Government of West Bengal
Directorate of Forests
Office of Divisional Forest Officer, Burdwan Division
Golapbag, P.O.-Rajbati, Pin-713104, Dist-Purba Bardhaman
Phone & Fax - 0342-2950507
E-Mail: dfobdn@yahoo.co.in & dfobur_wb@nic.in

No. 2563 / 8- ; Dated, Burdwan, the 19 / 07 /2023

To : The Principal Chief Conservator of Forests &
Nodal Officer, FCA, West Bengal.

Sub : Submission of Wildlife Management Plan & Soil Moisture Conservation Plan for diversion of 12.5492 ha. of Forest land for your kind approval.

Ref :
1. This office's letter no. 2179/8- dt. 21.06.2023.
2. This office's letter no. 2195/8- dt. 22.06.2023.
3. CCF/SE Circle office's memo no. 1397/SEC/2M-10 dt. 28.06.2023.
4. CCF/SE Circle office's memo no. 1398/SEC/2M-10 dt. 28.06.2023.
5. PCCF WL & CWLW's memo no. 1811/WL/2M-33/2015 dated. 05.07.2023.
6. CCF/SE Circle office's memo no. 1487/SEC/2M-10 dt. 11.07.2023.
7. This office's letter no. 2362/8- dt. 11.07.2023.
8. CCF/SE Circle office's memo no. 1503/SEC/2M-10 dt. 12.07.2023.
9. PCCF WL & CWLW's memo no. 04-CS(COR)/14-2023 dated. 17.07.2023.

Madam,

In enclosing herewith, I am submitting Wildlife Management Plan & Soil Moisture Conservation Plan duly approved by concerned higher authority against the proposal for Diversion of 12.5492 ha. of Forest land in favour of ESSAR Oil & Gas Exploration & Production Ltd. under Burdwan and Durgapur Forest Division for your kind perusal and necessary action from your kind end.

Enclo: As stated above.

Divisional Forest Officer,
Burdwan Division.

No. 2563 (3) / 8- ; Dated, Burdwan, the 19 / 07 /2023

Copy forwarded for kind information to:

1) The Chief Conservator of Forests, South-East Circle, West Bengal.
2) The Divisional Forest Officer, Durgapur Division.
3) The DGM, ESSAR Oil & Gas Exploration & Production Ltd. Durgapur.

Divisional Forest Officer,
Burdwan Division.

GOVERNMENT OF WEST BENGAL
DIRECTORATE OF FORESTS
OFFICE OF THE CHIEF CONSERVATOR OF FORESTS,
SOUTH – EAST CIRCLE, WEST BENGAL
WEBEL IT Park, (Phase-I), 3rd Floor, WEBEL Office (Near City Centre)
Gandhi More, Durgapur-713208. E-mail: ccfsewb@gmail.com & ccfse-wb@nic.in

No. 1398 /SEC/2M-10 **Date : 28/06/2023**

To: The Divisional Forest Officer
Burdwan Division, West Bengal.

Sub: **Soil Moisture Conservation Plan for diversion of 12.5492 ha. of Forest land.**

Ref : Your memo no 2179/8- dated 21/06/2023

Madam,

With reference to the above, this is for your information that the undersigned approved your proposal regarding Soil Moisture Conservation Plan for Diversion of 12.5492 ha. of Forest land.

You are requested to take necessary action.

Yours faithfully,

(Bidyut Sarkar, IFS)
Chief Conservator of Forests
South East Circle, West Bengal

No. 1398(2) /SEC/2M-10 **Date : 28/06/2023**

Copy forwarded for kind information to:

1) The Divisional Forest Officer, Durgapur Division.
2) The DGM, ESSAR Oil & Gas Exploration & Production Ltd. Durgapur.

Chief Conservator of Forests
South East Circle, West Bengal

Government of West Bengal
Directorate of Forests
Divisional Forest Officer, Burdwan Division
Golapbag, P.O. - Rajbati, Dist. - Purba Bardhaman – 713104.
Phone: 0342-2659507; Fax: 0342-2659507 * E-mail: dfobdn@yahoo.co.in

CHIEF CONSERVATOR OF FORESTS
Regd. No. 2179
Date 22.06.2023
Case No. 219-10
South East Circle

No. *2179 / 8-* ; *dated,* *Burdwan,* *the* *21 / 06 / 2023.*

To : The Chief Conservator of Forests,
South East Circle, West Bengal.

