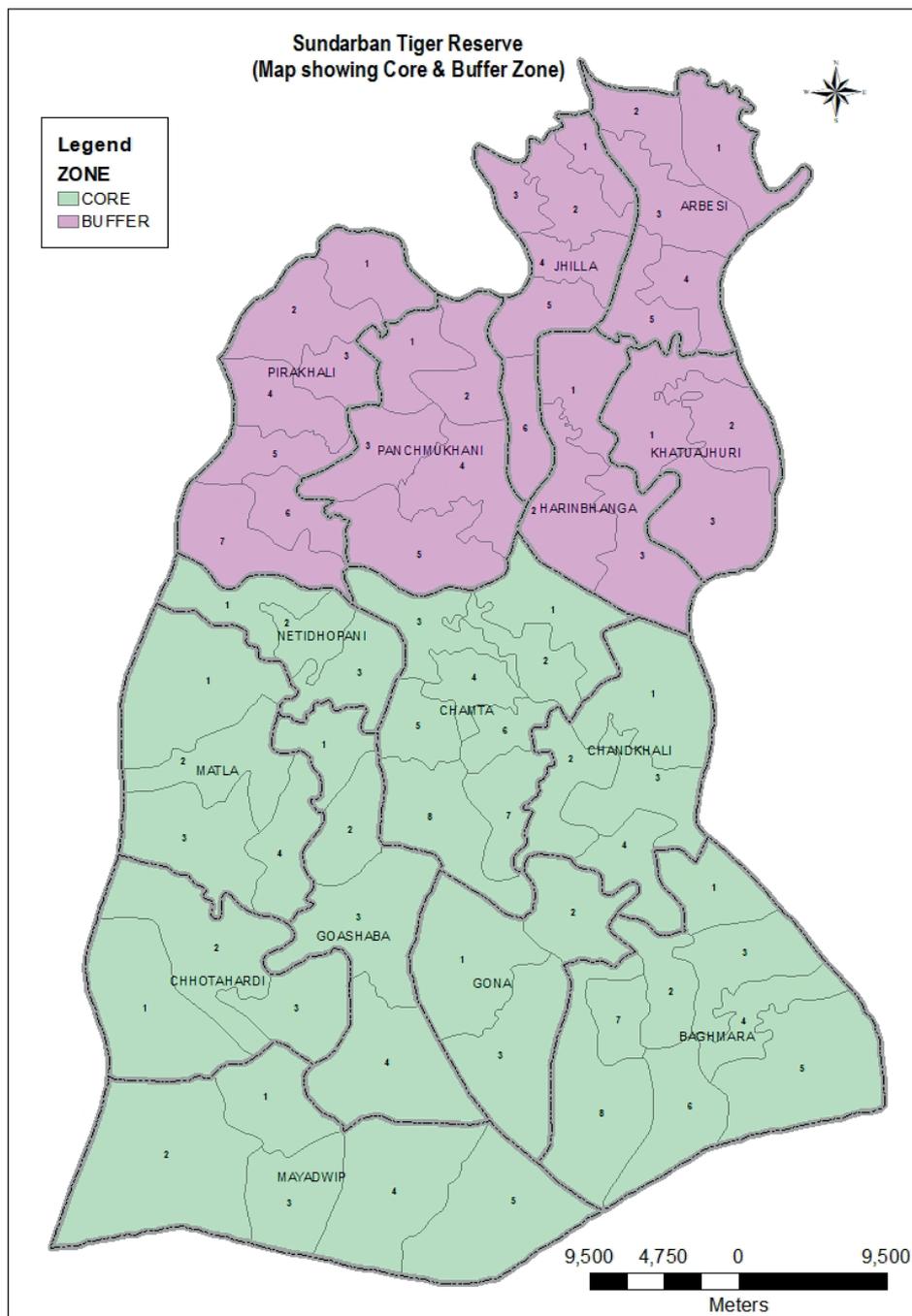
**Note:** 22 males, seven females and four fawns were released on 30<sup>th</sup> December, 2012, at Choraghazi khali of STR.

**Steps taken to ensure the sustenance and gradual acclimatization to the local environmental conditions:**

- a. Initial supplementation of green fodder and fresh water and gradually replacing them with leaves, fruits, and twigs of mangrove species such *Sonneratia apetala* (Keora), *Bruguiera gymnorhiza* (Kankra) and *Avicennia* sp. (since the wild population of spotted deer in STR are found to sustain mainly on the aforementioned plant species) and also saline water.
- b. Periodic health monitoring of the captive deer individuals in order to ensure the disease free condition amongst the individuals in captivity.

As of now the prey density has been deemed adequate for the predators in the Tiger Reserve by the management however future augmentation programmes would be carried based on scientific inputs from competent agencies.[

Note- In the recent past no augmentation programmes have been carried out by the department]



**Figure:** Map showing the entire area of Sundarban Tiger Reserve which has being considered under habitat management zone since the entire area has similar habitat type and there are no villages inside the Tiger Reserve



**Figure:** Map showing the locations of camps where further development of infrastructure in the existing camp sites are to be done

### 7.1.2.2. Theme Plans

The following themes have been identified for implementation in the Buffer area of the Tiger Reserve:

1. Protection Management
2. Man Animal Conflict Management
3. Disaster Management

### 7.1.2.2.1 Protection Management

#### Objectives:

1. To protect the tiger, its co predators and its prey species along with other floral and faunal components of this unique ecosystem against all biotic interference.
2. Upgrade and augment existing infrastructure like protection camps, patrolling boats, arms etc.
3. Developing a strong information network to prevent occurrence of wildlife crime.
4. Liaisoning with other Government agencies like BSF and Coastal Police Station to ensure the territorial integrity of the area.
5. Checking the increased use for forest area for smuggling cattle to Bangladesh.
6. Effective protection for the prey base of the tiger to avoid scarcity of the food and thus improvement of the habitat

#### Problems in Achieving these Objectives:

1. Porous international border with Bangladesh from where smuggling of men and material is very easy.
2. High population density and extremely poor fringe population coupled with high degree of natural resource dependency.
3. Budgetary constraints and vacancy in frontline staff positions
4. Difficult terrain of sundarban landscape makes foot patrolling a difficult task. Most of the regions of sundarban are inaccessible and due to thick vegetation it almost makes impossible to patrol by foot. During summer and monsoon, most of the river channels are extremely turbulent so it becomes very risky and virtually impossible to cruise along the channels and desired area by foot patrolling.
5. Siltation of creeks has led to narrowing down the village forest boundaries.
6. Lack of intelligence sharing and poor coordination between different agencies.

### 7.1.2.2.2 Man-Animal Conflict Management

Man animal conflict has existed in Sundarbans way before the actual declaration of the Tiger Reserve. Though there have been incidences of conflict with different animals like snakes and crocodiles though it is conflict relating to the tigers which has always been in focus for most of the time. The roots of the conflict lie in the original settlement of the area when the mangroves teeming with wild animals were cut down for settlement of humans. This policy started at the time of the Mughals was given a fillip during the British era with an aim of increasing revenue for the Government. Most of the conflicts recorded then were due to resident tigers which attacked humans and very often killed during the process of land clearing. So much was the depredation that the Britishers issued permits for killing of tigers.

Over the years conflict has been due to straying out of tigers in human habitations and killing of livestock by them. In the last twenty years, except for one case where a girl was accidentally killed by a tiger which had strayed in the village no human being has been killed by them in the village areas. There are also reports of crocodiles killing people who venture out for collection of tiger prawn seedlings or bathing in the river channels. Snakes are known as the silent killers in Sundarbans and the District ranks very high in the state on mortality figures which are mainly due to bites by kraits and cobras.

In addition to these, there have also been reports of deaths of fishermen, honey collectors who venture into the forests.

#### Objectives:

1. To minimize the incidents of man animal conflict.
2. To ensure that all strayed out animals are brought back safely to the forest.



3. To build capacity of the staff to handle conflict situations.
4. To build capacity of fringe villagers to deal with conflict situations.
5. To create awareness among the masses regarding the conflict.

**Problem in Achieving these Objectives:**

1. Difficulty in maintenance of the existing nylon net fence.
2. Antagonism among a section of villagers due to restrictions on entry into the forest.
3. Illegal entry of the locals for fishing, crab collection, honey collection, and also to collect fuel wood.
4. Siltation of the river channel leading to obliteration of the forest village interface.
5. Absence of proper medical infrastructure.
6. Collection of tiger prawn seeds by dragging of mosquito nets in the river channels.
7. Lack of electricity in the area.

**Strategies:**

1. The end of the existing bamboo posts to be coated with coal tar to increase its longevity.
2. Proper checking of fencing on a daily basis in the form of a protocol to be carried out on a daily basis.
3. Periodic training of staff in tranquilisation, arms, mob control, handling of trapped or injured animal to effectively handle the straying incidences.
4. Stationing of speed boats at all strategic camps in the fringe area prone to straying.
5. Presence of designated anti straying squads in which the members have pre assigned duties based on aptitude and ability to be stationed in all the three Ranges ie Sajnekhali Wildlife Sanctuary Range, Bashirhat and National Park West Range. The squads to be armed with proper tranquilization kits having tranquilising guns/pistol/blow pipe, gun and dart cartridge, drugs, syringe, distilled water, vaseline, search light, hand mike, walkie talkie set etc which shall be periodically checked by the concerned Range Officers and Assistant Field Directors.
6. In all the JFMC areas the joint convenor and few more influential persons should be given the responsibility of contacting the Tiger Reserve office/officials in case of emergency situations. They should also be involved in handling the mob and pacifying the crowds.
7. The contact number of the Range Office /officer and concerned beat officer should be displayed at prominent places so as to deliver the information of any incidence at the earliest and the live of the animal and humans are not endangered.
8. The villagers should also be made part of the mock drills on animal rescue which should be carried out in the locality at periodic intervals.
9. Periodic meetings to be carried with the concerned JFMC's so that all the pending issues are resolved and the contentious issues are vented so that some kind of action can be taken as and where possible. The villagers should also be made aware of the importance of the area and especially of the tiger which is facing an uncertain future due to the mounting threats to its very existence.
10. Villages with maximum possibility of straying to be identified and eco-development works carried out on a larger scale there.
11. The villagers should be made aware of the risks involved in collection of tiger prawn seedlings and the loss it causes to the biodiversity. Alternate livelihood options should be offered to the women folk who are mainly engaged in this activity to supplement their income. SHG may be formed and they should be encouraged to switch over to other activities which would fetch similar income with very little risk to human life and to the environment.

12. Dredging of the silted up area may be explored otherwise in future there is risk of encroachment happening with the obliteration of the boundary between the village and the forest area.
13. Efforts must be made to educate the villagers on dos and don'ts in case of snake bite along with the precautions to be taken to avoid such incidences.
14. Medical camps to be held at frequent intervals to make up for the shortfall in medical infrastructure and also to generate goodwill among the masses.
15. Efforts to be made to illuminate the forest fringe areas especially the strategic points with solar lights as it has been seen that the animals avoid illuminated areas.
16. Efforts to be made to check the illegal entry of people in the forest.
17. Awareness generation regarding crocodile attack through the decimation of knowledge of habit and habitat of crocodile by the preparation of zone wise sensitivity maps.
18. Another man animal conflict which is very common in this area is sneak bite. Adequate awareness generation and facilities for treatment of snake bite should also be taken into consideration with appropriate budgetary provision regarding the matter.

### 7.1.2.2.3 Disaster Management

Sundarban area has historically been prone to natural calamities like cyclones, tidal surges, earthquakes etc. Prominent among these, have been a huge surge in the Bay of Bengal in the year 1688 which took a toll of more than 60 thousand people in Sagar Island. In 1737, a severe cyclonic storm with wind speed 250 km/hr along with tidal thrust or surges of 13.0 m from msl and severe earthquake fully destroyed the human habitat and mangrove forest. Post independence the most disastrous cyclonic storm in this region was the one that occurred on 13<sup>th</sup> Nov, 1970 which caused thousands of deaths in Sundarban. The cyclone on 29<sup>th</sup> November, 1988 also had wind speed of 250 km/hr and had caused wide spread damage. The latest cyclone to wreak havoc in Sundarban was '**AILA**' which swept across Sundarban on 25<sup>th</sup> May, 2009 leaving thousands of people homeless and lakhs of hectares of farmland inundated thousands of cattle dead. The high waves accompanied by wind speeds 130-140 km/hr breached the river embankments causing large scale damage leaving people without any other support. In most of these cases, the mangrove forests have acted as a natural barrier by absorbing the impact of the high speed winds and the high waves and breaking their impact thereby protecting the hinterland from the actual intensity of the cyclone. Though cyclones, floods, famines and earthquakes are natural phenomenon and occur on a regular basis advance planning can leave us in a better state of preparedness to handle such situations.

#### Objectives:

1. To be able to anticipate the disasters and have preparedness accordingly.
2. Capacity building of staff to deal with such scenarios.
3. To build supporting infrastructure needed to cope with such events.

#### Problems in Achieving these Objectives:

1. Most of the time the disasters occur suddenly and give very little chance of preparedness.
2. Remoteness from the mainland hinders the swift movement to and from that area.
3. Waterways are the only means of approaching the area.
4. Very few landing ports or jetties on the approach points/gateways to the area.
5. Unstable nature of soil that is prone to sudden subsidence due to river water dynamics.
6. The earthen embankments /dykes guarding against the flooding of river waters are extremely vulnerable in the face of rising water currents.



### Strategies:

**1. Advance Warning System:** Cyclones can be predicted to a large extent due to recent advances in science and technology. The advance warning regarding the impending danger is to be broadcast through the R.T. system to all remote camps of the Tiger Reserve and through JFMC Committee to the fringe population.

Mobile R.T. handset to be provided to all watercrafts so that communication is possible in case of emergencies. Hooter system present in every camp to alert the patrolling staff of danger in the field.

New addition of an observatory and portable mobile laboratory in Sajnekhali has been established by IISER Kolkata and a concerned NGO, which shall eventually help to retract climate related data i.e, salinity, prediction of cyclones etc.

### 2. Improving Infrastructural Facilities in the Camps:

- (i) Presence of an elevated area like roof tops for staff to take shelter in case of tidal surge and rise of water in the camps.
  - (ii) Sufficient number of search lights and batteries to be provided in each camp.
  - (iii) Sufficient number of life jackets and tarpaulins to be provided in each camp.
  - (iv) Lofts created for storing of important documents, arms etc.
  - (v) First aid boxes to be provided at each camp.
  - (vi) Speed boats to be provided at all camp locations.
  - (vii) Spare water storage tanks to be provided at all camp locations
  - (viii) Height tube wells raised water pumps and generators placed elevated platforms
  - (ix) Brick pitching/bamboo piling of earthen embankment including land stabilization.
  - (x) All buildings to have pilling work in the foundation to increased the stability and longevity of the structure.
3. Capacity building of staff in first aid techniques and earthquake and flood combating drills with the help of specialist agencies.
4. Liasoning with line departments namely BSF, Army, Police and District Administration to chalk out a disaster management strategy along with the role of different agencies.

### Proposal for Infrastructure Development:

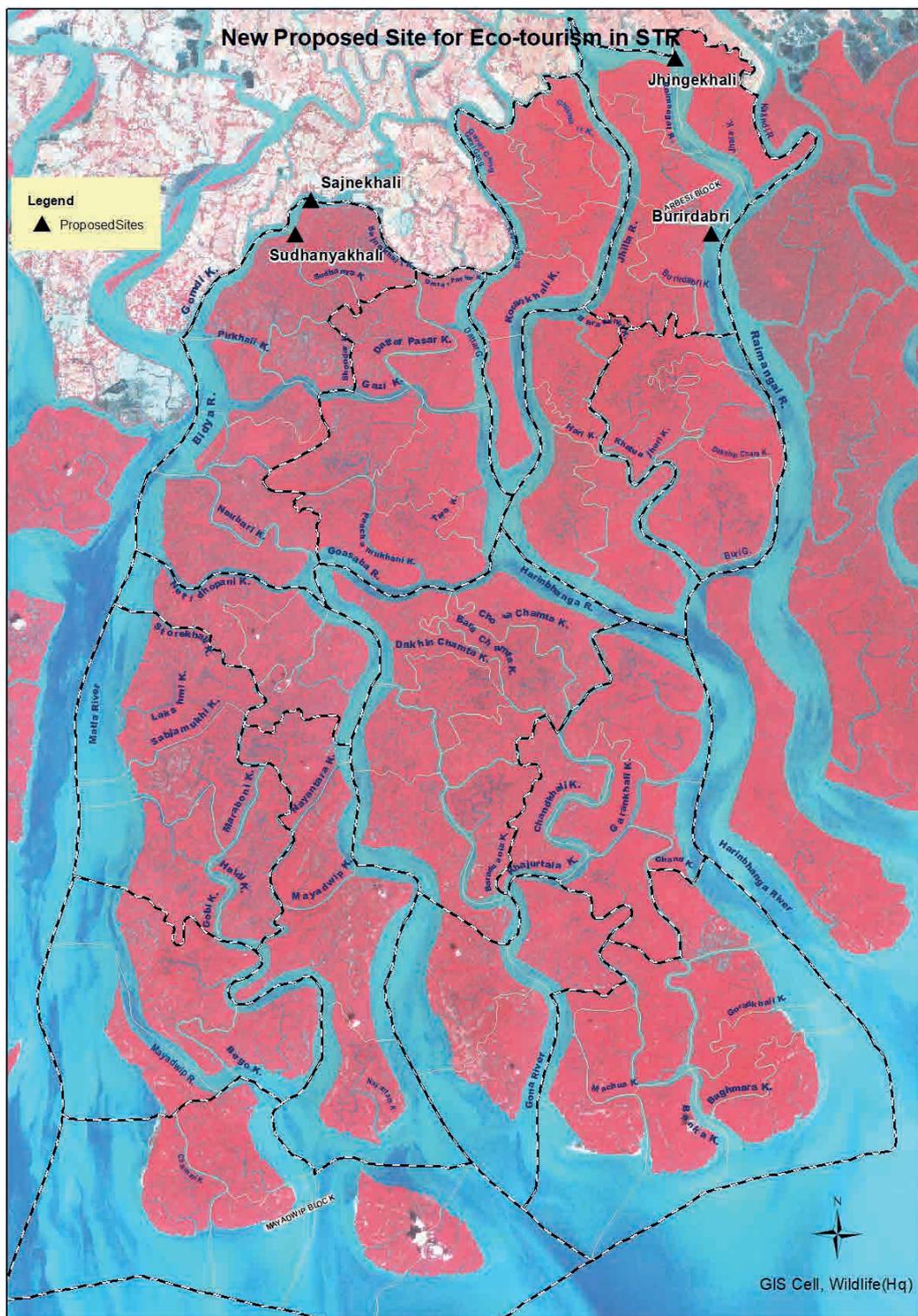
Recently, a new site has opened for the tourist in Harikhali. A new watch tower, tourist toilet is under construction at Harikhali for the said purpose.

Presently, the tourism facilities have become concentrated at the north western and north eastern ends of the Tiger Reserve. As travel from one end to the other takes a lot of time to most of the visitors are forced to choose between the two main tourist attractions namely the canopy walk at Dobanki situated at the north west and Cage at Burirdabri located at the eastern most corner. A visit to both of these structures is a must for a visitor to get a true feel of the forest. Also, presently the eastern sector is underdeveloped both in terms of tourist movement and infrastructure. Most of the new tourist lodges are coming up in and around Sajnekhali area only. Development of new tourism circuits in the eastern area may ease the congestion as well as provide a boost to the local economy if more facilities catering to tourists come up in the area.

### New Site Development Proposals:

1. Mangrove Park at Sudhanyakhali to be improved and better developed as a nature trail.
2. A new interpretation Center to be built in Jhingekhali which will orient visitors coming to the areas about the values of Sundarban Tiger Reserve. Thus, the work is undergoing.

3. All the tourist campuses to be landscaped and better signages, benches, rest rooms, waste bins etc.
4. The souvenir shop at Sajnekhali to be improved and another one to be opened at Burirdabri and Jhingekhali.
5. Village visit concept to be promoted and developed. Folk culture and dance drama to be given priority and handicrafts etc. Select villages to be developed with regards to brick paths, benches, solar lights etc which can be carried out from the proceeds of the 40% of tourism share given to them so that the local communities develop more stakes in tourism as well as conservation as a whole.



**Figure:** Map showing the locations of camps where further development of infrastructure in the existing camp sites are to be done

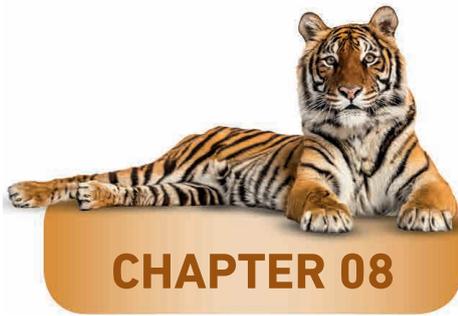
## ECO-TOURISM IN SUNDARBAN TIGER RESERVE



**Figure:** Eco-tourism activities in Sundarban Tiger Reserve



**Figure:** UNESCO World Heritage Site Monument at Netidhopani Camp of Sundarban Tiger Reserve



# Eco-development and Livelihoods

Sundarban Tiger Reserve is a compact block of mangrove forests spread over an area of 2585 sq km. There are no habitations within the forest area. The fringe areas of the Tiger Reserve were once upon a time forested but during the course of time these were cleared for human habitations. Post-independence period, this area witnessed an influx of population due to migration from both within and outside the country. All the villages are located along the northern boundary (river being the natural boundary) from Samsernagar adjacent to the Kalindi river in the north east upto Mathurakhand village in the north west of Tiger Reserve. Except for two Gram Panchayat i.e Kalitala and Jogeshgunj which fall under Hingalgunj P.S. of North 24 Parganas District, the other 8 adjoining Gram Panchyat i.e. Bali I and II, Gosaba, Lahiripur, Kumirmari, Gosaba, Rangabelia, fall under Gosaba P.S. and Chotomollakhali Coastal P.S. under South 24 Parganas District.

## 8.1 POLICY AND INSTITUTIONAL FRAMEWORK

The State of West Bengal is a pioneer in the field of participatory management approach. Following its resounding success in other parts of the State and the country this approach was replicated in this area. In line with the Government Resolutions Forest Protection Committees and Ecodevelopment Committees were constituted way back in 1996 though formally registered in 1998. Presently there are 26 Joint Forest Management Committees which are active in the fringe area. During the initial stages microplanning was carried out after detailed PRA/RRA exercises to find out the aspirations of the local people and also to provide road map to carry out development activities in the area.

### Forest Protection Committee/Eco-development Committee

As per the Government Resolution the Committee comprises of a General Body and an Executive Committee. The former is made up of all registered member generally comprising of the economically backward fringe communities living in the forest vicinity and having dependency on the natural resource. The General body members in turn select the Executive Committee. This committee also contains nominated members of the Gram Panchayat, Local MLA and the Panchayat Samiti. The Beat Officer acts as the Member Secretary. ( Appendix-16) and (Appendix-17) The Executive Committee is involved in the day to day functioning of the concerned JFMC. The AGM is to be held every year for election of new office bearers and discussions on significant issues. A meeting register is maintained by the JFMC which records the minutes of the meetings held from time to time, the resolutions passed and the proceedings of the Annual General Meeting.

The JFMC's/JFMC's have been given the responsibilities to ensure protection of forests and wildlife through members of the Committee. They have also been entrusted tasks of apprehending or assisting in apprehending of persons committing forest offence etc. The usufruct sharing at present is done from the revenue obtained from tourism. At present 40% of the revenue obtained from tourism is evenly distributed among the JFM Committees. Presently all the JFMC's / JFMC's are considered at par and all benefits are shared equally among them.



## 8.2 LIVELIHOOD SUPPORT INITIATIVES THROUGH VILLAGE MICRO-PLANS

The population in the district as per census figures of 2011 is 81.62 lakhs up from 69.07 lakhs in 2001; and the corresponding population density figures are 819 person per sq km in 2011 and 693 person per sq km in 2001 respectively. Of this, majority of the people belong to the weaker section of the society.

Agriculture is rain fed monoculture with the principal crop being 'aman' (June –October) rice followed by 'boro' (December-mid March) and little bit of 'aus' (mid March- may) rice or vegetable cultivation. Among other crops farmed are pulses (mung dal), oilseeds (of late Sunflower has been introduced into the villages), potatoes, chillies, watermelons, and vegetables like tomatoes, cucurbits etc. Most of the households keep livestock mainly cows, goats and poultry. Infrastructure in the villages is underdeveloped. Electrification has been done in most of the villages; there is lack of potable water, and public health centre's in majority of the areas. Only kutch roads exist in most of the villages and only means of transport are private mechanized boats and locally made motorized van rickshaw.

During 90's lots of people were involved in tiger prawn seed collection but presently, due to combination of strict protection, awareness generation and a fall in the price of the seeds the collection is restricted to the fringe areas namely in Jhilla, Kalindi, Duttar, Hogal, Pitchkhali, Korankhali and in Bidya and Matla rivers. Only a handful of people is involved in this work now.

Overall, there is a very high level of natural resource dependency among the people. The Tiger Reserve has been carrying out eco development in the fringe areas based on micro plans which were developed after detailed RRA exercises. The micro planning should be carried out for a period of ten years but reviewed after every five years for mid course corrections. Presently, the eco development activities can be grouped into community based and individual based activities. The former are aimed more at creating goodwill among the local people and the latter aimed at providing alternate livelihood options. The eco development needs to be streamlined and carried out on the basis of identified priority areas so as to achieve commensurate results in the field of conservation.

### Objectives:

1. To provide alternate livelihood options to the fringe population through capacity building and material inputs to help reduce natural resource dependency.
2. To carry out biodiversity conservation with the help of key stakeholders through awareness generation programmes.

### Problems in Achieving these Objectives:

1. Increasing population pressure
2. High level of resource dependency in the fringe villages.
3. Extremely poor infrastructure.
4. Budgetary Constraints.
5. Market linkages not existent.

### Strategies:

The following activities are proposed as part of the eco development initiative:

1. **Water Harvesting Structure:** Agriculture is the mainstay of the economy, it is proposed that efforts should be made towards increasing the yield from the existing land and also converting mono cropped rain fed agriculture into multi cropped, irrigated one. Water is scarce in most villages situated in Gosaba, Rangabelia and Kalitala, Samsernagar areas. The water layer present there is saline and unfit for drinking or cultivation. Therefore, the existing system of irrigation channels need to be re-excavated along the alignment of narrow creeks which existed prior to construction of embankment. Such channels generally crisscross the island are more than a km. in length with 60 ft or more in

width and a command area of 100-200 ha. These channels shall serve to hold water and enable multiple cropping in the lean season, provide employment to the rural poor and also act as reservoirs for carrying out pisciculture. They have been tried out in the past and given good results. Besides, reexcavation of large canals or 'khals' as they are locally called small ponds also need to be excavated or re excavated as they serve the locals in a variety of ways in this water scarce area. These are used by the community for carrying out routine cooking, cleaning and bathing especially where deep tubewell boring has failed to yield water. Pisciculture for local consumption is also carried in these ponds.

2. **Deep Tubewells:** As potable water is a scarcity in the area with the average depth of the water table being 900 ft. At many places boring upto 1400 ft has also not yielded any result. These tubewells are in great demand in the villages and serve as goodwill gestures from the Tiger Reserve. Before new deep tubewells are dug a mapping of the existing ones should be carried out and new ones given on the basis of gap analysis. Also, the villagers need to be educated about sealing the old and abandoned borings to prevent the underground aquifer from being contaminated.
3. **Pisciculture and Crab Culture:** The area is extremely rich in aquatic biodiversity. The people should be encouraged to go for rearing fishes and crabs in individual or community ponds. They can be helped with the technology involved and supply of fish and crab fingerlings.

Ornamental fish farming should also be encouraged as this has a good market in Kolkata. Liaison may be carried out with the Fisheries Department to see the benefits and schemes which can be availed under this program.

#### 4. Agriculture Related Initiatives:

- (a) **Agriculture Extension:** The Tiger Reserve can facilitate the training of the farmers in the latest techniques, trends with relation to the market place. Liaisoning can be carried out with the agriculture department to facilitate such capacity building. Farmers may be encouraged to take up organic farming as many of the big hotels in Kolkata are turning more and more towards organic food. These products can also be used for the new tourist lodges which are mushrooming all over the place in and around Sundarbans in view of the increased tourist influx.
- (b) **Newer Agricultural Crops:** Presently Sundarban is known for its crops like chillies, watermelons which are in great demand in Kolkata. New crops especially oilseeds and pulses with ready markets can be explored. Similarly, to supplement income farmers to be encouraged to grow fast growing fuelwood species along the field bunds for both local consumption and marketing. Plantation of species like Poplar, Eucalyptus, Acacia etc on degraded community lands to also be taken up.
- (c) **Agricultural Inputs:** Pump sets can be provided to the JFMC who can loan it out amongst members against a pre determined rate which would go to the JFMC Fund. The pump set should also be serviced using the same fund by making a committee resolution.

Compost units may be set up in the fringe areas to prepare compost from the bio degradable waste generated out of Eco tourism activity. Initial non recurring expenditure for construction of the compost unit and initial supply of worms may be provided departmentally as a part of JFM support activity.

Honey collection and Fishing are the traditional lively hood activities in the area. In order to protect the habitat of the tiger and utilize the resource sustainably, following strategies may be considered

- i) JFMC members in the fringe villages may be encouraged to take up apiary.
- ii) Process of issuance of Photo identity card to the fishermen and honey collectors have been initiated
- iii) Sustainable prone cultivation measure may be encouraged

6. **Capacity Building:** Absence of industries in the area, lack of skill sets has resulted in large sections of the population without any source of steady income. This has lead to the people to become dependent on the natural resource for



sustenance and livelihood. Training to be imparted to selected group of people based on their educational levels, physical condition and willingness. The Tiger Reserve can finance 3-6 month training at reputed vocational schools like Ramkrishna Mission, Neempith etc. in the following areas so as to provide alternate livelihood options. The items listed are indicative in nature and based on the field demand/situation:

- Carpentry, diesel generator set repairing, training as electrician, plumbing works hospitality management training, mobile repairing, masonry, solar light repairing and various such trainings are given to local people so that they can choose alternative livelihood options.
  - Tailoring and Embroidery- The local women have been given machines and also trained so that they can make income and many families have been benefitted.
  - Pisciculture - Composite pisci culture is practised along with integrated farming:About five SHGs were given training and inputs. It has been a successful project. Fifty SHG members with at least two hundred family members has been benefitted and trainings of ornamental fish culture is given.
  - Apiculture-For this practice about seventy eight potential members of three SHGs were given training and fifty members among them were given inputs. The honey produced by them will be branded and marketed by suitable agencies. About two hundred persons will be benefitted by this project.
  - Brown rice production- Brown rice having a potential market in city malls and a potential income therefore villagers have been trained so that they can produce it. However brown rice production is highly labour-intensive, time taking and output is low. So to overcome this situation new improvised 'Dheki' (device for making brown rice was introduced to them. About seven groups of SHGs from Samsernagar, Kalitala, Dulki, Bali and Amlamethi JFMCs was selected as per discussion in ground level meeting and given training and inputs. Final produce will be marketed as per as requirement. About two hundred eighty persons will be benefitted from this project.
  - *Gamchaa* making- Sundarban has a potential market of this handmade towel.Therefore seven groups of SHGs from Amlamethi, Bali and Rajatjubilee JFMCs was selected as per discussion in ground level meetings and given training and inputs. Final produce will be marketed as required.Around two hundred eighty persons will be benefitted from this project.
  - Incense stick making - Areas surrounding Sundarban is having a potential market of incense stick making. Next year this training and inputs will be given.
  - Poultry farming- About fifty-nine SHGs along with the female members were given training and inputs about this process. It is more or less successful project. About five hundred ninety members with of average total of two thousand three hundred sixty family members have been benefitted for this process.
  - Goat rearing & Pig rearing- Piggery with 'Ghungru' breed is practiced with two SHGs along with tribal female members who were given inputs about it. It has been very successful project but it is confined only to tribal groups. Twenty-four members with their ninety six members of their family got benefitted from this practice.
7. **Self-Help Groups or (SHGs):** These groups were first created during the UNDP project in the year 2004. A group of 10 women were given a onetime seed money of 24,000 rupees to purchase inputs like goats, pigs, poultry, fishes etc along with training regarding the same. Since then every year the number of SHGs has been increasing in Sundarban Tiger Reserve. This has given mixed results with some groups becoming non functional due to loss of all their assets (due to death, disease or selling) but there are many other groups which are still running. On the whole it is observed that it has given women economic independence and self confidence as they loan money from the group pool instead of approaching the money lenders it has inculcated a habit of saving in them. Therefore, these should be continued but different activities like puffed rice making, oil extraction, spice grinding and packaging and other activities which can be economically viable be included.

Till now SHG's have been formed with only women as members. However, it is proposed to form SHG's with males especially fishermen and honey collectors. These groups can then be given training in alternate livelihood practices along with group insurance and medical facilities.

- 8. Infrastructure Related Activities:** The infrastructure facilities here are very rudimentary. There is electricity only in some parts of Gosaba island, very few health centers, hardly any roads, jetties, schools, etc which creates lot of hardship for the people. So, with an aim of creating goodwill in the minds of the people as has been borne out by past experience it is proposed the following infrastructure related activities shall also be carried out.
- (a) Strengthening of Existing Earthen Bunds:** Most of the human inhabited islands were reclaimed from the river before the completion of the siltation process. As a result the islands are at a much lower level than the river water which frequently inundates the habitations leading to the land and sweet water bodies turning saline and therefore unfit for agriculture and human use respectively. To protect the villages from the river waters, earthen embankments having dimensions 8-10 ft height and width of 10-15' ft at the base and 8 ft at the top have been built all around the islands. The protection and maintenance of these earthen bunds is looked after primarily by the Irrigation Department. There are 3500 km. of earthen embankment which protect villages in 52 non-forested islands against flooding during the high tide which occurs twice daily. The cyclone AILA has exposed the weakness in the existing structures, which were breached due to strong waves leading to massive flooding in the village area. The flooding leads to loss of agricultural land and thereby affecting the livelihood of majority of people as agriculture is the mainstay of the economy. Strengthening of these earthen embankments shall serve to protect the villages from saline water; besides they are used as roads and thereby serve as a means of communication. This work shall generate man days besides maintenance of infrastructure.
  - (b) Brick Paved Roads:** Of the 5400 sq.km. of inhabited area of Sundarbans only 20% are metalled road network is present. In the villages 95% of the roads are kutchra roads. During the rainy season these roads become slippery, slushy and as a result non-negotiable. Paving them with bricks helps maintain the communication for easy access to markets, hospitals and schools for the local people. These have also proved to be useful in cases of rescue of strayed out tigers and other wild animals.
  - (c) Jetties:** Watercrafts are the main mode of transport. To reach the river bank one needs to negotiate and often wade through knee deep water and mud to board the watercraft. Jetties are concrete structure which facilitate boarding and landing from watercrafts. These activities create goodwill amongst the local people.
  - (d) Solar Lights:** Majority of the villages are without electricity. Solar lights will serve to illuminate the area and also help prevent the incidences of snake bites which are very common in the area. Lighted areas are also avoided by the tigers which often stray out into human habitations from the adjoining forest areas. Experience has shown that common property resource like solar light is often subject to theft. Therefore, it is proposed that the battery portion of the light should be kept within one of the houses in the fringes who shall maintain it and in return get one extra light point within their houses.
  - (e) Schools:** The existing schools are located at great distances and the school children have to trudge long distances to reach their school. The JFMC's namely Amlamethi and Satyanarayanpur under National Park West Range have utilized the money lying in the JFMC fund (40% share of ecotourism) to construct a school two primary schools. The salary of the teachers is also being met by this money. Such welcome initiatives need to be encouraged.
  - (f) Medical and Veterinary Camps:** The area is has extremely poor medical and veterinary facilities. Medical and veterinary camp in the fringe villages serve to strengthen and build bond of forest between the Tiger Reserve



management apart from creating an immunological barrier around the Tiger Reserve against outbreak of certain diseases. These have yielded positive results and need to be continued.

**(g) Development of Flood Shelters:** The entire Sundarban area is prone to flooding as most of the inhabited islands are low lying and are protected by earthen embankments. However, huge waves and tidal surges occurring as a consequence of earthquakes and cyclones often result in high waves which breach the earthen embankments leading to flooding of human habitation. Cyclones like Aila have demonstrated the need to develop a network of flood shelters which can double up as relief centres.

**9. Awareness Generation:** One of the main achievements of the eco-development programme is that it provides a platform in the form of JFMC's to reach out to the marginalized sections of society having maximum resource dependence. These JFMC's may be utilized to spread the message of conservation and peaceful co-existence of humans and wild animals among the masses and especially to the school children. Special functions can be organized to mark days like World Environment Day, Aranya Saptah, Wildlife Week, Sundarban Day etc.

Study tours of school children around the Tiger Reserve, sponsoring of events like annual sports can serve to reinforce the conservation message. Another popular event like boat race which takes place in Chotomollakhali island can be supported by the Tiger Reserve and used for spreading the conservation awareness as it can reach out to a large section of society/people.

Tours also to be conducted for JFMC members both within the State and outside the State to make them aware of the measures being taken for conservation in other parts of the country.

**i. Ecologically compatible land use pattern**

The basis of Man animal conflict arises mainly due to three activities of the fringe dwellers viz- Honey Collection, Fishing and illegal collection of fire wood. In all the three cases the fringe dwellers encroach upon the territory of the wild life and thereby make themselves prone to tiger and crocodile attack.

Alternative livelihood methodology must be incorporated so as to provide secured dispersed habitat for the flagship species population from core area. Apiary, sweetwater pisciculture, prawn cultivation, etc could have been very good option for alternative livelihood generation activities. Necessary budgetary provision should be incorporated for the purpose.

## 8.3 INTEGRATION OF RURAL DEVELOPMENT PROGRAM

At present, in the fringe areas there are a number of agencies which are involved in the development of the area. These include the Forest Department, panchayat, Sundarban Development Board and the different NGO's operating in the area. As most of the activities performed by the different agencies are common it is proposed that the development agenda for the fringe villages should be discussed at the level of the State Level Steering Committee which has representatives of different departments besides leading NGO's and is headed by the Chief Minister himself. This will help prevent the duplication of the work and spread out development activities throughout the area rather than being confined to few pockets.

At present Department of Agriculture Development and different NGOs are involved in providing mini-kits of resistant and high yielding variety of paddy. Also they are involved in providing awareness and adequate training regarding the use of bio-pesticides, bio-fertilizers, and multi cropping.