Sub : Submission of Soil Moisture Conservation Plan for diversion of 12.5492 ha. of Forest land for your kind approval.

Sir,

In enclosing herewith, I am submitting Soil Moisture Conservation Plan for Diversion of 12.5492 ha. of Forest land in favour of ESSAR Oil & Gas Exploration & Production Ltd. under Burdwan and Durgapur Forest Division for your kind approval.

Enclo: As stated above.

Divisional Forest Officer,
Burdwan Division.

No. *2179(2) / 8-* ; *dated,* *Burdwan,* *the* *21 / 06 / 2023.*

Copy forwarded for kind information to:

1) The Divisional Forest Officer, Durgapur Division.
2) The DGM, ESSAR Oil & Gas Exploration & Production Ltd. Durgapur.

Divisional Forest Officer,
Burdwan Division.

Soil Moisture Conservation Plan for Diversion of 12.5492 Ha. of Forest Land in favour of ESSAR OIL & GAS Exploration & Production Ltd. under Burdwan and Durgapur Forest Division

Paschim Bardhaman District **West - Bengal**

Prepared by:
Divisional Forest Officer,
Burdwan Division.

Contents

1 INTRODUCTION

Soil and water conservation measures are absolutely essential for forest development particularly in degraded sites where availability of moisture in soil is very low and the top soil is either eroded or prone to erosion. Such sites are very common in the forests of south west Bengal. Tree growth responds more to water stress than any other perennial factors of the forest site. Thus soil water is the key to forest site productivity for many species.

Soil-water stress plays an equally important role in the radial growth of trees. It affects the annual growth, and thus forest productivity, and various wood properties, particularly, wood specific gravity. Forest floor, if denuded and subjected to heavy erosion, loses the top layers of the soil. The topmost layer, unique to forest soils, contains organic matter, partly or well decomposed, and the next horizon in the soil profile is that of mineral soil mixed with organic matter. These are the layers that supply nutrients to plants and contribute to forest growth. Thus once these layers are removed due to erosion, the forest plants suffer from lack of food and become dependent on supply of fertilizers for survival and growth. Sustaining forest growth by external application of fertilizers is not an economic measure. Heavy erosion of the forest soil also destroys its physical properties like soil texture, structure, porosity etc. The physical properties of the solid, liquid, and gaseous phases of soil have a substantial influence on the supply of water, nutrients and oxygen for metabolism, and the availability of physical space to anchor the underground plant structures. Providing physical support for above ground tissues is of particular importance, because plants must properly orient themselves to capture sun's energy for use in photosynthesis. In shallow and poorly drained soils, wind throw is common because of limited physical space in the former case, and anoxic (without oxygen) condition in the latter. Thus arrest of soil erosion in forest floor is essential for survival and growth of forest trees.

1.1 About Coal Bed Methane (CBM)

Coal bed Methane (CBM), is an eco-friendly natural gas, stored in coal seams, generated during the process of the coalification. It generally refers to the methane gas produced from coal seams. Unlike conventional reservoirs, coal seams are the source, trap, and reservoir for Coalbed Methane (CBM). CBM exploration and exploitation has an important bearing on reducing the greenhouse effect and earning carbon credit in preventing the direct emission of methane gas from operating mines to the atmosphere. Further, extraction of the CBM through degassing of the coal seams prior to mining of coal is a cost-effective means of boosting coal production and maintaining safe methane level in working mines. Moreover, Methane explosions are common in Underground Coal Mines due to the threat of methane gas release from the coal seams. Extracting methane prior to mining eliminates threat of explosions. Thus, the Coal Bed Methane extraction will help in eliminating the risk of explosions leaving the coal seams safer for mining operations. The uses of CBM includes its usage in industries. for the production of cement, methanol, etc., usage in steel plants as well as rolling mills, may be used as a feedstock for fertilizers and also in the generation of power.

To extract the methane, CBM operators drill wells into coal seams and pump out formation water (produced water). Removing the ground water from the formation is necessary to produce CBM, as the water removal reduces the pressure and allows the methane to release from the coal to produce flowing natural gas. Extraction of CBM involves few of the below major steps followed internationally like 1. Drilling 2. Logging & Perforation 3. Stimulation 4. Completion. However, it requires specific skills and analysis at each step for optimum completion and healthy extraction. The complete cycle of a CBM project involves CBM Extraction, Processing and Transportation to utility places.

Natural gas has assumed a significant role in power generation, industrial applications, residential heating and in some cases as a transport fuel as well. Since, the natural gas is cleaner fuel the contribution of air pollution in the atmosphere is negligible when compared to conventional fuels like Coal & Furnace Oil. Durgapur Industrial Belt is categorized as severely

polluted area by Ministry of Environment and Forest due to rapid industrialization (Steel, Power, Fertilizer etc.) and the usage of conventional fuels like Coal and fuel oil which emit higher amount of Carbon Dioxide and Sulphur Dioxide into the atmosphere. The usage of Coal Bed Methane as cleaner fuel will significantly improve the ambient air quality levels in the surrounding areas.

1.2 About Essar Oil and Gas Exploration and Production Limited (EOGEPL)

Essar Oil and Gas Exploration and Production Limited (EOGEPL) was awarded block RG (East)-CBM-2001/1 covering an area of approx. 500 sq. km. under the CBM-I Round, contract signed on 26th July 2002. EOGEPL holds 100% participating interest in the block. The Petroleum Exploration License (PEL) was issued by the Government of West Bengal on 29th March 2005 (block effective date). It covers an area of 500 sq. km. approximately and is situated in the eastern-most part of the Raniganj Coalfield and falls largely in Paschim Bardhaman district (90% approximately), West Bengal. The block is bounded by Latitudes: 23° 21'45" and 23°41'12" N and Longitudes: 87°14'40" and 87°28'46" E. It lies in Survey of India Topographical Sheet Nos: 73 M/2, M/3, M/6 & M/7 (1: 50,000). Out of the total block area of 500 sq.km, identified fairway area favourable for CBM extraction is around 200 sq. km. In that fairway Essar has planned to drill around 500 wells to optimally exploit the resources economically. As within the fairway of 200 sq. km, around 60 sq. km of the area is covered by forest and thus a huge number of resources are locked-up beneath the forest cover.

1.3 About the Construction of the New Well Pads

Essar Oil and Gas Exploration and Production Limited (EOGEPL) is planning to construct few newer well pads in this region under Durgapur and Burdwan Forest Division. The details of their location along with area is given below.

Table 1: Proposed CBM well pads with land details in Forest Area of Burdwan Forest Division

Sl. No.	PadName	Mouza	Area proposed for diversion (wellpad+ approach road+ pipeline) (in ha.)
1	EDH-356	Akandara	0.7735
2	EDN-360	Bandra	0.4200
3	EDN-361	Bandra	0.4350
4	EDE-326	Bistupur	0.4465
5	EDE-330	Bistupur	0.6000
6	EDE-333	Bistupur	0.7940
7	EDI-338	Bistupur	0.4260
8	EDI-343	Bistupur	1.4540
9	EDN-348	Keshabpur	0.8500
10	EDN-349	Keshabpur	0.7475
11	EDN-363	Keshabpur	0.4200
12	EDI-355	Malandighi	0.6875
13	EDN-362	Rajkusum	0.4160
		Tilakchandrapur	0.1440
14	EDN-358	Tilakchandrapur	0.6800
15	EDN- 132 & 360 (Pipeline)	Bandra	0.856
16	EDE-307 Approach Road	Bistupur	0.1075
17	EDE-127 Approach Road	Bistupur	0.0705
		Saraswatiganj	0.0470.
	Total Area		**10.3750**

Table 2: Proposed CBM well pads with land details in Forest Area of Durgapur Forest Division

Sl.No.	Pad name	Mouza	Area proposed for diversion (wellpad+ approach road+ pipeline) (in ha.)
1	EDD-365	Gopedanga	0.5147
2	EDC-241	Parulia	0.9595
3	EDI-411	Banshia Approach Road	0.3775
4	EDD-248	Baragaria Approach Road	0.0975
5	EDD-364	Gopedanga Approach Road	0.2250
Total Area			**2.1742**

Table 3: total land area for forest diversion proposal of CBM Raniganj project, Durgapur

Sl.No.	Forest division	Area (in ha.)
1	Burdwan	10.3750
2	Durgapur	2.1742
	Total	**12.5492**

Table 4: Area under 10 km buffer zones of the well pads. The 10 km. buffer zone is calculated by dividing the well pads into three clusters and 10 km. area is taken from the centre of the clusters.