## Details of the prominent rural development schemes that are being implemented at the fringe villages of STR

Pension	No. of Beneficiary	Amt./Month	Total/Month
Fishery Oldage Pension	24	1000	24000
Fishery Gitanjali	50	186000	9300000
NSAP (IGNOAPS-60)	3521	400	1408400
NSAP (IGNOAPS-80)	1673	1000	1673000
NSAP (IGNWPS))	1460	600	876000
NSAP (IGNDPS)	211	600	126600
Manabik	61	1000	61000
Gitanjali	442	75000+16000	40222000
KCC	1167		642.75 L
PMAY/BAY	3646		
NREGA	<b>Employment Provided</b> Household=18953 Persondays=1783732		3359.49 L
NRLM	No. of Groups 2027	Total Members 23108	Turn Out/Month 898000
SHGs UNDER CO-OP SOCIETIES	No. of Groups 1448	Total Members 12052	Turn Out/Month 248.69 L

## Details of Pradhan Mantri Awas Yojna

SI No.	Panchayat name	Houses completed prior to 2012-2013	Houses completed for 2013-2014	Houses completed for 2014-2015	Houses completed for 2015-2016	Houses completed for 2016-2017	Houses completed for 2017-2018	Houses completed in 2017-2018
1	Amtali	0	0	0	0	126	134	260
2	Bali-I	0	0	0	0	107	293	400
3	Bali-II	0	0	0	0	148	304	452
4	Bipradaspur	0	0	0	0	81	193	274
5	Choto Mollakhali	0	0	0	0	134	92	226
6	Gosaba	0	0	0	0	68	189	257
7	Kachukhali	0	0	0	0	78	86	164
8	Kumirmari	0	0	0	0	104	35	139
9	Lahiripur	0	0	0	0	112	67	179
10	Pathankhali	0	0	0	0	155	400	555
11	Radhanagar-Taranagar	0	0	0	0	107	91	198
12	Rangabelia	0	0	0	0	66	125	191
13	Satjelia	0	0	0	0	51	41	92
14	Shambhunagar	0	0	0	0	90	169	259
	<b>TOTAL</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1427</b>	<b>2219</b>	<b>3646</b>



### Details of MGNREGA Report

Sl No.	Panchayats	Cumulative No. of HH issued jobcards				Employment Provided		Women Percentage	Average Persondays	No. of Families Completed 100 days	No. of Disabled beneficiary individuals	Cumulative Expenditure		
		SCs	STs	Others	Total	Household	Persondays					On Unskilled Wage	Actual Expenditure On Semi-skilled and Skilled Wage	On Material
1	AMTALI	701	51	2212	2964	867	81039	33047	40.78	93.47	4	84.92	3.2	0
2	BALI-I	1602	47	1291	2940	1909	177368	81733	46.08	92.91	5	299.1	8.47	152.88
3	BALI-II	1473	91	2061	3625	1576	145289	60848	41.88	92.19	1	234.96	1.05	13.35
4	BIPRADASPUR	870	100	2156	3126	1418	136406	62345	45.71	96.20	1	198.75	5.01	59.03
5	CHHOTA MOLLAKHALI	1020	122	1589	2731	889	80139	38615	48.19	90.15	0	113.22	4.45	2.91
6	GOSABA	1113	172	2622	3907	1593	146578	75685	51.63	92.01	0	224.04	5.05	23.94
7	KACHUKHALI	839	95	1812	2746	997	94926	42257	44.52	95.21	1	139.25	2.97	0
8	KUMIRMARI	1044	95	1394	2533	605	55703	23519	42.22	92.07	0	49.27	0	24.01
9	LAHIRIPUR	1586	156	3047	4789	1281	112223	54888	48.91	87.61	1	78.03	1	33.57
10	PATHANKHALI	1510	437	2443	4390	4103	400684	188663	47.09	97.66	1	767.54	18.09	308.25
11	RADHANAGAR-TARANAGAR	612	124	2704	3440	659	62314	32768	52.59	94.56	0	82.56	0.06	0
12	RANGABELIA	507	34	2628	3169	947	88016	41552	47.21	92.94	0	135.1	0	34.24
13	SATJELIA	672	54	1915	2641	818	75194	39153	52.07	91.92	1	89.37	5.16	8.98
14	SHAMBHUNAGAR	1268	380	1731	3379	1291	127853	56393	44.11	99.03	4	144.59	3.12	0
	<b>Total</b>	14817	1958	29605	46380	18953	1783732	831466	46.61	94.11	19	2640.71	57.63	661.16

## 8.4 MONITORING AND EVALUATION

This plays a very important role not only in gauging the efficacy of the work program and its actual implementation but also seeing if any mid course correction is actually required. It is proposed that beside the routine monitoring and checking that is carried out at the level of the Assistant Field Director, Deputy Field Director and the Field Director an outside agency be deputed to check the field works and there actual effectiveness in relation to the set goals. Such an evaluation may be carried out after every three years. The terms and conditions to be decided at the level of Director, Sundarban Biosphere Reserve. The feedback obtained shall help tailor the field programs to meet the actual needs of the people.



**Rally for awareness on van mahotsav**



**Plantation of saplings by local school children on Van Mahotsav**



**Awareness programmes at local school**



**A session of Nature Club at a local school of fringe village of Sundarban Tiger Reserve**



**Study tour organized for the local school children**

## INITIATIVES TAKEN FOR ECO-DEVELOPMENT AND SUSTAINABLE LIVELIHOOD GENERATION



A



B



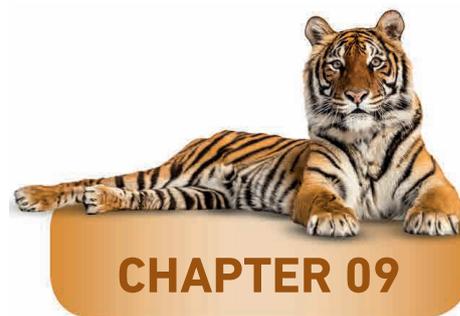
C



D

Figure: A-D: Different initiatives taken for eco-development and sustainable livelihood generation

# Implementation Strategy



## 9.1 STATE-LEVEL MONITORING COMMITTEE

The monitoring of the ecodevelopment works by a State Level Monitoring Committee shall ensure that there is synergy of operations between different government departments operating the area. This will prevent duplication of work and help in dovetailing of similar schemes to help comprehensive development of the area. This shall also help in sorting out problems relating to different departments in a quicker manner. The present State Level Steering Committee which is chaired by the Chief Minister and contains different departments operating in the region on board shall be act as the institutional mechanism for the purpose of coordination and implementation of decision taken at this level.

## 9.2 TIGER CONSERVATION FOUNDATION AND DISTRICT-LEVEL CO-ORDINATION COMMITTEE

The Sundarban Tiger Conservation Foundation which has been already formed. It shall play a key role in coordination between the different agencies at the District Level. The Chairman of the Executive Committee of the Foundation i.e the Field Director of the Tiger Reserve shall be the key person who shall be coordinating on different issues especially those relating to the development of the area. He shall hold meetings which shall work out the issues discussed at broad levels in the State Level Steering Committee and can iron out any problems arising in the field during the course of implementation of the different developmental schemes.

## 9.3 FORMATION OF JOINT FOREST MANAGEMENT COMMITTEE AND OTHER SUPPORTING INSTITUTIONS LIKE SELF-HELP GROUPS (SHGS) AND NATURE CLUBS

As detailed in Chapter 8 the Joint Forest Management Committees have been formed as per the Government Resolution. As per the Government Resolution the Committee comprises of a General Body and an Executive Committee. The former is made up of all registered member generally comprising of the economically backward fringe communities living in the forest vicinity and having dependency on the natural resource. The General body members in turn select the Executive Committee. This committee also contains nominated members of the Gram Panchayat and the Panchayat Samiti. The Beat Officer acts as the Member Secretary. The Executive Committee is involved in the day to day functioning of the concerned JFMC. The AGM is to be held every year for election of new office bearers and discussions on significant issues. A meeting register is maintained by the JFMC which records the minutes of the meetings held from time to time, the resolutions passed and the proceedings of the Annual General Meeting.

The JFMC's have been given the responsibilities to ensure protection of forests and wildlife through members of the Committee. They have also been entrusted tasks of apprehension or assisting in apprehension of persons committing forest offence etc. As per the Government Resolution the Committee comprises of a General Body and an Executive Committee. The former is made up of all registered member generally comprising of the economically backward fringe communities living in the forest vicinity and having dependency on the natural resource. The General body members in turn select the Executive Committee. This committee also contains nominated members of the Gram Panchayat and the Panchayat Samiti. The Beat Officer acts as the Member Secretary. The Executive Committee is involved in the day to day functioning of the concerned JFMC. The AGM is to be held every year for election of new office bearers and discussions on significant issues. A meeting register is maintained by the JFMC which records the minutes of the meetings held from time to time, the resolutions passed and the proceedings of the Annual General Meeting. The JFMC's have been given the responsibilities to ensure protection of forests and wildlife through members of the Committee. They have also been entrusted tasks of apprehension or assisting in apprehension of persons committing forest offence etc.

The eco development initiative should be carried out at two levels one at the level of awareness building of conserving this unique mangrove ecosystem and the issue of reducing the natural resource dependency so that in the long run whatever natural resources we are using are being carried out in a sustainable manner. The Nature Clubs should be created in all JFMC areas and the existing ones should be strengthened. The Tiger Reserve should sponsor their trips to the forest and different extracurricular events. They should be involved in a large way in the Aranya Saptah, Wildlife week, Earth Day, Water Day so that the conservation consciousness permeates all strata's of society especially the lower levels who are most intractably associated with the environment and any adverse impact shall affect them the most. Secondly the JFMC's shall also be the institution which shall play a crucial role in the field level implementation of the developmental schemes. The Committees through their resolutions shall decide on the site and the quantum of work to be carried out in their respective areas. The women members in the present JFMC have been encouraged to form SHG's which have to some extent given positive results. These need to be encouraged as it has been seen that it has encouraged women to save, increased their self confidence, and many of them who were earlier involved in tiger prawn seedling collection have given up that activity as they are able to earn some amount of money through the medium of SHG's. New and innovative schemes should be tried through the medium of these SHG's. Micro financing may also be explored for SHG's who have been performing well on a consistent basis.

Following are schemes that has been proposed by the department and shall implemented for the SHGs in the JFMC areas according to the need and demand of the local people (Note- This has been already explained in the previous chapter)

- Carpentry
- Diesel genset repairing
- Mobile repairing
- Masonry
- Solar light repairing
- Tailoring
- Embroidery
- Pisciculture
- Ornamental fish culture
- Apiculture
- Brown Rice
- *Gamcha* (Cotton towel) making
- Incense stick making



### LIST OF NATURE CLUB IN DIFFERENT JFMC AREAS OF SUNDARBAN TIGER RESERVE

We have taken 15 schools and 20 students of class VII and VIII from each school from three different ranges of Sundarban to form 15 Nature Clubs. Every nature Club has given a different unique name for their club which is related to any of the mangrove flora or bird fauna of Sundarban. The name of the schools is given below:

SI No.	Name of the School	Name of Nature Club	JFMC	Range
1	Satyanarayanpur Shashibhushan Uchcha Madhyamik Vidyalaya	Hental Sobuj Dol	Satyanarayanpur, Bidya 1No.	National Park West Range
2	Bali Purba Para High School	Mohanchura Sobuj Dol	Bali	National Park West Range
3	Bali Dhano Moni Model High School	Bene Bou Sobuj Dol	Bali	National Park West Range
4	Asitbaran High School	Garjan Sobuj Dol	Satyanarayanpur	National Park West Range
5	Bijaynagar High School	Kankra Sobul Dol	Bali	National Park West Range
6	Pakhiralay High School	Tora Sobuj Dol		Sajnekhali Wildlife Sanctuary
7	Rangabelia High School	Batasi Sobuj Dol		Sajnekhali Wildlife Sanctuary
8	Santigachhi High School	Fotka Sobuj Dol		Sajnekhali Wildlife Sanctuary
9	Rajat Jubili High School	Guriyal SobujDol		Sajnekhali Wildlife Sanctuary
10	Dayapur P. C. High School	Khalsi Sobuj Dol		Sajnekhali Wildlife Sanctuary
11	Kumirmari High School	Bani Sobuj Dol	Adharpara, Kumirmari GP	Basirhat Range
12	Bhim Chandra High School	Dakshinray Sobuj Dol	Kalidaspur, Mollakhali G.P.	Basirhat Range
13	Satjelia Natabar Vidyayatan (H.S.)	Babunai Sobuj Dol	Emlibari, Satjelia G.P.	Basirhat Range
14	Samsernagar High School, Kamalakhali	Banshpati Sobuj Dol	Samsemgar, Kalitala G.P.	Basirhat Range
15	Hemnagar High School	Goran Sobuj Dol	Hemnagar, Jogeshganj G.P.	Basirhat Range

### 9.4 LIVELIHOOD SUPPORT INITIATIVE THROUGH VILLAGE MICRO-PLANS

Village level microplanning has a very big role to play in the success or failure of a particular program. The quality of the microplan shall determine the quality of the field output. Therefore, this tool which helps in planning at the grassroots level should be utilized extremely judiciously so as to prepare JFMC level microplans. Based on the inputs so obtained, the microplans should be prepared for a period of ten years with a midterm review after five years. The microplanning should be directed at the kind of eco development activities are required at the village level and their priorities. Emphasis should be given on skill building activities at the individual level and assets creation which should be carried out at the community level. Common concerns like creation of Community based plantation to greening of the village through plantation activities, proper garbage disposal, water resource management, tourism and related issues should also be taken up the microplanning level. Any other issue of topical interest which shall have a bearing on the area in the coming days should also be taken up.

The micro plan for all the JFMCs around Sundarban Tiger Reserve had been prepared during 2014-15 and is to be reviewed during 2019.

The list of JFMCs and the date of preparation of respective micro plan is given below:

SI No.	Name of JFMC	Date of Preparation of Microplan
1	Mitrabari	26-12-13
2	Emlibari	26-02-14
3	Gobindapur	07-06-14
4	Hentalbari	09-03-14
5	Bgnapara	06-12-13
6	Vuruliapara	14-12-13

Contd.

SI No.	Name of JFMC	Date of Preparation of Microplan
7	Adibasipara-Kumirmari	01-03-14
8	Kalitala-Pargumti	02-12-13
9	Samsernagar	05-07-14
10	Kalidaspur	30-05-14
11	Adharpara	07-06-15
12	Hemnagar	07-12-13
13	Anpur-Rajatjubilee	10-08-14
14	Dayapur	23-07-14
15	Dulki	15-07-14
16	Jamespur	12-07-14
17	Lahiripur-Chargheri	04-04-15
18	Lahiripur-Santigachhi	30-03-15
19	Luxbagan-Parasmani-Bidhancolony	06-04-15
20	Pakhirala	14-06-15
21	Sonaga	27-01-14
22	Amlamethi	07-06-15
23	Bally	25-06-15
24	Bijohnagar	25-06-15
25	Mathurakhanda	04-06-15
26	Satyanarayanpur	05-06-15

## 9.5 INTEGRATION OF RURAL DEVELOPMENT PROGRAMS

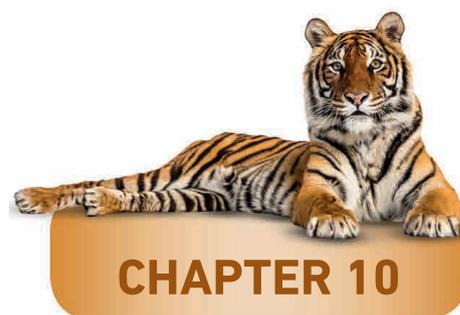
In order to reduce natural resources dependency, the forest department meticulously promotes alternate livelihood programs (which has already been discussed in Chapter 8) as well as the schemes that has been put forward by central and state government to augment livelihood income.

Details of the schemes has already given in Chapter 8

## 9.6 MONITORING AND IMPLEMENTATION

This plays a very important role not only in gauging the efficacy of the work program and its actual implementation but also seeing if any mid course correction is actually required. It is proposed that beside the routine monitoring and checking that is carried out at the level of the Assistant Field Director, Deputy Field Director and the Field Director an outside agency be deputed to check the field works and there actual effectiveness in relation to the set goals. Such an evaluation may be carried out after every three years. The terms and conditions to be decided at the level of Director, Sundarban Biosphere Reserve. The feedback obtained shall help tailor the field programs to meet the actual needs of the people. Most of the activities should be carried out by involving the local people so that they are able to derive the maximum benefit from the said activities.

# Main Streaming Strategy with various Production Sectors



## 10.1 FORESTRY

The Tiger Reserve is flanked on the western side by a territorial Division of 24 Parganas South. This forest area separated only by the Matla river which also serves as a tiger corridor between the Tiger Reserve and the neighbouring Division. Tigers have been often noticed to cross over from STR to this neighbouring Division and vice versa. The 24 Parganas South Division also harbours two Wildlife Sanctuaries namely Halliday and Lothian WLS. At present, there is no production related activity in the Tiger Reserve and the adjacent Division and protection is the main focus of management especially in the Tiger Reserve. In 24 Parganas Division also protection is the prime mandate and along with that plantation on newly developed “Char” lands is the major forestry activity. All the activities of South 24 Parganas Division are guided by their approved Working Plan. It is proposed that to improve better coordination and cooperation between both the Divisions meetings should be held at the level of the DFO and the DFD at an interval of two months to sort out all pending issues. Information sharing especially with regards to criminals operating in the areas and strategies as joint raid program can also be thought of. Joint patrolling operations once in two months are also proposed especially in the border areas and along the sea facing areas. Since the staff of the Tiger Reserve have a much more orientation towards conservation it is proposed that there should be exchange visits between staff of the two Divisions wherein the wildlife techniques like tranquilization and other field craft being utilized in the field shall be shared. Recently a proposal has been made to incorporate the adjacent portion of South 24 Parganas Division under CATS.

## 10.2 AGRICULTURE

The mainstay of the economy here is agriculture. However, agriculture is not practiced scientifically as the land holdings are mostly marginal. The farmers practice agriculture after leasing of the land from the land owners. In the absence of any irrigation facilities the farmers depend on the rain and agriculture is usually rain fed monocrop. The Tiger Reserve has taken initiative and undertaken the re-excavation of the irrigation channels in the villages in a big way. These hold water which is used to carry out irrigation in the lean season as a result of which farmers are being able to carry out multi cropping. It is proposed that there should be liasoning with the agriculture department to carry out agriculture extension activities which shall help boost the productivity of the agriculture. Also, the indiscriminate use of fertilizers and pesticides the runoff from which have been contaminating water bodies also needs to be curbed. The strategies for managing the effect of indiscriminate use of fertilizers and pesticides are as follows –

- Recycling of organic wastes through composting and vermicomposting.
- Biological and mechanical control of pests like pheromone trapping, light trapping etc.
- Use of bio pesticide like Neem based pesticides.

- Use of fertilizer considering the result of soil tests.
- Use of bio fertilizer like compost.
- Generation of awareness among local farmers.
- Provide proper training to the farmers.

This is also imperative as post Aila many of the inundated areas have lost their productivity and are lying barren/fallow leading to significant impact on the local economy. In the absence of work, many of the village men folk have migrated to Kolkata, Andaman and other areas in search of work.

### 10.3 INTEGRATED DEVELOPMENT

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This has been dealt in chapter-8

### 10.4 ECO-TOURISM

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Tourism is one of the upcoming industries in the area. Over the years there has been an exponential rise in the number of people visiting the area. This has resulted in the mushrooming of tourist lodges, shops selling edible items, handicrafts etc. A number of local people have found employment in the tourist lodges and hotels which have come up in the area. A number of local boat owners are using the boats to ferry people coming from outside into different tourist places within the Tiger Reserve. However, there are a number of attendant issues related to tourism like improper disposal of garbage, oil pollution, sound pollution crowding at tourist spots need to be addressed at the earliest otherwise these will adversely impact the visitor experience to the area. There needs to be comprehensive guideline and policy in place for promoting tourism in the area which needs to be worked out with the Tourism department. Carrying capacity of the area also needs to be worked out and has been given in detail in the Tourism chapter. Infrastructure like roads, electricity, drinking water, jetties also has to be developed to achieve the actual tourist potential of the area.

The strategies / action to be taken for mitigation of negative effects of tourism-

- Placement of dustbins in tourist spots for collection of solid waste.
- Creation of large vats for collection of solid wastes.
- Sundarban has been declared as a no plastic zone by the Department of Environment, Govt. of West Bengal. Strict no use of plastic policy which is implemented by Forest Dept. and local JFMC.
- Collection of Plastic bottles from river and forest side for recycling by engaging stake holders.
- Regular checking and raids in the lodges and boats for plastic.
- Creation of pay and use toilets for the tourists.
- Awareness generation program in regular interval to motivate local people for using of biodegradable materials instead of plastic bags.
- No. of jetties has been built to avoid rush among the tourist during boarding the boats / launches.
- No loud speaker is allowed on the boats while entering the forest areas. In adjacent villages there are time limits and noise level restriction for using loud speaker.

### 10.5 FISHERIES

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The Fisheries Department regulate the fishing activity in the non forest areas of Sundarbans whereas the Tiger Reserve is in charge of all the activities occurring within the Reserve. Presently, regulated fishing is only allowed in the Multiple



Use Area but the fishermen try to enter the restricted area of the Tiger Reserve. The major reasons of conflict with the local community are

1. Fisheries department observes closure of fishing for two months whereas it is three months in case of the Tiger Reserve.
2. The Fisheries Department also issues the Marine licences under the West Bengal Marine and Fishing Regulation Act, 1993. The fishermen try to enter the forest area using that licence.
3. Mechanised boats and trawlers are not allowed inside the Tiger Reserve except on humanitarian grounds in case of rough weather for weather.

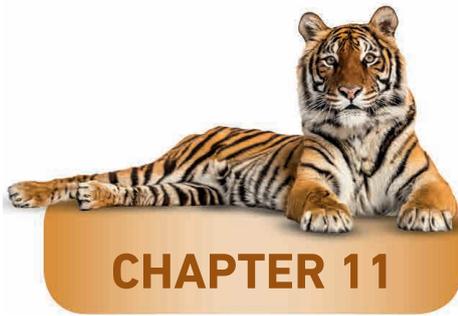
Due to these and other issues a Committee has been formed at the District level and is chaired by the DM. It has been looking into the issues raised. It is proposed that the same mechanism may continue or the policy issues be resolved at the higher level in the meeting of the Steering Committee.

#### Range wise details of Fishing Permits (BLC's)

SI No.	Name of the Range	Active BLCS (Nos.)	Cancelled BLCS* (Nos.)	Total (Nos.)
1.	Basirhat Range	191	77	268
2.	Sajnekhali Wildlife Sanctuary	308	119	427
3.	Head Quarter Range	194	11	205
		693	207	923**

Note- 23 nos. RPT fishing BLCS have been temporarily suspended.

\*Vide letter no 2186/FD/2M-16



# Research, Monitoring, Training and Wildlife Health

## 11.1. RESEARCH PRIORITIES, MAIN PROJECTS AND IMPLEMENTATION

Research and monitoring are effective tools for knowing more about an area and also serve to provide an effective feedback regarding the efficacy of the existing strategies being followed. The mangrove ecosystem is one of the most biologically productive and taxonomically diverse biodiversity gene pool in the country. It exhibits enormous diversity on the basis of its genesis, geographical location, and hydrological regime. The structural complexity of the ecosystem lends to the presence of a number of ecological niches. The mangrove ecosystem is being affected by a number of factors like, upstream water pollution, increased off take of fish catch, illicit felling, illegal fishing and honey collection and poaching. The increased silt load in the river channels have been resulting in changed river courses. High salinity levels especially in the western boundary of the Tiger Reserve have been correlated to declining status of Sundari trees in the Tiger Reserve.

Tiger straying has been one of the major issues confronting the Tiger Reserve management. Of late, the Tiger Reserve has seen a spate of tiger straying incidences. In the absence of scientific studies, a large number of theories abound to explain the tiger straying phenomenon most of which are based on reasoned guesses rather than hard scientific data. Similarly, hardly any concrete data exists with regard to the actual range of tiger numbers, its ecology and behavior especially territoriality, its breeding biology and genetic diversity vis a vis other tiger populations of the country and these would make for an interesting study. Monitoring prey base of the tiger needs to be carried out on a priority basis so as to aid management decisions in event of low prey base as is often alleged.

Other forms of flora and fauna especially endangered species like Irrawaddy and Gangetic Dolphins, also need to be monitored for their distribution population size and kinds of threats faced. Similarly, vegetation plots could be laid down in different part of the Reserve for carrying out vegetation monitoring. Over the years tourism has come up in the area in a big way and its impacts on the Tiger Reserve need to be studied.

Similarly, the impact of climate change on the sea level rise which could endanger the very existence of the Tiger Reserve in the long run should be studied to find the factual position in this regard.

On the whole, detailed scientific studies needs to be carried out on the above mentioned topics to help the field managers in formulating sound policies and taking informed decisions based on scientific facts instead of reasoned guesstimates.

Research activity requires dedicated personnel, adequate infrastructure and financial support. The Tiger Reserve management faced with a crunch of men and material resources by itself cannot spend the time required for carrying out the Research. Therefore, research studies could be carried out in collaboration with local universities, scientific institutions or NGO's of repute. However, all the research activity should be undertaken as per the management priority and in consultation and direct co supervision of the field managers. The outcome of these scientific investigations will help them refocus or fine tune their management interventions.



### 11.1.1. Strategies

1. The Research Range which has become moribund in the absence of a full time Research Officer (despite a sanctioned post), Range officer, beat officer and needs to be revitalised. It should be made in charge of the routine monitoring activities especially relating to monitoring of biodiversity i.e. fortnightly monitoring of wildlife, tiger monitoring, data collection on weather, tidal fluctuations, camera traps, salinity etc. along with compilation of the data collected.
2. Improved research methodology should be devised in terms of base line study of flora, fauna and conservation biology with the help of expert groups, NGOs and Academia with the requisite budgetary provisions regarding the matter.
3. Special studies related to marine and aquatic spp of Sundarbans should also be devised with the help of expert groups, NGOs and Academia after making the requisite budgetary provisions regarding the matter.
4. Presently, all the Research proposals are cleared at the level of the Chief Wildlife Warden. Field level requirements and inputs should be taken into consideration before giving permission for the conducting of field based research. In this regard a Research Advisory Committee is proposed which shall vet all the Research Proposals before giving a final go ahead.

#### Constitution of Research Advisory Committee

A Research Advisory Committee may be constituted with the following members:

(i) The Chief Wildlife Warden, W.B.	Chairman
(ii) Director, Sundarban Biosphere Reserve	Member Secretary
(iii) Field Director, Sundarban Tiger Reserve	Member
(iv) Deputy field Director, Sundarban Tiger Reserve	Member
(v) Scientist, Calcutta University	Member
(vi) Scientist, BSI, ZSI	Member
(vii) Any other Scientist/Forest officials, NGO nominated by the Chief Wildlife Warden	Member/Special invitee

#### The Committee shall have the following Activities

- (a) To finalize the selection/identification of relevant research based studies.
- (b) To review the progress of research activities carried out for the STR
- (c) Provide suggestion/recommendations for improvement and smooth functioning of the research activities.

The meeting should be arranged as per the requirement, but at least once in six months. The members would be eligible to get TA/DA and other facilities, decided by the Government from time to time.

#### Research Projects

Though the area lends itself to undertaking research into a number of areas the following areas should be the focal / or thrust areas for the management of the Reserve:

- Estimation of tiger densities, dispersal and ranging patterns through radio collaring studies.
- Estimation of prey species especially spotted deer and wild boar populations.
- Successional patterns in mangroves
- Spatial distribution of 'Sundari' or *Heritiera fomes* with reference to the salinity regime in the Tiger Reserve.
- Straying of tiger in the village areas
- Impact of eco development works on villages and its linkages with conservation
- Ecotourism its impact on conservation awareness, local economy and the environment.

- Change in river courses, erosion and accretion patterns in different parts of the Tiger Reserve.
- Studying the sea level rise, and tidal movement especially in the context of global warming.

In addition to these a list of research which has already been conducted has been given in Appendix 12.

### 11.1.2. Monitoring Framework

Monitoring is one of the most effective methods of gauging the efficacy of a process or a management intervention along with this it also serves as a regulatory tool as well as a means of detecting incipient change. One of the outcomes of a good monitoring program is that it generates good baseline data. It has been seen that in most of our Protected Areas we lack good baseline data collected in a scientific manner which often results in decisions being taken in an adhoc and piecemeal manner.

In the Tiger Reserve the present system of monitoring involves data being collected in pre designated formats by the field staff. The different field camps are involved in collection of data related to the following:

- (i) tiger sighting direct and indirect evidences on a day to day basis.
- (ii) wildlife sighting on a daily basis.
- (iii) protection related data collected on a daily basis. The monitoring of this data is carried in the form of *Protection Monitoring Protocol (PMP)* which reflects the duties performed by the field staff along with its outcome in the form of data generated with respect to the area where duties were carried out, number of night halts, number and nature of offence detected, etc has proved to be an effective tool for monitoring the protection regime. The same needs to wbe continued and monitored regularly and corrective action applied based on the basis of the monthly review meetings chaired by the Field Director.

To overcome the limitations of time dependency on RT network, errors and time consumptions in manual entry, possibilities of data manipulation and absence of real time data E-patrol/Smart patrolling was introduced in Sundarban Tiger Reserve in 2015.

In this new system every camp has been given a cell phone having an android operating system with a compatible mobile application installed in it for monitoring and patrolling purpose. With the help of this application the frontline staffs are recording their every possible activity like patrolling, monitoring the condition of fences, night patrolling, offence detections, and wildlife sightings.

These recorded real time data will directly be going into main database. The real time patrolling data which has been well tabulated, analysed and synchronised into the main server database, can directly be monitored by the application installed in a compatible android cell phone of a senior official. In addition to that, the software allows arranging and/or comparing the reports on numerous strata, by providing various relevant filters.

Recently there has been a new addition of an observatory and portable mobile laboratory in Sajnekhali, established by IISER Kolkata and a concerned NGO, which shall eventually help to retract climate related data which can be used in various research purposes.

### 11.1.3. Training Needs Assessment

Training or capacity building is an integral part of all the management activities and inputs and is invariably reflected in an increased efficiency or output. Training needs are different depending on the persons and activities involved. The staff posted in wildlife areas need to be well versed with the biodiversity values of the area along with different field signs. Towards this end staff which appear promising or with potential should be identified and capacity building carried out. The Park Management should ensure that the newly inducted staff undergoes wildlife training conducted by various Institutes in the State and outside. Officers and staff right up to the Range Officer level should be encouraged to undergo Diploma, Certificate and Capsule courses conducted by the Wildlife Institute of India, Dehradun. The information about the training and institute providing training is as following:



SI No	Course Name	Course Type	Course Duration	Participant Level	Resource person/org.	Frequency
1	Improved Wildlife Management	Diploma Course	Nine Months	A.C.F./DCF	WII, Dehradun	Once
2	Eco-development	Module	Three Months	A.C.F./DCF	WII	Once
3	Improved Wildlife Management	Certificate Course	Three Months	F.R.	WII	Once

### 11.1.4. HRD Plan

Wildlife management is a specialized branch, which need special orientation, skill and knowledge. It requires men with high degree of motivation, dedication and skills in field craft. The Tiger Reserve management should systematically carry out capacity building through trainings along with a system of incentive to increase the skill sets and the motivation levels of the staff. The existing human resource at the disposal of the Tiger Reserve management needs to be given exposure to good efforts in other PA's can help develop motivation to achieve the goal to the same degree or higher also. Not only this, tremendous degree of confidence is also developed if the initiative done is appreciated by others. Therefore, it is nice to initiate effort to impart special training to all level of staff in various relevant fields. Technical assistance and guidance should be availed from the concerned experts as and when required.

#### Training Calendar:

SI No	Type of Training	Designation/level of participants	Resource Person	Frequency
1.	Tranquilisation	FR, BO, FG, BS/BM	DFD, AFD	3 months
2.	Arms training	FR, BO, FG, BS/BM	State Police Academy	Yearly
3.	Mob control	FR, BO, FG, BS/BM	State Police Academy	Yearly
4.	First Aid	FR, BO, FG, BS/BM	Block Doctor	Yearly
5.	Hospitality training	FR, BO, FG dealing with tourists, tourist guides	From Hospitality industry	Yearly
6.	Law and related matters	FD, DFD, AFD, FR, BO, FG	APP and Judges	Yearly
7.	Computer	FD, DFD, AFD, FR, BO, Clerical staff	Professional from a training institute	Yearly
8.	Waste Management	Local lodge owners, boat operators, FR, BO	Expert from the concerned field	Yearly
9.	Radiocollaring and Monitoring	FD, DFD, AFD, FR, BO, FG	Experts from WII	Yearly
10.	Surveillance and intelligence gathering	DFD, AFD, FR, BO	Experts from CID	Yearly
11.	Tourism, interpretation and conservation awareness	DFD, AFD, FR, Tourist Guides	Local Experts	Yearly
12.	Livelihood options	FR, BO, JFMC members	Local Experts	Yearly
13.	JFMC account keeping	FR, JFMC members	Forest Range Officer	Yearly
14.	GPS and Smart Patrolling	FR, BO, FG, BS/BM	Local Experts	3 Months

#### In addition to the above, the following are also proposed:

- (i) Study tours to other PA's to study their management activities and initiatives. The JFMC members also should be given exposure during these visits to see the ecocodevelopment activities being carried out in other areas.
- (ii) The Sundarbans is a contiguous forest between India and Bangladesh. Officials and staff should visit Bangladesh to study the management being carried out there.
- (iii) International study tours to gain exposure to the new initiatives being carried out elsewhere.
- (iv) Yearly workshops should be conducted to present the findings of the studies being carried out in Sundarbans by different departments like BSI, ZSI other institutions, NGO's which shall result in updation and exchange of ideas and help in keeping abreast with the latest information in the concerned field.

### 11.1.5. Species recovery programme

Since the 1980's *ex situ* conservation program of olive ridley turtle (*Lepidochelys olivacea*), was fully operational in Sundarban Tiger Reserve, where eggs of the species were collected from the turtle pits and incubated at a controlled environment (at Sajnekhali). The hatchlings were subsequently released in the sea.

During the 1990s amongst the hatchlings of olive ridley turtles nine hatchlings of some other species were spotted and later these were identified as Northern River Terrapin (*Batagur baska*). By 2008, there were 12 individuals (7 males and 5 females). Thereafter a species recovery program is ongoing in this reserve with active assistance from Madras Crocodile Bank Trust and TSA. Unfortunately, one male was lost from the pond of Sajnekhali when cyclone *Aila* hit Sundarbans and adjoining areas. However, later in 2013, an adult female was received from Mollakhali.

#### Objectives of the species recovery program of *Batagur baska* in Sundarban Tiger Reserve

The major objectives of the *species* recovery program of *Batagur baska* are:

- a. Initially, creating *ex situ* breeding conditions and favorable growth environment.
- b. Later, when the individuals ages to about two years and attains a body weight of about one kilogram, soft release would be done after adequate habitat survey. Soft release would be carried out by constructing temporary enclosures on the tertiary creeks at the release site in order to acclimatize the individuals to the natural conditions and as per the protocol for the monitoring of the released individuals, ultrasonic transmitter with temperature sensor would be fitted to them.

#### Soft Release of *Batagur baska* in Sundarban Tiger Reserve:

During March 2014, selected river stretches were surveyed for soft release of the individuals. As per the protocol a temporary enclosure was constructed at the creek of Chamta khal. On 17/01/2016, 10 (six female and four males) juvenile *Batagur baska* were released at the creek of Chamta khal, fitted with ultrasonic transmitter with a temperature sensor.

#### Breeding Status (*ex situ*) of *Batagur baska* in Sundarban Tiger Reserve

Yearling	No. of Individuals	Male	Female	Unidentified	Remarks
2008	12	7	5		
2012	33	0	32	1	1 could not be captured and examined
2013	56	20	36		
2014	55	4	51	1	
2016	96				Sex of the individuals yet to be identified
2017	74				
<b>Total</b>	<b>326</b>				

### 11.1.6. Wildlife Health Monitoring

There are no villages inside Sundarban Tiger Reserve area and the unique habitat of Sundarban Tiger Reserve makes it isolated from the fringe villages through river channels and creeks. Also scenario of cattle entering the forest area does not exist; hence there is no chance of spreading of infection to the wild animals. However, in case of animals rescued after straying into the villages, proper health monitoring is carried out by the veterinary officer following standard operating procedure. Standard protocols are followed in case of animal carcass that has been removed from the tiger reserve. As an added precautionary measure veterinary camps are organized in all of the 26 fringe villages of STR, throughout the year, aiming at the immunization of the cattle population in the fringe villages. (Note- No etiological studies nor trend analysis of livestock has been done in the recent years). The routine details of veterinary camps is given below.



GIST OF WORK DONE IN THE VETERINARY CAMPS (20 NOS) AT BHT, SAJNEKHALI & NPW RANGE IN THE YEAR 2017-2018													
SL NO	RANGE	BEAT	NAME OF JFMC	DATE OF CAMP	TREATMENT					VACCINATION			
					CATTLE	SHEEP/GOAT	POULTRY BIRD	DUCK	OTHERS	TOTAL	CATTLE	SHEEP/GOAT	TOTAL
1	BHT	BAGNA	MITRABARI	01-Jan	136	293	1011	540	-	1980	97	98	195
2	BHT	BAGNA	KALIDASPUR	02-01-2018	152	327	1129	530	-	2138	98	93	191
3	BHT	BAGNA	BHULIAPARA & BAGNAPARA	03-01-2018	209	256	1098	593		2156	93	89	182
4	BHT	BAGNA	ADIBASIPARA	04-01-2018	213	250	1452	551		2466	168	170	338
5	BHT	JHINGEKHALI	HEMNAGAR	05-01-2018	74	131	683	173	1	1062	49	98	147
6	BHT	JHINGEKHALI	SAMSERNAGAR	06-01-2018	189	587	1191	798		2765	146	97	243
7	SWLS	DUTTAR	Luxbagan	08-01-2018	151	206	505	183		1045	91	94	185
8	SWLS	DUTTAR	LAHIRIPUR, CHARGHERI	09-01-2018	242	252	1394	347	1	2236	176	189	365
9	SWLS	DUTTAR	LAHIRIPUR, SANTIGACHI	10-01-2018	205	489	2260	659	1	3614	153	97	250
10	SWLS	DUTTAR	TRIPLIGHERI	11-01-2018	106	166	383	135		790	49	98	147
11	SWLS	DUTTAR	RAJATJUBILEE	12-01-2018	186	195	1151	536		2068	98	98	196
12	SWLS	SAJNEKHALI	SONAGAON	14-01-2018	195	235	1698	269	6	2403	160	170	330
13	SWLS	SAJNEKHALI	JAMESPUR	15-01-2018	187	264	1068	344		1863	130	99	229
14	SWLS	SAJNEKHALI	DAYAPUR	16-01-2018	162	157	831	223	3	1376	120	98	218
15	SWLS	SAJNEKHALI	DULKI	17-01-2018	221	193	848	168	24	1454	210	187	397
16	SWLS	SAJNEKHALI	PAKHIRALA	18-01-2018	176	212	1016	236	6	1646	160	170	330
17	NPW		BALI, BIJAYNAGAR	21-02-2018	191	251	1137	167		1746	163	197	360
18	NPW		AMLAMETHI	22-02-2018	127	180	662	144	1	1114	109	140	249
19	NPW		MATHURAKHANDA	23-02-2018	194	429	898	116	13	1650	160	198	358
20	NPW		MATHURAKHANDA	24-02-2018	175	301	1401	118	3	1998	145	196	341
<b>TOTAL</b>	<b>3</b>	<b>4</b>	<b>20</b>		<b>3491</b>	<b>5374</b>	<b>21816</b>	<b>6830</b>	<b>59</b>	<b>37570</b>	<b>2575</b>	<b>2676</b>	<b>5251</b>

## 11.7 MORTALITY SURVEY

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This should be carried out in the Tiger Reserve throughout the year. The field staff should prepare a register an details of mortality recorded in time along with the area, species, approximate age, probable causes of mortality. In all cases of Scheduled I species post mortem is to be carried. The Standard operating procedure for disposing the tiger/ leopard carcass/ body parts as put forward by NTCA is given below:

1. **Title:** Standard Operating Procedure for disposing the tiger/ leopard carcass/ body parts.
2. **Subject:** Tiger death/seizure of body parts
3. **Reference:** Advisories of the Ministry of Environment & Forests/ Project Tiger/ NTCA on the subject (Advisory No: 1-60/89-WL I dated 04-11-1994 from the Addl. IGF (wildlife) Ministry of Environment and Forests)
4. **Purpose:** To ensure that the carcass/ body parts of tiger/ leopard are disposed of in a transparent manner to prevent any pilferage for illegal market.
5. **Short summary:** This Standard Operating Procedure (SOP) provides the basic, minimum steps which are required to be taken at the field level (tiger reserve or elsewhere) for disposing of tiger/leopard carcass/ body parts where carcass is available or the body parts have been seized.
6. **Scope:** The SOP applies to all forest field formations including tiger reserves besides other areas where the incident has occurred.
7. **Responsibilities:** The Field Director would be responsible in the case of a tiger reserve. For a protected area (National Park / Wildlife Sanctuary), the concerned protected area manager would be responsible. In the case of other areas (revenue land/conservation reserve/community reserve/village/township) the Wildlife Warden, as per the Wildlife (Protection) Act, 1972, or Divisional Forest Officer/ Deputy Conservator of Forests (under whose jurisdiction the area falls), would be responsible. The overall responsibility at the State level would rest with the Chief Wildlife Warden of the concerned State.
8. **Detailed instructions for the procedure to be followed for disposing of the tiger/ leopard carcass/ body part(s) where body part(s) / carcass is available**

**(i) At Scene of crime (SoC) / incident: when carcass or parts available:**

Follow the SOP issued by the NTCA on dealing with the tiger mortality/ seizure of body parts. Dispose of the carcass by incineration in the presence of the Field Director or an officer not below the rank of the Conservator of Forests besides the Post Mortem (PM) Team having representation from the civil society institution

While incinerating the carcass, the sequence must be photographed and video recorded. Before leaving the site, ensure that the whole carcass including bones are fully burnt.

After ensuring the complete incineration of the carcass, prepare a 'Panchnama (Memo) on disposal of the carcass, duly signed by the PM Team and officer incharge, and send a final report (Annexure-I) to the CWLW under intimation to the NTCA with supporting photographs/ documents.

**(ii) In case of seizure of body parts (Skin – dry o r fresh/ bones/meat or other body parts):**

Follow the SOP issued by the NTCA on dealing with the tiger mortality/ seizure of body parts. In case of seizures of body parts, the same may be required as evidence for prosecution in the courts of law and hence in such situations do not dispose the same till the orders of the concerned court for such disposal are obtained.

Once orders have been obtained by the competent authority, dispose of the body part (s) by incineration in the presence of the Field Director or an officer not below the rank of the Conservator of Forests besides the Team (same as prescribed for the Post Mortem) having representation from a civil society institution

While incinerating the body parts, the sequence must be photographed and video recorded. Before leaving the site, ensure that the whole/ all body parts are fully burnt.

After ensuring the complete incineration of the body part (s), prepare a 'Panchnama' (Memo) on disposal of



the body part (s), duly signed by the said Team and officer incharge, and send a final report (Annexure-I) to the CWLW under intimation to the NTCA with supporting photographs/ documents.

**(iii) In cases of seized stock of wildlife trophies obtained during seizure/ confiscation:**

All seized stock of wildlife trophies, where no case is pending in a Court of law, should be destroyed through incineration in the presence of the Field Director or an officer not below the rank of the Conservator of Forests besides a team (same as prescribed for the post mortem) having representation from a civil society institution. While incinerating the body parts, the sequence must be photographed and video recorded. Before leaving the site, ensure that the whole/ all body parts are fully burnt.

After ensuring the complete incineration of the body part (s), prepare a 'Panchnama' (Memo) on disposal of the body part (s), duly signed by the said Team and officer incharge, and send a final report (Annexure-I) to the CWLW under intimation to the NTCA with supporting photographs/ documents.

The provisions of the Wildlife (Protection) Act, 1972 must be followed before destroying such stock.

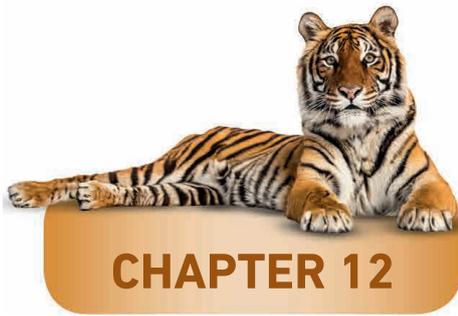
## **ANNEXURE - 1**

### **FINAL REPORT**

To be submitted for disposal of each case of tiger/ leopard carcass/ body part (s)/ trophy

- 1 Name of Office
- 2 *Locational details of the mortality:* description, GPS, Compartment /Block/Range /Sub-Division/ Forest Division/ Tiger Reserve or place/ time
- 3 Date of Mortality/ carcass report
- 4 In case of seizure of body parts details indicating the status of carcass or seized material
- 5 Details of the person (staff/ Others) who reported the incident first: name/address/ contact details/ telephone numbers/e-mail
- 6 For carcass: Date, time and Place of Post Mortem (PM)
- 7 Details of PM Team (names/designation/ address/ contact)
- 8 Details of the missing body parts, if any
- 9 Cause of death as ascertained after the PM
- 11 Colour photographs of the carcass/ body part (s)- (close ups, indicating injury, if any ); details of comparison with camera trap photo data base
- 12 Cause of death: Natural/ Poaching
- 13 In case of poaching/ seizure of body parts:
  - i. further action taken/ proposed:
  - ii. attach colour photographs of the seized body part/s
  - iii. attach certification regarding species identity (for bone pieces/ meat/ other body parts which are not physically identifiable)
  - iv. action taken with respect to offenders/ suspects (if arrested)
  - v. status of Case/ complaint: number, date of filing the complaint, Sections of law, name of Court where filed
- 14 Panchnama/memo of disposal of Enclosed/ not-enclosed carcass/ body part (s)
- 15 Remarks if any
- 16 Signature of the Officer In-charge with name, designation, date and stamp

(SOP prepared with inputs from Field Officers of Tiger Reserves)



# Tiger Population and Habitat Assessment

## 12.1 DAILY MONITORING AND FORECASTING

### 12.1.1. Tiger

Tiger is the flagship species in this mangrove ecosystem and the management focus is geared towards conservation and monitoring of the tiger and its habitat. Presently, an organized system of wildlife monitoring is operative in the Tiger Reserve, where information regarding the direct and indirect evidences of all the animals are recorded and the last ten days of a monthly is exclusively dedicated towards the monitoring of tiger (the information are recorded during routine patrolling). The data collected at the range level is collated and compiled at the Field Director's office and sent to National Tiger Conservation Authority (NTCA) and other state level officials. The present monitoring system needs to be continued, however, keeping in mind the unique conditions of the habitat which limits access to the entire forest area, e-patrolling data corresponding to wildlife sighting, offence detection, and patrolling are being used to generate relevant maps, thereby strengthening the protection strategies in the tiger reserve.

### 12.1.2. Radio collaring

The biology of the Sunderban tiger, its ranging or distribution patterns, presence or absence of territoriality have for long intrigued the field managers and wildlife biologists alike. The dense vegetation cover and limited access to the forest area on foot or otherwise necessitates the simultaneous tracking using a VHF antenna as well. A study of Radio Collaring should be carried out with scientific and technical inputs by the Wildlife Institute of India, Dehradun. A dedicated research personnel and staff shall be used for monitoring the radio collared animals. These might lead to valuable insights into the animal behaviour especially the movement patterns, which in turn might be useful in formulation of management strategies regarding straying of animals in localities.

**Table1:** Details of Radio Collaring Operation in Sundarban Tiger Reserve

SI No	Date of Radio Collaring	sex	Place of trapping / straying	Place of release	Type of collar	Results	Remark
1	05.12.07	Female	Trapped at Panchamukhani-3 of SWLS Range	Panchamukhani-3 of SWLS Range	GPS	Covered around 35 sq km area as evident from available reading	The collar functioned till April, 2008 ( <b>4 MONTHS ONLY</b> ). Sh. Qamar Qureshi of WII was present during collaring operation.
2	24.02.10	Female	Strayed out in Sonagaon village from Pirkhali – 2 compartment of SWLS Range	On same day at Netidhopani-2 of NP(W) Range, which is at around 65 km from straying site	Satellite	Travelled around 80km running distance	The collar found dropped on forest floor on 9 <sup>th</sup> April, 2010 ( <b>SIGNAL RECEIVED FOR 1.5 MONTHS ONLY</b> ). Dr. Parag Nigam of WII was present during collaring operation.

Contd.



SI No	Date of Radio Collaring	sex	Place of trapping / straying	Place of release	Type of collar	Results	Remark
3	28.02.10	Female	Trapped at Pirkhali – 5 Of SWLS Range	On 1 <sup>st</sup> March Pirkhali – 7 of SWLS Range, just opposite to trapping site	Satellite	Travelled around 5 sq km area from release site	On 11.3.10, the collar was found dropped on forest floor at Pirkhali-6 ( <b>SIGNAL RECEIVED FOR 11 DAYS ONLY</b> ). Collaring done by STR.
4	20.03.10	Male	Trapped at Netidhopani – 1 Of NP(W) Range	On 21 <sup>st</sup> March Pirkhali – 7 of SWLS Range, just opposite to trapping site	Satellite	Travelled around 30 sq km area around release site	Last signal received from collar on 6 <sup>th</sup> April 2010 ( <b>17 DAYS ONLY</b> ); later the collar ceased functioning, though the tiger has been directly sighted afterwards by STR staff with the collar on its neck. Collaring done by STR.
5	22.05.10	Male	Strayed out in Kalidaspur Village from Jhilla – 3 compartment of Basirhat Range	On same day Near Khatuajhuri camp at Khatuajhuri – 1 compartment, approx 40 km from straying site	Satellite	Travelled around 70 km running distance from release site	Last signal received from collar on 5 <sup>th</sup> August, 2010 at Talpatti, Bangladesh ( <b>2.5 MONTHS ONLY</b> ). Afterwards no signal from was collar received nor any direct sightings of the animal was reported. Collaring done in presence of Dr YV Jhala, WII.
6	22.05.10	Male	Netidhopani – 1 Of NP(W) Range	Netidhopani – 1 Of NP(W) Range, at trapping site itself	Satellite (1 <sup>st</sup> case) & GPS (2 <sup>nd</sup> case)	Travelled around 30 sq km area in and around release site combining both operation	Signal received continuously till 02.10.10 ( <b>4 MONTHS ONLY</b> ). Then on 02.10.10, GPS based 2 <sup>nd</sup> collar was fitted on the animal which emitted signal till 15 <sup>th</sup> December, 2010 ( <b>2 MONTHS ONLY</b> ). There after the 2 <sup>nd</sup> collar also ceased functioning. Both collaring operation were done in presence of Dr YV Jhala, WII.
7	15.08.14	Female	Pirkhali-I; beside Padmapukur	Netidhopani-I; beside Netidhopani camp	GPS-Satellite	Travelled a linear distance of 100km from the site of release	Collaring operation was done in presence of Dr Parag Nigam, WII.
8	29.01.2016	Female	Bali Khal; Tridibnagar under Matla Range	Released on 31.01.2016 at Chora-Mayadwip Khal at Gosaba-3 compartment	GPS-Satellite		Collaring operation was done in presence of Dr YV Jhala, WII.
9	25.01.2016	Female	Captured at Kishorimohanpur. Radiocollared at Jharkhali Camp	Released at Ajmalmari near Boni camp	GPS-Satellite	Ongoing Tracking by a research personnel from WII	Radiocollar functional Collaring operation was done in presence of Dr YV Jhala, WII.

### 12.1.3 Camera Trapping

#### Method

The standard method of camera trapping in accordance with Capture-Recapture framework (Otis et al. 1978; Pollock et al. 1990) was followed to collect and analyse data.

#### Pre-field work

As Sundarbans ecosystem is subjected to tides twice a day with varying tide levels, there is high risk of the camera traps being inundated. The first step was to analyse the tidal fluctuation from the data available through tide tables (Survey of India, 2016).

A high resolution image of the study areas were procured and processed for its use in the reconnaissance survey and thereafter. The study areas were divided into grids of four sq. km each, so as to systematically divide the area and help the team plan during reconnaissance survey and also to decide on the sites and minimum distance between camera trap stations.

### Reconnaissance survey

Reconnaissance survey was carried out in different grids for potential camera trap locations. Geo-coordinates of the survey and suitable sites was recorded using a handheld Global Positioning System receiver (Garmin 72 H). These tracks and points were laid over gridded high-resolution image in Geographic Information System environment using MapInfo 8.5.

The grids were selected based on the following criteria: (i) tiger pugmarks (ii) comparatively high elevation areas unlikely to get submerged even during high tides and (iii) avoid excessive human disturbance.

### Data collection

Data was collected for 30 occasions (days) commencing from 4th December, 2015 and ended on 2nd January, 2016 in Sajnekhali Wildlife Sanctuary; 38 occasions (days) commencing from 8th January, 2016 and ended on 14th February, 2016 in National Park (West) Range; 38 occasions (days) commencing from 19th January, 2016 and ended on 25th February, 2016 in National Park (East) Range; 40 occasions (days), commencing from 3rd March, 2016 and ended on 11th April, 2016 in Basirhat Range and for 40 occasions (days) commencing from 10th March, 2016 and ended on 18th April, 2016 in 24 Parganas (South) Forest Division.

Cameras with heat-motion sensors were deployed to capture tigers and other fauna. The distance between two camera trap stations was kept at a minimum of 1 km to maximise the capture probability. At each station, two camera units were deployed between 40 and 50 cm height from the ground in such a way that both flanks of the animal are captured. The camera delay was minimised to ensure photo captures of tigresses with cubs in case such an event occurred. To maximise both tiger captures as well as recaptures, an olfactory lure was applied. All the camera trap stations at the Range were monitored periodically to check the status of camera traps and if required the height of camera trap was changed or comparatively high elevation sites within the same grid were selected. This was done due to the high water mark presence in the sampling session which may inundate camera trap units in the particular sites.

Every tiger captured in the camera traps was examined visually based on the stripe pattern on the flanks, limbs, forequarters and sometimes even tail of tiger, and also with Extract Compare V1.08 (Hiby 2009) software.

**Table 1:** Division wise details of Camera Trapping exercise in Sundarban Tiger Reserve 2015-16

Forest Division/ Range	Total area (sq. km)	Total grids of 4 sq. km each	Camera trap grids	Trapping area [sq. km] (Grid)	Session date (start)	Session date (end)	Total grid with tiger captures
24 Parganas (South) Forest Division	454	116	50	200	10.03.2016	18.04.2016	37
National Park (East) Range	850	155	60	240	19.01.2016	25.02.2016	23
National Park (West) Range	890	138	60	240	08.01.2016	14.02.2016	38
Sajnekhali Wildlife Sanctuary	430	103	60	240	04.12.2015	02.01.2016	27
Basirhat Range	466	94	44	176	03.03.2016	11.04.2016	16



**Table 3:** Demography of camera trapped tiger individuals in Sundarban Tiger Reserve

Sl. No.	Area	Tiger Individuals				
		Male	Female	Unidentified Sex	Cub	Total
1	24 Parganas (South) Forest Division	11	15	0	1	26
2	National Park (East) Range	2	12	0	0	14
3	National Park (West) Range	4	13	2	3	19
4	Sajnekhali Wildlife Sanctuary	1	8	2	0	11
5	Basirhat Range	3	6	2	0	11
<b>Total</b>		<b>21</b>	<b>54</b>	<b>6</b>	<b>4</b>	
	<b>Grand Total</b>					

## 12.1.1 Animal and Vegetation

### Prey species

Spotted deer and wild pig form the principal prey species of the tiger. Currently, they are monitored on a daily basis and the same recorded in the camp wildlife register. However, this data is only to highlight the presence and absence of the target species in a given area.

Owing to the unique habitat condition of sundarbans, the distance sampling through line transect is practically impossible instead boat transects along with sign survey and vegetation sampling are done for prey-base estimation. As part of phase I exercise of All India Tiger Estimation, 2017-2019; total 40 teams participated to cover 229 number of transects including various sides of khals in Sundarban Tiger Reserve. Each team comprised of at least 3 numbers (2 nos. of field staffs + 1 no. of volunteer).

**Table 1:** Details of Creek Transect survey for Phase – I, Tiger Estimation at 2018 (Period from 5<sup>th</sup> February to 8<sup>th</sup> February, 2018)

Sl No	Division	Range	Total Number of Teams	Number of Members/Team	Number of Transects
1	STR	NPE	9	3	56
2	STR	NPW	8	3	38
3	STR	SWLS	7	3	57
4	STR	BHT	7	3	45
5	24 PGS (S) Forest Division	24 PGS	9	3	33

### Aquatic Species

River channels and waterways harbour a wide variety faunal species. Prominent among these are the estuarine crocodile, gangetic and Irrawaddy dolphins. Due to remoteness and difficult terrain of Sundarban, no research on habitat and distribution studies of aquatic species has been done extensively. However there is a species recovery programme of critically endangered *Batagur baska* is ongoing in Sundarban Tiger Reserve.

### Vegetation

Since the 100mtsX100mts plots are very difficult to maintain in Sundarban and also hinders the movement of wildlife, therefore has been discontinued. It has been deemed that maintaining vegetation plots is not a viable methodology.

### Abiotic factors

Water marks to be created to measure changes in tidal amplitude and rain gauge and six thermometer to be installed in a few selected camps to monitor changes in rainfall, relative humidity respectively especially to monitor the weather related changes in the wake of global warming.

## 12.2 TIGER POPULATION ESTIMATION AND MONITORING FRAMEWORK

### 12.2.1 Phase I: Spatial mapping and monitoring of tigers, prey and habitat

For estimating the distribution, extent and relative abundances of tigers, other carnivores and ungulates data will be collected in simple formats on carnivore signs and ungulate sightings and on indices of human disturbance and habitat parameters. For this data collection, beat will be taken as a unit. All the concerned staffs must be adequately trained with the data collection protocol.

The detailed methodological approach for sampling carnivore signs, ungulate encounter rates, pellet/dung counts, habitat and anthropogenic pressures is as follows:

#### 12.2.1.1. Sampling for Tiger, and other carnivore species direct and indirect evidences

- A beat will be considered as a sampling unit.
- Maximum area to be searched in the form of river based transects.
- Both signs i.e. indirect evidences and direct evidences need to be recorded. Tiger signs should be classified into the following categories 1) Pugmark trails, 2) Scats (Old: dry with hair and bones visible; Fresh: dry but intact with shiny surface; Very Fresh: soft, moist, and smelly, 3) Scrapes, 4) Scent marks (spray, rolling), 5) Rake marks on trunks, 6) Actual sighting, 7) Roaring (vocalization), 8) Kills (Predation on wild prey).
- Average length of a transect should be 10-15 km. It is important to record the distance covered and the time spent during each search separately (in the data sheet-1) and accurately. If time is spent resting or in other activities while conducting the search, this duration should be reported separately. If possible the GPS coordinate of the beginning point of each search path should be recorded.
- A brief description of the topography and forest type is to be recorded for each sign.
- In case of pugmark trails, each trail set is considered as one sign (not each pugmark as one sign). In case a tiger (or other carnivore) continues to walk along the mudflat for a long distance (say 1 km), then this should be considered as one sign, and a comment recorded in the remarks section of the data regarding distance covered by a pugmark trail of a single tiger.
- Tiger if encountered outside of the sampling route should also be recorded with GPS coordinates (if available) and with appropriate comments.
- Special emphasis should be given to sign of tigress and cubs, and any authentic evidence of tiger cubs (sightings of cubs, lactating tigress, tracks, etc.) obtained within the past twelve months should be mentioned in the data sheet.
- While sampling for tiger signs, record should also be kept for signs of any other carnivore that are encountered.
- The number of livestock that are killed by predators within the past three months needs to be recorded in the questionnaire following the data sheet.
- It is important to report data sincerely. It is likely that there may be reliable information that tiger is present in the beat being sampled, but no tiger signs are recorded during the intensive search survey. In such cases, mention should be made in the remarks column of the data sheets. However, failure in obtaining tiger sign from a beat is equally important as recording tiger signs and for appropriate analysis of this data the actual data should be reported.



### 12.2.1.2. Distance Sampling for Animal Densities:

This protocol outlines a simple method for quantifying animal (chital, wild pig, rhesus macaque, otter, tiger, crocodile, dolphin, lesser adjutant stork, etc.) density in an area based on visual encounters during boat transects. The following procedure needs to be followed for data collection

- i. The boat transects need to be conducted in channels having a minimum width of 40 meters to a maximum width of 200 meters for a distance of minimum 5 kilometers and maximum 15 kilometers. Avoid sampling transects/khals when facing directly into rising or setting sun.
- ii. The GPS should be in track mode so as to record the entire transect (channel) sampled during the survey. This track should be saved and downloaded on to a computer at the end of the exercise.
- iii. During the exercise, only one side of the channel should be surveyed. Do not focus on the other bank which is not being surveyed as it might increase confusion and chances of missing individuals on the bank being surveyed.
- iv. The exercise should be conducted at such a time when the tidal conditions are ideal. Three hours AFTER the beginning of low tide and 3 hours FROM the beginning of high tide will provide a window of 6 hours when mudflats will remain exposed during which time sampling should be done under appropriate light conditions.
- v. The boat should move at 5 km/hour or slower so as to reduce the chances of missing any individual as well as minimizing noise which might scare the animals away.
- vi. Maintain the distance between the boat and the sampled bank at a constant of 20 to 30 meters.
- vii. Complete silence must be maintained during the survey and undue gesturing or shouting on spotting animals should be strictly forbidden.
- viii. Fill in the 'Census unit', 'Observers' names', 'Date', 'Forest Circle/Div', 'Range' (where the transect is being conducted), 'Forest Block & Comp', 'Khal name', 'Khal ID', 'Side of channel', 'Lunar date', 'Time of past lowest tide', 'Start time', 'Begin GPS' (in Degree, Minute, Second format) just when the survey is about to start.
- ix. When any animal is spotted, note the 'Time' - when it was spotted, 'Species', 'Total number of individuals including the young', 'Number of young', 'Mangrove type' – classified as 'Tall', 'Medium' and 'Small' depending upon the average mangrove height of more than 10 feet, 4-10 feet and 2-4 feet respectively. 'Bank type' depending on the average slope should be classified as 'Steep' (more than 60°), 'Medium' (30° to 60°) and 'Gentle' (less than 30°).
- x. If the animal is spotted from afar, then keep a mental note where it was first spotted by observing any nearby tree, log, creek etc. As the boat comes parallel to the 'landmark', record the GPS location (in Degree, Minute and Second format) and then use the range finder to record the perpendicular distances of the observer to water, grass patch (whenever present), upper bank (the upper bank is defined as the point from where the land flattens out into the forest), vegetation (the point where the mangrove forest starts) and the animal. Check the figure (Page no. 10) to avoid any confusion. All the readings must be recorded using the range finder and checked against visual estimates as often the laser can hit objects far or near other than the target and give wrong reading. If on pressing the button on the range finder once, the reading does not show up in the screen, keep on repeating the exercise till you get the correct distance. The GPS location and the perpendicular distances should be recorded where the animal was initially spotted and not the location where it has moved away after sighting it. In case of animals observed in side khals, perpendicular distance need to be recorded by navigating into these khals. If the side khal is non-navigable, in that case, the observation should not be recorded.
- xi. When a group of animals is seen, measurements should be taken for the centre of the group. An animal is considered to be a part of a group if its distance from its nearest neighbor is less than 30 meters.

- xii. If one observes animals on the other bank (the bank which is not being surveyed) then note the sighting in the remarks column only. Do not include it in the observation.
- xiii. In the end, note the 'End Time', 'End GPS' (in Degree, Minute, Second format), 'Total distance' travelled during the transect obtained from the track log of the GPS when the transect gets over.
- xiv. One could select the side (smaller) khals while conducting transects of big channels to maximize spatial coverage. In such cases, the following should be considered –
  - a) The 'Total distance' should include only the 'going inside the small khal' distance and not the distance covered while coming out of the same. Hence, start recording the distance while one starts the transect, continue till one has reached the last reachable point inside the smaller khal, stop recording while coming out and start recording again once one comes back to the junction of the bigger khal till the transect ends.
  - b) Select side channels only if they can be navigated for more than 500 metres.

Ideally, on one's way back after the transect is complete, one should conduct the exercises of sign survey and sampling for vegetation and human disturbance on the same khal bank to save time. Whether one does the same bank or opposite bank of the same khal or a different khal altogether for these exercises, one should always start with the transect for direct sighting so as to minimize a priori disturbance to the animals and increase detection.

### 12.2.1.3. Sampling for Animal and Human Sign Encounter Rates

To obtain data on presence, absence and intensity of use by chital, wild pig, rhesus macaque, otter, tiger, crocodile and humans, we shall quantify the relative abundance of their signs in an area. The following procedure need to be followed for data collection

- i. Surveys should be restricted in channels having an average width of 40-200 meters. During the exercise, only one side of the channel should be surveyed as it might increase confusion and chances of missing signs on the bank being surveyed. Be ever vigilant to detect signs as these could easily be missed if full attention is not given.
- ii. The exercise should be conducted at such a time when the tidal conditions are ideal. Three hours AFTER the beginning of low tide and 3 hours FROM the beginning of high tide should provide adequate time and exposed bank surface to detect the signs.
- iii. The boat should move at 5 km/hour or slower so as to reduce the chances of missing any sign.
- iv. Drive the boat as near to the bank as possible so as to detect and record all signs successfully.
- v. Fill in the "Census Unit", "Observers' names", "Date", "Forest Circle/Div", "Range" (where khal is being surveyed), "Forest Block & Comp", "Khal name", "Khal ID", "Side of channel", "Lunar date", "Time of past lowest tide", "Start time", "Begin GPS" (in Degree, Minute, Second format) just when the survey is about to start.
- vi. When any sign is detected, note the "Sl. No", "GPS Location" (in Degree, Minute, Second format), "Animal species/ Human sign", "Sign type" (pugmark/ hoof print/ foot print/ scat/ pellet/ direct sighting), "Mangrove type" – classified as "Tall", "Medium" and "Small" depending upon the average mangrove height of more than 10 feet, 4-10 feet and 2-4 feet respectively. "Bank type" specific to the sign location, should be classified as "Steep" (more than 60°), "Medium" (30° to 60°) and "Gentle" (less than 30°). Signs should be classified as "Very Fresh" when they seem less than 2 days old, "Fresh" when they seem 2-3 days old, "Old" when they seem more than 3 days old. Since accurate freshness categorization depends upon experienced individuals, such individuals should be more encouraged to carry out this exercise.
- vii. Whenever possible coordinates can be saved as waypoints on the GPS unit and subsequently entered on datasheets to save time.



- viii. If one observes signs/ animals on the other bank (the bank which is not being surveyed) then note the sighting on the remarks column only. Do not include it in the observation. Do not record signs on side channels if those channels are not being included during the particular survey.
- ix. In the end, note the "End Time", "End GPS (in Degree, Minute, Second format)", "Total distance" travelled during the survey obtained from the track log of the GPS when the transect gets over.
- x. In case of pugmark/hoof print/foot print trails each trail is considered as one sign (not each pugmark/hoof print/foot print unit). In case the animal/ human has walked along the channel bank for a long distance, then this is to be considered as one sign, and a comment should be recorded in the remarks section of the data regarding the distance covered by the trail of the single animal/human.
- xi. If side channels are considered during transects on big channels, conduct the sign survey on the way out of these smaller channels during the transect for direct sighting. The survey length (of one side) of the small/ side khal will be added to the total survey length.

#### 12.2.1.4. Sampling for Vegetation and Human Disturbance

To quantify the habitat parameter and determine levels of human disturbance, sampling will be done along the same side of the channels used to record sign types at the same time. This form needs to be filled at every 15 minutes intervals while conducting the sign survey (when the boat is moving at 5 km/hr).

- i. Conduct this survey at the same time as you survey the channel side for signs (could be done on your way back after direct sighting exercise).
- ii. Fill in the 'Census unit', 'Date', 'Khal name' and 'Khal ID' just when the survey is about to start.
- iii. The different fields in the form should be recorded on a 10 metre radius semicircular plot, with the plot starting from the first line of vegetation. Refer to figure on page 24.
- iv. Once at the beginning, record the GPS location (in Degree, Minute, Second format) and consecutively coordinates should be recorded for every plot, note the 'Sl. No.', 'Mangrove type' – classified as 'Tall', 'Medium' and 'Small' depending upon the average mangrove height of more than 10 feet, 4-10 feet and 2-4 feet respectively. Give the local/ scientific names of the tree species in descending order of abundance. Write the percentage occupied in the plot by each of these abundant species, as well. Accordingly, follow the same for recording local/scientific names and percentages of grass/ herbs/ sedges including regenerating mangrove abundance (strata less than 2 feet height). The density of the vegetation should be recorded as 'Low' when one can see a chital sized object more than 20 meters clearly through the mangrove, 'Medium' when a chital sized object is barely visible at about 10 meters distance, 'High' when a chital sized object is barely visible at 5 meters distance into the mangrove. Record the perpendicular distance from the observer to the vegetation (grass patch, wherever present, otherwise treeline).
- v. If the vegetation is 50 metres away from the observer, record only the perpendicular distance from the observer to the vegetation and the density of the distant treeline as 'Low', 'Medium' and 'High' as per the above 'chital visibility' criterion.
- vi. Do not write about the vegetative attributes which lie beyond the plot even if they are different and visible from your boat.
- vii. At each plot, count the number of trees or palms cut or lopped.
- viii. Count the number of tourist/fishing boat, fishing nets and fishing poles in all directions as far as you can see.
- ix. At the end of the survey take a similar vegetation plot at the end GPS location.
- x. Do not forget to conduct the sign survey continuously and simultaneously as the vegetation and human disturbance sampling is being carried out.

## 12.2.2 Phase II: Spatial and attribute data

The spatial data that are likely to influence tiger occupancy of a landscape will be used for modeling in a GIS domain. The vegetation map, terrain model, night light satellite data, drainage, transportation network, forest cover, climate data, Normalised Difference Vegetation Index (NDVI), livestock abundance, human density, socio-economic parameters, etc will be used for modelling habitat condition and tiger occupancy. Beat-wise vegetation sampling will be done to generate broad vegetation map. Part of this component will be done in collaboration with Forest Survey of India and Survey of India. This modelling helped in determining current spatial distribution of tigers, potential habitats, threats to crucial linkages between occupied landscapes and conservation planning.

## 12.2.3 Phase III: Estimating the population of tigers and its prey

This will deal with the actual range of how many tigers and ungulates are there. Teams of researchers shall be deployed for estimating tiger density and ungulate densities within stratified sampling units.

- 1. Tiger numbers:** After stratifying landscape into tiger sign abundance classes of high, medium, low and number tiger sign at the beat and larger spatial resolution (100 km<sup>2</sup>). In each of these strata, within a landscape, the actual tiger density in 3-5 replicates of sufficient size (100-200 km<sup>2</sup>) shall be estimated. Primarily dependent on remote camera traps to identify individual tigers based on stripe patterns, population estimates shall be based on mark-recapture framework. These densities shall be then extrapolated for the areas under various density classes within the landscape to arrive at a tiger population estimate.
- 2. Tiger prey:** Phase I of the protocol would be reporting encounter rates on line transects. To convert encounter rates to density, an estimate of the effective strip width of these transects would be essential. The effective strip width of a transect primarily depends on the visibility (vegetation and terrain type), ability to detect ungulates by different observers and animal behavior response. Effective strip widths determined from the model and actual sighting of ungulates for different vegetation types. However ungulate response is likely to play an important role in disturbed area in determining effective strip width. The habitat and terrain specific effective stripe width will be determined by actual sampling and by modeling. These estimates of effective stripe width will be used for converting encounter rates of ungulates to density estimate by modeling detection probabilities.

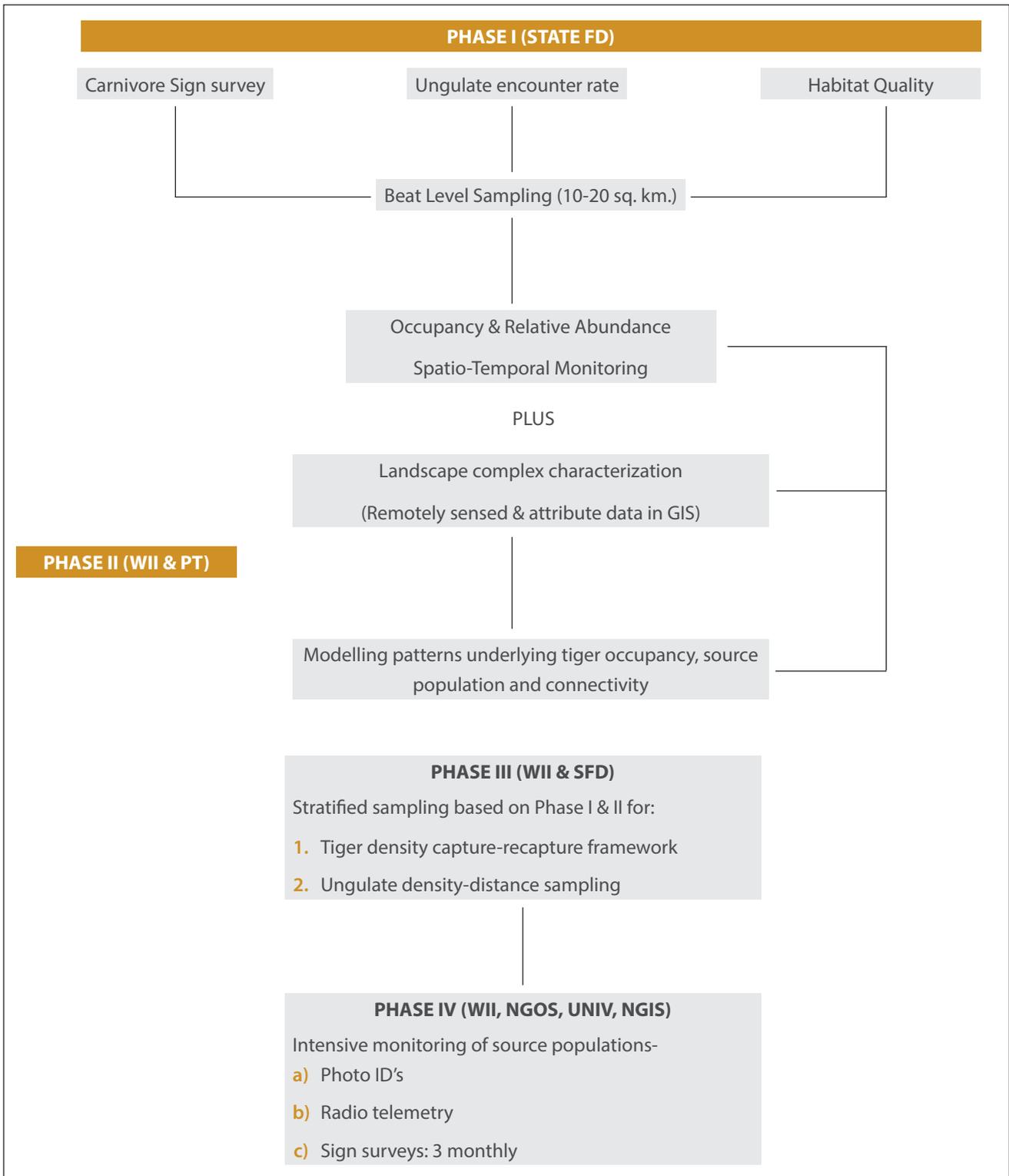
## 12.2.4 Phase IV: Intensive monitoring of source populations

- 1. Photo registration of tigers:** Pictures of individual tigers obtained by camera traps or by regular cameras should be maintained in the form of a photo identity album. Records should be kept on the location, condition (breeding status, injury, etc) and associated tigers whenever a tiger is sighted. This will provide crude data on ranging patterns, demography and mortality.
- 2. Tiger pugmark and other signs:** Regular monitoring of tiger signs (pugmark tracings, plaster casts, etc) should be undertaken in every beat at a weekly interval with monthly compilation of data. Sign surveys and individual tiger monitoring should become a regular task for every guard. The monthly data should be mapped and maintained to analyse trends.
- 3. Monitoring by telemetry in select areas:** Use modern technology of VHF, GPS and satellite telemetry to study and monitor aspects of demography, metapopulation dynamics (dispersal, ranging patterns), mortality, predation ecology and behavior. In all source populations, tiger abundance and density should be estimated using camera traps, digital images of pugmarks and/or DNA profile from non-invasive methods biannually.

## 1.3. HABITAT ASSESSMENT AND MONITORING FRAMEWORK

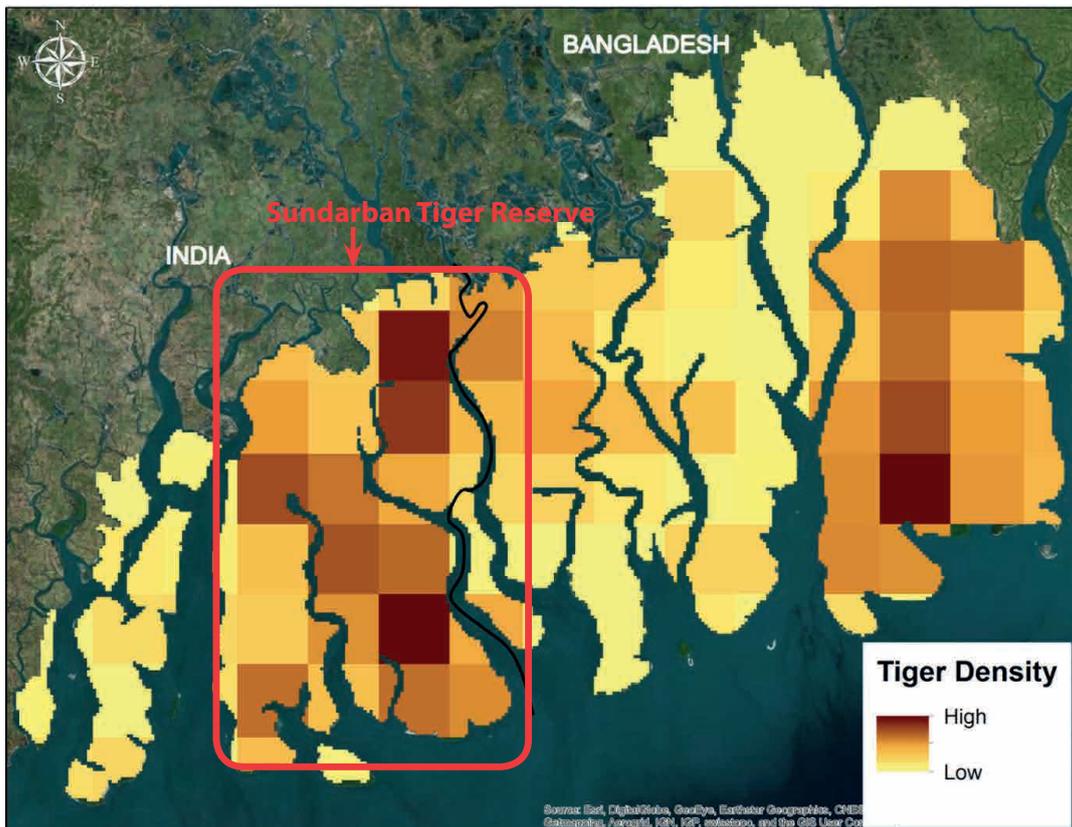
The data collected during Phase I for sampling for Vegetation, Human disturbance will be collated and put in GIS Domain. This can be correlated with tiger and prey base presence. Any change in the habitat can be monitored by serial data present in GIS Domain.



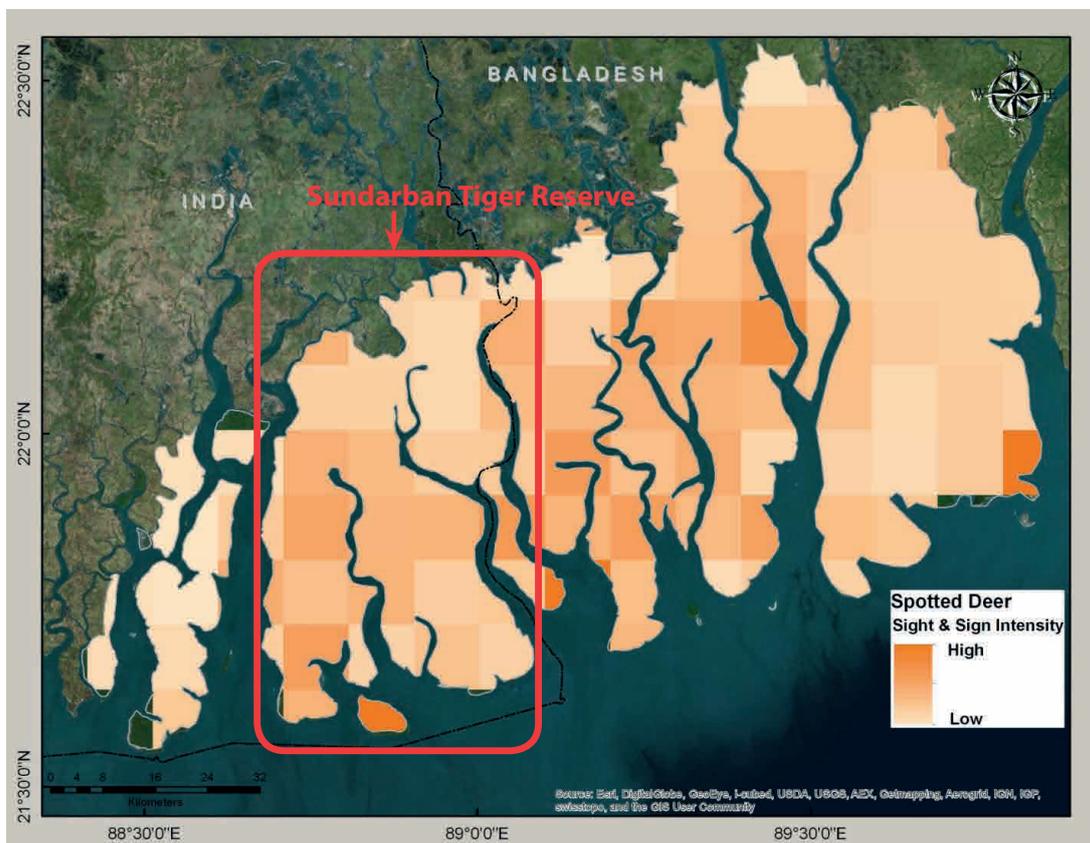


## 1.4. SPATIAL DATABASE DEVELOPMENT

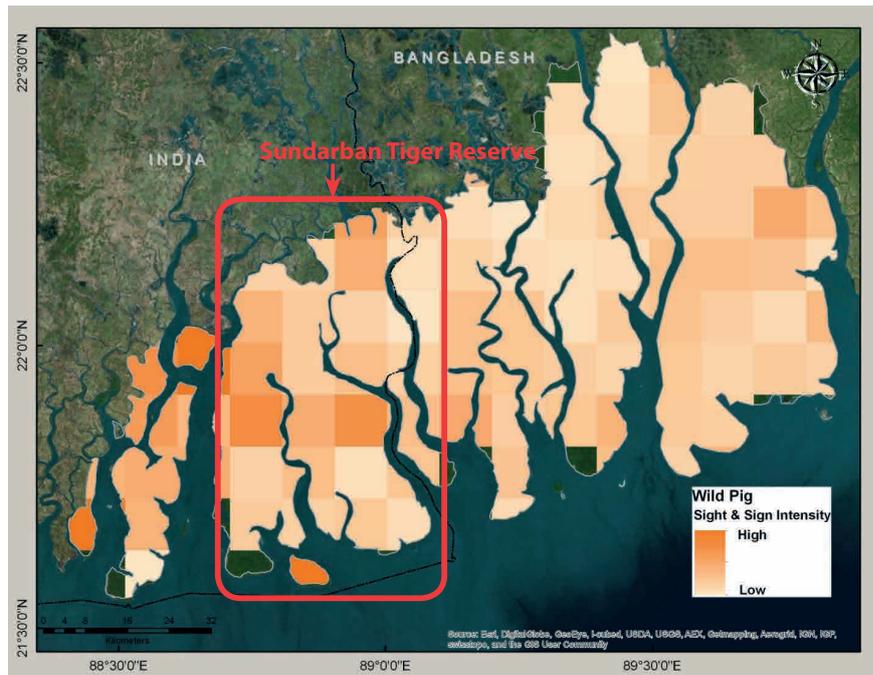
The information on the encounter rates Tiger and its prey base obtained from the camera trapping exercise conducted as a part of All India Tiger Estimation, 2014, has been used to prepare maps in GIS Domain to get the spatial distribution of the key species of Sundarban Tiger Reserve. Maps of distribution of key species Sundarban Tiger Reserve is given below.