Cluster no.	Pad name	Mouza	Areas under 10 km buffer zone	Forest divisions and ranges in the buffer zone
1	EDN- 360, EDN-361, EDN- 348, EDN- 349, EDN-363, EDN- 362, EDN- 358	Bandra, Keahabpur, Rajkusum, Tilakchandrapur	Malandighi, Paschim Gangarampur, Bamunara, Kanksa, Panagarh, Debsala, Dihipara	Burdwan Division-. Panagarh & Durgapur Ranges Durgapur Division-Ukhra Range
2	EDE- 326, EDE-330, EDE- 333, EDE- 338, EDE-343, EDI- 355, EDE- 127	Malandighi, Bistupur, Saraswatiganj	Laudoha, Gourbazar, Joydev Kenduli, Gourangapur, Balijuri	Burdwan Division-Durgapur Range Durgapur Division-Ukhra Range
3	EDD- 365, EDC-241, EDI- 411, EDD- 248, EDD-364, EDH- 356	Gopedanga, Parulia, Akandara	Laudoha, Balijuri, malandighi, Benachity, Ukhra	Durgapur Division-Ukhra Range
Un-clustered	EDC- 241, EDI-411	Parulia, Banshia	Gopedanga, Laudoha, Ukhra, Benachity	Durgapur Division-Ukhra range

According to the above-mentioned tables, this 12.5492 ha. Forest area where the new well pads will be constructed constitutes the Project Area (PA) and the 10 km area surrounding this Core Zone/Project Area will constitute the Buffer Zone or Project Impact Area (PIA). This study is concerned with the preparation of Soil and Moisture Conservation Plan (SMCP)of Essar Oil and Gas Exploration and Production Limited (EOGEPL) and its adjoining 10 km area (buffer or project impact area). Located between the junction of Chhotanagpur plateau and Gangetic plain, Durgapur was once upon a time mostly a forested landmass. Due to gradual industrialisation, most of the forested land has been gradually converted to township and industry. Still, the city has a lot of greenery and diverse array of habitats, which supports a great biodiversity. The previous work on biodiversity of this area can be found in (Gauntlett 1985; Dey et al. 2013; Nayak and Roy 2016; Gayen et al. 2017, 2021; Adhurya et al. 2019; Ghosh 2020).

The execution of the project for extraction is likely to have several adverse effects on the wildlife as well as its habitat, underground water, Soil moisture regime along with other environmental parameters in general, the village communities which are dependent upon the forest areas proposed for diversion for their livelihood and day to day requirements. The forests provide an important ecosystem service by recharging underground aquifers. Soil and moisture conservation is essential for river rejuvenation as it helps in enhancing percolation of water in the soil and lowering surface runoff and keeping a check on soil erosion by lengthening retention of water in catchment area, improvement of environmental flow and improvement of quality of water. This will eventually help in enhancing the site quality which ultimately improves the natural regeneration, plant survival and growth, forest productivity and biodiversity conservation. It improves the overall water quantity and quality. It is also the responsibility of any industry to asses periodically the impact of their running project on the surrounding wildlife and environment; and also, to help the concerned government authorities to protect the prevailing wildlife and their habitat. Keeping all this in view a Soil and Moisture Conservation plan (SMCP) is hereby submitted for the project area and its surrounding 10 km radius. Soil and moisture conservation methods aims at strengthening the soil and moisture measures in forested areas through measures like construction of conservation ditches, contour trenches, contour bunds, earthen check dams, brushwood check dams, loose boulder check dams, ponds, gully plugs and so on. The present study has focus on the SoilandMoistureConservation Plan (SMCP) for the forest area proposed for diversion. The detailed methodology, impact on soil and wildlife habitat and proposed conservation plan is discussed in the later sections.

2. METHODOLOGY

1.4 SITES VISITED

For a large study area, it is very difficult to conduct census over all area. To overcome this problem, it is better to go for sampling and survey. Random sampling is one of the popular methods to remove human biasness. Choosing study location with random sampling with computer may give some coordinates which is difficult to access due to some barrier like large water body, lack of roads etc. To overcome this issue, the study sites were selected based on information from satellite imagery. All project areas and five sites for each cluster of projectimpact area (10 km around project area) were chosen as study site.