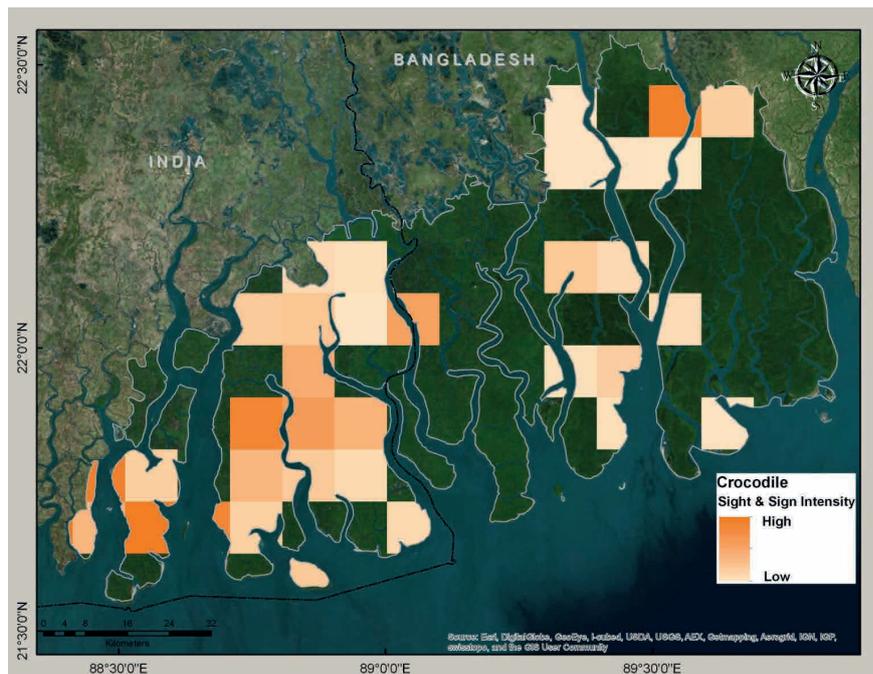
**Figure 1:** Tiger density across Sundarban obtained from camera trap based spatially explicit capture recapture and covariate based regression model (Jhala et al. 2016)



**Figure 2:** Intensity of spotted deer sign and sighting encounter rate across Sundarban (Status of tigers in the Sundarban landscape Bangladesh and India (Jhala et al. 2016))



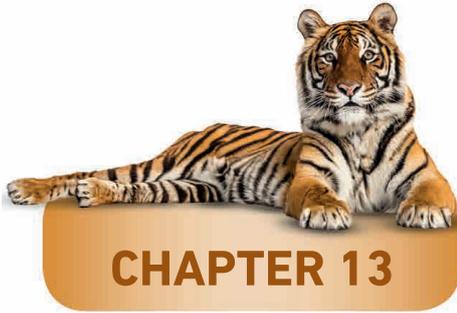
**Figure 3:** Intensity of Wild pig sign and sighting encounter rate across Sundarban (Status of tigers in the Sundarban landscape Bangladesh and India (Jhala et al. 2016))



**Figure 4:** Intensity of Crocodile sign and sighting encounter rate across Sundarban (Status of tigers in the Sundarban landscape Bangladesh and India (Jhala et al. 2016))

## 12.5. ANALYSES AND REPORTING FRAMEWORK

Data analysis is to be carried out by WII during monitoring tiger, co-predators prey base along with their habitat. Apart from this routine monitoring shall be carried out as mentioned earlier and analysis of the data obtained done at the Divisional level with help from GIS cell. The results obtained to be used as a feedback based on which proper management interventions can be planned.



# Protection and Intelligence Gathering

Protection is the most vital management intervention being carried out in the Tiger Reserve. The entire status of the Reserve i.e. habitat integrity along with the well being of the fauna and flora depend on the kind of protection measures that are being taken there. Intelligence gathering is an important component of the protection strategy through which the protection can be made much more effective and can lead to prevention of untoward incidences.

## 13.1. OBJECTIVES

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1. Conservation of the tiger, co predators and its prey species along with other floral and faunal assemblages of this unique ecosystem against biotic interferences.
2. Developing a strong information network to prevent occurrence of wildlife crime.
3. Upgrade and augment existing infrastructure like protection camps, arms, patrolling boats to result in more effective protection measures.

### 13.1.1. Problems in achieving these objectives

- a. Porous international border with Bangladesh from where smuggling of men and material is very easy.
- b. Extremely poor fringe population with high degree of resource dependency.
- c. Vacancy in frontline staff positions
- d. Difficult terrain and tendency of tiger to attack inside the forest of the tiger make foot patrolling a difficult task.
- e. Fewer number of camps with inadequate staff leading and large areas to be patrolled.

## 13.2. DEPLOYMENT OF NATIVE WORKFORCE

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The pressure on the Tiger Reserve is enormous. International poachers, honey and timber smugglers usually enter and exit through porous international border along the eastern boundary. There have been incidences of them indulging in deer poaching and fishing. The northern fringe of the Reserve is densely populated and has a density of about 819 persons per sq. km. with little or no means of regular income especially in the lean season.

With a view to combat this biotic pressure a network of camp and floating check posts have been developed within the Tiger Reserve. Most of the camps are manned by a Beat Officer/ Forester along with Forest Guards in few locations. However as about 50% of the Group D staff posts are vacant there is an acute shortage of people for field patrolling and manning camps. Floating check post have been positioned at the most vulnerable spots and are headed by Head forest

Guards or forest guards. Along with the people from the JFMC are deployed to augment the staff strengthen. This also helps in creating goodwill as the locals also develop a stake in the conservation process. Besides they can also serve as eyes and ears of the Tiger Reserve management and can bring information from the village level to the management.

#### Existing sanctioned staff strength of Sundarban Tiger Reserve (as on 01/01/2019):

Sl. No.	Category of Post	Sanctioned Strength	Existing	Vacant	Audited Against	Existing G.O. No.
1.	CCF & FD	1	1	-	-	PCCF, WB's O.O. No.20-Misc/2001 dt. 18.05.2001
2.	DFD	1	1	-	-	-do-
3.	AFD	2	2	-	-	1234-For dt. 27.2.1974
4.	Research Officer	1	-	1	-	11343-For dt. 21.12.1976
5.	Lab. Asstt.	1	-	1	-	4253-For dt. 10.7.1978
6.	Veterinary Officer	1	1	-	-	1130-For/11B-22/88 dt.14.2.1991
7.	Head Clerk	1	1	-	-	G.O. No. 1683-F dt. 23.02.2009 & PCCF, WB's O.O. No. 147-50/PMC/09 dt. 30.6.09
8.	Accountant	1	1	-	-	PCCF, WB's Letter No.11062/ PMC/2E-212 dt. 15.09.97
9.	UDC	6	3	3	-	-do-
10.	PA	1	1	-	-	
11.	Clerk-cum-Typist	7	2	5	-	-do-
12.	Typist	1	-	1	-	5295-For/11B-41/80-I, dt. 21.7.84
13.	Forest Ranger	11	8	3	-	PCCF, WB's O.O. No. 20-Misc/2001 dt. 18.05.2001
14.	DR/Fr.	24	23	1	-	-do-
15.	Head Forest Guard	8	2	6	-	-do-
16.	Forest Guard	100	49	51	-	-do-
17.	Majhi	21	06	15	-	CCF/WB's O.O. No. 45/S, dt. 24.9.1975
18.	BoatMan	54	16	38	-	4192-For dt. 19.9.1981
19.	Forest Watcher	1	-	1	-	769-For dt. 9.2.1974
20.	Karmabandhu	1	1	-	-	5295-For/11B-41/80-I dt.21.7.1984
21.	Mali	1	1	-	-	769-For dt. 9.2.1974
22.	Driver	2	-	2	-	8815-For dt. 20.9.1976
23.	Chowkidar	2	1	1	-	769-For dt. 9.2.1974
24.	Karmasathi	2	-	2	-	769-For dt. 9.2.1974
25.	Peon	4	4	-	-	*Audited against PCCF, WB. G.O. No. 760-For dt. 9.2.1974 & 5295-For/11B-41-80-I dt. 21.7.1984
26.	Orderly	8	6	2	-	769-For dt. 9.2.1974 & 5926-For dt. 2.9.1977 & 2661-For dt. 27.4.1974
27.	Engine Driver	5	3	2	-	1170-For dt. 17.12.76 & 4128-For dt. 19.7.1980
28.	Sereng	3	2	1	-	4128-For dt. 17.09.80 & 4192-For dt. 19.09.1981
29.	Sukhani	2	-	2	-	1170-For dt. 17.12.76 & 4128-For dt. 19.07.1980
30.	OMG	3	1	2	-	-do-
31.	Laskar	8	1	7	-	-do-
	Total	284	134	150	-	Existing strength includes nos. Banashramik

## 13.3. PATROLLING STRATEGY INCLUDING JOINT PATROLLING

### 13.3.1. Tiger Cell

It shall be a nodal centre to coordinate all protection, tiger straying, disaster management related issues and any other emergency situations. It shall be headed by the Field Director who shall be assisted by the Deputy Field Director and

the Assistant Field Directors. The Range Officers of all four Territorial Ranges and the Range Officer Headquarter Range shall be members of the cell. Permanent invitees to the Tiger Cell shall also include SP and DM of 24 Parganas North and South, BSF Commandant, BDO's of Canning, Basanti, Gosaba, Hingalganj, Block Level Medical Officer, Block Level Veterinary Officer. There shall be monthly in house meetings which shall be chaired by the Field Director to review the field situation. Meetings with line agencies shall be carried out on six monthly basis. The following activities shall be performed by the Tiger Cell:

1. Monitoring protection scenario in the field and fine tuning protection strategy based on field conditions.
2. Monitoring the local village markets etc to detect trade of wildlife and timber related products.
3. Discuss information related to smuggling of cattle and other goods, poaching, illicit felling etc.
4. Coordinate all tiger straying, rescue and release operations.
5. Coordinate rescue and release of other wild animals.
6. It shall coordinate all rescue and relief operations in case of natural calamities like earth quakes, cyclones like Aila etc, and any other emergency.

### **1.1.2. Strike Force**

As on date, Sundarban Tiger Reserve has not been allotted Tiger Protection Force which is operational in some of the Tiger Reserves in the country. There is one unit of SAP (Special Armed Police) posted in STR at Jhilla. This additional force is quite handy in conducting raids, carrying out patrolling and helping in tiger straying cases but needs replication in other ranges. Therefore, a special strike force or Tiger Protection Force is proposed for tackling emergency situations like tiger straying, village side raids, special patrolling drives against poaching, illicit felling, honey and cattle smuggling, especially against international smuggling. It shall be a mixed force comprising both of forest officials and police force or retired army/ police officers and few local youth with good track record.

The Tiger Protection Force would be under the direct control of a Range Officer with his headquarters at Pakhiralaya. The Deputy Field Director of the Reserve should be made supervisory officer, who would ensure its proper functioning. There should be a schedule of patrolling prepared by Deputy Field Director and supervised by Assistant Field Director for every patrolling party of Tiger Protection Force. The Tiger Protection Force will be equipped with firearms and provided a watercraft and wireless system. Daily movement message shall be sent to the Field Director's office at Canning to obtain appropriate instructions, especially in case of emergency.

#### **Duties of the Tiger Protection Force:**

- Patrolling along the international border, sea-facing area of National Park West and East Ranges along with the interdivisional boundary along the Matla river.
- Regular checking of nearby weekly markets, bus stops and railway stations also keep an eye to ascertain presence of wandering tribal poaching gangs.
- Assist in tiger straying cases.
- Intensive regular patrolling on highly sensitive paths.
- Carrying out raids.
- Regular watch on the movement of antisocial elements engaged in illegal fishing, felling, poaching, cattle smuggling activities etc to prevent crime occurrence.



### 13.3.3. Joint Patrolling

The tiger reserve shares boundary with Bangladesh on one side, fringe villages on the other and a territorial Division on the third side. A system of joint patrolling is proposed to strengthen the existing patrolling regime. The following should be carried out at regular intervals and based on the exigency of circumstances:

1. Inter Division joint patrolling: this is to be carried at an interval of two months each.
2. Patrolling with BSF along the border areas at regular interval.
3. Patrolling with the mobile force from headquarters in the vulnerable periods at regular intervals.
4. Improvised patrolling techniques through the application of modern equipments and modernized watercrafts
5. Engagement of JFMC members as wageearner to strengthen the protection measures till the problem of shortage of staffs is mitigated.

## 13.4 STRATEGY FOR PROTECTION AND COMMUNICATION

### 13.4.1. Protection camps

Presently there are 21 land based camp and 05 number of floating camps and checkpost for manning an area of 2585 Sq Km. An analysis of the location of these camps reveals that only 15 camps are present within the forest locations and the rest are concentrated at along the periphery. The table below shows the areas covered by the different protection camps:

#### Area Covered by Different Land base Camps of STR ( Buffer zone)

SI No	Name of Range	Name of the Camp	Name Of the Block	Compt. No	Area covered (sq.km)
1	SWLS	Sajnekhali	Pirkhali	1,2,3	<b>83.13</b>
2	SWLS	Sudhanyakhali	Pirkhali	1,2,3	<b>83.13</b>
3	SWLS	Dobanki	Pirkhali	4,5,6,7	<b>116.60</b>
4	SWLS	Duttar	Panchmukhani Jhilla	1,2 4,5,6	<b>56.01</b> <b>69.45</b>
5	Bashirhat Range	Bagna	Jhilla	1,2,3	<b>62.14</b>
6	Bashirhat Range	Kaksa	Jhilla	2,3	<b>44.41</b>
7	Bashirhat Range	Jhingekhali	Arbesi	1,2	<b>57.67</b>
8	Bashirhat Range	Samsernagar	Arbesi	1,2	<b>57.67</b>
9	Bashirhat Range	Buridabri	Arbesi	3,4,5	<b>82.70</b>
10	Bashirhat Range	Khatuajhuri	Khatuajhuri	1- 3	<b>119.59</b>
11	Bashirhat Range	Harikhali	Harinbhanga	1-3	<b>118.05</b>

#### New Protection Camps:

Therefore, it is proposed that the number of camps should be increased which of course is dependant on staff strength and budgetary support and water availability. In recent years, NTCA has released funds for development of camps and watch towers at strategic locations so the limiting factor could be the manpower which can be addressed if a special

recruitment drive for group D staff is be permitted by the Government. Proposed location of the new protection camps is as follows:

**New camps should be developed at the following locations:**

**(At Buffer Zone)**

SI No.	Name of Range	Camp location (Block & Compartment)	Jurisdiction	Justification
1.	Basirhat Range	Jhilla-3 or Kakmari floating camp	Jhilla – 2, 3,4	This area is opposite to Kakmari village and extremely prone the tiger straying, illicit deer poaching and felling. Existing floating camp needs to be upgraded to a permanent land base camp.
2	Bashirhat Range	Jhilla-1 or Chilmari floating camp	Jhilla-1	The existing floating camp needs to be upgraded to a permanent camp as during tiger straying duties, the area is left unguarded due to the floating camp moving to fringe areas
3	Sajnakhali Wildlife Sanctuary Range	Pirkhali floating camp	Pirkhali-2,3,4	The existing floating camp needs to be upgraded to a permanent camp as during tiger straying duties
4	Sajnakhali Wildlife Sanctuary Range	Sadakkhali floating camp	Pirkhali1, Panchmukhani-2	The existing floating camp needs to be upgraded to a permanent camp as during tiger straying duties
5	Sajnakhali Wildlife Sanctuary Range	Tentultala floating camp	Pirkhali 2	The existing floating camp needs to be upgraded to a permanent camp as during tiger straying duties

*Note: The Camp location is indicative as the actual location depends on the availability of water*

### 13.4.2. Management of Field Staff/Personnel

Frontline staff mainly forest guards, boat man, laskar, majhi, forester etc. are crucial to the protection of the Tiger Reserve. However more than considerable vacancy in these posts have lead to staff crunch leading to many of the camp being undermanned. To some extent this is being compensated by utilizing the services of people from the fringe areas mainly JFMCs.

As the area is remote the following incentives are proposed to improve efficiency in duty/ output of the staff.

#### 13.4.2.1. Monetary rewards

Monetary rewards shall be awarded to the entire patrolling team for detection/prevention of significant crime cases especially those pertaining to schedule I animals. Individual staff may also be given reward in case of exemplary performance of duty. Such rewards if linked to promotional opportunities shall have a positive impact on staff morale. The amount of the reward should be fixed in consultation with the field level officers and CWLW of the state, and awarded at the time of state level function of Wildlife week, falling on 23rd December every year.

#### 13.4.2.2. Special Allowance

Sundarban Tiger Reserve is a different ecosystem with difficult terrain conditions which are physically and mentally taxing on the staff. Presently the staffs are getting the following allowances:

Rank of Staff	FG/BS	Beat Officer/Forester	Ranger
Project Tiger Allowance	700	900	1000
Sundarban Allowance	50	70	100
Ration Allowance	860	860	
Risk Allowance	400	400	500



These allowances are very paltry and do not provide any significant benefit as compared to the hardships faced by the staff. This can be given to the staff instead of the existing Project Allowance.

### 1.1.1.3. Training

It is extremely important for increasing the efficiency of the staff. Presently the State Govt. conducts a 6 month training for untrained Forest Guards in the state where they are made familiar with the overall forestry and wildlife activities being performed in the state. However, being posted in Tiger Reserve in house trainings in wildlife crime prevention, law, tranquilization, arms, first aid etc involving specialist resource persons should be conducted from time to time to staff so as to be better equipped to perform the task at hand more effectively.

### 13.4.3. Communication

a) **Wireless:** There exists a well established network of wireless communication with one Control Room at Gosaba. The control room monitors round the clock activities in the field and the same is reported to the higher officials.

The Present RT timing are:

Station	Timing of RT Calls
Gosaba and other field Stations	6:00; 8:00; 10:30; 12:00*; 14:30; 16:30; 19:00; 20:30*; 22:00.

The wireless network has been functioning well and should be continued as such. All patrolling boats also need to be fitted with wireless sets. Also charging of batteries in the field is especially designed solar chargers need to be provided to all camps and patrolling boats. Detailed list of RT stations is given in **Appendix-12**

**Patrolling-boats/Watercrafts:** The Tiger Reserve is a maze of rivers, creeks and islands and boats are the only means for carrying out patrolling duties. Presently, all the main land based camps have a larger 2 cylinder house boat for performing night halts in the field; and are also supported by smaller dingi boats which can go right inside small creeks which are otherwise inaccessible to larger boats as they require greater draft.

**Patrolling:** Protection is carried out by patrolling the area using watercrafts like launches, dingi boats and occasionally speed boats. Foot patrolling is also carried out but only selectively owing to the difficult nature of the terrain and since the tigers are prone to attack human beings entering the forest area, it is mainly carried out along the sea facing areas; areas with less under growth or on basis of specific information. Rivers in the Tiger Reserve experience tides on a daily basis. Due to this patrolling in narrow creeks is only possible during the high tide period i.e. when they are filled with water which drains back during low tide rendering it impossible to approach the creek by means of dingi boat. Also the tides are governed by the waxing and waning of the moon with maximum water rising and falling around new moon and full moon days. These periods of high tide are the time when the poachers, fishermen and timber smugglers enter the forest.

The staff duty therefore has to coincide with this lunar cycle to have the maximum efficacy. Also night halt/ patrolling at sensitive areas should be compulsorily followed. More number of tiger guards to be provided for the safety of the staff these are to be used during foot patrolling.

There must be a different schedule during different seasons, like monsoon patrolling summer season patrolling etc., which should be focused on specific problems during the period.

The Patrolling should be focused on following sensitive areas:

- Sweet water ponds
- 'Chataks' or open areas in the forest devoid of tree cover and are favoured by the ungulates. These areas are used by poachers for setting up snares.

- During honey season the eastern border is vulnerable due to people coming in to smuggle honey from Bangladesh.
- During rough weather (April-September) the sea facing areas.
- During winters the sea facing areas and the western and eastern borders.
- In addition, to the above the village hats/local markets.

**Smart Patrolling:**

a. **Use of specially designed app for patrolling:** To overcome the limitations of old practices of using pen, pencil and papers along with prolonged and time bound use of RT system. Main constraints were time dependency on RT network, errors and time consumptions in manual entry, possibilities of data manipulation and absence of real time data. Hence, in order overcome all these limitations E-patrol/Smart patrolling was introduced in Sundarban Tiger Reserve in 2015.

In this new system every camp has been given a cell phone having an android operating system with a compatible mobile application installed in it for monitoring and patrolling purpose. With the help of this application the frontline staffs are recording their every possible activity like patrolling, monitoring the condition of fences, night patrolling, offence detections, and wildlife sightings.

These recorded real time data will directly be going into main database. The real time patrolling data which has been well tabulated, analysed and synchronised into the main server database, can directly be monitored by the application installed in a compatible android cell phone of a senior official. In addition to that, the software allows arranging and/or comparing the reports on numerous strata, by providing various relevant filters.



**Figure 1:** E-patrolling screens

b. **Use of Unmanned Aerial Vehicle (UAV):** UAV or Drones has been introduced as a part of the Smart Patrolling initiative in Sundarban Tiger Reserve. These have proven a remarkably useful tool in patrolling those areas in the Tiger Reserve which are otherwise inaccessible. This tool has also proven useful in case of locating a strayed animal in a locality especially tiger. UAV are also being used to monitor an animal post release into the wild up to considerable distance inside the forest at close vicinity.

## Maintenance of Village Level Crime Dossier:

### Wildlife Crime Dossier:

All the wildlife Crime especially these relating to Schedule I and part II of Schedule II species need to be compiled at the office of Field Director into a crime dossier. Similarly at the Range level Wildlife Crime Database register need to be opened which should contain the following details:

SI No	Range	POR/UDOR/ COR	Year	Place of Crime	Species involved	Name and Address of accused	Photo of accused	Remarks
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In addition to the above the following are proposed to gear up Protection on the basis of data base of offenders along with GIS which should be applied for protection and crime management:

- Creation of a crime database in the **GIS domain** of the Tiger Reserve and adjoining forest Division. The crime data is to be overlaid on the map of the area using GPS coordinates. This will help in mapping out the vulnerable zones.
- Regular round the clock updating of the crime database from the field through **wireless** from **Patrolling Camps**.
- Updating the database with **surveillance information** like: **crime-history, criminal dossiers from local police, district and inter-district criminals, criminals operating on railways, wandering gangs, resident gangs.**
- **Monitoring** the movement of 'anti-poaching squads' (village patrol, road patrol, forest patrol).

Using the database to monitor pendency in Courts. This information should be sent to the head office on a monthly basis. This Dossier should serve as a guide for gathering more information related to the accused; fast tracking of court cases especially those related to Scheduled species and help further fine tuning the protection strategy by keeping track of habitual offenders, planning of raids, or increasing patrolling at vulnerable points. Based on this information Crime Maps should be generated of the Tiger Reserve depicting the crime area with date. Important cases to be followed up with the judiciary for conduction of a speedy trial and awarding of punishment to the accused.

The Park Management should also ensure that the staff remains trained and updated on the latest amendments to the concerning Acts, and for this purpose easy Bangla translation of the concerning Acts may be circulated down to the lowest level for a better understanding of the subject. Besides, periodic Legal Workshops and discussions should also be organized, involving resource persons from the judiciary and the police department to guide the staff in the proper investigation of forest offences, procedural norms, and to simplify the intricacies of the laws. The staff would be benefited by such arrangements, as these close interactions point out the various shortcomings/ mistakes in the entire procedure which render the cases weak, increasing the possibility of criminals going scot-free.

### Monitoring of Protection Duties:

Active supervision at all levels is required to ensure that patrolling is carried out in a proper manner in the field. The concerned Range officer, having jurisdiction over various camps, should regularly report in brief the duties performed to the AFD. The AFD in turn should monitor the patrolling schedules and actual field patrolling and should periodically report the same to Deputy Director and Field Director. Minimum number of night halts in the fields should be fixed. The higher authorities during their field visit should carry out surprise checks of the patrolling duties as also check the presence of staff in the field. They may also join some patrolling party to check the patrolling activities and provide the on spot knowledge with regard to the native fauna and flora.

At present, monitoring of the field performance is carried for all levels of field staff from Beat Officer/Forester, Forest Ranger, and AFD. This has been termed as **Protection Monitoring Protocol: (PMP)** (PMP formats see **Appendix 11**). Monitoring is carried out by means of actual field verification along with analysis of a series of forms which mention the details of the duties performed along with the night halts, offence detected etc. Based on the duties performed a duty

map is generated, and on the basis of offence records of the past three months along with the intelligence reports and site vulnerability a sensitive area map is generated. This map is used by the patrolling staff to identify the weak spots and intensify the duties. This field performance is monitored by the Assistant Field Directors who visit all the field camps during a given month which is followed by visit of the Deputy Field Director. The Field Director holds a meeting almost every month to review the protection scenario in the field.

As the current system has been giving good results the same needs to be followed but it has to be insured that the current protocol should not become a form filling exercise rather it should serve as an index of the field condition which has to be verified by actual field visits.

The following registers i.e. Wildlife Register, Arms Registers, RT Register, Nylon net fencing register, Offence Register which are being maintained by all the camps need to be continued. These are also to be checked by the inspecting officers.

## **13.5. INTELLIGENCE GATHERING AND COORDINATION**

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### **13.5.1. Intelligence Gathering**

Intelligence gathering is a very important component of protection as it helps in the prevention of the crime or in tracking out the people involved in the crime and bringing them to book. All the territorial Range Officers shall be encouraged to develop a network of local informers whose identity should be kept secret. There should be proper system of payment to informers. Local persons like shopkeeper, boatmen, and hoteliers may be identified and imparted basic training of wildlife crime detection so as to avail their services as and when required as informers.

Sensitizing the JFMC members through workshops and involving them in assisting the management through information related to wildlife crime. Introducing a system of incentives like monetary rewards / recognition in return for important information. Quantum of the reward to be as per discretion of the Field Director.

Owing to the poor network connectivity throughout Sundarban initiating a toll-free number for the JFMC to contact the management of the tiger reserve was not possible. Nevertheless, with the recent improvement in network connectivity in some areas of the tiger reserve, network service providers has been contacted for initiating a toll-free number, and shall be implemented shortly along with concerned staff. Instead of toll free number, the contact no. of FD, DFD, AFDs and all Range officers are circulated widely which is available through posters, calendar, awareness generating posters etc. However toll free number is available in Wildlife Head Quarter. Also, the contact no. of FD, DFD, AFDs and all Range officers are circulated widely which is available through posters, calendar, awareness generating posters etc. and a toll free number is available in Wildlife Head Quarter.

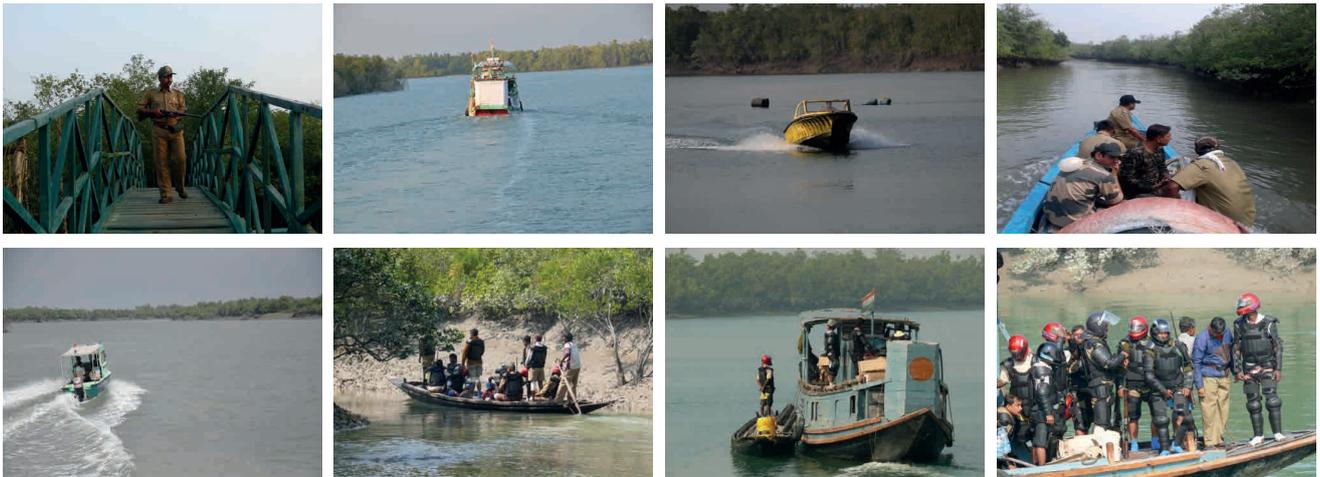
### **13.5.2. Coordination**

Apart from the Forest Department other Government agencies involved in policing are BSF and State Police. Presently police stations are located at Gosaba, Chotto Mollakhali (the later is a coastal police station). BSF patrols the area along the international border and have established Joint camps with the Tiger Reserve one at Khatuajhuri and another at Bagna. Talks are on to establish another BSF camp at Bagmara. Apart from the land based camps BSF has a number of BOP's (Border Out Post) in the form of floating camps situated at Bharkunda, Chaya Kapura, and Raimongal rivers. The local BSF headquarters are at Samsernagar situated in the eastern fringe of the Tiger Reserve. The BSF has extremely good infrastructural support in the form of sophisticated arms and speed boats. These camps undertake periodic joint patrolling with the forest staff. Their presence adds to the confidence of the staff especially in remote locations like Bagmara.



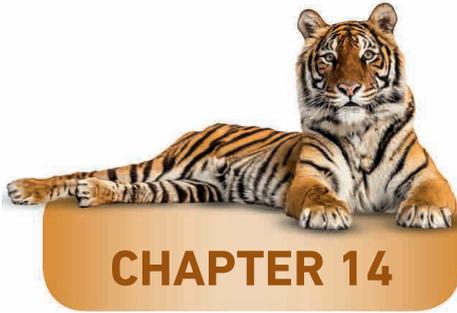
Though there is staff level contact between these agencies; formal contact mechanism at the level of the Field Director needs to be institutionalized. Tripartite meeting between the F.D, Police and BSF should take place at quarterly interval staffs to review the crime against wildlife and be coordinated at the level of the Director, Biosphere Reserve. The exchange of crime dossiers must be carried out at range and thana level by concerning range officer. Relevant telephone numbers should be made available to both sides for passing on relevant information. Apart from this, meetings should also be held with the Director, Wildlife Crime control Bureau (Eastern Region) to share information related to wildlife crime. The Bureau may be asked to act as a resource centre for capacity building of staff and officers in the field of wildlife crime.

## PROTECTION STRATEGIES IN SUNDARBAN TIGER RESERVE



## NYLON NET FENCING SUNDARBAN TIGER RESERVE





# Eco-tourism and Interpretation

## Eco-tourism Interpretation and Conservation Education

Eco-tourism is one of the major aspect of management in tiger reserve. Therefore, it has a major impact on both the people and the environment. Responsible Eco-tourism can help generate awareness and support for conservation and local culture apart from creating economic opportunities for countries and communities. On the other hand, inappropriate Eco-tourism development and practice can degrade habitats and landscapes, deplete natural resources and generate waste and pollution.

Eco-tourism in Protected Areas like National Parks and Wildlife Sanctuary is primarily aimed at spreading conservation awareness among the people by exposing them to the rich biodiversity and cultural values of the area. Apart from this it also helps in fostering ties with different stakeholders; thereby making them partners in the conservation process. Ecotourism is defined as given by I.U.C.N (1996) as “Eco-tourism is environmentally responsible travel and visitation to relatively undisturbed natural areas in order to enjoy and appreciate nature and any accompanying cultural features both past and present that promotes conservation has low visitor impact, provides for beneficially active socio-economic involvement of local populations.”

Also the National Policy on Eco-tourism stipulates that Eco-tourism should become a unifying force nationally and internationally, fostering better understanding through travel.

## 14.1. ORGANIZATION SETUP AND MANAGEMENT

**Zone of Eco-tourism:** Presently Eco-tourism is confined to i.e. Basirhat Range (buffer area), part of the Sajnekhali Wildlife Sanctuary (SWLS) Range.

### 14.1.1. Objectives of Eco-tourism

- Create conservation awareness among the masses.
- Forging partnership with the local communities and thereby developing their stakes in the conservation process.
- Enhance the visitor experience to the area by suitable interpretation.
- Carry out low impact Eco-tourism.

### 14.1.2. Problems in achieving the objectives

- Limited access to the forest areas on foot.
- Visibility in the forests is limited to areas along the bank and to the exposed mud flats during low tides. Thick undergrowth and cyclical tidal rhythms often interfere with the visibility often leading to poor sightings resulting in low visitor satisfaction.



- Watercrafts which are the only means of transport are often old and not compliant with pollution standards.
- Limited number of tourist spots catering to large number of tourists.
- Inadequately developed interpretation facilities.
- No proper place / policy for garbage and sewage disposal.
- In the fringe areas lack of infrastructure by way of proper roads, water supply, electricity.

### 14.1.3. Approach and Access

The Headquarters of Sundarban Tiger Reserve is located at Canning Town, South 24-Parganas District and is connected by broad gauge Railway line with Sealdah South Suburban station which is 46 km from Canning. The entry permits are available at Sonakhali, Gossaba, bagna and Sajnekhali. Tourists generally avail conducted tours organized by private tour operators as well as West Bengal Eco-tourism Development Corporation Limited. The Reserve can be approached by road from Calcutta up to embankment points at Jharkhali, Sonakhali, Gadkhali & Dhamakhali. From these points, the Reserve is approachable by waterways only. The Reserve can also be approached from Basirhat and Hasnabad under North 24-Parganas District. There are numerous train and bus services up to Canning and Hasnabad and bus services up to Dhamakhali and Gadkhali. From these points, service launches and ferry boats are available to various places of tourist interest. Kolkata is the nearest major city well connected through air and rail. Inside the Reserve, the only means of transport is Launches and boats.

### 14.1.4. Season & Climate

The best season to visit Sunderbans is between October and February as the rivers are calm and free from turbulence. Although the tract is situated south of the Tropic of Cancer, the temperature is equable due to its proximity to the sea though humid climate prevails for most part of the year.

**Summer:** extends from middle of March to middle June. Maximum temperature 36°C

**Winter:** December to February. Minimum temperature 9.2°C.

**Monsoon:** usually about the middle of June and lasts up to middle of September. The autumn lasts from mid September to November. Rough weather lasts from 15<sup>th</sup> March to 15<sup>th</sup> September and the fair weather prevails between mid September to mid March.

**Rainfall:** Average annual rainfall is 1920.30 mm. Average humidity is about 82% and is more or less uniform throughout the year.

There is a specialized Range called as the Eco-tourism Range functioning in the Tiger Reserve which is headquartered at Sajnekhali. It is headed by a Range Officer, and has a Beat Officer and a Forest Guard functioning under it. The Eco-tourism Range looks after permits to the watercrafts carrying tourists, collection of entrance fees, allocation of tourist guides etc. However, as the eco spots are scattered over different ranges and are controlled by the respective Range Officers. This issue needs to be relooked at. During the tourist season (usually from November to February) Eco-Tourism volunteers from JFMC area and SAP personnel are engaged temporarily to control the rush of tourist at various spots.

## 14.2 DETERMINATION OF CARRYING CAPACITY

Discussed in detail in Chapter 7

## 14.3 IMPLEMENTATION OF ECO-TOURISM GUIDELINES

At present the Government of India's Policy and Guidelines (2002) (**Annexure 14**) and NTCA has issued circular for proper regulation of Eco-tourism – dated 15th October, 2012 is being broadly used as a reference to guide the Eco-tourism in the Tiger Reserve.

Presently the following principles are being used for carrying out ecoEco-tourism:

1. Eco-tourism with minimum negative impact on the environment.
2. Educating the visitors regarding the conservation importance of the area.
3. Development of infrastructure in harmony with the local environment.
4. Maximize the benefit from ecoEco-tourism to the local people.

In addition to the above the following regulations are prescribed for different categories of stakeholders

### 14.3.1. Park Management

#### 14.3.1.1. Eco-tourism

- The eco-Eco-tourism planning should be flexible, site-specific and participatory. As far as possible local people should benefit from the Eco-tourism activities.
- The eco-Eco-tourism package should invariably include:
  - Interpretation/ Visitor Centres
    - Way-side exhibits
    - Signage's
    - Observation towers
    - Public conveniences
    - Garbage disposal facility
    - Dos and don'ts
    - Brochures and leaflets (bilingual)
  - Site-specific micro - planning for community based eco-Eco-tourism should be resorted to.
  - Environmental, physical and social carrying capacities to limit the various developmental activities in the fringe area to be identified for Eco-tourism.
  - Mechanism to ensure continuous monitoring of adverse effects of Eco-tourism for quick redressal should be devised.
  - Periodic training programmes on Eco-tourism should be conducted for Eco-tourism administration, planners, operators and general public.
  - Private parties may be involved in the conservation process adopting certain sites and be responsible for their maintenance and upkeep
  - Periodic meetings with all the stakeholders may be carried out both at the beginning and closing of the tourist season to smoothen out any difficulties being faced as well bring about better coordination resulting in a better visitor experience.
  - A formal mechanism of rewarding such tourist practices may be by acknowledging them publically at functions like Earth day, World Environment Day, Aranya Saptaha and Wildlife week.



- Improving the existing website so that bookings can be made on internet.
- Ensuring training programmes for the host community in:
  - Conservation awareness
  - Health and sanitation
  - Development and sale of local souvenirs
  - Code of conduct
  - Garbage disposal

#### **14.3.1.2. Tour Operators/ Developers**

- The private entrepreneurs need to be encouraged to go for Ecolodges. These would be lodges which are designed to be in accordance or gel with the natural surroundings and are constructed with little disturbance to the natural surroundings. They adopt the concept of rain water harvesting, and of reducing, reusing, and recycling waste products and encourage minimum use of non renewable resources, to abide by the planning restrictions, codes and standards prescribed by the authorities.
- Conducting EIA/ environmental audits for new/ ongoing Eco-tourism projects.
- Sensitization regarding conservation of endangered species.
- To take into consideration the carrying capacity and sociological use-limits of the site while creating tourist facilities, and ensuring safety & convenience of tourists
- Energy and water saving devices should be used apart from controlled sewage disposal
- Control of noise pollution, chemical pollution and air emissions.
- Reduced use of environmentally unfriendly items like asbestos, CIS, pesticides, inflammable material.
- Providing appropriate interpretive service to visitors for communication with nature and local culture
- Ensuring proper marketing of Eco-tourism products.
- Ensuring training of staff on environmental issues.
- Ensuring safety and security of visitors.
- Respecting local inhabitants, culture and involving them in various activities as far as possible.