1.5 SAMPLING AND IDENTIFICATION

Sampling of fauna was performed with the help of standard equipment (binocular, camera and recorder) and the sampling of flora was done using standard protocols. The photographs (for both flora and fauna) and audio (for fauna like birds, mammals, and amphibians) were identified using proper field guides and web materials.

1.6 SOIL SURVEY

The threats related to the soil due to the construction of the new well pads in the Project Area and Project Impact Area were assessed and proper conservation strategies were devised which are detailed in following section.

1.7 Threat Assessment and Development of Conservation Plan

Survey data were served as the baseline data for threat assessment. Importance will be given for following cases:

1. Vulnerability of forest areas prone to soil erosion: The areas vulnerable to soil erosion and related losses were identified during study.
2. Presence of species enriched patches: Important patches with high faunal and floral diversity was marked and suggested for conservation. Conservation plan for these patches is suggested as per observed diversity, habitat use pattern and threats assessed.

1.8 Duration of the Visit

Rapid surveys were conducted between 28.9.2022 to 4.10.2022

1.9 Referred Records

1. Operative working plan of Paschim Bardhaman District.
2. The Forest (Conservation) Act, 1980
3. The Environment (Protection) Rules, 1986 and its amendments
4. The Wildlife (Protection) Act,1972
5. The Biological Diversity Act, 2002
6. EIA Notification, 2006 and its amendments
7. IUCN Red List of Threatened Species ver 4.1
8. eBird (https://ebird.org/home)
9. India Biodiversity Portal (https://indiabiodiversity.org/)
10. iNaturalist (https://www.inaturalist.org/)
11. Biodiversity of West Bengal(https://bdwb.wildwingsindia.in/)

2 PROJECT IMPACT

2.1 PROBLEMS RELATED TO SOIL

Industrial and construction activities degrade the landscape and adjoining areas to a large extent. A large stretch of land had to be either deforested or degraded for these industrial activities and construction activities. This leads to various problems related to soil in the Project Area and the Project Impact Area, the main amongst them is the soil erosion. Soil erosion caused by human land use is a widely known and intensively studied subject. The mobilisation and the transport of soil particles primarily causes losses of the fine and less dense particle fractions, including humus particles and clay, both of which are important carriers of soil nutrients and stabilizing agents for the physical properties of soils. The development of diverted area will include felling of trees in the approach road as well as well sites, due to the construction of the well pads and other miscellaneous activities, the topsoil will be removed from the area in addition to the deforestation which will result in loosening of the soil. The soil is then carried by the wind or water and leads to the soil erosion which in turn affects the flora and fauna of the surrounding area. The soil also losses its retention capacity and its natural characteristics which are also extreme threats for the natural regeneration, plant survival and growth, forest productivity and biodiversity conservation.

3 Soil Conservation Plan

3.1 Soil Characteristics

The soil is mainly coarse gritty and blended with rock fragments formed from the weathering of pegmatite, quartz veins and conglomeratic sandstones, whereas sandy soil characteristic of granite rocks and sandstones. This soil is of reddish colour, medium to coarse in texture, acidic in reaction, low in nitrogen, calcium, phosphate, and other plant nutrients. Water holding capacity of this soil increases with depth as well as with the increase of clay portions. However alluvial soils are also seen in some portions of the study area.

3.2 Soil Erosion

Wherever the natural cover of forest is disrupted, there are signs of accelerated erosion. Sheet and rills erosion are quite common while gullies have formed wherever the slope is on higher side. Grazing, Cart-tracks, temporary irrigation channels have aggravated the problem more.

3.3 Activities to be done for Soil Conservation

3.3.1 Plantation

Mixed-speciesreforestation needs to be taken up in various areas as part of improving greenery. Reforestation would also result in binding the soil. During reforestation, proper care should be taken to avoid monocultures and plantations of exotic species, which though enhance greenery, but degrade the soil quality and microhabitat immensely. Reforestation would increase water retention capacity of the soil.At the same time, it would improve the habitat for birds and other wildlife including butterflies. It would also bind the soil and curb soil erosion. Forestry would also increase water retention capacity of the soil and would not let it to be dry.