#### **14.3.1.3. Visitors**

- Abiding by the code of conduct, "Do's" & "Don'ts"
- Sensitized regarding conserving water and electricity, waste segregation, avoiding wastage of natural resources so that they also may be an active part of a responsibly practiced Eco-tourism.
- Avoiding littering and carrying back all non - degradable litter.
- Leaving the tourist sites clean before departing.
- Avoiding plucking of plants, flowers, drift - wood from the site.
- Respecting local culture/ customs.
- Strictly adhering to the safety precautions.
- Patronizing tour operators or lodges who follow environment friendly policies.
- Filling up of feed back forms.

#### 14.3.1.4. For the Host Community

- Respect the value of environment and cultural heritage.
- Do not indulge in illegal activities like illicit felling, poaching, cattle smuggling.
- Co-operate with the local authorities.
- Be friendly with the visitors as effective “nature guides” & “conservationists”

#### 14.3.2 Waste Management

This has been discussed detail in Chapter-8

#### 14.3.3 Proposal for Infrastructure Development

Discussed detail in Chapter-8

#### 14.3.4 New Site development Proposals

This has been discussed in detail Chapter-8 of Buffer Area Plan.

#### 14.3.5 Recycling of gate receipts

The Sundarban Tiger Conservation Foundation has been created under the provisions of Sec 38 X of the Wildlife (Protection)Amendment Act 1972 (2006 )-

##### 38X.

1. *The State Government shall establish a Tiger Conservation Foundation for tiger reserves within the State in order to facilitate and support their management for conservation of tiger and biodiversity and, to take initiatives in eco-development by involvement of people in such development process.*
2. *The Tiger Conservation Foundation shall, inter alia have the following objective:*
  - a. *to facilitate ecological, economic, social and cultural development in the tiger reserves;*
  - b. *to promote eco-tourism with the involvement of local stakeholder communities and provide support to safeguard the natural environment in the tiger reserves;*
  - c. *to facilitate the creation of, and or maintenance of, such assets as may be necessary for fulfilling the above said objectives;*
  - d. *to solicit technical, financial, social, legal and other support required for the activities of the Foundation for achieving the above said objectives;*
  - e. *to augment and mobilise financial resources including recycling of entry and such other fees received in a tiger reserve, to foster stake-holder development and eco-tourism;*
  - f. *to support research, environmental education and training in the above related fields.*

to facilitate and support management apart from taking initiatives for involving people in conservation. It can augment the present funding support through recycling of gate receipts, service charges, and donations etc. It can also take up activities like staff welfare, capacity building programs etc. Tourists may also be encouraged to donate to such funds which may then be used to improve the existing tourist facilities and develop new ones.



## 14.4 PARK INTERPRETATION PROGRAMME

Nature interpretation forms one of the most important components of Eco-tourism. It can be defined as 'An educational activity which aims to reveal meaning and relationship through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information' – Freeman Tilden (1977). The different tools and techniques for interpretation are through appropriate signages, pamphlets, interpretation centers, audio visual presentations, publications, museums, discussions, etc depending on the type of target audience.

Present Scenario of Nature Interpretation in Sundarban Tiger Reserve:

At present, there are Mangrove Interpretation Centres at Sajnekhali, Jhingekhali and Netidhopani; apart from this there is a mangrove arboretum in Sudhanyakhali and different tourist sites have posters and signages. Eco guides accompany tourists and help interpreting the ecosystem and other things of interest. However these measures are not adequate and the Interpretation program needs to be taken up in a more systematic and intensive way to help enhance the visitor experience in area.

### 14.4.1 Proposals for Interpretation

1. Setting up a new interpretation centre catering to the tourists in the eastern sector.
2. Improving the existing signage at the different Eco-tourism centres and also along tourist routes along with phasing out old and worn out ones.
3. Developing a good collection of audio visual medium on wildlife, related culture and another natural history aspects of the area for visitor shows.
4. Selling of brochures and other publicity material a few prominent sites for educating the visitors.
5. Developing visitor boards thereby encouraging the visitors to share interesting information regarding their experiences with other visitors.
6. At times different eminent speakers or park officials may be invited to directly interact with tourists and share their experiences.
7. Trips of local school children and also from Kolkata need to be organized to sensitize them about their rich heritage.
8. System of feed back to be improved and tourists encouraged to provide direct feedback through use of official website.
9. **Ecoguides:** These are local people who are trained to interpret the area to the tourists visiting the area. Since sightings are mostly a matter of chance and the visibility limited to the exposed mudflats especially at low tides the visitor satisfaction may be relatively low. It depends on the creative skill of the ecoguides to keep the visitors engaged and interested throughout the trip by interpreting and highlighting seemingly mundane features. Apart from emphasizing the natural history aspects they also need to be trained to focus on the socio cultural aspects of the people. For this a guide training as well as refresher course may be carried out especially during the lean tourist seasons.

## 14.5 Nature Education

### Objectives

1. Spreading awareness about the rich biodiversity and cultural values of the area.
2. Developing a strong base for conservation among all sections of society especially targeted at children and developing partners in conservation.
3. Direct interaction of the Reserve officials with the people visiting the area.
4. Highlighting the problems and issues being faced by the area.

**Problems:**

1. No structured platform / media for sharing of opinion and views.
2. Lack of qualified manpower.

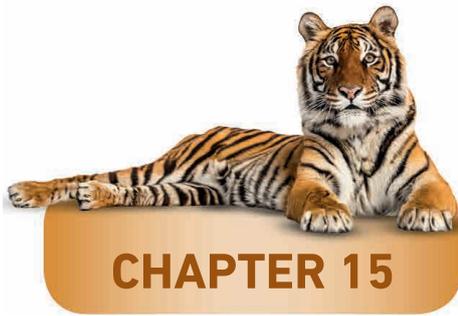
**Strategies:**

1. **Target Group Fixation:** The nature education program is to be structured keeping the target audience in mind. Apart from the routine visitors an important target group can be school children and college going individuals, corporate houses, lawyers, other line departments, media, police personnel, and officials of other line departments.
2. **Proposals for Effective Outreach Program:** Outreach program plans to reach as many people who are opinion makers and who can have an impact on the conservation programme and spread the message of conservation far and wide. Towards this end the following may be carried out:
  - Publication of news letter, brochures and pamphlets
  - Competitions like nature based quiz, essay, drawing etc for children.
  - Tours of school children to the field to expose the mangrove ecosystem.
  - Inviting different line departments on the occasion of Aranya Saptah and Wildlife week celebrations.
  - Suggestions invited through the medium of the official website.
  - Officials to visit different schools and colleges and deliver talks on the subject.
  - Workshops for media and police personnel sensitizing them to the views of the management and soliciting their cooperation for the same.
  - Street shows and village level theatre groups.

## ECO-TOURISM IN SUNDARBAN TIGER RESERVE







# Organization, Administration and Budget

## 15.1 BUFFER AREAS CO-ORDINATION COMMITTEE AND ITS LINKAGE WITH THE TIGER STEERING COMMITTEE AND TIGER CONSERVATION FOUNDATION

The existing buffer areas comprises of the Sajnekhali Wildlife Sanctuary area and the adjoining Range of Bashirhat. The northern fringe villages and the 24 Parganas South Division though not included in the buffer region constitute the northern and western flank of the Tiger Reserve. Therefore, to bring together this disparate group of stakeholders a Buffer Area Coordination Committee is proposed which shall include the Field Director, as the Chairman and the Deputy Field Director as the Member Secretary apart from this the Joint Convenors of all JFMC'S shall be members. Leading NGO's two numbers shall be nominated by the Field Director to the Committee. Representative of local tour operators, boat owners association, and tourist lodge association shall also be part of the committee. The Local BSF Commandant and the DFO of 24 Parganas South may be Special Invitees to the Committee. The Committee shall meet from time to time to decide problems related to the buffer areas and any developmental works to be taken up in the area. As the Field Director is also head of the TCF he shall act as a liaison between the Committees.

## 15.2 CO-ORDINATION WITH JFMCs, AND OTHER LINE AGENCIES/ DEPARTMENTS/PRODUCTION SECTORS

This has been dealt with in previous chapters.

## 15.3 STAFF DEPLOYMENT

At present the field staff is posted against the four territorial ranges. Each Range is further divided into beats and camps. The camps are located all over the Tiger Reserve and are manned by the field staff. The staff performs patrolling duty on a routine basis with exceptions occurring only in periods of rough weather (June to mid September). The staff in the field is to perform a minimum number of night halts and night patrolling as per the established protection protocol for the beat Officer and Camp In charge. One of the major factors hindering the actual field performance of the field staff is old age, multitude of diseases and an acute shortage of frontline staff amounting to considerable vacancy. To compensate for this shortfall fringe villagers from the JFMC's are taken to assist the staff in patrolling duties. In the vulnerable seasons like pre monsoon, post monsoons and the monsoon period special patrolling drives are carried out to nab the offenders. In these drives the routine patrolling teams are joined by the team from Headquarter.

The Headquarter team should also carry out surprise checks on patrolling and in field camps to ensure proper patrolling as well as the presence of the staff in the field. Special drives or joint patrolling is to be carried out with the BSF and the neighboring Division i.e. 24 Parganas South Division on the Eastern and Western borders respectively.

The camps stationed towards the border areas should be given more resources in the form of men and material. Periodic reshuffling of the staff is carried out but it should be carried in a more systematic manner i.e. after every three years, which is the maximum limit, the staff from the remote locations to be brought to the upper portions of the Reserve and vice versa.

In case of floating camp, the time limit is maximum 1 year. In addition it has to be ensured that the proper staff amenities are to be provided in all the camps. Like clean barrack/quarters, toilets, drinking water, fuel for cooking, first aid, light, mosquito nets etc. In addition field equipments like arms, binoculars, uniform, tapes, compass, field diaries etc are to be ensured. Proper health checkups and staff insurance should also be carried out from time to time.

## 15.4 TIGER STEERING COMMITTEE

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As per the requirement of section 38 U of WPA. The process of constituting Tiger Steering Committee for ensuring, co-ordination, monitoring, protection and conservation of tiger, co-predators and prey animals is in progress.

## 1.5. TIGER CONSERVATION FOUNDATION

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As per section 38 X of Wildlife (Protection) Amendment act 1972, the Sundarban Tiger Conservation Foundation for the Reserve has been established in order to facilitate and support management for conservation of tiger and biodiversity and, to take initiatives in eco-development. It will act as a nodal body for the Tiger Reserve and help in recycling of the gate receipts, receipt of funds from donor agencies, coordinate research, awareness campaigns etc.

## 1.6. CO-ORDINATION WITH LINE AGENCIES / DEPARTMENTS

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Coordination with line departments is the need of the hour. The different problems and issues facing the Reserve are generally multi dimensional and often involve multiple agencies. In the absence of a formalized structure for coordination many of the issues remain lingering on for long periods thereby decreasing the overall efficiency of the management. In general, it is required to ensure a better protection, development of the area, conflict resolution and overall better management of the Tiger Reserve. Some of the key agencies with which better coordination should be there are Police, BSF, District administration and Judiciary. For the purpose of coordination the Tiger Cell has been designated as the nodal cell for coordination both within the Tiger Reserve and with other line departments. (Details are given in Chapter 10). Similarly for the purpose of research coordination with different scientific institutions and bodies and universities may be carried out.

## 15.7 FUND RAISING STRATEGIES

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The main source of funding shall be the Government of India (NTCA) for developing of new infrastructure, ecocodevelopment, awareness and the State Government for meeting the establishment costs and other recurring expenditure. Similarly, TCF is used for the to maintain and augment the existing infrastructure and facilities. Funds may also be raised from different donors through the Tiger Conservation Foundation.

## 15.8 SCHEDULE OF OPERATIONS

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Protection is a major activity. It is reinforced at different points in time within a year based on the threat perception. (Details given in Ch 14). In addition to this water hole maintenance of the existing waterholes and maintenance of nylon fencing. Fencing checking is carried out twice a day on a regular basis.

## 15.9 ACTIVITY BUDGET

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All the activities to be carried out are mentioned in different chapters. Apart from patrolling there are very few activities which are being carried out throughout the year. The budget has both recurring and non recurring items of work including the item of works proposed in the Plan. Details are given in **Appendix 15**.



# APPENDICES

# Appendix 1

## Area Statement

AREA STATISTICS OF SUNDERBAN TIGER RESERVE FOREST				
BLOCK_NAME	COMP_NO	PERIMETER	RECORDED AREA(OLD)	AREA(SATELLITE IMAGERY)
			(HA)	(HA)
ARBESI	ARB1	29672.67	4178.947	3248.9266
ARBESI	ARB2	29703.73	4225.101	2519.7894
ARBESI	ARB3	31709.76	2082.186	3463.9606
ARBESI	ARB4	25489.71	2160.728	2295.965
ARBESI	ARB5	33183.21	2401.619	2509.2446
<b>TOTAL</b>			<b>15048.58</b>	<b>14037.8862</b>
BAGHMARA	BGHM1	23571.01	2430.364	2799.5868
BAGHMARA	BGHM2	27275.52	2255.465	2613.0744
BAGHMARA	BGHM3	34435.64	4180.566	3677.1006
BAGHMARA	BGHM4	38094.73	2402.834	2583.0656
BAGHMARA	BGHM5	40792.89	8054.251	7127.3444
BAGHMARA	BGHM6	31812	2546.558	3849.7476
BAGHMARA	BGHM7	17768.85	1589.473	1764.3604
BAGHMARA	BGHM8	48107.52	5945.344	6674.7566
<b>TOTAL</b>			<b>29404.86</b>	<b>31089.0364</b>
CHAMTA	CHMT1	40433.79	3865.182	4116.7736
CHAMTA	CHMT2	36265.34	2072.874	2382.4294
CHAMTA	CHMT3	44431.61	3694.331	3298.6744
CHAMTA	CHMT4	26209.54	1668.016	1985.0078
CHAMTA	CHMT5	20145.9	2652.631	2244.0494
CHAMTA	CHMT6	21873.66	1382.591	1649.5752
CHAMTA	CHMT7	26108.4	2627.53	2698.5916
CHAMTA	CHMT8	37390.46	4114.17	4762.2164
<b>TOTAL</b>			<b>22077.33</b>	<b>23137.3178</b>
CHANDKHALI	CHND1	37927.35	6284.21	5810.2908
CHANDKHALI	CHND2	36906.03	2701.619	3157.798
CHANDKHALI	CHND3	42282.53	3725.91	3701.5172
CHANDKHALI	CHND4	30118.94	2885.02	2808.168
<b>TOTAL</b>			<b>15596.76</b>	<b>15477.774</b>
CHHOTAHARDI	CHTH1	35501.28	6950.607	6657.6528
CHHOTAHARDI	CHTH2	51257.86	6719.433	6620.8146
CHHOTAHARDI	CHTH3	27163.25	3903.643	3501.3412
<b>TOTAL</b>			<b>17573.68</b>	<b>16779.8086</b>
GONA	GNA1	32828.36	5188.259	5754.994
GONA	GNA2	28465.24	3631.578	3529.8606
GONA	GNA3	36230.98	5089.068	5742.2804
<b>TOTAL</b>			<b>13908.91</b>	<b>15027.135</b>

Contd.



AREA STATISTICS OF SUNDERBAN TIGER RESERVE FOREST				
BLOCK_NAME	COMP_NO	PERIMETER	RECORDED AREA(OLD)	AREA(SATELLITE IMAGERY)
			(HA)	(HA)
GOASHABA	GSB1	26347.43	2411.336	2377.564
GOASHABA	GSB2	22664.67	2857.085	2758.7558
GOASHABA	GSB3	41990.85	6571.255	5946.9848
GOASHABA	GSB4	36776.21	5340.08	6401.9882
<b>TOTAL</b>			<b>17179.76</b>	<b>17485.2928</b>
HARINBHANGA	HRNB2	40103.84	42f05.668	4183.9042
HARINBHANGA	HRNB3	39630.18	4283.4	4354.3816
<b>TOTAL</b>			<b>11691.5</b>	<b>11805.1192</b>
JHILLA	JHL1	21617.06	1479.757	1617.195
JHILLA	JHL2	33496.11	2231.578	2824.9412
JHILLA	JHL3	22294.49	1549.392	1770.783
JHILLA	JHL4	24355.45	2124.959	2116.15
JHILLA	JHL5	22192.08	2151.012	2610.5094
JHILLA	JHL6	22582.46	2776.923	2219.7134
<b>TOTAL</b>			<b>12313.62</b>	<b>13159.292</b>

WBLOCK_NAME	COMP_NO	PERIMETER	RECORDED AREA(OLD)	AREA(SATELLITE IMAGERY)
			(HA)	(HA)
KHATUAJHURI	KHTH1	48819.45	4716.599	4320.7902
KHATUAJHURI	KHTH2	34083.31	3369.635	2948.9178
KHATUAJHURI	KHTH3	29548.41	5160.323	4689.4772
<b>TOTAL</b>			<b>13246.56</b>	<b>11959.1852</b>
MATLA	MTL1	37621.47	7049.797	7173.642
MATLA	MTL2	39090.13	3134.008	3859.8284
MATLA	MTL3	38317.31	4778.947	5050.525
MATLA	MTL4	29703.06	2674.089	3070.1896
<b>TOTAL</b>			<b>17636.84</b>	<b>19154.185</b>
MAYADWIP	MYDP1	25583.64	3880.971	3497.2178
MAYADWIP	MYDP2	44997.94	6252.631	10248.84
MAYADWIP	MYDP3	25204.03	3966.801	3724.15
MAYADWIP	MYDP4	36443.71	6738.056	6622.097
MAYADWIP	MYDP5	35948.97	6508.502	6818.1992
<b>TOTAL</b>			<b>27346.96</b>	<b>30910.504</b>
NETIDHOPANI	NETD1	34978.8	2642.105	3049.503
NETIDHOPANI	NETD2	24562.87	2790.688	1895.1656
NETIDHOPANI	NETD3	33749.68	3870.85	3276.3658
<b>TOTAL</b>			<b>9303.643</b>	<b>8221.0344</b>

Contd.

WBLOCK_NAME	COMP_NO	PERIMETER	RECORDED AREA(OLD)	AREA(SATELLITE IMAGERY)
			(HA)	(HA)
PANCHMUKHANI	PNCH1	28548.75	2598.38	2639.7828
PANCHMUKHANI	PNCH2	30935.49	2631.578	2961.4208
PANCHMUKHANI	PNCH3	29444.56	4236.032	3296.3768
PANCHMUKHANI	PNCH4	38526.32	3602.429	4082.7738
PANCHMUKHANI	PNCH5	38866.41	4604.453	4892.2762
<b>TOTAL</b>			<b>17672.87</b>	<b>17872.6304</b>
PIRAKHALI	PRKL1	23242.92	2762.139	2762.1392
PIRAKHALI	PRKL2	32837.57	3301.214	3775.8014
PIRAKHALI	PRKL3	18579.72	1908.906	1795.5238
PIRAKHALI	PRKL4	26775.33	2221.862	2888.3454
PIRAKHALI	PRKL5	28188.29	3017.813	2254.3924
PIRAKHALI	PRKL6	27282.69	2438.461	2246.6862
PIRAKHALI	PRKL7	37134.5	3521.457	4250.3468
<b>TOTAL</b>			<b>19171.85</b>	<b>19973.2352</b>

**Total Recorded Area (Old) of all the Blocks of Str = 259173.709 H.a**

**Total Area of all the Blocks of Str (According to Satellite Imagery) = 265689.4362 H.a.w**



# Appendix 2

## Notification of Sajnekhali Wildlife Sanctuary

GOVERNMENT OF WEST BENGAL

FOREST DEPARTMENT

### FOREST NOTIFICATION

No. 5396-For/—24<sup>th</sup> June 1976—Whereas the area whose situation and boundaries are described in the Schedule below (hereinafter referred to as the said area) is considered to be of adequate ecological, faunal, natural and zoological significance;

Now, therefore, in exercise of the power conferred by sub-section (1) of section 18 of the Wild Life (Protection) Act, 1972 (53 of 1972), and in supersession of such part of all previous notifications as declared the said area or part thereof as a sanctuary, the Governor is pleased hereby to declare, with effect from the date of publication of this notification in the Official Gazette, the said area to be a sanctuary to be known as Sajnekhali Wild Life Sanctuary for the purpose of protecting, propagating and developing wild life and its' environment.

### The Schedule

#### A. Situation

**District:** 24-Parganas

24-Parganas Forest Division, Basirhat Range (Part) covering an approximate area of 362.40 Sq. Km. and comprising following forest blocks and compartments:

Blocks	Compartments
Panchamukhani	1 to 5
Pirkhali	1 to 7

#### B. Boundaries

North	:	Bara Herobhanga Khal, Gomdi Khal and Pitch Khal.
East	:	Duttar Gang.
South	:	Part of Gosaba river and Netidhopani Khal.
West	:	Bidya river.

By order of the Governor,
A.K. GUPTA
Dy. Secy. to the Govt. of West Bengal

# Appendix 3

## Notification of National Park

GOVERNMENT OF WEST BENGAL  
FOREST DEPARTMENT

### FOREST NOTIFICATION

No. 2867-For./11B-6/83.—4<sup>th</sup> May 1984.—Whereas by notification No. 3640 For., dated the 6<sup>th</sup> June 1978 published at page 1361 of Part I of the “Calcutta Gazette” dated the 13<sup>th</sup> July 1978, the Governor was pleased to declare his intention to constitute the forest lands covering an approximate area of 1330.10 sq. kms. and comprising reserve forest blocks and compartments, in the district of 24-Parganas, more fully described in the Schedule below (hereinafter referred to as the said lands) as a National Park to be called the “**Sunderbans National Park**” for the purpose of protecting, propagating and developing wild life therein;

And whereas more than two months from the date of such proclamation have elapsed for preferring claim, as required under clause (b) of section 21 of the Wild Life (Protection) Act, 1972, (53 of 1972), (hereinafter referred to as the said Act);

And whereas no claim has been preferred under section 19 of the said Act;

And whereas all rights in respect of the said lands have been vested in the State Government;

Now, therefore, in exercise of the power conferred by sub-section (4) of section 35 of the said Act, the Governor is pleased hereby to specify in the Schedule below the limits of the said lands comprising the reserve forest blocks and compartments and declare that with effect from the 14<sup>th</sup> May 1984, the same shall be a National Park to be called the “**Sunderbans National Park**” for the said purpose.

### The Schedule

#### A. Situation

**District:** 24-Parganas

Forest lands covering an approximate area of 1330.10 sq. kms. and comprising the following reserve forest blocks and compartments:

Blocks	Compartments
Matla	1 to 4
Chamta	4, 5, 6, 7 and 8
Chhotahardi	1 to 3
Gosaba	1 to 4
Gona	1 to 3
Baghmara	2 to 8
Mayadwip	1 to 5

#### B. Boundaries

North	:	Reserve forest blocks and compartments, namely, Netidhopani-1, 2 and 3; Chamta-3 and 2; Chandkhali-2 and 4; and Baghmara-1.
East	:	Harinbhanga river adjoining the international boundary with Bangladesh.
South	:	Bay of Bengal.
West	:	Matla river.

By order of the Governor,  
R.N. DE  
Secy. to the Govt. of West Bengal



# Appendix 4

## Mangroves and associates found in Sundarbans

SI No	Family	Scientific name	Mangrove/ Nonmangrove	Local name
1	Arecaceae	<i>Nypa fruticans</i>	Mangrove	Golpata
2	Avicenniaceae	<i>Avicennia officinalis</i>	Mangrove	Jatbain
3		<i>A. alba</i>	Mangrove	Kalobain
4		<i>A. marina</i>	Mangrove	Pyarabain
5	Combretaceae	<i>Lumnitzera racemosa</i>	Mangrove	Kripa
6	Euphorbiaceae	<i>Exocoecaria agallocha</i>	Mangrove	Genwa
7	Meliaceae	<i>Xylocarpus granatum</i>	Mangrove	Dhundul
8		<i>X. mekongensis</i>	Mangrove	Passur
9	Myrsinaceae	<i>Aegiceras corniculatum</i>	Mangrove	Khalsi
10	Plumbaginaceae	<i>Aegialitis rotundifolia</i>	Mangrove	Tora
11	Rhizophoraceae	<i>Rhizophora mucronata</i>	Mangrove	Garjan
12		<i>R. apiculata</i>	Mangrove	Garjan
13		<i>Bruguiera gymnorrhiza</i>	Mangrove	Kankra
14		<i>B. sexangula</i>	Mangrove	Kankra
15		<i>B. cylindrica</i>	Mangrove	Bakulkankra
16		<i>B. parviflora</i>	Mangrove	Bakulkankra
17		<i>Ceriops decandra</i>	Mangrove	Jhamtigoran
18		<i>C. tagal</i>	Mangrove	Math goran
19		<i>Kandelia candel</i>	Mangrove	Garia
20	Rubiaceae	<i>Scyphiphora hydrophyllacea</i>	Mangrove	Tagribani
21	Sonneratiaceae	<i>Sonneratia apetala</i>	Mangrove	Keora
22		<i>S. griffithii</i>	Mangrove	Ora
23		<i>S. caseolaris</i>	Mangrove	Chakkeora
24		<i>S. alba</i>	Mangrove	
25	Sterculiaceae	<i>Heritiera fomes</i>	Mangrove associate	Sundari
26	Acanthaceae	<i>Acanthus ilicifolius</i>	Mangrove associate	Hargoja
27		<i>A. volubilis</i>	Mangrove associate	Lata hargoja
28	Arecaceae	<i>Phoenix paludosa</i>	Mangrove associate	Hental
29	Caesalpiniaceae	<i>Cynometra ramiflora</i>	Mangrove associate	
30		<i>Caesalpinia bonduc</i>	Mangrove associate	Nata
31		<i>C. crista</i>	Mangrove associate	Shingrilata
32	Malvaceae	<i>Hibiscus tiliaceus</i>	Mangrove associate	Bhola
33		<i>H. tortuosus</i>	Mangrove associate	Bhola
34		<i>Thespesia populnea</i>	Mangrove associate	Paras
35	Papilionaceae	<i>Dalbergia spinosa</i>	Mangrove associate	Chuliakanta
36		<i>Derris scandens</i>	Mangrove associate	Noa lata
37		<i>D. trifoliata</i>	Mangrove associate	Pan lata
38		<i>D. indica</i>	Mangrove associate	Karanja
39	Rutaceae	<i>Atalantia correa</i>	Mangrove associate	Ban Lebu
40	Tiliaceae	<i>Browlowia tersa</i>	Mangrove associate	Lata Sundari
41	Amaryllidaceae	<i>Crinum defixum</i>	Halophytes	Sukha Darsan

SI No	Family	Scientific name	Mangrove/ Nonmangrove	Local name
42	Araceae	<i>Cryptocorne ciliata</i>	Halophytes	Kerali
43	Aizoaceae	<i>Sesuvium portulacastrum</i>	Halophytes	Gada Bani
44	Asclepiadaceae	<i>Sarcolobus globosus</i>	Halophytes	Caw Phal
45		<i>S. carinatus</i>	Halophytes	Baole Lata
46		<i>Pentatropis capensis</i>	Halophytes	Dudhi Lata
47	Boraginaceae	<i>Heliotropicum curassavicum</i>	Halophytes	Nona Hatisnur
48	Convolvulaceae	<i>Ipomoea pes-caprae</i>	Halophytes	Chhagal Knuri
49	Rubiaceae	<i>Hydrophylax maritima</i>	Halophytes	
50	Verbenaceae	<i>Clerodendrum inerme</i>	Halophytes	Ban Jhampi
51	Loranthaceae	<i>Viscum orientale</i>	Halophytes	Manda
52		<i>Dendrophthoe falcata</i>	Halophytes	Bara Manda
53	Poaceae	<i>Porteresia coarctata</i>	Halophytes	Dhani Ghas
54	Tamaricaceae	<i>Tamarix dioica</i>	Xerophytes	Lal Jhau
		<i>Tamarix aphylla</i>	Xerophytes	Lal Jhau
		<i>Tamarix troupii</i>	Xerophytes	Nona Jhau
55	Solanaceae	<i>Solanum trilobatum</i>	Xerophytes	Lala Gurbegun
56	Opuntiaceae	<i>Opuntia dillenii</i>	Xerophytes	Fanimansa
57	Casuarinaceae	<i>Casuarina equisetifolia</i>		
58	Loranthaceae	<i>Viscum monoicum</i>	Epiphyte	Manda
		<i>Dendrophthoe falcata</i>	Epiphyte	Bara Manda
59	Verbenaceae	<i>Premna corymbosa</i>		
60		<i>Holarrhena antidysenterica</i>		
61	Apocynaceae	<i>Cerbera manghas</i>	Mangrove associate	Dabur
62		<i>Launaea sermentosa</i>		
63		<i>Trianthema portulacastrum</i>		
64		<i>Ammannia baccifera</i>		
65	Barringtoniaceae	<i>Barringtonia asiatica</i>	Fresh water Mangrove	Hijal
66	Barringtoniaceae	<i>Barringtonia racemosa</i>	Fresh water Mangrove	Hijal
67	Malvaceae	<i>T. populneoides</i>	Mangrove associate	Paras

#### List of Bryophytes recorded from the Biosphere Reserve:

1. Pogonatum sp.
2. Polytrichum sp.
3. Porella sp.
4. Marchantia sp

#### List of Pteridophytes:

1. Acrostichumaureum
2. Adiantum caudatum
3. Azolla pinnata
4. Ceratopteristhalictroides
5. Marsilea minuta
6. Pteris vittata
7. Salvinia cucullata
8. S. natans



# Appendix 5

## List of Mammal Fauna

### A. Recorded from reserved forests

Sl. No.	Species (Extant)	Scientific Name
1	Tiger	<i>Panthera tigris</i>
2	Fishing Cat	<i>Prionailurus viverrinus</i>
3	Rhesus Macaque	<i>Macaca mulatta</i>
4	Spotted Deer or Chital	<i>Axis axis</i>
5	Wild Pig	<i>Sus scrofa</i>
6	Finless Porpoise	<i>Neomeris phocaenoides</i>
7	Gangetic Dolphin	<i>Platanista gangetica</i>
8	irrawaddy Dolphin	<i>Orcaella brevirostris</i>
9	Smooth coated otter	<i>Lutrogale perspicillata</i>

Sl. No.	Species (Locally extinct)	Scientific Name
1	Javan Rhinoceros	<i>Rhinoceros sondaicus</i>
2	The Swamp Deer	<i>Cervus duvaucelli</i>
3	The Wild Buffalo	<i>Bubalis arnee</i>
4	Barking Deer	<i>Muntiacus muntjac</i>
5	Hog Deer	<i>Axis porcinus</i>

### B. Recorded from Reclaimed Area

1.	Asian House Shrew	<i>Suncus marina</i>
2.	Common Jungle Cat	<i>Felis chaus</i>
3.	Leopard Cat	<i>Prionailurus bengalensis</i>
4.	Jackal	<i>Canis aureus</i>
5.	Indian Fox	<i>Vulpes bengalensis</i>
6.	Small Indian Civet	<i>Viverricula indica</i>
7.	Common Grey Mongoose	<i>Herpestes edwardsii</i>
8.	Five-striped Squirrel	<i>Funumbulas pennanti</i>
9.	Field Mouse	<i>Mus booduga</i>
10.	Large Bandicoot Rat	<i>Bandicota indica</i>
11.	House Rat	<i>Rattus rattus</i>
12.	House Mouse	<i>Mus musculus</i>
13.	Indian Flying Fox	<i>Pteropus giganteus</i>
14.	Short-nosed Fruit Bat	<i>Cynopterus sphinx</i>
15.	Lesser Yellow Bat	<i>Scotophilus temmincki</i>
16.	Greater False Vampire	<i>Megaderma lyra</i>
17.	Lesser Mouse-Tailed Bat	<i>Rhinopoma hardwickii</i>
18.	Bicoloured Leaf-nosed Bat	<i>Hipposideros bicolor</i>
19.	Indian Pygmy Bat	<i>Pipistrellus tenuis</i>
20.	Small clawed otter	<i>Amblonyx cinereus</i>

# Appendix 6

## Reptiles Recorded from Sundarbans

### Aquatic species:

#### Order: Chelonia

Sl. No.	Species	Scientific Name
1	Northern river Terrapin	<i>Batagur baska</i>
2	Flap shell turtle	<i>Lissemys punctata</i>
3	Chitra Turtle	<i>Chitra indica</i>
4	Indian roofed turtle	<i>Kachuga tecta</i>
5	Olive Ridley Turtle	<i>Lepidochelys olivacea</i>
6	Green Turtle	<i>Chelonia mydas</i>
7	Hawksbill Turtle	<i>Eretmochelys imbricata</i>

#### Order: Squamata

Sl. No.	Species	Scientific Name
1	Common Checkered Keelback	<i>Xenochrophis piscator</i>
2	Common smooth water snake	<i>Enhydris enhydris</i>
3	Dog faced Water Snake	<i>Cerberus rhynchops</i>
4	Wart Snake or file snake	<i>Acrochordus granulatus</i>
5	Glossy Marsh snake	<i>Gerarda prevostiana</i>
6	Sea-snake	<i>Enhyrina schistose</i>
7	Estuarine Sea-snake	<i>Hydrophis obscurus</i>
8	Black banded Sea-snake	<i>Hydrophis nigrocintus</i>
9	Blue Sea-snake	<i>Hydrophis caeruleus</i>
10	Sea-snake	<i>Microcephalophis gracilis</i>
11	Sea-snake	<i>Microcephalophis cantoris</i>
12	Estuarine Crocodile	<i>Crocodylus porosus</i>
13	Tokay gecko	<i>Gekko gekko</i>
14	Mouse Gecko	<i>Hemidactylus frinatas</i>
15	House Gecko	<i>Hemidactylus flaviridis</i>
16	Brook's House Gecko	<i>Hemidactylus brookii</i>
17	Indian Garden Lizard	<i>Calotes versicolor</i>
18	Indian Chameleon	<i>Chamaeleon zeylanicus</i>
19	Common dotted garden skink	<i>Riopa punctata</i>
20	Water Monitor	<i>Varanus salavator</i>
21	Monitor Lizard	<i>Varanus flavescens</i>
22	Ornate Flying Snake or Gliding Snake	<i>Chrysopelea ornata</i>
23	Blind Snake	<i>Indotyphlops porrectus</i>
24	Common Blind snake	<i>Indotyphlops braminus</i>
25	Indian Rock Python	<i>Python molurus</i>
26	Common Sand Boa	<i>Gongylophis conicus</i>
27	Trinket Snake	<i>Elaphe helena</i>
28	Indian Rat Snake	<i>Ptyas mucosa</i>

Contd.



Sl. No.	Species	Scientific Name
29	Banded kukri Snake	<i>Oligodon arnensis</i>
30	Common vine snake	<i>Ahaetulla nasuta</i>
31	Common wolf snake	<i>Lycodon aulicus</i>
32	Striped Keelback	<i>Amphiesma stolatum</i>
33	Olivaceous Keelback	<i>Atretium schistosum</i>
34	Bronze-back	<i>Derdreluphis ahactulla</i>
35	Common Indian Bronzeback	<i>Dendrelaphis tristis</i>
36	Common Indian Krait	<i>Bungarus caeruleus</i>
37	Banded Krait	<i>Bungarus fasciatus</i>
38	Indian Cobra	<i>Naja naja</i>
39	King Cobra	<i>Ophiophagus hannah</i>
40	Rusell's viper	<i>Daboia russelli</i>
41	Spot tailed Pit Viper	<i>Trimeresurus erythrurus</i>

# Appendix 7

## Checklist of Birds Sunderban Biosphere Reserve

Compiled by Sumit K Sen [sumitsen@rediffmail.com]

Updated till August 2010.

### ORDER: GALLIFORMES

#### Family: Phasianidae

Swamp Francolin - *Francolinus gularis*

Common Quail - *Coturnix coturnix*

Rain Quail - *Coturnix coromandelica*

Blue-breasted Quail - *Coturnix chinensis*

Red Junglefowl - *Gallus gallus*

### ORDER: ANSERIFORMES

#### Family: Dendrocygnidae

Lesser Whistling-duck - *Dendrocygna javanica*

#### Family: Anatidae

##### Oxyurinae

White-headed Duck - *Oxyuraleuco cephalo*

##### Anatinae

##### Anserini

Greylag Goose - *Anser anser*

Bar-headed Goose - *Anser indicus*

Ruddy Shelduck - *Tadorna ferruginea*

Common Shelduck - *Tadorna tadorna*

Comb Duck - *Sarkidiornis melanotos*

Cotton Pygmy-goose - *Nettapus coromandelianus*

##### Anatini

Gadwall - *Anas strepera*

Falcated Duck - *Anas falcata*

Eurasian Wigeon - *Anas penelope*

Mallard - *Anas platyrhynchos*

Spot-billed Duck - *Anas poecilorhyncha*

Common Teal - *Anas crecca*

Garganey - *Anas querquedula*

Northern Pintail - *Anas acuta*

Northern Shoveler - *Anas clypeata*

Red-crested Pochard - *Netta rufina*

Common Pochard - *Aythya ferina*

Ferruginous Pochard - *Aythya nyroca*

Baer's Pochard - *Aythya baeri*

Tufted Duck - *Aythya fuligula*

Greater Scaup - *Aythya marila*

Red-breasted Merganser - *Mergusser rator*

### ORDER: PICIFORMES

#### Family: Picidae

Eurasian Wryneck - *Jynx torquilla*

Speckled Piculet - *Picumnus innominatus*

Rufous Woodpecker - *Cealeus brachyurus*

Brown-capped Pygmy Woodpecker - *Dendrocopos nanus*

Fulvous-breasted Woodpecker - *Dendrocopos macei*

Yellow-crowned Woodpecker - *Dendrocopos mahrattensis*

Lesser Yellownappe - *Picus chlorolophus*

Streak-throated Woodpecker - *Picus xanthopygaeus*

Grey-headed Woodpecker - *Picus canus*

Common Flameback - *Dinopium javanense*

Black-rumped Flameback - *Dinopium benghalense*

Greater Flameback - *Chrysocola pteslucidus*

White-naped Woodpecker - *Chrysocola ptesfestivus*

#### Family: Megalaimidae

Brown-headed Barbet - *Megalaima zeylanica*

Lineated Barbet - *Megalaima lineata*

Blue-throated Barbet - *Megalaima asiatica*

Coppersmith Barbet - *Megalaima haemacephala*

### ORDER: UPUPIFORMES

#### Family: Upupidae

Common Hoopoe - *Upupa epops*

### ORDER: CORACIIFORMES

#### Family: Coraciidae

Indian Roller - *Coracias benghalensis*

Dollarbird - *Eurystomus orientalis*

#### Family: Alcedinidae

Common Kingfisher - *Alcedo atthis*

Blue-eared Kingfisher - *Alcedo meninting*

#### Family: Halcyonidae

Brown-winged Kingfisher - *Halcyon amauroptera*

Stork-billed Kingfisher - *Halcyon capensis*

Ruddy Kingfisher - *Halcyon coromanda*

White-throated Kingfisher - *Halcyon smyrnensis*

Black-capped Kingfisher - *Halcyon pileata*

Collared Kingfisher - *Todiramphus chloris*

#### Family: Cerylidae

Pied Kingfisher - *Ceryle rudis*



**Family: Meropidae**

Green Bee-eater - *Merops orientalis*  
 Blue-tailed Bee-eater - *Merops philippinus*  
 Chestnut-headed Bee-eater - *Merops leschenaulti*

**ORDER: CUCULIFORMES****Family: Cuculidae**

Pied Cuckoo - *Clamator jacobinus*  
 Chestnut-winged Cuckoo - *Clamator coromandus*  
 Common Hawk Cuckoo - *Hierococcyx varius*  
 Indian Cuckoo - *Cuculus micropterus*  
 Eurasian Cuckoo - *Cuculus canorus*  
 Oriental Cuckoo - *Cuculus saturatus*  
 Lesser Cuckoo - *Cuculus poliocephalus*  
 Grey-bellied Cuckoo - *Cacomantis passerinus*  
 Plaintive Cuckoo - *Cacomantis merulinus*  
 Asian Koel - *Eudynamys scolopacea*  
 Green-billed Malkoha - *Phaenicophaeus tristis*

**Family: Centropodidae**

Greater Coucal - *Centropus sinensis*  
 Lesser Coucal - *Centropus bengalensis*

**ORDER: PSITTACIFORMES****Family: Psittacidae**

Rose-ringed Parakeet - *Psittacula krameri*

**ORDER: APODIFORMES****Family: Apodidae**

Asian Palm Swift - *Cypsiurus balasiensis*  
 House Swift - *Apus affinis*  
 Fork-tailed Swift - *Apus pacificus*

**ORDER: STRIGIFORMES****Family: Tytonidae**

Barn Owl - *Tyto alba*

**Family: Strigidae**

Oriental Scops Owl - *Otus sunia*  
 Indian Scops Owl - *Otus bakkamoena*  
 Brown Fish Owl - *Ketupa zeylonensis*  
 Buffy Fish Owl - *Ketupa ketupu*  
 Spotted Owlet - *Athene brama*  
 Short-eared Owl - *Asio flammeus*

**Family: Caprimulgidae**

Large-tailed Nightjar - *Caprimulgus macrurus*  
 Indian Nightjar - *Caprimulgus asiaticus*  
 Savanna Nightjar - *Caprimulgus affinis*

**ORDER: COLUMBIFORMES****Family: Columbidae**

Rock Pigeon - *Columba livia*  
 Laughing Dove - *Streptopelia senegalensis*

Spotted Dove - *Streptopelia chinensis*  
 Red Collared Dove - *Streptopelia tranquebarica*  
 Eurasian Collared Dove - *Streptopelia decaocto*  
 Emerald Dove - *Chalcophaps indica*  
 Orange-breasted Green Pigeon - *Treron bicincta*  
 Yellow-footed Green Pigeon - *Treron phoenicoptera*

**ORDER: GRUIFORMES****Family: Heliornithidae**

Masked Finfoot - *Heliopais personata*

**Family: Rallidae**

Slaty-legged Crane - *Rallina eurizonoides*  
 Slaty-breasted Rail - *Gallirallus striatus*  
 Water Rail - *Rallus aquaticus*  
 White-breasted Waterhen - *Amaurornis phoenicurus*  
 Baillon's Crane - *Porzana pusilla*  
 Ruddy-breasted Crane - *Porzana fusca*  
 Watercock - *Gallicrex cinerea*  
 Purple Swamphen - *Porphyrio porphyrio*  
 Common Moorhen - *Gallinula chloropus*  
 Common Coot - *Fulica atra*

**ORDER: CICONIIFORMES****Family: Scolopacidae****Scolopacinae**

Eurasian Woodcock - *Scolopax rusticola*  
 Wood Snipe - *Gallinago nemoricola*  
 Pintail Snipe - *Gallinago stenura*  
 Swinhoe's Snipe - *Gallinago megala*  
 Common Snipe - *Gallinago gallinago*  
 Jack Snipe - *Lymnocyptes minimus*

**Tringinae**

Black-tailed Godwit - *Limosa limosa*  
 Bar-tailed Godwit - *Limosa lapponica*  
 Whimbrel - *Numenius phaeopus*  
 Eurasian Curlew - *Numenius arquata*  
 Spotted Redshank - *Tringa erythropus*  
 Common Redshank - *Tringa tetanus*  
 Marsh Sandpiper - *Tringa stagnatilis*  
 Common Greenshank - *Tringa nebularia*  
 Green Sandpiper - *Tringa ochropus*  
 Wood Sandpiper - *Tringa glareola*  
 Terek Sandpiper - *Xenus cinereus*  
 Common Sandpiper - *Actitis hypoleucos*  
 Ruddy Turnstone - *Arenaria interpres*  
 Asian Dowitcher - *Limnodromus semipalmatus*  
 Great Knot - *Calidris tenuirostris*  
 Sanderling - *Calidris alba*

Little Stint - *Calidris minuta*

Red-necked Stint - *Calidris ruficollis*

Temminck's Stint - *Calidris temminckii*

Long-toed Stint - *Calidris subminuta*

Dunlin - *Calidris alpina*

Curlew Sandpiper - *Calidris ferruginea*

Spoon-billed Sandpiper - *Calidris pygmeus*

Broad-billed Sandpiper - *Calidris falcinellus*

Ruff - *Philomachus pugnax*

Red Phalarope - *Phalaropus fulicaria*

**Family: Rostratulidae**

Greater Painted Snipe - *Rostratula benghalensis*

**Family: Jacanidae**

Pheasant-tailed Jacana - *Hydrophasianus chirurgus*

Bronze-winged Jacana - *Metopidius indicus*

**Family: Burhinidae**

Eurasian Thick-knee - *Burhinus oedicnemus*

Great Thick-knee - *Esacus recurvirostris*

**Family: Charadriidae**

**Recurvirostrinae**

**Haematopodini**

Eurasian Oystercatcher - *Haematopus ostralegus*

**Recurvirostrini**

Black-winged Stilt - *Himantopus himantopus*

Pied Avocet - *Recurvirostra avosetta*

**Charadriinae**

Pacific Golden Plover - *Pluvialis fulva*

Grey Plover - *Pluvialis squatarola*

Common Ringed Plover - *Charadrius hiaticula*

Little Ringed Plover - *Charadrius dubius*

Kentish Plover - *Charadrius alexandrinus*

Lesser Sand Plover - *Charadrius mongolus*

Greater Sand Plover - *Charadrius leschenaultii*

River Lapwing - *Vanellus duvaucelii*

Grey-headed Lapwing - *Vanellus cinereus*

Red-wattled Lapwing - *Vanellus indicus*

White-tailed Lapwing - *Vanellus leucurus*

**Family: Glareolidae**

**Glareolinae**

Oriental Pratincole - *Glareola maldivarum*

Small Pratincole - *Glareola lactea*

**Family: Laridae**

**Larinae**

**Larini**

Heuglin's Gull - *Larus heuglini*

Pallas's Gull - *Larus ichthyaeus*

Brown-headed Gull - *Larus brunnicephalus*

Black-headed Gull - *Larus ridibundus*

**Sternini**

Gull-billed Tern - *Gelochelidon nilotica*

Caspian Tern - *Sterna caspia*

River Tern - *Sterna aurantia*

Lesser Crested Tern - *Sterna bengalensis*

Great Crested Tern - *Sterna bergii*

Common Tern - *Sterna hirundo*

Little Tern - *Sterna albifrons*

Whiskered Tern - *Chlidonias hybridus*

White-winged Tern - *Chlidonias leucopterus*

Black Noddy - *Anous minutus*

**Family: Accipitridae**

**Pandioninae**

Osprey - *Pandion haliaetus*

**Accipitrinae**

Black-shouldered Kite - *Elanus caeruleus*

Black Kite - *Milvus migrans*

Brahminy Kite - *Haliastur indus*

White-bellied Sea Eagle - *Haliaeetus leucogaster*

Pallas's Fish Eagle - *Haliaeetus leucoryphus*

Grey-headed Fish Eagle - *Haliaeetus ichthyaeus*

White-rumped Vulture - *Gyps bengalensis*

Slender-billed Vulture - *Gyps tenuirostris*

Short-toed Eagle - *Circaetus gallicus*

Crested Serpent Eagle - *Spilornis cheela*

Eurasian Marsh Harrier - *Circus aeruginosus*

Pied Harrier - *Circus melanoleucos*

Hen Harrier - *Circus cyaneus*

Pallid Harrier - *Circus macrourus*

Crested Goshawk - *Accipiter trivirgatus*

Shikra - *Accipiter badius*

Oriental Honey-Buzzard - *Pernis ptilorhynchus*

Greater Spotted Eagle - *Aquila clanga*

Indian Spotted Eagle - *Pomarina hastata*

Bonelli's Eagle - *Hieraaetus fasciatus*

Booted Eagle - *Hieraaetus pennatus*

Changeable Hawk Eagle - *Spizaetus cirrhatu*

**Family: Falconidae**

Common Kestrel - *Falco tinnunculus*

Red-necked Falcon - *Falco chicquera*

Amur Falcon - *Falco amurensis*

Eurasian Hobby - *Falco subbuteo*

Oriental Hobby - *Falco severus*

Peregrine Falcon - *Falco peregrinus*



**Family: Podicipedidae**

Little Grebe - *Tachybaptus ruficollis*

**Family: Anhingidae**

Darter - *Anhinga melanogaster*

**Family: Phalacrocoracidae**

Little Cormorant - *Phalacrocorax niger*

Indian Cormorant - *Phalacrocorax fuscicollis*

Great Cormorant - *Phalacrocorax carbo*

**Family: Ardeidae**

Little Egret - *Egretta garzetta*

Great Egret - *Casmerodius albus*

Intermediate Egret - *Mesophoyx intermedia*

Cattle Egret - *Bubulcus ibis*

Indian Pond Heron - *Ardeola grayii*

Grey Heron - *Ardea cinerea*

Goliath Heron - *Ardea goliath*

Purple Heron - *Ardea purpurea*

Little Heron - *Butorides striatus*

Black-crowned Night Heron - *Nycticorax nycticorax*

Yellow Bittern - *Ixobrychus sinensis*

Cinnamon Bittern - *Ixobrychus cinnamomeus*

Black Bittern - *Dupetor flavicollis*

**Family: Threskiornithidae**

Glossy Ibis - *Plegadis falcinellus*

Black-headed Ibis - *Threskiornis melanocephalus*

Eurasian Spoonbill - *Platalea leucorodia*

**Family: Pelecanidae**

Great White Pelican - *Pelecanus onocrotalus*

Spot-billed Pelican - *Pelecanus philippensis*

**Family: Ciconiidae**

Painted Stork - *Mycteria leucocephala*

Asian Openbill - *Anastomus oscitans*

Black-necked Stork - *Ephippiorhynchus asiaticus*

Lesser Adjutant - *Leptoptilos javanicus*

Greater Adjutant - *Leptoptilos dubius*

**Family: Fregatidae**

Christmas Island Frigatebird - *Fregata andrewsi*

**Family: Procellariidae****Hydrobatinae**

Wilson's Storm-petrel - *Oceanites oceanicus*

**ORDER: PASSERIFORMES****Family: Pittidae**

Indian Pitta - *Pitta brachyura*

Mangrove Pitta - *Pitta megarhyncha*

**Family: Irenidae**

Golden-fronted Leafbird - *Chloropsis aurifrons*

**Family: Laniidae**

Brown Shrike - *Lanius cristatus*

Bay-backed Shrike - *Lanius vittatus*

Long-tailed Shrike - *Lanius schach tricolor*

Grey-backed Shrike - *Lanius tephronotus*

Southern Grey Shrike - *Lanius meridionalis*

**Family: Corvidae****Pachycephalinae**

Mangrove Whistler - *Pachycephala cinerea*

**Corvinae****Corvini**

Rufous Treepie - *Dendrocitta vagabunda*

House Crow - *Corvus splendens*

Large-billed Crow - *Corvus macrorhynchos*

**Artamini**

Ashy Woodswallow - *Artamus fuscus*

**Oriolini**

Eurasian Golden Oriole - *Oriolus oriolus*

Black-naped Oriole - *Oriolus chinensis*

Black-hooded Oriole - *Oriolus xanthornus*

Large Cuckooshrike - *Coracina macei*

Black-winged Cuckooshrike - *Coracina melaschistos*

Black-headed Cuckooshrike - *Coracina melanoptera*

Rosy Minivet - *Pericrocotus roseus*

Small Minivet - *Pericrocotus cinnamomeus*

Scarlet Minivet - *Pericrocotus flammeus*

Bar-winged Flycatcher-shrike - *Hemipus picatus*

**Dicrurinae****Rhipidurini**

White-throated Fantail - *Rhipidura albicollis*

**Dicrurini**

Black Drongo - *Dicrurus macrocercus*

Ashy Drongo - *Dicrurus leucocephalus*

White-bellied Drongo - *Dicrurus caerulescens*

Bronzed Drongo - *Dicrurus aeneus*

Spangled Drongo - *Dicrurus hottentottus*

Greater Racket-tailed Drongo - *Dicrurus paradiseus*

**Monarchini**

Black-naped Monarch - *Hypothymis azurea*

Asian Paradise-flycatcher - *Terpsiphone paradisi*

**Aegithininae**

Common Iora - *Aegithina tiphia*

**Family: Muscicapidae****Turdinae**

Blue Rock Thrush - *Monticola solitarius*

Orange-headed Thrush - *Zoothera citrina*

Scaly Thrush - *Zoothera dauma*  
Tickell's Thrush - *Turdus unicolor*

**Muscicapinae**

**Muscicapini**

Red-throated Flycatcher - *Ficedula parva*  
Little Pied Flycatcher - *Ficedula westermanni*  
Verditer Flycatcher - *Eumyias thalassina*  
Pale-chinned Flycatcher - *Cyornis unicolor*  
Blue-throated Flycatcher - *Cyornis rubeculoides*  
Tickell's Blue Flycatcher - *Cyornis tickelliae*  
Grey-headed Canary Flycatcher - *Culicicapa ceylonensis*

**Saxicolini**

Siberian Rubythroat - *Luscinia calliope*  
Bluethroat - *Luscinia svecica*  
Oriental Magpie Robin - *Copsychus saularis*  
Indian Robin - *Saxicoloides fulicata*  
Black Redstart - *Phoenicurus ochruros*  
Siberian Stonechat - *Saxicola torquata*  
White-tailed Stonechat - *Saxicola leucura*  
Pied Bushchat - *Saxicola caprata*

**Family: Sturnidae**

Chestnut-tailed Starling - *Sturnus malabaricus*  
Brahminy Starling - *Sturnus pagodarum*  
Common Starling - *Sturnus vulgaris*  
Asian Pied Starling - *Sturnus contra*  
Common Myna - *Acridotheres tristis*  
Bank Myna - *Acridotheres ginginianus*  
Jungle Myna - *Acridotheres fuscus*

**Family: Sittidae**

**Sittinae**

Chestnut-bellied Nuthatch - *Sitta castanea*  
Velvet-fronted Nuthatch - *Sitta frontalis*

**Family: Paridae**

**Parinae**

Great Tit - *Parus major*

**Family: Hirundinidae**

**Hirundininae**

Sand Martin - *Riparia riparia*  
Barn Swallow - *Hirundo rustica*  
Red-rumped Swallow - *Hirundo daurica*  
Streak-throated Swallow - *Hirundo fluvicola*

**Family: Pycnonotidae**

Red-whiskered Bulbul - *Pycnonotus jocosus*  
Red-vented Bulbul - *Pycnonotus cafer*

**Family: Cisticolidae**

Zitting Cisticola - *Cisticola juncidis*

Grey-breasted Prinia - *Prinia hodgsonii*  
Yellow-bellied Prinia - *Prinia flaviventris*  
Ashy Prinia - *Prinia socialis*  
Plain Prinia - *Prinia inornata*

**Family: Zosteropidae**

Oriental White-eye - *Zosterops palpebrosus*

**Family: Sylviidae**

**Acrocephalinae**

Rusty-rumped Warbler - *Locustella certhiola*  
Blyth's Reed Warbler - *Acrocephalus dumetorum*  
Large-billed Reed Warbler - *Acrocephalus orinus*  
Clamorous Reed Warbler - *Acrocephalus stentoreus*  
Thick-billed Warbler - *Acrocephalus aedon*  
Common Tailorbird - *Orthotomus sutorius*  
Common Chiffchaff - *Phylloscopus collybita*  
Dusky Warbler - *Phylloscopus fuscatus*  
Tickell's Leaf Warbler - *Phylloscopus affinis*  
Lemon-rumped Warbler - *Phylloscopus chloronotus*  
Yellow-browed Warbler - *Phylloscopus inornatus*  
Hume's Warbler - *Phylloscopus humei*  
Greenish Warbler - *Phylloscopus trochiloides*  
Large-billed Leaf Warbler - *Phylloscopus magnirostris*  
Blyth's Leaf Warbler - *Phylloscopus reguloides*  
Golden-spectacled Warbler - *Seicercus burkii*

**Megalurinae**

Striated Grassbird - *Megalurus palustris*

**Sylviinae**

**Timaliini**

Puff-throated Babbler - *Pellorneum ruficeps*  
White-browed Scimitar Babbler - *Pomatorhinus schisticeps*  
Striped Tit-Babbler - *Macronous gularis*  
Chestnut-capped Babbler - *Timalia pileata*  
Yellow-eyed Babbler - *Chrysomma sinense*  
Striated Babbler - *Turdoides earlei*  
Jungle Babbler - *Turdoides striatus*

**Family: Alaudidae**

Bengal Bushlark - *Mirafra assamica*  
Ashy-crowned Sparrow Lark - *Eremopterix nigriceps*  
Oriental Skylark - *Alauda gulgula*

**Family: Nectariniidae**

**Nectariniinae**

**Dicaeini**

Thick-billed Flowerpecker - *Dicaeum agile*  
Orange-bellied Flowerpecker - *Dicaeum trigonostigma*  
Pale-billed Flowerpecker - *Dicaeum erythrorhynchus*  
Scarlet-backed Flowerpecker - *Dicaeum cruentatum*



**Nectariniini**

Purple-rumped Sunbird - *Nectarinia zeylonica*

Purple Sunbird - *Nectarinia asiatica*

Loten's Sunbird - *Nectarinia lotenia*

Crimson Sunbird - *Aethopyga siparaja*

Little Spiderhunter - *Arachnothera longirostra*

**Family: Passeridae****Passerinae**

House Sparrow - *Passer domesticus*

**Motacillinae**

Forest Wagtail - *Dendronanthus indicus*

White Wagtail - *Motacilla alba*

Citrine Wagtail - *Motacilla citreola*

Yellow Wagtail - *Motacilla flava*

Grey Wagtail - *Motacilla cinerea*

Richard's Pipit - *Anthus richardi*

Paddyfield Pipit - *Anthus rufulus*

Tawny Pipit - *Anthus campestris*

Tree Pipit - *Anthus trivialis*

Olive-backed Pipit - *Anthus hodgsoni*

**Ploceinae**

Black-breasted Weaver - *Ploceus benghalensis*

Streaked Weaver - *Ploceus manyar*

Baya Weaver - *Ploceus philippinus*

Finn's Weaver - *Ploceus megarhynchus*

**Estrildinae**

Red Avadavat - *Amandava amandava*

Indian Silverbill - *Lonchuramalabarica*

Scaly-breasted Munia - *Lonchura punctulata*

Black-headed Munia - *Lonchura malacca*

**Family: Fringillidae****Fringillinae****Carduelini**

Common Rosefinch - *Carpodacus erythrurus*

**Emberizinae**

Chestnut-eared Bunting - *Emberiza fucata*

Taxonomy, nomenclature and sequence follow An Annotated Checklist of the Birds of the Oriental Region by Tim Inskipp, Nigel Lindsey and William Duckworth (1996)

# Appendix 8

## List of Finfish found in the Sundarbans

### Common Shark species found in and around Sundarbans:

1. *Scoliodon laticaudus* Indian Dog Shark [Near Threatened]
2. *Carcharhinus dussumieri* White cheek shark [Endangered]
3. *Carcharhinus limbatus* Blacktip shark [Vulnerable]
4. *Sphyrna blochii* Arrow headed hammer headed shark [Endangered]
5. *Sphyrna zygaena* Hammer headed shark [vulnerable]
6. *Glyphis gangeticus* River shark [Critically endangered, Schedule I]
7. *Glyphis glyphis* Speartooth shark [Vulnerable]
8. *Glyphis siamensis* Irrawaddy river shark [Critically Endangered]
9. *Galeocerdo cuvier* Tiger shark [Near Threatened]
10. *Carcharhinus leucus* Bull shark [Vulnerable]

### Few other common finfish of Indian Sundarbans

Sl. No.	Name	Characters	Systematic position	Economic importance
1	<i>Pisodonophis boro</i> Common name: Bengal's snake eel	<ul style="list-style-type: none"> <li>• Elongated cylindrical body</li> <li>• Snout subconical with short lower jaw</li> <li>• Dorsal fin originates behind the tip of pectoral fin and tail tip finless</li> </ul>	Class: Osteichthyes Order: Anguilliformes Family: Ophichthidae	Low priced edible fish
2	<i>Escualosa thoracata</i> Common name: White sardine	<ul style="list-style-type: none"> <li>• Body flattened and highly compressed and presence of sharp keeled belly</li> <li>• Mouth terminal, upper jaw slightly notched, with two large supra-maxillae, the second being rectangular</li> <li>• Dorsal fin originates at the mid portion of the body with 12 branched rays</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Clupeidae Subfamily: Clupeinae	Sold as trash fish
3	<i>Anguilla bengalensis</i> Common name: Long finned eel, locally called Baan mach	<ul style="list-style-type: none"> <li>• Snake like body, anteriorly cylindrical</li> <li>• Rudimentary scales embedded in skin</li> <li>• Dorsal fin long inserted near the tip of snout, midway between gill opening and anal fin base</li> <li>• Absence of spine</li> <li>• Long anal fin and caudal fin continued round the tail end</li> </ul>	Class: Osteichthyes Order: Anguilliformes Family: Anguillidae	Consumed in fresh condition
4	<i>Tenualosa toli</i> Common name: Toli shad, locally called Kajliilish	<ul style="list-style-type: none"> <li>• Fusiform body with prominent scales</li> <li>• Upper jaw with distinct median notch</li> <li>• Head covered with thick skin without striated fronto-parietal areas</li> <li>• Absence of teeth on jaws</li> <li>• Caudal fin longer than head</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Clupeidae Subfamily: Alosinae	Consumed in fresh condition
5	<i>Tenualosa ilisha</i> Common name: Hilsa, locally called Ilish	<ul style="list-style-type: none"> <li>• Fusiform body with prominent scales</li> <li>• Upper jaw with prominent median notch</li> <li>• Thick skin covering the top of head</li> <li>• Absence of teeth on jaws</li> <li>• Anal fin lies behind the dorsal fin and caudal fin as long as head</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Clupeidae Subfamily: Alosinae	Highly delicious and fetches high price

Contd.



Sl. No.	Name	Characters	Systematic position	Economic importance
6	<i>Ilisha elongata</i> Common name: Elongate ilisha	<ul style="list-style-type: none"> <li>• Body is elongated and silvery</li> <li>• Mouth is terminal in position</li> <li>• Lower jaw projecting</li> <li>• Pelvic fin small with no auxillary scales</li> <li>• Belly strongly keeled</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Clupeidae Subfamily: Alosinae	It is rich in protein content and is of moderate importance
7	<i>Ilisha melastoma</i> Common name: Indian ilish	<ul style="list-style-type: none"> <li>• Slightly brownish colour body, but silvery</li> <li>• Edge of dorsal fin with dark pigment</li> <li>• Body is strongly compressed</li> <li>• Belly with keeled scutes</li> <li>• Dorsal fin origin nearer to snout tip than caudal fin base</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Clupeidae Subfamily: Alosinae	Occurs in small numbers but has high edible value
8	<i>Coilia dussumeri</i> Common name: Gold-spotted grenadier anchovy	<ul style="list-style-type: none"> <li>• Elongated body and tapering end</li> <li>• Pointed snout</li> <li>• Maxilla tip pointed and extending to gill opening</li> <li>• Anal fin very long and confluent with caudal fin</li> <li>• Dorsal fin originates near the tip of snout</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	Consumed in fresh condition
9	<i>Coilia ramcarati</i> Common name: Tapertail anchovy	<ul style="list-style-type: none"> <li>• Compressed body with tapering end</li> <li>• Rounded belly</li> <li>• A small spine before dorsal fin</li> <li>• Long anal fin confluent with caudal fin</li> <li>• Maxilla tip pointed</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	It forms the main anchovy fishery of Indian Sundarbans and consumed in fresh condition
10	<i>Setipinna phasa</i> Common name: Gangetic anchovy, locally called Phasa	<ul style="list-style-type: none"> <li>• Fusiform body</li> <li>• Deeply compressed belly</li> <li>• Supra maxilla absent</li> <li>• First ray of pectoral fin filamentous</li> <li>• Dorsal fin originates nearer to snout</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	Low priced edible fish, but constitute a good fishery, specially during winter fishery operations in the estuarine region.
11	<i>Setipinna taty</i> Common name: Hairfin anchovy	<ul style="list-style-type: none"> <li>• Body is fusiform</li> <li>• Snout is bluntly pointed</li> <li>• Anal fin long</li> <li>• First ray of pectoral fin filamentous in nature</li> <li>• Gill rakers form distinct clumps</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	Low priced edible fish
12	<i>Stolephorus baganensis</i> Common name: Spined anchovy	<ul style="list-style-type: none"> <li>• Body is creamish with two rows of small spots on back</li> <li>• Body fusiform and slightly depressed</li> <li>• A distinctive spine present on pelvic scute</li> <li>• Snout is projected and rounded</li> <li>• Dorsal fin with small predorsal spine</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	Consumed in fresh condition for local use
13	<i>Stolephorus commersonii</i> Common name: Anchovy	<ul style="list-style-type: none"> <li>• Body is spindle shaped</li> <li>• Mouth is blunt and ventral in position</li> <li>• Eyes are large and prominent</li> <li>• Dark brown patches in pectoral and pelvic fins</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	Consumed in fresh condition by local people
14	<i>Thryssa dussumieri</i> Common name: Dussumier's thryssa	<ul style="list-style-type: none"> <li>• Strongly compressed fusiform body</li> <li>• Snout is rounded</li> <li>• Gill rakers are found in distinct clumps</li> <li>• Brownish black body</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	Constitutes a good fishery in the region
15	<i>Thryssa hamiltonii</i> Common name: Hamilton's thryssa	<ul style="list-style-type: none"> <li>• Body is greenish brown in colour</li> <li>• Body is fusiform</li> <li>• Snout is rounded</li> <li>• Presence of predorsal spine</li> <li>• Dorsal fin has branched rays</li> </ul>	Class: Osteichthyes Order: Clupeiformes Family: Engraulididae	Common in winter bagnetfishery

Contd.

Sl. No.	Name	Characters	Systematic position	Economic importance
16	<i>Arius jella</i> Common name: Small-eye catfish	<ul style="list-style-type: none"> <li>• Body is slightly elongated</li> <li>• Head is depressed</li> <li>• Presence of sharp dorsal and pectoral spine</li> <li>• Mouth is terminal in position</li> <li>• Body is silvery grey in colour</li> </ul>	Class: Osteichthyes Order: Siluriformes Family: Ariidae	It is one of the important species among catfishes and constitute a bulk share in marine fishery
17	<i>Arius arius</i> Common name: Hamilton's catfish	<ul style="list-style-type: none"> <li>• Body is silvery in appearance and elongated</li> <li>• Head flat</li> <li>• Snout rounded</li> <li>• Eyes fairly large</li> <li>• Three pairs of barbels</li> <li>• Dorsal and pectoral fins with strong spines</li> </ul>	Class: Osteichthyes Order: Siluriformes Family: Ariidae	Very commonly caught, consumed in fresh condition, usually of high demand
18	<i>Harpadon nehereus</i> Common name: Bombay duck	<ul style="list-style-type: none"> <li>• Body is elongated and very soft</li> <li>• Body is translucent</li> <li>• Head and snout very short</li> <li>• Mouth is very wide and unequal in size</li> <li>• Lower jaw is enlarged</li> </ul>	Class: Osteichthyes Order: Aulopiformes Family: Harpadontidae	Has high demand in dried condition and has good import value
19	<i>Lates calcarifer</i> Common name: Bhetki or Giant sea perch	<ul style="list-style-type: none"> <li>• Body is elongated and oblong</li> <li>• Head is pointed</li> <li>• Presence of a small spine in the operculum</li> <li>• Caudal fin is rounded</li> <li>• Body is concave anteriorly and convex posteriorly</li> </ul>	Class: Osteichthyes Order: Perciformes Family: Centropomidae	Generally consumed for preparation of fish fry, fish finger and other spicy dishes
20	<i>Sillago sihama</i> Common name: Silver sillago	<ul style="list-style-type: none"> <li>• Body is light brown in colour and elongate</li> <li>• Snout is pointed</li> <li>• Mouth small and terminal</li> <li>• Swim bladder with two distinct post coelomic extensions</li> </ul>	Class: Osteichthyes Order: Perciformes Family: Sillaginidae	Constitutes an important catch in winter fishery
21	<i>Sillago soringa</i>	<ul style="list-style-type: none"> <li>• Body is elongated and gradually tapering towards the tail</li> <li>• Absence of notch between head and body</li> <li>• Eye large and prominent</li> <li>• Mouth is terminal and triangular</li> <li>• Dorsal fin divided into two series</li> </ul>	Class: Osteichthyes Order: Perciformes Family: Sillaginidae	Constitutes an important catch in winter fishery in the Hugli-Matla estuarine complex
22	<i>Sillaginopsis panijus</i> Common name: Gangetic whiting	<ul style="list-style-type: none"> <li>• Body is rayish yellow in appearance</li> <li>• Shape of the body is cylindrical</li> <li>• Snout is greatly depressed</li> <li>• Mouth and eyes are very small</li> <li>• Presence of 2 spines on anal fin</li> </ul>	Class: Osteichthyes Order: Perciformes Family: Sillaginidae	It is a commercially important species of winter fishery
23	<i>Scatophagus argus</i> Common name: Spotted butterflyfish, locally called Pyramach	<ul style="list-style-type: none"> <li>• Body is dull greenish in colour with numerous large brown spots</li> <li>• Body is slightly quadrangular in shape</li> <li>• Head is triangular in shape</li> <li>• Eyes are very prominent and large</li> <li>• Mouth is small and not protrusible</li> </ul>	Class: Osteichthyes Order: Perciformes Family: Scatophagidae	They are good aquarium fishes
24	<i>Lutjanus johni</i> Common name: John's snapper	<ul style="list-style-type: none"> <li>• Body is reddish with distinct dark spot on each side</li> <li>• Body is spindle shaped</li> <li>• Head gradually tapering</li> <li>• Mouth central in position</li> <li>• Eyes large and prominent</li> </ul>	Class: Osteichthyes Order: Perciformes Family: Lutjanidae	Constitutes moderate fishery during post-monsoon fishing season
25	<i>Pomadasys argenteus</i> Common name: Blotched grunt	<ul style="list-style-type: none"> <li>• Body is silvery grey with prominent black spots</li> <li>• Body is compressed and oblong</li> <li>• Head is blunt with small mouth</li> <li>• Anal fin with 3 spines</li> </ul>	Class: Osteichthyes Order: Perciformes Family: Haemulidae	Occurs along with other perches on good numbers during post-monsoon fishing season

Contd.



Sl. No.	Name	Characters	Systematic position	Economic importance
26	<i>Chanos chanos</i> Common name: Asiatic milk fish	<ul style="list-style-type: none"> <li>• Brownish green body colour with sides silvery</li> <li>• Elongated, rather torpedo shaped</li> <li>• No scutes along belly</li> <li>• Dorsal fin positioned at the centre</li> <li>• Anal fin short and close to caudal fin</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Conorynchiformes <b>Family:</b> Chanidae	Has high edible value
27	<i>Mystu sgulio</i>	<ul style="list-style-type: none"> <li>• Body elongated and compressed</li> <li>• Head compressed</li> <li>• Mouth terminal and jaws unequal</li> <li>• Four pairs of barbules</li> <li>• Caudal fin forked</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Siluriformes <b>Family:</b> Bagaridae	Largely consumed in West Bengal in fresh condition
28	<i>Zenarchopterus ectuntio</i> Common name: Halfbeck	<ul style="list-style-type: none"> <li>• Body elongate and subcylindrical, laterally compressed</li> <li>• Snout pointed</li> <li>• Mouth wide and eyes small</li> <li>• Lower jaw elongated with a flap at the tip</li> <li>• Nasal barble elongated</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Cyprinodontiformes <b>Family:</b> Hemiramphidae	Has not much commercial value
29	<i>Leiognathus blochii</i> Common name: Bloch's ponyfish	<ul style="list-style-type: none"> <li>• Body compressed and silvery with vertical stripes on back</li> <li>• Dorsal and ventral sides are convex</li> <li>• Snout pointed and mouth small</li> <li>• Dorsal fin with spines</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Leiognathidae	Commonly found year round
30	<i>Leiognathus equulus</i> Common name: Common ponyfish	<ul style="list-style-type: none"> <li>• Body compressed, silvery with narrow vertical stripe on back</li> <li>• Mouth small and complex</li> <li>• Scales are minute and thin not visible clearly</li> <li>• Head naked</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Leiognathidae	Common fish in winter fishery
31	<i>Liza parsia</i> Common name: Parse	<ul style="list-style-type: none"> <li>• Body is slender</li> <li>• Head is moderately flattened on top</li> <li>• Golden spot on upper portion of the operculum</li> <li>• Dorsal fin separated into two parts</li> <li>• Anal fin with three spines</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Mugilidae	Very delicious fish, commands a very high market price locally
32	<i>Liza tade</i> Common name: Bhangone	<ul style="list-style-type: none"> <li>• Body is slender and elongate</li> <li>• Head bulged at sides</li> <li>• Two widely separated dorsal fin</li> <li>• Anal fin with spines</li> <li>• Caudal fin forked</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Mugilidae	Very delicious and widely consumed
33	<i>Rhinomugil corsula</i> Common name: Corsula mullet, corsula	<ul style="list-style-type: none"> <li>• Body is light brown in colour and is short and stout</li> <li>• Mouth is protrusible and ventral</li> <li>• Dorsal fin is separated into two distinct parts</li> <li>• First dorsal fin with three spines and second dorsal fin with one spine.</li> <li>• Anal fin with three spines</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Mugilidae	Consumed in fresh condition
34	<i>Mugil cephalus</i> Common name: Flathead grey mullet	<ul style="list-style-type: none"> <li>• Body is olive green in colour with a broad head</li> <li>• Adipose tissue covers the eye completely</li> <li>• Dorsal fin is highly separated into two parts, first with 4 spines and second with one spine</li> <li>• Anal fin with three spines and caudal fin is forked</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Mugilidae	It is widely found in fresh and marine waters and hence widely consumed
35	<i>Polynemus paradiseus</i> Common name: Paradise threadfin, locally called Topse	<ul style="list-style-type: none"> <li>• Body is oblong and compressed</li> <li>• Snout projecting with mouth subterminal</li> <li>• Very small eyes</li> <li>• Pectoral fin is divided into two parts, the upper with unbranched rays and lower with 7 free filamentous rays</li> <li>• Caudal fin is deeply forked, with upper lobe longer than lower.</li> <li>• Dorsal fin divided into two parts, the first with 7 spines and second with 1 spine</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Polynemidae	It accounts for an important fishery and fetches high market price

Contd.

Sl. No.	Name	Characters	Systematic position	Economic importance
36	<i>Lepturacanthus savala</i> Common name: Small-headed ribbonfish	<ul style="list-style-type: none"> <li>• Body is elongated, ribbon like silvery blue with metallic reflection</li> <li>• Mouth large with fang like teeth</li> <li>• Dorsal fin is long covering almost entire length of the body from nape to tail.</li> <li>• Anal fin reduced and in spine form</li> <li>• Pelvic and caudal fins absent</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Trichiuridae	Common fishery in postmonsoon season
37	<i>Lepturacanthus pantuli</i> Common name: Gangetic ribbon fish	<ul style="list-style-type: none"> <li>• Body is elongate and compressed, ribbon like and tapering gradually to the tail</li> <li>• Dorsal fin long running from nape to tail</li> <li>• Anal fin reduced to spines</li> <li>• Pectoral fin small</li> <li>• Pelvic and caudal fin absent</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Trichiuridae	It occurs almost in all season with greater abundance during monsoon months
38	<i>Trichiurus lepturus</i> Common name: Large head ribbon fish	<ul style="list-style-type: none"> <li>• Body elongated, compressed, ribbon like and gradually tapering with metallic reflection</li> <li>• Head is small</li> <li>• Mouth large with barbed fang like canine teeth</li> <li>• Dorsal fin very long extending from nape to tail</li> <li>• Anal fin is reduced to spines with pelvic and caudal fins absent</li> </ul>	<b>Class:</b> Osteichthyes <b>Order:</b> Perciformes <b>Family:</b> Trichiuridae	Very commonly sold in local markets



# Appendix 9

## List of Out-Turn of Timber and Fuel Obtained from Forest Coupes

YEAR		Compartment	Area in (h.a.)	Total Volume in (qtls.)	Total Value (₹)
1985-86	RWC	Khatuajhuri-1(part)	1242	126770	506240
	FWC	Harinbhanga-3(P)			
1986-87	RWC	Khatuajhuri-1(part)	1242	104208	422226.8
	FWC	-do-	1242	92080	445731
1987-88	RWC	Arbesi-2	1242	79360	457795
	FWC	Khatuajhuri-1	711		
		Arbesi-2	531	88704	478878
1988-89	RWC	Arbesi-2	930	53010	323638
	FWC	Khatuajhuri-2	600	54563.2	349593.6
1989-90	RWC	Arbesi- 2&3	800	47410	307324.5
	FWC	Khatuajhuri-2	700	55550	367938
1990-91	RWC	Arbesi-3	600	#####	386610
	FWC	Khatuajhuri-3	600	47710	433895
1991-92	RWC	Arbesi-4	500	44085	525840
	FWC	Khatuajhuri-3	500	45070	542780
1992-93					
	Annual Coupe	Khatuajhuri-3	1000	62009	1260697
1993-94	AC	Khatuajhuri-3	1000	72320	1459740
1994-95	AC	Harinbhanga-1	1000	55390	1593610
1995-96	AC	Harinbhanga-1	1000	48880	1670599
1996-97	AC	Harinbhanga-1 (1 trip)	490	9723	270848
1997-98	AC	Harinbhanga-II	1000	39730	1074600
1998-99	AC	Harinbhanga-II	1000	32110	1023700
1999-2000	AC	Harinbhanga-II 1st Tr		14450	467250

# Appendix 10

## Notification of Critical Tiger Habitat

Government of West Bengal  
Forests Department  
Forest Branch

Writers' Buildings, Kolkata – 700 001

### NOTIFICATION

No. 6028-For

Dated: 18.12.2007

WHEREAS it has been established on the basis of scientific and objective criteria that the area described in the Schedule below (hereinafter referred to as the said area) is required to be kept as inviolate for the purpose of tiger conservation, without affecting the rights of the Scheduled Tribes or such other forest dwellers;

WHEREAS the State Government agrees with the recommendation of the Expert Committee set up vide P.C.C.F. (Wildlife), Govt. of West Bengal's Office Order No. 12-M/8-2007 dt. 4.11.2007 that the said area should be maintained as the Core or Critical Tiger Habitat of Sundarban Tiger Reserve.

WHEREAS National Tiger Conservation Authority, Govt. of India, vide its memo No. 1501/11/2007-PT (Part) dated December 3, 2007, has also recommended that the said area be notified as the Core or Critical Tiger Habitat of Sundarban Tiger Reserve.

NOW, therefore, in exercise of the power conferred by paragraph (1) of the Explanation following sub-section (4) of Section 38 V of the Wildlife (Protection) Act, 1972, the Governor is pleased hereby to declare, with effect from the date of issue of this Notification, the said area to be the Core or Critical Tiger Habitat of Sundarban Tiger Reserve.

### THE SCHEDULE

Sl. No.	Block	Compartment	Total Area (in Ha.)	Legal Status
1	Matla	1-4	17630	National Park
2	Chamta	1-3	9632	Reserved Forest
		4-8	12437	National Park
3	Chotahardi	1-3	17567	National Park
4	Goasaba	1-4	17173	National Park
5	Gona	1-3	13903	National Park
6	Baghmara	1	2430	Reserved Forest
		2-8	26963	National Park
7	Mayadwip	1-5	27336	National Park
8	Netidhopani	1-3	9300	Reserved Forest
9	Chandkhali	1-4	15591	Reserved Forest
			169962	

By order of the Governor

(K. Chaudhury)

Addl. Chief Secretary to the Govt. of West Bengal



# Appendix 11

## Protection Monitoring Protocol Format

### INSPECTION REPORT

#### PROTECTION MONITORING PROTOCOL – SUNDARBAN TIGER RESERVE

1. Period : \_\_\_\_\_
2. Camp / Beat / Range : \_\_\_\_\_
3. Report by (Name) : \_\_\_\_\_
4. Updated Sensitive Area MAP : \_\_\_\_\_  
(For the period)  
(Map to be Prepared based to crime incidences and other information)
5. Duty Map for the period : Available / Not Available  
(With Offence detection)  
(+ for Fishing / - for Felling / \* for Poaching)
6. Forest Compartments Covered (With frequency) :

Compartment No.	Visit Dates.	Compartment No.	Visit Dates.	Compartment No.	Visit Dates.