Table 5: Plant species suggested for reforestation

Sl.No	Common Name	Scientific Name
1	Banyan	*Ficus benghalensis*
2	Bakul	*Mimusops elengi*
3	Sacred Fig	*Ficus religiosa*
4	Sacred Tree	*Butea monosperma*
5	Mahua	*Madhuca indica*
6	Tamarind	*Tamarindus indicus*
7	Kadam	*Neolamarckia cadamba*
8	Black Plum	*Syzygium cumini*
9	Neem	*Azadirachta indica*
10	Indian Tree of Heaven	*Ailanthus excelsa*
11	Sisoo	*Dalbergia sissoo*
12	Shimul	*Bombax ceiba*
13	Arjun	*Terminalia arjuna*
14	Jarul	*Lagerstroemia speciosa*
15	Bamboo	*Dendrocalamus strictus*
16	Babla	*Vachellia nilotica*
17	Karanj	*Pongamia pinnata*
18	Chhatim	*Alstonia scholaris*

3.3.2 Creation of Contour Trenches

Creation of Contour trenches is a definite way to reduce the soil erosion that will occur due to this project and thus will help in the soil conservation. The earthen ditches of specific dimensions for the purpose of exerting some control on runoff & erosion along with the

improvement of soil moisture with its subsequent benefit to vegetative cover. The main purpose of contour trenches is to aid the recovery of vegetative cover to the extent that vegetation will eventually exert the maximum possible control on surface runoff & erosion.

Trenches are especially valuable in situations where surface flow & erosion are preventing revegetation of the area. These trenches help control the water from flooding downstream areas, which helps in saving water and channelling it in the right direction. The water that percolates into these trenches after a rainfall, keeps the soil moisture intact for a long time that may even extend up the following dry season. Without trenches, a lot of soil erosion happens which increases the salt build-up in the water downstream. Also, the roots and foliage of the vegetation trap sediment that would otherwise overflow from the trench during heavy rainfall.

3.3.3 Water Harvesting Structures:

Water harvesting is defined as the collection of runoff for its productive use. Runoff may be harvested from roofs and ground surfaces as well as from intermittent or ephemeral watercourses. Water harvesting techniques which harvest runoff from roofs or ground surfaces fall under the term, rainwater harvesting, while all systems which collect discharges from watercourses are grouped under the term, floodwater harvesting. Scarcity of water or drought is not a characteristic of low rainfall area alone. Occurrence of dry spells even during monsoon in high rainfall areas is not uncommon. Thus while on the one hand high rainfall areas are in general prone to floods, on the other, irregular rainfall or occasional dry spell in critical times may create a condition of drought even in high rainfall areas. Needless to say, that drought prone areas or areas of low rainfall are the regions worst affected by scarcity of water. In drought condition, water becomes scarce not only for irrigation but also for drinking and household purposes. However, for most of the drought affected regions of our country, low rainfall is not the only or major reason of drought. Scarcity of water for use is more attributable to lack of arrangement for harvesting runoff water. It is essential that runoff water is harvested, stored and put to optimum use.

Benefits of Water harvesting:

• Mitigates drought condition • Moderate floods; • Develops water resources

Storage of harvested runoff water: Depending on requirements and topography, water harvesting and storage can be done in the reservoirs.

• Small earthen dams / embankments

• Dug-out farm ponds;

• Embankments-cum-dug out farmponds

Creation of Earthen Dams

On gentle slopes where stones are not available, Earthen dams of generally 2/ height are constructed. The soil is taken from the uphill side & piled on contour lines. At both ends, spillways pitched with stone are left. The structure of bund is planted with grass tufts for its stability. The alignment along the contour is much important otherwise chances of failure will be more. In the storage area behind the bund structure, the grasses, shrubs & plants of indigenous nature are planted. The choice of species depends upon the environmental conditions & the objective of the management. The dams trap the runoff water & sediment yield from the slopes in between the consecutive contour bunds. The velocity of water is reduced, so the kinetic energy of water is reduced resulting in the mitigation of surface erosion. The sediment trapped behind the bund proves to be ideal soil for plant growth & from here the process of succession also starts naturally.

Creation and re-excavation of ponds

The creation of small ponds and re-excavation of old ponds in the Project area and Project Impact area will also help in the soil conservation.

3.3.4 Monitoring

Regular monitoring and check-up of the intelligence and management of the initiatives is to be discussed with the Project Proponents and the Forest Department.