7. Average Staff Strength Available for the period : \_\_\_\_\_
8. Boat Night- halt of the BO / CI : \_\_\_\_\_  
(Minimum 8 nights in a month for BO)

Date	Place	Date	Place

9. Boat & Fuel Allotment : Sufficient / Not Sufficient ( Give reasons)

9. RECORDS :

- a) Leave Register : Maintained / Not Maintained
- b) Offence Register : Maintained / Not Maintained
- c) Docket Register : Maintained / Not Maintained
- d) Duty Register : Maintained / Not Maintained
- e) Wildlife Register : Maintained / Not Maintained
- f) Arms Register : Maintained / Not Maintained
- g) Nylon – Net Register : Maintained / Not Maintained
- h) RT Register : Maintained / Not Maintained
- i) Store Register : Maintained / Not Maintained

10. Duty Output :

- a) Fishing Cases : \_\_\_\_\_
- b) Felling Cases : \_\_\_\_\_
- c) Poaching Cases : \_\_\_\_\_
- d) Boat / Dingi Seized : \_\_\_\_\_
- e) Timber / FW Seized : \_\_\_\_\_

11. Fire Arms :

- a) No. of Guns / Rifles : \_\_\_\_\_
- b) When last cleaned : \_\_\_\_\_
- c) No. of Bullets / Cartridges : \_\_\_\_\_
- d) Firing Incidences (give details) : \_\_\_\_\_

12. Inspecting Officer's Note :

a) Duties are : Sufficient / Not Sufficient (Reasons)  
\_\_\_\_\_

b) Duty directives : \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

No. : \_\_\_\_\_

Dated : \_\_\_\_\_

(Signature of Inspecting Officer)



# Appendix 12

## List of Showing the RT Stations with Code numbers in Sundarban Tiger Reserve

Sl. No.	Name of Station	Code No	Details	Make	Chassis No.
			About RT Set(Fixed/ Mobile)		
1	Gosaba	Control – Tiger – 4	Fixed Set	Motorola	103TRS-2391
2	FD's Office, Canning	Tiger – 1	Fixed Set	Motorola	103TSE-1915
3	AFD/Residence	Cobra	Fixed Set	Motorola	103TSE-2109
4	Bidya Beat	Tiger – 2	Fixed Set	Motorola	103TSE-138
5	Bidya Boat	2 Mobile	Mobile	Motorola	103TSE-1839
6	Netidhopani Beat	Tiger – 2/1	Fixed Set	Motorola	103TSE-1854
7	Netidhopani Boat	2/1 Mobile	Mobile	Motorola	103TSE-1863
8	Haldibari Beat	Tiger – 2/2	Fixed Set	Motorola	103TRS-2437
9	Haldibari Boat	2/2 Mobile	Mobile	Motorola	103TRS-2442
10	Kendo Beat	Tiger 2/4	Fixed Set	Motorola	103TRS-2436
11	Kendo Boat	2/4 Mobile	Mobile	Motorola	103TRS-1849
12	PakhiralyaRange	Tiger – 3	Fixed Set	Motorola	103TSE-2097
13	RO/SWLS Boat	3 Mobile	Mobile	Raxon	01AV12010258
14	Sajnakhali Beat	Tiger – 3/1	Fixed Set	Raxon	01AV12010255
15	BO/Sajnekhali Boat	3/1 Mobile	Mobile	Motorola	103TSE-1850
16	Sudhanyakhali Camp	Tiger – 3/2	Fixed Set	Raxon	01AV12010257
17	Sudhanyakhali Boat	3/2 Mobile	Mobile	Motorola	103TSE-1866
18.	Duttar Beat	Tiger – 3/3	Fixed Set	Motorola	103TRS-2390
19	BO/Duttar Boat	3/3 Mobile	Mobile	Motorola	103TSE-1918
20	Dobanki Beat	Tiger – 3/4	Fixed Set	Motorola	103TSE-1849
21	BO/Dobanki Boat	3/4 Mobile	Mobile	Motorola	103TSE-1845
22	Sadakkhali Camp	Tiger – 3/5	Fixed Set	Raxon	01AV12010252
23	Pirkhali Camp	Tiger – 3/6	Fixed Set	Motorola	103TSE-1897
24	Tentultala Camp	Tiger – 3/7	Fixed Set	Motorola	103TSE-1902
25	RO/NPE Range Boat	4 Mobile	Mobile	Motorola	103TSE1843
26	Chamta Beat	Tiger – 4/1	Fixed Set	Motorola	103TSE-1729
27	BO/ChamtaBoat	Tiger – 4/1 Mobile	Mobile	Motorola	103TSE-1698
28.	Baghmara Beat	Tiger – 4/2	Fixed Set	Motorola	103TRS-2401
29	BO/Bagmara Boat	4/2 Mobile	Mobile	Motorola	103TRS-1720
30	Chandkhali Beat	Green Camp	Fixed Set	Motorola	103TRS-1714
31	BO/Chandkhali Boat	Green Camp Mobile	Mobile	Motorola	103TRS-0524
32	Sonakhali Beat	Tiger – 4/3	Fixed Set	Motorola	103TSE-1922
33	Basirhat Range/Jhilla	Tiger-5	Fixed Set	Motorola	103TRS-2447
34	RO/ Basirhat Boat	Tiger-5 Mobile	Mobile	Raxon	01AV12010234
35	Bagna Beat	Tiger – 5/0	Fixed Set	Motorola	103TSE-2009
36	BO/Bagna Boat	5/0 Mobile	Mobile	Motorola	103TSE-2111
37	Jhingakhali Beat	Tiger – 5/1	Fixed Set	Motorola	103TRS-1744

Contd.

Sl. No.	Name of Station	Code No	Details	Make	Chassis No.
			About RT Set(Fixed/ Mobile)		
38	BO/Jhingakhali Boat	5/1 Mobile	Mobile	Raxon	01AV12010215
39	Burirdabri Camp	Tiger – 5/2	<i>Fixed Set</i>	Motorola	103TRS-2420
40	BO/Burirdabri Boat	5/2 Mobile	Mobile	Motorola	103TRS-1908
41	Khatuajhuri Beat	Tiger – 5/3	<i>Fixed Set</i>	Motorola	103TRS-2361
42	BO/Khatuajhuri Boat	5/3 Mobile	Mobile	Raxon	01AV12010256
43	Harikhali Beat	Tiger – 5/4	<i>Fixed Set</i>	Motorola	103TRS-2421
44	BO/Harikhali Boat	5/4 Mobile	Mobile	Motorola	103TRS-2362
45	Kakmari Camp	Tiger – 5/5	<i>Fixed Set</i>	Motorola	103TRS-1441
46	Chilmari Camp	Tiger-5/6	<i>Fixed Set</i>	Motorola	103TRS-2446
47	Kaksa Camp	Tiger – 5/7	<i>Fixed Set</i>	Motorola	103TRS-589
48	Samshernagar Camp	Tiger – 5/8	<i>Fixed Set</i>	Motorola	103TRS-1745
49	Rampura Patrol Range	Tiger – 6	<i>Fixed Set</i>	Motorola	103TSE-2010
50	Headquarter Patrol Boat	1/Mobile	Mobile	Motorola	103TSE2019
51	Bonoshova Launch	Dolphin	Mobile	Motorola	103TSE-1865
52	Debraj Launch	Shark	Mobile	Motorola	103TSE-1842
53	Bharat Laxmi Launch	Goliath	Mobile	Motorola	103TSE-0696
54	Banaraj Launch	Crocodile	Mobile	Motorola	103TSE-1869



# Appendix 13

## Details of JFMC's in Sundarban Tiger Reserve

Sl. No.	Name of the Range	Name of the Beat/Station	Name of JFMC	Registration	Total Protected Area (in ha.)	Name of Protected area		Area in ha.
						Block	Compt.	
1	SWLS Range	Sajnakhali	Dayapur	1/JFMC/FD/STR, dt. 4.5.98	960	Pirkhali	1	2444
2	SWLS Range	Sajnakhali	Pakhiralaya	2/JFMC/FD/STR, dt. 4.5.98	480	Pirkhali	1 & 2	
3	SWLS Range	Sajnakhali	Dulki	5/JFMC/FD/STR, dt. 4.5.98	640	Pirkhali	1	
4	SWLS Range	Sajnakhali	Sonagaon	6/JFMC/FD/STR, dt. 4.5.98	700	Pirkhali	2	3261.6
5	SWLS Range	Sajnakhali	Jamespur	7/JFMC/FD/STR, dt. 4.5.98	650	Pirkhali	1	
6	SWLS Range	Duttar Station	Lahiripur-Chargheri	3/JFMC/FD/STR, dt. 4.5.98	2000	Jhilla	4 & 5	2125.2
7	SWLS Range	Duttar Station	Bidhan Colony-Luxbagan	4/JFMC/FD/STR, dt. 4.5.98	520	Jhilla	2 & 3	
8	SWLS Range	Duttar Station	Lahiripur-Santigachi	8/JFMC/FD/STR, dt. 4.5.98	2400	Panchamukhani	2	2600
9	SWLS Range	Duttar Station	Enpur-Rajatjubilee	9/JFMC/FD/STR, dt. 4.5.98	700	Panchamukhani	1 & 2	2567.2
10	NP(W) Range	Bidya Station	Bijoynagar	10/JFMC/FD/STR, dt. 5.5.98	680	Pirkhali	2	
11	NP(W) Range	Bidya Station	Mathurakhand	11/JFMC/FD/STR, dt. 5.5.98	550	Pirkhali	4	2195.2
12	NP(W) Range	Bidya Station	Satyanarayanpur	12/JFMC/FD/STR, dt. 5.5.98	800	Pirkhali	2	
13	NP(W) Range	Bidya Station	Amlamethi	13/JFMC/FD/STR, dt. 5.5.98	500	Pirkhali	4	
14	NP(W) Range	Bidya Station	Bally	14/JFMC/FD/STR, dt. 5.5.98	770	Pirkhali	2	
<b>(A) Sub-Total</b>					<b>12350</b>			<b>15193.2</b>
15	Basirhat	Bagna Station	Hentalbari	1/JFMC/FD/STR, dt. 6.5.98	500	Jhilla	2 & 3	
16	Basirhat	Bagna Station	Kalidaspur	3/JFMC/FD/STR, dt. 6.5.98	300	Jhilla	3	
17	Basirhat	Bagna Station	Emilibari	4/JFMC/FD/STR, dt. 6.5.98	580	Jhilla	2 & 3	
18	Basirhat	Bagna Station	Bhruliapara	5/JFMC/FD/STR, dt. 6.5.98	567	Jhilla	1	1462
19	Basirhat	Bagna Station	Adibasipara-Kumirmari	6/JFMC/FD/STR, dt. 6.5.98	875	Jhilla	1	
20	Basirhat	Bagna Station	Mitrabari	7/JFMC/FD/STR, dt. 6.5.98	360	Jhilla	3	1530.8
21	Basirhat	Bagna Station	Bagnapara	9/JFMC/FD/STR, dt. 6.5.98	500	Jhilla	2	2204.8
22	Basirhat	JhingakhaliStn.	Samsernagar	2/JFMC/FD/STR, dt. 6.5.98	2584	Arbesi	1	4128.8
23	Basirhat	JhingakhaliStn.	Kalitala-Perghumti	8/JFMC/FD/STR, dt. 6.5.98	1544	Arbesi	1	
24	Basirhat	JhingakhaliStn.	Hemnagar	10/JFMC/FD/STR, dt. 6.5.98	4174	Arbesi	2	4174.4
25	Basirhat	Bagna Station	Gobindapur	11/JFMC/FD/STR, dt. 10.12.02	860	Jhilla(part)	2	
	Basirhat	Bagna Station	Adharapara	121 /JFMC/FD/STR dated 25.05.2015	420	Jhilla(part)	2	
<b>(B) Sub-Total</b>					<b>13264</b>			<b>13500.8</b>
<b>Grand Total</b>					<b>25614</b>			

# Appendix 14

## Eco-tourism: Policy & Guidelines (2002)



GOVERNMENT OF INDIA  
MINISTRY OF ENVIRONMENT & FORESTS  
PROJECT TIGER

### EXECUTIVE SUMMARY

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Eco-tourism is ecologically sustainable nature-tourism, and is emerging as an important component of the tourism industry. At the outset, **Eco-Tourism** has to be differentiated from general or **Mass Tourism**. Eco-tourism has been considered as a sustainable, equitable, community based effort for improving the living standards of indigenous host-communities, especially in delineated notified areas outside National Parks / Wildlife Sanctuaries, preferably notified as "Non Plan areas" under the "City & Country Planning Act" of the states. The need for forging partnership with the indigenous stake-holders and the existing tourism industry has also been stressed. The need for dovetailing eco-tourism sites with some major tourism circuits has been emphasized. While adopting the general principles of the National Eco-tourism Policy and Guidelines, 1998, guidelines for fostering eco-tourism through eco-development/eco-regional planning have been made to include "**Eco-development**" as a **landuse** for fostering "**eco-tourism**". The special environmental requirements for such areas have also been indicated. While suggesting statutory protection to such notified areas under the **Environmental Protection Act, 1986**, the local "**Panchyat**" has been recognized as the '**authority having jurisdiction**' for according permission for development. It has also been suggested that the local authority should be advised by a specially constituted committee under the Chairmanship of the district Collector, with the respective Protected Area manager as the member-secretary, having adequate representatives from Panchyats, Eco-development Committees, apart from local NGOs and honorary Wildlife Wardens. Operational guidelines have been prescribed for the Government as well as tour operators / developers and the visitors. For the development of Protected Area (National Park/ Sanctuary) level participatory eco-tourism and visitor strategy, and also for the development of State level eco-tourism and visitor strategy, action points have been indicated which may serve as terms of reference. During formative years, the Forest Department should be the main implementing agency. However, at a later stage this may be entrusted to the Confederation of Eco-development Committees, with the State Tourism Development Corporation/Tourism Department and Forest Department assuming a supportive and supervisory role.

Since eco-tourism is not a “**money spinner**” and is visualised as a “**low key**” venture, financial support to the stakeholders as per site-specific eco-tourism plan is envisaged through soft-loans from **specially created trust funds** based on recycled gate receipts of Protected Areas, and other community credit programmes created by the Government. However, the general development of Protected Areas including eco-tourist facilities would continue with inputs under the **Centrally Sponsored Schemes**. Apart from this, scope for generating resources by inviting private entrepreneurs to develop site-specific packages by providing appropriate incentives has also been emphasised.

## Eco-tourism: Policy & Guidelines (2002)

- 1. Preamble:** Eco-tourism is emerging as an important component of the Indian tourist industry. The significant growth in nature tourism and the numerous tourist operators bear adequate testimony to this. Though the term “eco-tourism” is popular, it is rather loosely used by many. Hence, it is imperative to distinguish this from the general mass tourism. Eco-tourism has been considered here as a sustainable, equitable, community based endeavour for improving the living standards of indigenous host communities. Apart from these stake holders, there is also a dire need to forge partnership with the existing tourism industry of the state.
- 2. Eco-tourism defined:** Eco-tourism is “sustainable, nature tourism” involving the indigenous stake holders, while forging partnership with the existing tourism industry. The World Tourism Organization (WTO) defines eco-tourism as “tourism that involves travelling to relatively undisturbed natural areas with the specified object of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural aspects (both of the past or the present) found in these areas”. Eco-tourism or Nature tourism is distinguished from resort tourism or mass tourism by requiring lesser infrastructure development and a lower impact on the environment.

The key elements of eco-tourism are:

1. Existence of National Park / Sanctuary / natural environment as a prime, star attraction
2. Should be ecologically, socially, culturally and economically sustainable
3. Should have participation of the local stake-holders (host community)
4. Should be a low profile venture
5. Should be capable of dove-tailing in the existing tourism of the State

## 2. Synonyms of Eco-tourism

- Environmentally friendly tourism
- Nature tourism
- Green tourism
- Scientific tourism
- Cottage tourism
- Wildlife tourism
- Wilderness tourism
- Safari tourism
- Designer tourism
- Hard tourism
- Risk tourism
- Adventure tourism

## 3. Policy and Planning

The National Eco-tourism Policy & Guidelines (1998), after considering the National Policy on Tourism, has identified the following cardinal principles for the development of Eco-tourism:

1. It should involve the local community and lead to the overall economic development of the area
2. It should identify the likely conflicts between resource use for tourism and the livelihood of local inhabitants and attempt to minimize such conflicts

3. The type and scale of tourism development should be compatible with the environment and socio-cultural characteristics of the local community and
4. It should be planned as a part of the overall area development strategy, guided by an integrated land-use plan while avoiding inter-sectoral conflicts and ensuring sectoral integration, associated with commensurate expansion of public services

While adopting the above general principles, the following guidelines are laid down for eco-regional planning to foster eco-tourism.

1. Delineation and notification of “fringe areas” (special areas) around identified eco-tourism sites (NPs / WLS) as “Non-Plan Areas **under the “City & Country Planning Act” of the States**, to avoid cross-sectoral conflicts and to achieve sectoral integration of inputs, for wise land use to foster **eco-tourism** as per the operational guidelines.
2. Fostering eco-tourism through eco-development as a land use.
3. Prescription of environmental requirements for such specially notified areas for incorporation in the relevant rules of the State (Appendix-1).
4. The first benefit of eco-tourism must go to the local people (**host-community**), and in the long run the capacity building in this regard should be built-in for forging partnership with the local people.
5. According statutory protection to such specially notified areas under the Environmental Protection Act, 1986
6. Recognising the local Panchyat as the “**authority having jurisdiction**”, for granting permission for development
7. Constituting a special committee under the chairman-ship of the district Collector, with the respective Protected Area manager as the member-secretary having adequate representatives from concerned **Panchyats, Eco-development Committees**, apart from local NGOs and honorary Wildlife Wardens, for advising the Panchyats on issues relating to development
8. Creation of village level micro-institutions (VFC/ JFMC/ JFMC) as per the resolution of the State Forest Dept, and formulation of site- specific eco-tourism plans with indigenous, participatory planning
9. Providing soft loans from Community Credit Programme /Special Trust Funds / Special Central Assistance/ Developmental Schemes of Tribal Department / District- level Integrated Developmental Programme, to identified host- community / beneficiaries for promoting eco-tourism
10. Establishing standards for eco-tourism in the site-specific microplans in tune with the operational guidelines, and the suggested modifications in the State rules, apart from ensuring adherence to these standards by the tourist developers and operators through the Panchyats

#### 4. Key players in Eco-tourism

**Implementing Agency:** During formative years, the Forest Department of the State should be the main implementing agency. However, at a later stage this should be entrusted to the Confederation of Eco-development Committees, with State Tourism Development Corporation/Tourism Department, and Forest Department of States assuming supportive and supervisory roles.

#### Financial Support

- 1) The host community would be provided financial support mainly through soft loans from Community Credit Programme /Special Trust Funds / Special Central Assistance / Developmental Schemes of Tribal Department / District- level Integrated Developmental Programme, to ensure their participation as stake holders for promoting eco-tourism.



- 2) The general development of the Protected Area including Eco-tourist facilities, Interpretation Centres, Literature and the like would continue with funding support under the Centrally Sponsored Schemes, based on site specific proposals received from States.
- 3) Generating resources by inviting private entrepreneurs to develop site-specific packages by providing appropriate incentives.

#### **At the State – level**

1. Tourism Department & MPSTDC
2. Forest Department
3. PWD
4. State Electricity Board
5. Water / Irrigation Department
6. Private entrepreneurs : Tour operators, hoteliers

#### **At the District level**

1. Zilla Sarkar / Local district administration
2. Panchayats
3. JFMC \*/ VFC\* / JFMC\*
4. Municipal Corporations
5. PA\* managers (local units of forest department)

### **5. Operational Guidelines**

**For the Government:** In addition to the guidelines (1 to 10) laid down in para-3 under “policy and planning”, the following additional operational guidelines are also indicated:

- The planning should be flexible, site-specific & participatory, and should form part of a larger eco-development/eco-regional plan for the area, within the normative standards of a **Landscape Code**
- Assessment of existing infrastructure, surface transportation, air service, road, electricity, water supply, law and order situation
- The eco-tourism package should invariably include:
  - Simple, adequate boarding & lodging facilities, in tune with the environment & the general setting of the landscape
  - Road network within the identified tourism zone
  - Self – guided Nature trails
  - Transportation options
  - Interpretive Centres
  - Way-side exhibits
  - Signages
  - Observation towers
  - Public conveniences
  - garbage disposal facility



- To ensure construction of structures blending with the environment as per the prescribed building code
- To take into consideration the Carrying capacity & Sociological use-limits of the site while creating tourist facilities, and ensuring safety & convenience of tourists
- To use local material & design as far as possible, while avoiding over construction
- The planning, architectural design and construction of tourist facilities should use eco-friendly techniques viz., solar energy, recycling of garbage, harvesting of rain water, natural cross-ventilation instead of AC, self-sufficiency in food through kitchen garden & farming
- Energy & water saving devices should be used apart from controlled sewage disposal
- Control of noise pollution, chemical pollution and air emissions
- Use of signages / boards as per the standard prescriptions in the code
- Reduced use of environmentally unfriendly items like asbestos, CIS, pesticides, inflammable material
- Respecting the historic & religious sites in the area
- Providing appropriate interpretive service to visitors for communication with nature & local culture
- Ensuring proper marketing of eco-tourism products
- Ensuring training of staff on environmental issues
- Ensuring safety & security of visitors
- Respecting local inhabitants, culture & involving them in various activities & vocations as far as possible

#### **For The Visitors:**

- Abiding by the code of conduct, "Do s" & "Don'ts"
- Helping conservation, apart from protecting any site natural or cultural, which may be adversely affected by tourism
- Avoiding wastage of resources
- - Avoiding littering & carrying back all non – degradable litter
- Leaving the camp sites clean before departing
- Avoiding removal of plants, seeds, drift - wood from the site
- Respecting local culture / customs
- Respecting holy places
- Strictly adhering to the safety precautions

#### **For Host community:**

- Respect the value of environment, cultural heritage
- Avoid overusing the area
- Co-operate with the authorities in ensuring healthy eco-tourism
- Realize & react to the threat of investors who see opportunities & exploit the locals
- Be friendly with the visitors as effective "nature guides" & "conservationists"

## 6. Development of PA-level Participatory Eco-tourism & Visitor Strategy

### Action points for planning:

- To develop an overall eco-tourism strategy which shall incorporate:
- Local participation
- Sound environmental design
- Visitor management
- Conservation education
- Training
- Financial sustainability
- Monitoring & evaluation
- To assess:
- - The existing tourism situation & potential
- The desirable tourism situation & identify steps to attain the same
- To prepare a Participatory Community Based Eco-tourism strategy for the project area, involving the stakeholders through meetings & workshops
- The Eco-tourism strategy should also address the following :
- Potential PA attributes vis-à-vis eco-tourism
- Identification of sites
- Development of monitoring mechanisms for ecological impact of eco-tourism
- Visitor information & levels
- Identify marketing opportunities.
- Development of guidelines for visitors / staff viz., visitor centre, orientation centre, brochures, handbook, signages
- Development of mechanisms to collate visitation data for management
- Development of guidelines / building code for environmentally acceptable & culturally appropriate designs
- Identification of : staffing levels for tourism, future requirements & training needs
- Identifying : institutional arrangement for eco-tourism management, mechanisms to increase long-term local participation in benefit -sharing & decision-making, local training needs
- Developing monitoring & evaluation plans to assess local participation & benefit sharing
- Evolving legal framework for eco-tourism activities
- Establishing administration & legal requirements for : Zoning, entry fees, revenue-sharing with indigenous people

## 7. Development of State-level Eco-tourism and Visitor Strategy

### Action Points:

- To develop a State-level Community Based Participatory Eco-tourism strategy which would incorporate : elements of local participation, sound environmental design, visitor management, marketing, conservation education, training, financial sustainability & monitoring and evaluation
- For PA s throughout the State assessment of :
- Tourism situation & potential



- Determination of the PA specific desirable tourism situation & steps to attain this situation
- Preparation of PA level Community Based Participatory Eco-tourism strategies
- The strategy should also address the following :
- The current / potential PA attributes relevant for eco-tourism
- Site-selection criteria & processes for eco-tourism activities
- Development of monitoring mechanisms for ecological impact of eco-tourism / tourism
- Procedures to calculate visitation information & levels
- Identification of marketing opportunities for eco-tourism
- Development of guidelines for visitor / staff behaviour in PA s
- Identification “Interpretation” inputs for visitors viz., orientation centre, visitor centre, museum, way – side exhibits, signages, road-side markers, literature, brochures, posters
- Monitoring of visitation data for management
- Development of generic guidelines for environmentally acceptable & culturally appropriate architectural designs
- Establishing guidelines on PA staffing for ecotourism
- Identification of training needs, sources for PA staff & stakeholders
- Identification of appropriate Institutional / Organizational structures for participatory management of eco-tourism
- Identification of mechanisms to ensure long-term local participation in benefit-sharing & decision-making
- Developing monitoring-evaluation criteria to assess local participation & benefit sharing
- Development of government & private stakeholders
- Development of State-level legal framework for eco-tourism / activities viz., delineation of “fringe areas” around PA, legal provisions for “Zilla Sarkars” & Panchayats
- Assessment of existing State-level policy considerations for tourism
- Assessment of current State-level financial provisions & infrastructure for tourism management
- Identification activities or modification of existing practices to improve financial sustainability
- - Identification of potential private-public sector linkages related to tourism/ eco-tourism, apart from opportunities for future collaboration & related guidelines
- Development of an “Action Program” for follow-up

## 8. Community based Eco-tourism : Possible Inputs

### Opportunities For indigenous host communities

- Creation & management of low cost accommodation for tourists
- Providing guide service to visitors for jungle excursions
- Providing sale outlets for local herbal medicine
- Management of eco-tourism inputs like :
- Canoeing / boating
- Angling
- Cafeteria
- Pony ride

- Souvenir making & sale
- Organizing folk dance
- Picnic spots
- Elephant rides
- Nature trail
- Cycle trail
- Organizing visit to a typical host community village & exposure to country culture
- Organizing bird club (restricted)

### Attractions For visitors

- |                          |                        |
|--------------------------|------------------------|
| ● Eco centres            | ● Vehicular excursions |
| ● Nature trail           | ● Picnic spots         |
| ● Interpretation inputs: | ● Canoeing / boating   |
| ● Orientation centre     | ● Elephant rides       |
| ● Visitor centre         | ● Angling              |
| ● Museum                 | ● Pony rides           |
| ● Amphitheater           | ● Village visit        |
| ● Road-side exhibits     | ● Ethnic / folk dance  |
| ● Signages               | ● Bird club            |
| ● Road-side Markers      | ● Souvenir shops       |
| ● Literature             | ● Cycle trail          |
| ● Light & sound display  |                        |

## Appendix 14.1

Environmental requirements for specially notified **non planning** areas under the State Town and Country Planning Act, for Eco-development /Eco-tourism.

- 1. The hotel / resort area should not be less than 8 ha., and should be encompassed by chain-link fencing for security and control reasons.**
- 2. The hotel / resort should comprise of :**
  - Reception
  - Administrative office
  - Lobby
  - Manager's office and safe
  - Small shop
  - First aid dispensary



- Storage area
  - Wash room facilities (men and women)
  - Dining area with seating capacity for at least 5 tables
  - Kitchen
  - Lodging for manager and staff
- (Approximate area for the above complex should not be less than 2000 sq. m.)

**3. The bungalow sector should comprise of at least :**

- 10 hutments, each with a built-up area of approximately 50 sq. m.
  - ☐ A multiple use area (living / sleeping) with 2 beds, desk and chair, closet, bathrooms with WC, wash basin and shower, with provision for hot water through solar energy
  - ☐ A small terrace
  - ☐ The accommodation bungalows should be paired with parking space
  - ☐ The layout of the bungalows should be informal around a central area and no trees or natural features of the landscape should be destroyed
  - ☐ A camping and recreational area with out door picnic tables, communal bathrooms and wastebins
- Waste recycling plant
- Vegetable garden area for self sufficiency
- Facility for cooking gas (bio-gas)
  - ☐ Area for cattle and poultry with fencing and provision for stall feeding
  - ☐ Machine room
- Entry control barrier

**4. The carrying capacity (site-specific) of each eco-tourism site should be assessed at the following three levels:**

- Physical carrying capacity
  - Real carrying capacity
  - Effective / permissible carrying capacity
5. The land use in the notified area should be environmentally compatible, without causing any adverse impact. Activities like mining, quarrying, industries with the likely discharge of environmental pollutants should be prohibited in such areas.
  6. Structures with exotic look causing visual pollution should be avoided. Temporary housing structures merging with the surrounding with sloping roof using local material and design should be encouraged.
  7. The planning, architectural design and construction of tourist facilities should use eco-friendly techniques like : solar energy, recycling of garbage, harvesting of rain water, natural cross ventilation instead of AC, self sufficiency in food through kitchen garden and farming with controlled sewage disposal.
  8. The development should be sensitive to the conservation of fauna and flora, the corridor value of the area, apart from respecting the religious and historic sites in the area.
  9. The local authority having jurisdiction, on the advise specially constituted district level committee, can make relaxation with respect to serial nos. 1, 2 and 3 as indicated above for involving the indigenous community in promoting eco-tourism.

# Appendix 14.2

(MODEL CALCULATION)

## ESTIMATION OF CARRYING CAPACITY

### 1. KANHA TIGER RESERVE

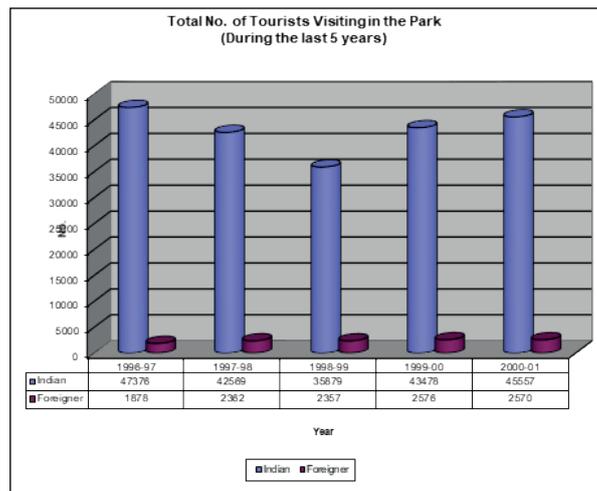
#### (a) Visitation Data

(Average of last 5 years)

Visitors (Indian) : 42971.8

Visitors (Foreign) : 2348.6

Total: : 45320.4



Number of tourist vehicles per day (average) = 50

#### (b) Carrying Capacity Computation

##### i. Physical Carrying Capacity (PCC)

$$PCC = A \times v/a \times Rf$$

- ✓ Only vehicular movements permitted on forest roads, hence road length is more relevant than area
- ✓ "Standing area" is not relevant, but closeness between vehicles is important
- ✓ There is a required distance of at least 500 m. (½ km.) between 2 vehicles to avoid dust (2 vehicles / km.)
- ✓ At least 3½ km. hours are needed for a single visit
- ✓ The PA is open to tourists for 9 months in a year and 9 hours per day
- ✓ Linear road length (for tourists) = 283 km.

$$\text{Rotation Factor (Rf)} = \frac{9 \text{ hours}}{3.5 \text{ hours}} = 2.6$$

$$\begin{aligned} PCC &= 283 \text{ km.} \times 2 \text{ vehicles / km.} \times 2.6 \\ &= 1471.6 \text{ or } 1472 \text{ visits / day} \end{aligned}$$



## ii. Real Carrying Capacity (RCC)

### Road Erosion

Total Road Length = 283 km. (Mt.)

Medium erosion risk = 50 km. (weightage factor = 2)

High erosion risk = 40 km. (weightage factor = 3)

$$M_1 = 50 \times 2 + 40 \times 3 = 100 + 120 = 220 \text{ km.}$$

$$Cf_2 = \frac{220}{283} \times 100 = 77.8 \text{ or } 78\%$$

### Disturbance to Wildlife

$$\text{Barasingha} = Cfw_1 = \frac{1}{9} \times 100 = 11.1\% \\ \text{(1 month)}$$

$$\text{Chital} = Cfw_1 = \frac{2}{9} \times 100 = 22.2\% \\ \text{(2 months)}$$

$$\text{Tiger} = Cfw_1 = \frac{2}{9} \times 100 = 22.2\% \\ \text{(2 months)}$$

Overall corrective factor for disturbance of wildlife in Kanha National Park =

$$Cfw = Cf_1 + Cf_2 + Cf_3 = 11.1 + 22.2 + 22.2 = 55.5 \text{ or } 55\%$$

### Temporary closing of sites

$$Cf_t = \frac{2 \text{ limiting weeks / year}}{36 \text{ weeks / year}} \times 100 = 5.5\%$$

$$100 - Cf_e \quad 100 - Cf_w \quad 100 - Cf_t$$

$$RCC = PCC \times \frac{\quad}{100} \times \frac{\quad}{100} \times \frac{\quad}{100}$$

$$1472 \times \frac{100 - 78}{100} \times \frac{100 - 55}{100} \times \frac{100 - 5.5}{100}$$

$$1472 (0.22 \times 0.45 \times 0.95)$$

$$138.4 \text{ or } 138 \text{ visits / day}$$

## iii. Effective Permissible Carrying Capacity

(MC = Managerial Capacity = 40%)

$$EPCC = RCC \times MC$$

$$138 \times 0.40 = 55.2 \text{ or } 55 \text{ vehicles / day}$$

# Appendix 15

## Budgetary Requirement for Sundarban Tiger Reserve

### Financial years 2017-18 to 2026-27

#### 1) For financial years 2017-18 to 2021-22:

Particulars of Work	2017-18		2018-19		2019-20		2020-21		2021-22	
	Physical	Financial								
<b>A. Recurring Expenditure ( Central : State 50:50)</b>										
Project Allowance	LS	38	LS	40	LS	42	LS	45	LS	47
Wages of daily workers for protection camps	LS	12	LS	14	LS	16	LS	18	LS	20
Hiring of watercrafts and vehicles	LS	50	LS	60	LS	70	LS	80	LS	90
Salary of Strike force	LS	70	LS	80	LS	90	LS	100	LS	110
POL for watercrafts and vehicles	LS	360	LS	400	LS	440	LS	460	LS	500
Establishment of floating camps	LS	25	LS	27	LS	29	LS	31	LS	33
Transportation of water for staff	LS	10	LS	12	LS	14	LS	16	LS	17
Overhauling engine/body of motor launches/boats	LS	12	LS	14	LS	18	LS	20	LS	22
Special patrolling in vulnerable areas	LS	15	LS	16	LS	18	LS	20	LS	22
Office expenses	LS	10	LS	13	LS	16	LS	20	LS	24
Publicity & Extension	LS	10	LS	12	LS	14	LS	16	LS	18
Maintenance of Buildings and staff quarters	10 nos	30	10 nos	32	10 nos	35	10 nos	38	10 nos	40
Payment of compensation for families of tiger victims inc medical treatment	LS	10	LS	12	LS	14	LS	16	LS	18
Feeding of captive animals like crocodiles	LS	15	LS	17	LS	19	LS	20	LS	22
Olive ridley turtle, <i>Batagurbaska</i> and deer	LS	5	LS	7	LS	9	LS	11	LS	13
other rescued animals	LS	2	LS	3	LS	4	LS	5	LS	6
Repair and maintenance of Jetties	10	25	10	28	10	30	10	35	10	38
Veterinary care of rescued animals including post mortem	LS	6	LS	8	LS	10	LS	12	LS	14
Repair and maintenance of nylon net fencing	45	90	45	95	45	100	45	105	45	110
Repair and maintenance of solar lights	LS	10	LS	12	LS	14	LS	16	LS	18
Repair and maintenance of RT Sets and batteries	LS	8	LS	10	LS	13	LS	15	LS	18

Financial ₹ in Lakh

Contd.

Particulars of Work	2017-18		2018-19		2019-20		2020-21		2021-22	
	Physical	Financial								
Maintenance of earthen embankments around camps.	3 km	50	3 km	60	3 km	70	3 km	80	3 km	90
Maintenance of bamboo pilling	LS	25	LS	30	LS	40	LS	50	LS	60
Emergency tiger straying duties	LS	10	LS	12	LS	13	LS	14	LS	15
Maintenance of compound chain link fencing	LS	30	LS	35	LS	40	LS	45	LS	50
Maintenance of observation lines	LS	6	LS	8	LS	10	LS	12	LS	14
Maintenance of sweet water ponds	20	30	20	35	20	40	20	45	20	50
Amenities to staff like cooking gas, first aid etc	LS	8	LS	10	LS	13	LS	15	LS	17
Research Activities	LS	50	LS	50	LS	55	LS	60	LS	65
Staff training in P.A. management and tranquillisation of wildlife	LS	10	LS	12	LS	14	LS	16	LS	18
Training to local youths for combating tiger straying	LS	5	LS	8	LS	11	LS	14	LS	17
Maintenance of tourist spots including fencing	8	35	8	40	8	45	8	50	8	55
Capacity building of staff	LS	6	LS	8	LS	10	LS	12	LS	14
Maintenance of Landscape	LS	10	LS	12	LS	14	LS	18	LS	22
Secret Fund for intelligence gathering	LS	6	LS	8	LS	10	LS	12	LS	14
Maintenance of tourist facilities like toilets, drinking water supply, Dos & Don't etc	LS	10	LS	15	LS	20	LS	25	LS	30
Maintenance of generator and electric wiring	LS	10	LS	12	LS	14	LS	16	LS	18
Maintenance of water storage tank & distribution system	LS	10	LS	12	LS	14	LS	16	LS	18
<b>Grand Total</b>		<b>1117</b>		<b>1269</b>		<b>1435</b>		<b>1583</b>		<b>1748</b>

Particulars of Work	2017-18		2018-19		2019-20		2020-21		2021-22	
	Physical	Financial								
<b>A. Non Recurring Expenditure (Central : State 60-40)</b>										
Construction of Protection Camps in Core area *	1 (Part)	40	1 (Part)	45	1 (Part)	50	1 (Part)	60		
Construction of Protection Camps in Buffer area	1 (Part)	40	1 (Part)	45	1 (Part)	50	1 (Part)	60	1 (Part)	65
Construction of Watch Towers at Jhilla, Samsernagar, Kaksa, Sajnekhali	1 no	25	1 no	27	1no	30	1no	33		

Particulars of Work	2017-18		2018-19		2019-20		2020-21		2021-22	
	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
Construction of raised tube wells	5 nos	20	5 nos	25	5 nos	27	5 nos	30	5 nos	33
Purchase of speed boats	3 nos	36	3 nos	39	3 nos	42	3 nos	45	3 nos	48
Construction of Of pucca jetty	3 nos	21	3 nos	24	3 nos	27	3 nos	30	3 nos	33
Compound fencing	7.5 km	40	7.5 km	45	7.5km	48	7.5 km	50	7.5 km	55
Approach road to watch tower & staff location brick paved)	LS	20	LS	22	LS	25	LS	28	LS	30
Purchase of battery & spare parts for wireless sets.	LS	10	LS	12	LS	14	LS	16	LS	18
Purchase of rifles & dart guns for tran-quillisation of animals & other accessories	LS	4	LS	5	LS	6	LS	7	LS	8
Population Monitoring of estuarine crocodile, dolphin etc	LS	9	LS	10	LS	11	LS	12	LS	13
Nylon net fencing along forest boundary to prevent straying of tiger including replacement of old one	10 km(new)	45	10km(new)	50	10km(new)	55	10 km(new)	55	10km(new)	55
Research Activities	LS	50	LS	50	LS	50	LS	55	LS	60
Purchase of wireless sets and batteries	LS	10	LS	11	LS	12	LS	13	LS	14
Purchase of life jackets, search lights etc	LS	7	LS	8	LS	9	LS	10	LS	12
Purchase of solar lights, panels and batteries	LS	12	LS	14	LS	16	LS	18	LS	20
Purchase of camera, binoculars, GPS and computers	LS	6	LS	6	LS	6	LS	6	LS	6
Purchase of firearms	LS	2	LS	4	LS	4	LS	4	LS	4
Development of new tourist spots at Samsernagar, Jhilla	LS	25	LS	25	LS	20	LS	20	LS	20
Development of signages	LS	8	LS	8	LS	10	LS	10	LS	12
Waste management (construction of vat etc)	LS	12	LS	12	LS	14	LS	14	LS	16
Outreach program	LS	4	LS	4	LS	4	LS	5	LS	5
Study tour for officers and staff	LS	6	LS	6	LS	7	LS	7	LS	7
Purchase and maintainance of Smart pastrolling system	LS	15	LS	20	LS	20	LS	25	LS	30
Purchase of fibre body small boat	1 no	20	1 no	20	1 no	22	1 no	22	1 no	24
Purchase of House boat			1 no	50	1 no	55	1 no	60	1 no	65
Development of new MIC on eastern side			1 no(part)	30	1 no(part)	35				
Training to staff, officers & stake holders	10 nos	20	10 nos	20	10 nos	21	10 nos	22	10 nos	22

Contd.

Particulars of Work	2017-18		2018-19		2019-20		2020-21		2021-22	
	Physical	Financial								
Purchase of publicity & awareness generation materials	LS	5	LS	5	LS	6	LS	7	LS	8
Embankment protection works with bamboo piling etc	LS	30	LS	35	LS	40	LS	45	LS	50
Plantation of mangrove species on blank & char land										
a) Advance & creation work	15 ha	5.5	15 ha	6.0	15 ha	6.5	15 ha	7	15 ha	7.5
b) Maintenance Year-1			15 ha	2	15 ha	2.5	15 ha	3	15 ha	3.6
c) Maintenance Year-2			15 ha	1.5	15 ha	1.5	15 ha	2	15 ha	2.5
<b>Ecodevelopment</b>										
Purchase of solar lights for illuminating village forest interface	5 km	30	5 km	32	5 km	34	5 km	36	5 km	38
Reexcavation of sweet water ponds	10 nos	18	10 nos	20	10 nos	25	10 nos	30	10 nos	35
Reexcavation of irrigation canals	10 nos	100	10 nos	105	10 nos	110	10 nos	115	10 nos	120
Supply & installation of fuel efficient and smokeless chullah in fringe villages	LS	2	LS	2	LS	2	LS	3	LS	3
Sinking tube wells on elevated platform	10 nos	30	10 nos	35	10 nos	37	10 nos	39	10 nos	40
Construction of Of 1.8 mtr. wide brick approach path to village schools	4 km	100	4 km	110	4 km	120	5 km	130	5 km	140
Construction of Flood Centres in JFMC areas	1 nos	35	1 nos	38	1 nos	42	1 nos	47	1 nos	52
Education trips for school and college students	LS	3	LS	3	LS	4	LS	4	LS	5
Vocational training and supply of inputs poultry, duckery, beekeeping and tailoring.	LS	30	LS	30	LS	30	LS	35	LS	35
Supply of agricultural implements like pumpmset, paddy threshers machines, spray machines, shallow tube wells	LS	30	LS	22	LS	23	LS	24	LS	30
Provisions for alternate livelihood supports materials	LS	15	LS	15	LS	18	LS	18	LS	20
Construction Of RCC jetties for the villa- gers in the fringe	6 nos	50	6 nos	50	6 nos	55	6 nos	60	6 nos	65
Holding medical camps in collaboration with State Health Deptt. as well as NGOs	LS	15	LS	15	LS	15	LS	18	LS	18
Conducting Veterinary camps in fringe villages	LS	6	LS	7	LS	8	LS	9	LS	10
Study tour programme for villagers & staff in JFM success areas	LS	3	LS	3	LS	4	LS	4	LS	5

Contd.

Particulars of Work	2017-18		2018-19		2019-20		2020-21		2021-22	
	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
Awareness generation activities among villagers	LS	4	LS	5	LS	5	LS	6	LS	6
a) Advance & creation work for creation of fuel wood lots strip plantation in fringe village	5 ha	2	5 ha	2	02ha	0.8	5 ha	2	2 ha	1.2
b) Maintenance Year-1			5 ha	1	5 ha	1	2 ha	0.4	2 ha	0.4
c) Maintenance Year-2					5 ha	0.5	5HA	0.5	2 ha	0.2
<b>Grand Total</b>		<b>975</b>		<b>1176</b>		<b>1247</b>		<b>1304</b>		<b>1337</b>

3) For financial years 2022-2023 to 2026-2027:

Particulars of Work	2022-23		2023-24		2024-25		2025-26		2026-27	
	Physical	Financial								
<b>A. Recurring Expenditure (Central : State 50:50)</b>										
Project Allowance	LS	49	LS	51	LS	53	LS	56	LS	58
Wages of daily workers for protection camps	LS	22	LS	24	LS	26	LS	29	LS	31
Hiring of watercrafts and vehicles	LS	92	LS	94	LS	97	LS	100	LS	102
Salary of Strike force	LS	120	LS	130	LS	140	LS	150	LS	160
POL for watercrafts and vehicles	LS	540	LS	580	LS	620	LS	660	LS	700
Establishment of floating camps	LS	35	LS	37	LS	39	LS	41	LS	43
Transportation of water for staff	LS	18	LS	20	LS	22	LS	23	LS	25
Overhauling engine/body of motor launches/boats	LS	24	LS	26	LS	30	LS	32	LS	34
Special patrolling in vulnerable areas	LS	23	LS	24	LS	26	LS	28	LS	30
Office expenses	LS	23	LS	26	LS	29	LS	32	LS	35
Publicity & Extension	LS	20	LS	22	LS	24	LS	26	LS	28
Maintenance of Buildings and staff quarters	10 nos	42	10 nos	42	10 nos	45	10 nos	48	10 nos	50
Payment of compensation for families of tiger victims inc medical treatment	LS	20	LS	22	LS	24	LS	26	LS	28
Feeding of captive animals like crocodiles	LS	24	LS	26	LS	28	LS	30	LS	32
Olive ridley turtle, <i>Batagurbaska</i> and deer other rescued animals	LS	15	LS	17	LS	19	LS	21	LS	23
Repair and maintenance of Jetties	10	7	10	8	10	9	10	10	10	11
		41		44		47		50		53

Particulars of Work	2022-23		2023- 24		2024-25		2025-26		2026 -27	
	Physical	Financial								
Veterinary care of rescued animals including post mortem	LS	16	LS	18	LS	20	LS	22	LS	24
Repair and maintenance of nylon net fencing	45	115	45	120	45	125	45	130	45	135
Repair and maintenance of solar lights	LS	20	LS	22	LS	24	LS	26	LS	28
Repair and maintenance of RT Sets and batteries	LS	20	LS	22	LS	24	LS	26	LS	28
Maintenance of earthen embankments around camps.	3 km	100	3 km	110	3 km	120	3 km	130	3 km	140
Maintenance of bamboo piling	LS	65	LS	70	LS	80	LS	90	LS	100
Emergency tiger straying duties	LS	17	LS	19	LS	20	LS	22	LS	24
Maintenance of compound chain link fencing	LS	55	LS	60	LS	65	LS	70	LS	75
Maintenance of observation lines	LS	16	LS	18	LS	20	LS	22	LS	24
Maintenance of sweet water ponds	20	55	20	60	20	65	20	70	20	75
Amenities to staff like cooking gas, first aid etc	LS	19	LS	21	LS	23	LS	25	LS	27
Research Activities	LS	70	LS	75	LS	80	LS	85	LS	90
Staff training in P.A. management and tranquillisation of wildlife	LS	20	LS	22	LS	24	LS	26	LS	28
Training to local youths for combating tiger straying	LS	20	LS	23	LS	25	LS	27	LS	30
Maintenance of tourist spots including fencing	8	60	8	65	8	70	8	75	8	80
Capacity building of staff	LS	16	LS	18	LS	20	LS	22	LS	24
Maintenance of Landscape	LS	24	LS	26	LS	28	LS	30	LS	30
Secret Fund for intelligence gathering	LS	16	LS	18	LS	20	LS	22	LS	24
Maintenance of tourist facilities like toilets, drinking water supply, Dos & Don't etc	LS	35	LS	40	LS	45	LS	55	LS	60
Maintenance of generator and electric wiring	LS	20	LS	22	LS	24	LS	26	LS	28
Maintenance of water storage tank & distribution system	LS	20	LS	22	LS	24	LS	26	LS	28
<b>Grand Total</b>		<b>1117</b>		<b>1269</b>		<b>1435</b>		<b>1583</b>		<b>1748</b>

Contd.

Particulars of Work	2022-23		2023-24		2024-25		2025-26		2026-27	
	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
<b>A. Non Recurring Expenditure( Central : State 60:40)</b>										
Construction of Protection Camps in Core area *	1 (Part)	65	1 (Part)	70	1 (Part)	75	1 (Part)	80		
Construction of Protection Camps in Buffer area	1 (Part)	70	1 (Part)	75	1 (Part)	80	1 (Part)	85	1 (Part)	90
Construction of raised tube wells	5 nos	36	5 nos	39	5 nos	41	5 nos	44	5 nos	46
Purchase of speed boats	3 nos	51	3 nos	54	3 nos	57	3 nos	59	3 nos	62
Construction of Of pucca jetty	3 nos	36	3 nos	39	3 nos	42	3 nos	45	3 nos	48
Compound fencing	7.5 km	40	7.5 km	45	7.5km	48	7.5 km	50	7.5 km	55gt
Approach road to watch tower & staff location brick paved)	LS	20	LS	22	LS	25	LS	28	LS	30
Purchase of battery & spare parts for wireless sets.	LS	10	LS	12	LS	14	LS	16	LS	18
Purchase of rifles & dart guns for tran-quillisation of animals & other accessories	LS	9	LS	10	LS	11	LS	12	LS	13
Population Monitoring of estuarine crocodile, dolphin etc	LS	14	LS	15	LS	16	LS	17	LS	18
Nylon net fencing along forest boundary to prevent straying of tiger including replacement of old one	10 km(new)	60	10km(new)	60	10km(new)	65	10 km(new)	70	10km(new)	75
Research Activities	LS	60	LS	60	LS	60	LS	70	LS	75
Purchase of wireless sets and batteries	LS	15	LS	16	LS	17	LS	18	LS	19
Purchase of life jackets, search lights etc	LS	14	LS	15	LS	16	LS	17	LS	18
Purchase of solar lights, panels and batteries	LS	22	LS	24	LS	26	LS	28	LS	30
Purchase of camera, binoculars, GPS and computers	LS	6	LS	6	LS	6	LS	6	LS	6
Purchase of firearms	LS	4	LS	4	LS	4	LS	6	LS	6
Development of new tourist spots at Samsernagar, Jhilla	LS	30	LS	30	LS	35	LS	40	LS	40
Development of signages	LS	12	LS	14	LS	16	LS	16	LS	18
Waste management (construction of vat etc)	LS	16	LS	17	LS	18	LS	20	LS	2
Outreach program	LS	5	LS	5	LS	5	LS	6	LS	6
Study tour for officers and staff	LS	7	LS	7	LS	7	LS	8	LS	8
Purchase and maintainace of Smart pastrolling system	LS	30	LS	30	LS	35	LS	35	LS	40
Purchase of fibre body small boat	1 no	24	1 no	24	1 no	26	1 no	28	1 no	30

Contd.

Particulars of Work	2022-23		2023- 24		2024-25		2025-26		2026 -27	
	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
Purchase of House boat	1 no	70	1 no	75	1 no	80	1 no	85	1 no	90
Development of new MIC on eastern side	1 no (part)	40	1 no(part)	45	1 no(part)	50				
Training to staff, officers & stake holders	10 nos	22	10 nos	22	10 nos	24	10 nos	26	10 nos	28
Purchase of publicity & awareness generation materials	LS	8	LS	8	LS	10	LS	12	LS	1
Embankment protection works with bamboo pilling etc	LS	55	LS	60	LS	65	LS	70	LS	75
Plantation of mangrove species on blank & char land										
a) Advance & creation work	15 ha	8.0	15 ha	8.5	15 ha	9.0	9.5 ha	7	15 ha	10
b) Maintenance Year-1	15 ha	4.5	15 ha	4.5	15 ha	5.0	15 ha	5.5	15 ha	6.0
c) Maintenance Year-2					15 ha	2.5	15 ha	3.0	15 ha	3.5
<b>Ecodevelopment</b>										
Purchase of solar lights for illuminating village forest interface	5 km	40	5 km	42	5 km	44	5 km	46	5 km	48
Reexcavation of sweet water ponds	10 nos	40	10 nos	45	10 nos	45	10 nos	50	10 nos	5
Reexcavation of irrigation canals	10 nos	100	10 nos	105	10 nos	110	10 nos	115	10 nos	120
Supply & installation of fuel efficient and smokeless chullah in fringe villages	LS	2	LS	2	LS	2	LS	3	LS	3
Sinking tube wells on elevated platform	10 nos	30	10 nos	35	10 nos	37	10 nos	39	10 nos	40
Construction of. Of 1.8 mtr. wide brick approach path to village schools	4 km	150	4 km	160	4 km	170	5 km	180	5 km	190
Construction of Flood Centres in JFMC areas	1 nos	55	1 nos	58	1 nos	60	1 nos	63	1 nos	66
Education trips for school and college students	LS	5	LS	5	LS	7	LS	8	LS	8
Vocational training and supply of inputs poultry, duckery, beekeeping and tailoring.	LS	35	LS	40	LS	40	LS	45	LS	45
Supply of agricultural implements like pumpmset, paddy threshers machines, spray machines, shallow tube wells	LS	30	LS	30	LS	33	LS	34	LS	34
Provisions for alternate livelihood supports materials	LS	20	LS	20	LS	25	LS	25	LS	0
Construction Of RCC jetties for the villa- fringes in the fringe	6 nos	70	6 nos	70	6 nos	75	6 nos	80	6 nos	85
Holding medical camps in collaboration with State Health Deptt. as well as NGOs	LS	18	LS	18	LS	18	LS	20	LS	20

Contd.

Financial ₹ in Lakh

Particulars of Work	2022-23		2023- 24		2024-25		2025-26		2026 -27	
	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial	Physical	Financial
Conducting Veterinary camps in fringe villages	LS	10	LS	10	LS	11	LS	11	LS	12
Study tour programme for villagers & staff in JFM success areas	LS	5	LS	5	LS	6	LS	6	LS	6
Awareness generation activities among villagers	LS	6	LS	6	LS	6	LS	7	LS	7
a) Advance & creation work for creation of fuel wood lots strip plantation in fringe village	5 ha	2	5 ha	2	02ha	2	5 ha	2.5	2 ha	2.5
b) Maintenance Year-1			5 ha	1	5 ha	1	2 ha	0.4	2 ha	0.4
c) Maintenance Year-2					5 ha	0.5	5HA	0.5	2 ha	0.2
<b>Grand Total</b>		<b>975</b>		<b>1176</b>		<b>1247</b>		<b>1304</b>		<b>1337</b>

# Appendix-16



**Government of West Bengal**  
**Department of Forest**  
**For Branch**  
**Aranya Bhawan, Block – LA, 10A, Sector –III**  
**Saltlake City, Kolkata – 700098**

**No. 2063 – For/6M – 28/02**

**Kolkata the 25<sup>th</sup> October, 2016**

This Department Resolution Nos 3841 – For /FR/0/11M – 7/95, dt 26.06.1996.5969 – For, dt.04.08.2009 and 2794 – For, dt. 28.11.2011 dew with the matters relating to Joint Forest Management Committees (JFMC), Forest protection Committee (FPC), Eco-Development Committee (EDCs) and sharing usufructuary benefit with members of JFMC, FPCs and EDCs. In continuation of these resolutions the Governor is pleased to make following memorandums of resolutions in the matter of sharing of usufructuary benefits with the members of the JFMCs, FPCs & EDCs of the Forest Divisions within Sundarban Tiger Reserve (STR) & 24 Parganas (South) Division.

1. The Shares of usufructuary benefits payable to members of FPCs and EDCs of Sundarban Tiger Reserve (STR) and 24 Parganas (South) Division who are termed as JFMC and treated as per in all aspects including receiving of 25% share from Eco-Tourism revenue may be paid through the Sundarban Tiger Conservation Foundation Trust (STCFT).
2. The share payable to the members of JFMC, FPCs & EDCs of Sundarban Tiger Reserve (STR) and 24 – Parganas (South) Division may be distributed equally amongst the JFMCs, FPCs & EDCs in STR and 24-parganas (South) Division.
3. The STCFT will decide about the benefits to be distributed and the manner in which these will be distributed.
5. The aforesaid resolution will stand modified as stated above.

The resolution will be only applicable for the division in STR and 24- Parganas (South) Division under Wildlife Wings of Forest Directorate.

## **ORDER**

Ordered that the Resolution be published in the Kolkata Gazette and copy to all concerned

By order of the Governor,  
Joint Secretary to the Government of West Bengal  
Kolkata the 25<sup>th</sup> October,2013

# Appendix-17



**Government of West Bengal**  
**Department of Forests**  
**Writers' Buildings, Kolkata – 700 001.**

**No. 310-For/6M-28/2002**

**Kolkata, the 14<sup>th</sup> February, 2012**

## **RESOLUTION**

After thorough review of the present structure of the Joint Forest Management Committees, the Governor is pleased to reconstitute the Executive Committees of the JFMCs concerned constituted in the districts of Jalpaiguri, Coochbehar, Darjeeling (excluding-areas under Darjeeling Gorkha Hill Council), Malda, Murshidabad, Nadia, Uttar Dinajpur, Dakshin Dinajpur and Hooghly, and also in the Districts of Purba Medinipur, Pachim Medinipur, Bankura, Purulia, Burdwan, Birbhum, North 24 Pgs. and South 24 Pgs. as per provisions laid down in item No. 2(ii) of the Resolutions No. 5969-For, dated 03/10/2008 and No. 5971-For, dated 03/10/2008 respectively, in the following manner:

- a) Representative of Local M. L. A. to be nominated by local M.L.A. - Member.
- b) Karmadhyaksha or any member of the "Bon-O-Bhumi Sanskar Sthayee Samiti" of the Local Panchayat Samiti as may be nominated by the Karmadhyaksha. - Member.
- c) Gram pradhan or any member Local Gram Panchayat (s) as may be Nominated by the Pradhan / Chairman of the Municipality or any Councilor of the LocalMunicipality as nominated by the Chairman of the said Municipality. - Member.
- d) Elected representative of the beneficiary (Five numbers of members of the JFMCs subject to the condition that at least two members will be women and among all the members at least one member will be tribal). - Member.
- c) Concerned Beat Officer or his nominee in the rank of Head Forest Guard / Forest Guard / Ban Majdur / Ban Shramik. - Member Secretary.
- f) One Head Forest Guard / Forest Guard/ Ban Majdur / Ban Shramik to be nominated by concerned Range Officer. - Member.

The members of the Executive Committee shall elect the president in each meeting.

## **ORDER**

Ordered that the Resolution be published in the Kolkata Gazette and copy be sent to all concerned.

By order of the Governor,  
U. Mukherjee,  
Special Secretary to the Government of West Bengal



# Appendix - 18



**Government of West Bengal**  
**Department of Forests**  
**Aranya Bhaban, Block-LA/ 10A,**  
**Sector-III, Salt Lake City, Kolkata-98**

No.40-For

Date: 03/01/2017

## JOINT FOREST MANAGEMENT COMMITTEE RESOLUTION

1. The Joint Forest Management Committee Resolution has been in vogue for last 26 years and there are 4 (four) resolutions for implementation of the Joint Forest Management in the State. It was noticed that there are some discrepancies in implementing the various resolutions, resulting in administrative problem. In order to overcome these discrepancies it was under active consideration of the Government in the Department of Forests, West Bengal, to have one common Resolution covering all Districts of the State including the Protected Areas with the Objectives of:
2. Bringing FPC & EDC under a common nomenclature;
3. Redefining the eligibility for membership in the JFMC;
4. Redefining the mechanism for sharing of usufructary benefits;

Motivating Forest Communities in the Development, Protection, Forest Management & Conservation of Wildlife as envisaged in the National Forest Policy, 1988.

Now, in suppression of Government Resolutions No. 3481-For/FR/0/11M-7/95 dated 26.06.1996, No. 5969-For dated 03.10.2008, No. 5970-For dated 03.10.2008 and No. 5971-For dated 03.10.2008 and in suppression of all other orders and instructions issued on the subject, the Governor is pleased to decide that Joint Forest Management Committees (JFMCs) shall be constituted for the purpose of management and development of degraded forests/forests prone to forces of degradation and for the purpose of protection, management and development of PAs and conservation of wildlife in the districts of Darjeeling, Kalimpong, Alipurduar, Jalpaiguri, Coochbehar, Uttar Dinajpur, Dakhin Dinajpur, Malda, Murshidabad, Nadia, Hooghly, Purba Medinipur, Paschim Medinipur, Bankura, Purulia, Burdwan, Birbhum, North 24 Parganas and South 24 Parganas and direct that composition, duties, and functions, the usufructary benefits and restrictive measures pertaining to such Joint Forest Management Committees shall be the following:

### 1. COMPOSITION:

- (i) The Divisional Forest Officer/Deputy Field Director/Divisional Manager in consultation with "Bon-O-Bhumi SanskarSthayeeSamiti" of concerned Panchayat Samiti or in consultation with the concerned Sabhasad of Gorkhaland Territorial Authority (GTA)/Councilor of local Municipality shall select members for constitution of the Joint Forest Management Committee(s) within his/her jurisdiction and within the framework of this resolution.
- (ii) Every family living adjacent to the forests shall have the option of becoming a member of the Joint Forest Management Committee at any time if such family is interested in protection, management and conservation of forests and wildlife.

- (iv) There shall be normally a joint membership for each household (i.e. if husband is a member, wife automatically becomes a member and vice versa). Either of the two can exercise right to represent the household at any point.
- (v) Constitution of the Joint Forest Management Committee including the Executive Committee will be approved by the Divisional Forest Officer/Deputy Field Director/Divisional Manager concerned on recommendation of the "Bon-O-Bhumi SanskarSthayee Samiti" of the concerned Panchayat Samiti or the concerned Sabhasad of GTA / Councilor of local Municipality as may be the case.
- (vi) The Divisional Forest Officer/Deputy Field Director/Divisional Manager approving the committee shall, as soon as possible, demarcate the area of forest, allocated to each JFMC on the field as well as on maps.  
The concerned Gram Panchayat(s) /Sabhasad under GTA / Councilor(s) of local Municipality shall extend necessary support and help to such committee(s) to ensure their smooth and proper functioning.

## 2. EXECUTIVE COMMITTEE:

- (i) Each Joint Forest Management Committee shall have an Executive Committee to carry out the various activities assigned to the Committee.
- (ii) The composition of the Executive Committee shall be as follows:
  - a. Representative of the Local M.L.A. to be nominated - Member from the concerned JFMC.
  - b. Karmadhakshya or any member of the "Bon-O-Bhumi - Member SanskarSthayee Samiti" of the local Panchayat Samiti may be nominated by the Karmadhakshya, or Local Sabhasad of GTA or any member nominated from the local area by the Sabhasad of GTA.
  - c. Any Councilor of the local Municipality as nominated - Member by the Chairman of the said Municipality or the Pradhan of the local Gram Panchayat or his local representative.
  - d. Elected representative of the beneficiaries. - Member (The number of elected representatives shall be eight, where total number of members of the JFMC is within 100; fifteen, where total number of JFMC members is between 101 to 200; twenty, where total number of JFMC members is between 201 to 400 and maximum twenty five where total number of JFMC members is above 400. 40 % of the members of EC shall be from SC, ST and women out of which a minimum of at least one third shall be women and one from each category of SC & ST where JFMCs are having SC & ST members.)
  - e. Concerned Beat Officer/Deputy Range Manager or - Member his nominee in the rank of Head Forest Guard/Forest Secretary Guard/Ban Majdur/Ban Shramik/Nigam Shramik
  - f. The Executive Committee shall have three office bearers besides the Member Secretary out of which the President/Vice President/Treasurer will be from among the elected members and out of which at least one shall be woman.
- (iii) The Member Secretary shall convene the meetings of the Executive Committee as well as Joint Forest Management Committee as per agreed procedure, preferably in Government premises.
- (iv) Quorum for each meeting of the Executive Committee shall be 50% of the elected members and that for the AGM shall be 50% of ordinary members.
- (v) The representatives of the JFMC to the Executive Committee shall be elected after every three years in Annual General Meeting of the Committee, where the concerned Range Officer will be the Returning Officer following the Guidelines for the election procedure to be prescribed by the Principal Chief Conservator of Forests, HoFF, W.B.
- (vi) If any inclusion or change in the JFMC/EC is necessitated, after initial constitution, the Executive Committee shall make suitable recommendation to the forest officer duly endorsed by the BanO-Bhumi SanskarSthayee Samiti of the local Panchayat Samiti / concerned Sabhasad under GTA / Councilor(s) of local Municipality as the case may be.



### 3. DUTIES OF EXECUTIVE COMMITTEE:

- (i) The Executive Committee of Joint Forest Management Committee shall maintain a register showing the necessary particulars of beneficiaries who are members of the committee, i.e. name, father's name, address, age, bank details, contact number, Aadhar number, number of family members, name of nominee, etc. Nomination forms duly filled in and approved by the Executive Committee should be pasted on the register. A copy of such register is also to be maintained in the concerned Range Office of the Forest Department for permanent record.
- (ii) The Executive Committee of Joint Forest Management Committee shall maintain a "Minute Book" wherein proceedings of the meeting of the Executive Committee held from time to time as well as the proceedings of the Annual General Meeting of the Joint Forest Management Committee will be recorded under the signature of the President of the Committee and such Minute duly attested by the Member Secretary shall be sent to concerned Range Officer / Range Manager for record.
- (iii) The Executive Committee of Joint Forest Management Committee shall hold an Annual General Meeting once every year where, *inter cilia*, activities of committee as well as details of distribution of usufructuary benefits are to be discussed, besides electing representatives of the beneficiaries to the Executive Committee. Nothing mentioned herein prevents holding any number of Special General Meetings as and when deemed necessary.
- (iv) The Executive Committee shall meet at least once every three months and discuss issues related to ongoing forestry works, preparation and implementation of action plan and other emergent works etc.
- (v) Every JFMC will have an account in bank/post office for maintaining a common fund by deposits from the members/or other sources. The fund will be operated jointly by the Beat Officer/ Deputy Range Manager and the Treasurer as per written resolution of the executive committee. Receipts and withdrawals from this account shall be presented in every AGM for approval.

### 4. FUNCTIONS OF JOINT FOREST MANAGEMENT COMMITTEE:

- A. (i) To ensure protection of forests (including plantations) and wildlife by preventing trespass, encroachment, grazing, fire, poaching, theft etc. through' the members of the committee.
- (ii) To inform forest personnel about wilful or malicious attempts of trespass and encroachment, grazing, fire, poaching, theft etc in forests / PAs.
- (iii) To apprehend or assist the forest personnel in apprehending of such person or persons committing any of the offences mentioned above.
- (iv) To actively participate in mitigation of human-wildlife conflict and to render assistance to the forest personnel during animal driving / rescue operation.
- B. (i) To ensure smooth and timely execution of all forestry and fringe area development works taken up in their jurisdiction by extending necessary help to the officials of Forest Department.
- (ii) To involve every member of the Committee in the matter of protection of forests and wildlife as well as other duties assigned to the Committee.
- (iii) To assist the concerned Forest Officials in the matter of engagement of labourers required for forestry work.
- C. (i) To ensure smooth implementation of activities like regeneration, harvesting of the forest produce and eco-development by the Forest Department.
- (ii) To assist the concerned Forest Official in proper distribution of the earmarked portion of the net sale proceeds among the eligible members of the Committee.
- (iii) To ensure that usufructuary rights allowed by the Government is not in any way misused by any of the members and forest/ plantation sites are kept free from any encroachment whatsoever.

- D. (i) To prevent any activity that is in contravention of the provisions of Indian Forest Act, 1927 and any Act and Rule made there under and the Wildlife (Protection) Act, 1972 as amended from time to time and any Act and Rule made there under.
- (ii) To report about activities of particular member which are found prejudicial and detrimental to the interest of a particular plantation and or/forest and wildlife to the concerned Beat Officer/ Deputy Range Manger/Range Officer/Range Manager which may result in cancellation of membership of the erring member.
- (iii) To assist the forest officials to take action or proceed under Indian Forest Act, 1927 and the Wildlife (Protection) Act, 1972 and any Act and Rule made there under, against, the offenders, including any erring members of the Committee found to be violating the Act or damaging the forest/ plantation/wildlife.

## 5. USUFRUCTUARY BENEFITS:

### A. From Forests other than PAs under JFMCs in districts of PurbaMedinipur, Paschim Medinipur, Bankura, Purulia, Burdwan, Birbhum, North 24 Parganas and South 24 Parganas.

- 1) The members will have to protect the forest and wildlife for at least 5 years to be eligible for sharing of usufructs under this programme.  
For the purpose of counting length of eligible service rendered by a particular member, his/ her membership in any household in the same JFMC area will be counted.
- 2) The members shall be entitled to collect following items free of royalty without causing any damage to the forest.
  - i) Fallen twigs, grass, fruits (including cashew), flowers including Mahua flowers, mushroom, seeds including Sal seeds, leaves including Kendu leaves and intercrops raised by JFMCs subject to any restriction imposed from time to time. Provided, the Government may at any time, by suitable legislation, regulate collection of Sal seeds and Kendu leaves and prescribe their marketing procedure.
  - ii) Free collection of medicinal plants by JFMC members will be permitted on the basis of approved plans.
  - iii) Members of the concerned JFMC will receive 40% of net sale proceeds of final harvest obtained during clear felling coupe operations and 100% of the produce obtained from thinning and cultural operations. Such produce shall however be utilised for bonafide use of the members only.
  - iv) 25% share of Government receipts on account of tourist and transport entry and photography and such other activities related to Ecotourism in the concerned forest area.
- 3) The eligible members will receive share of the usufructs from the harvesting from concerned forest officials after discharging satisfactory service as detailed hereinbefore.
- 4) The usufruct sharing will be subject to restrictions imposed from time to time on account of silvicultural and management requirements of Forest and Wildlife.
- 5) Goods and services generated by community benefit oriented activities will be enjoyed by each member of the JFMC in equal proportion. Those generated by individual benefit oriented activities will be enjoyed by the individual concerned.

### B. From Forests other than PAs under JFMCs in districts of Darjeeling, Kalimpong, Alipurduar, Jalpaiguri, Coochbehar, Uttar Dinajpur, Dakshin Dinajpur, Malda, Murshidabad, Nadia and Hooghly.

- 1) The members will have to protect the forest and wildlife for at least 5 years to be eligible for sharing of usufructs under this programme.  
For the purpose of counting length of eligible service rendered by a particular member, his/ her membership in any household in the same JFMC area will be counted.



- 2) The members shall be entitled to collect following items free of royalty without, causing any damage to the forest.
  - i) Fallen twigs, grass, fruits (including cashew), flowers including Mahua flowers, mushroom, seeds including Sal seeds, leaves including Kendu leaves and intercrops raised by JFMCs subject to any restriction imposed from time to time. Provided, the Government may at any time, by suitable legislation, regulate collection of Sal seeds and Kendu leaves and prescribe their marketing procedure.
  - ii) Free collection of medicinal plants by JFMC members will be permitted on the basis of approved plans.
  - iii) Members of the concerned JFMC will receive 40% of net sale proceeds of firewood and poles, which are harvested during thinning and cultural operations. The poles for the purpose of this order will be under 90 cm GBH for all species except Teak. For Teak the upper limit of GBH is 60 cm.
  - iv) Share of the JFMC shall be 25% of the net sale proceeds of timber which is harvested at the time of final felling and all other legal extraction of timber done by the Directorate. Such share shall be distributed in the following manner:
    - a) 20% will be distributed to the concerned JFMC.
    - b) 80% will be distributed to the other JFMCs of the Division proportionately.
  - v) 25% share of Government receipts on account of tourist and transport entry and photography and such other activities related to Ecotourism in the concerned forest area.
- 3) The eligible members will receive share of the usufructs from the harvesting from concerned forest officials after discharging satisfactory service as detailed hereinbefore.
- 4) The usufruct sharing will be subject to restrictions imposed from time to time on account of silvicultural and management requirements of Forest and Wildlife.
- 5) Goods and services generated by community benefit oriented activities will be enjoyed by each member of the JFMC in equal proportion. Those generated by individual benefit oriented activities will be enjoyed by the individual concerned.

**C. From Wildlife PAs under JFMCs in all districts:**

- i) The members of the JFMC will have to protect and participate in the management of the Protected Area to the satisfaction of the forest officer for a minimum period of one year to become eligible for 40% share of Government receipts on account of tourist and transport entry and photography and such other activities related to Ecotourism in the Protected Area.
- ii) The eligible members will receive their share from concerned forest officials after discharging satisfactory service as detailed hereinbefore.
- iii) Usufruct sharing, as mentioned above, will be subject to restrictions imposed from time to time on wildlife management and other related considerations
- (iv) Goods and services generated by community benefit oriented activities will be enjoyed by each member of the JFMC in equal proportion. Those generated by individual benefit oriented activities will be enjoyed by the individual concerned.

**6. TERMINATION OF MEMBERSHIP, DISSOLUTION OF COMMITTEE, APPEALS ETC.**

- i) Failure to comply with any of the conditions laid down hereinbefore as well as contravention of provisions of the Indian Forest Act, 1927, Wildlife (Protection) Act, or Acts and/or Rules made there under, may entail cancellation of individual membership and/or dissolution of the Executive/Joint Forest Management Committee, as the case may be by the Officers of the Forest Departments stated below in (ii) and (iii) below:

- ii) The concerned Divisional Forest Officer/Deputy Field Director/ Divisional Manager shall be entitled to take appropriate action including dissolution of any Executive/Joint Forest Management Committee on the grounds stated above by giving prior notice to the Executive/Joint Forest Management Committee and such information to the concerned Bon-O-Bhumi SanskarSthayeeSamiti of the concerned Panchayat Samiti/Sabhasad under GTA Councilor(s) of local Municipality as the case may be.
- iii) The concerned Range Officer/Range Manager may be authorized by the Divisional Forest Officer/Deputy Field Director/ Divisional Manager to take appropriate action, including suspension for a specified period or termination of an individual membership, on the above mentioned grounds, on the recommendation of the Executive Committee of Joint Forest Management Committee.
- During the period of suspension the suspended member will not be eligible to receive his usufructuary benefits and exercise his rights as a JFMC member.
- (iv) Appeal against any such penal action by the Range Officer/ Range Manger may be preferred to the concerned Divisional Forest Officer/Deputy Field Director /Divisional Manager.
- (v) Appeal against any such penal action by the Divisional ForestOfficer/Deputy Field Director/Divisional Manger may be preferred to the concerned Circle -In-Charge/General Manager. The decision of the Circle-In-Charge/ General Managers shall be final.

By order of the Governor  
Sd/-  
Principal Secretary, to the Govt. of West Bengal  
Department of Forest  
Kolkata the 3<sup>rd</sup> January 2017

# Appendix 19

## List of Water-holes(Sweet-water pond) in Sundarban Tiger Reserve

	Range	Beat	No. of Ponds	Compartment	Name of Pond
1	Sajnekhali Wildlife Sanctuary	Sajnekhali	4	Pirkhali-1 (2 nos.) Panchamukhani-3 (1 No.) Panchamukhani-5 (1 No.)	Sajnekhali, Padmapukur SudhanyakhaliChoragazi Panchamukhanikhal side
		Dobanki	2	Pirkhali-5 (1 No.) Pirkhali-6 (1 No.)	Dobanki camp side Deulvarani pond
		Duttar	3	Jhilla-4 (2 Nos.) Jhilla-5 (1 No.)	Bijoybharani, Bhajjora ChotoBhajjora
2	National Park West	Haldibari	6	Gosaba-2 (1 No.) Matla-4 (1 No.) Gosaba-3 (2 Nos.) Mayadip-1 (1 No.) Chotohardi-3 (1 No.)	
		Netidhopani	6	Matla-2 (1 No.) Matla-3 (1 No.) Gosaba-1 (1 No.) Netidhopani-1 (2 Nos.) Netidhopani-2 (1 No.)	
3	National Park East	Chamta	2	Chamta-4 (1 No.) Chamta-6 (1 No.)	Chandraduani Chotoduani
		Chandkhali	2	Chandkhali-3 (2 Nos.)	Bakultala Chandkhalivarani
		Bagmara	4	Bagmara-4 (1 No.) Bagmara-3 (1 No.) Bagmara-5 (1 No.) Gona-2 (1 No.)	GonaBhurkunda Gorankati Bagmarakhal side Gonakhejurtola
4	Basirhat Range	Jhingekhali	5	Arbesi-1 (1 No.) Arbesi-2 (1 No.) Arbesi-3 (1 No.) Arbesi-4 (1 No.) Arbesi-5 (1 No.)	Outside of Office Compound Outside of Office Compound JhillaBurirdabrijn. Burirdabri camp Kalukhali/Gabboni
		Khatuajhuri	2	Khatuajhuri-1 (1 No.) Khatuajhuri-2 (1 No.)	Tushkhalikhal side North Chara-South Chara junction
		Harinbhanga	3	Harinbhanga-1 (2 Nos.) Harinbhanga-3 (1 No.)	Bolkhali/Jhilla side CheraHarikhaliJhillajn. Baraharikhali
		Jhilla	2	Jhilla-3 (1 No.) Jhilla-2 (1 No.)	Kaksa Chilmari

# Appendix 20

## “Sundarban Tiger Reserve Station and R.T code – Tiger”

Sl. No.	Station Name	Station code
1	Canning Head Quarter	<b>1</b>
2	A.F.D's Control office, Canning	Cobra
3	A.F.D. Boat (Maa Sumitra)	Shardul
4	A.F.D. Lunch (Barat Lakshmi)	Goliath
5	D.F.D. Lunch (Debraj)	Shark
6	F.D. Lunch (Banashobha)	Dolphin
7	Bidya Range Office (N.P.W)	Control
8	Bidya Range Officer's Boat (N.P.W)	<b>2</b> Mobile
9	Nethi dhopani Beat Office	<b>2/1</b>
10	Nethi dhopani Beat Officer's Boat	<b>2/1</b> Mobile
11	Haldibari Beat Officer	<b>2/2</b>
12	Haldibari Beat Officer's Boat	<b>2/2</b> Mobile
13	Habhati Floating camp	Viper
14	Kendo Beat	<b>2/4</b>
15	Kendo Beat Officer's Boat	<b>2/4</b> Mobile
16	Sajnekhali Range Office (Pakhiralaya)	<b>3</b>
17	Sajnekhali Range Officer's Boat	<b>3</b> Mobile
18	Chayan	<b>3/0</b>
19	Sajnekhali Beat	<b>3/1</b>
20	Sajnekhali Beat Officer's Boat	<b>3/1</b> Mobile
21	Sudhanya khali Beat	<b>3/2</b>
22	Sudhanya khali Beat Officer's Boat	<b>3/2</b> Mobile
23	Duttar Beat	<b>3/3</b>
24	Duttar Beat Officer's Boat	<b>3/3</b> Mobile
25	Dobanki Beat	<b>3/4</b>
26	Dobanki Beat Officer's Boat	<b>3/4</b> Mobile
27	Sadak khali camp	Kite
28	Pirkhali Floating camp	Eagle
29	Gosaba Range Office (N.PE)	<b>4</b>
30	Gosaba Range Officer's Boat (N.PE)	<b>4</b> mobile
31	Chamta Beat	<b>4/1</b>
32	Chamta Beat Officer's Boat	<b>4/1</b> mobile
33	Bagmara Beat	<b>4/2</b>
34	Bagmara Beat Officer's Boat	<b>4/2</b> mobile
35	Ludhirduani Floating camp (Banaraj Lunch)	Crocodile
36	Chandkhali Beat	Green camp
37	Basirhat Range Office (Jhilla)	<b>5</b>
38	Basirhat Range Officer's Boat (Jhilla)	<b>5</b> Mobile
39	Bagna Boat	<b>5/0</b>
40	Bagna Boat Officer's Boat	<b>5/0</b> Mobile
41	Jhingakhali Beat	<b>5/1</b>



Sl. No.	Station Name	Station code
42	Jhingakhali Beat Officer's Boat	<b>5/1</b> Mobile
43	Burirdabri Beat	<b>5/2</b>
44	Burirdabri Beat Officer's Boat	<b>5/2</b> Mobile
45	Khatuajhuri Beat	<b>5/3</b>
46	Khatuajhuri Beat Officer's Boat	<b>5/3</b> Mobile
47	Harikhali Beat	<b>5/4</b>
48	Harikhali Beat Officer's Boat	<b>5/4</b> Mobile
49	Kakmari Floating camp	Kingfisher
50	Chilmari Floating camp	Stork
51	Kaksha Protection camp	<b>5/7</b>
52	Samshernagar Protection camp	<b>5/8</b>
53	Rampura Patrol Range	<b>6</b>
54	Rampura Range Officer's Boat	<b>6</b> Mobile

Call time – 6 a.m, 8 a.m, 10.30 a.m, 12 Noon, 2.30 p.m, 4.30 p.m, 7 p.m., 8.30 p.m, 10 p.m.

# Appendix 21

## Honey collection details from Sundarban Tiger Reserve

Year	2013-14	2014-15	2015-16	2016-17
Crude honey collection in kg	20,950	47,412	33,515	19,060
Total Permit Issue	98	160	91	82
Total Man Involvement	735	1155	979	604









**Directorate of Forest**  
Government of West Bengal