4 FINANCIAL FORECAST

4.1 BUDGET FOR THE ACTIVITIES TO BE CARRIED OUT BY PROJECT PROPONENTS FOR SOIL CONSERVATION

Table 6: Summary of the budget

Sl.No	Particulars	Total (in lakhs)
1	Construction of earthen dam	4.0
2	Re-excavation of ponds	5.0
3	Creation of contour trenches	3.0
4	Creation of New ponds for water harvesting	5.0
5	Creation of Crescent shaped trenches	2.0
6	Monitoring and Evaluation	1.0
	Grand Total	**20.0**

COUNTERSIGNED

Chief Conservator of Forests
South East Circle, W.B.

GOVERNMENT OF WEST BENGAL
DIRECTORATE OF FORESTS
Office of the Principal Chief Conservator of Forests (Wildlife)
& Chief Wildlife Warden, West Bengal
Bikash Bhawan, North Block, Third Floor, Saltlake City, Kolkata – 700 091
Tel No. 2334-6900/2358-3208, Fax. 91-033-2334-5946
e-mail.: pccfwl-wb@nic.in/pccfwloffice.fd-wb@bangla.gov.in, Visit us at www.wildbengal.com

Office Order No.: 04-CS (COR)/14-2023 **Date:** 17/07/2023

ORDER

The Wildlife Conservation Plan for diversion of 12.5492 ha of forest land in Burdwan Division (10.3750 ha.) and Durgapur Division (2.1742 ha.) under South-East Circle in favour of ESSAR OIL and GAS Exploration and Production Limited for the purpose of Habitat Improvement, Protection of Forest and Wildlife, Mitigation of Human-Animal Conflict, Community development & JFMC support activities and Wildlife research and monitoring, amounting to Rs. 1,56,73,000/- is hereby approved.

Encl.: *As Stated Above*

Yours faithfully,

17/7/23

(Debal Ray)
Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, West Bengal

Memo No.: 1930(6) / WL / 2M-33/ 2015 **Date:** 17 / 07 / 2023

Copy forwarded (along with the approved WCP) for information and necessary action to:-

1. The Additional Chief Secretary to the Govt. of West Bengal, Department of Forests.
2. The Principal Chief Conservator of Forests & HoFF, West Bengal.
3. The PCCF & Nodal Officer, FCA, Govt. of West Bengal.
4. The Chief Conservator of Forests, South-East Circle, West Bengal. This has a reference to his memo no. 1593/SEC/2M-10 dated 12/07/2023.
5. The Divisional Forest Officer, Burdwan Division/ Durgapur Division, West Bengal.
6. The Chief Financial Officer, ESSAR Oil & Gas Exploration and Production Ltd.

17/7/23

Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, West Bengal

Sarita/ WL(Hq)

GOVERNMENT OF WEST BENGAL
DIRECTORATE OF FORESTS
OFFICE OF THE CHIEF CONSERVATOR OF FORESTS,
SOUTH - EAST CIRCLE, WEST BENGAL
WEBEL IT Park, (Phase-I), 3rd Floor, WEBEL Office (Near City Centre)
Gandhi More, Durgapur-713208. E-mail: ccfsewb@gmail.com & ccfse-wb@nic.in

No. 1503/SEC/2M-10 **Date : 12/07/2023**

To: The Principal Chief Conservator of Forests &
Chief Wild Life Warden, West Bengal.

Sub: **Submission of Wildlife Management Plan for diversion of 12.5492 ha. Of Forest land for your kind approval.**

Ref : Your office memo no.1811/WL/2M-33/2015 dated. 05.07.2023 &
DFO Burdwan Division's memo no.2362-8 dated. 11.07.2023.

Sir,

With reference to above, please find enclosed herewith a copy received from Divisional Forest Officer, Burdwan Division regarding re-evaluation the unit rate of Wildlife Management Plan for Diversion of 12.5492 ha. of Forest land in favour of ESSAR Oil & Gas Exploration & Production Ltd. The undersigned recommended the Proposal.

Hence you are requested to issue necessary approval in these regards.

Yours faithfully,

Chief Conservator of Forests
South East Circle, West Bengal

No. 1503(3)/SEC/2M-10 **Date : 12/07/2023**

Copy forwarded for information:

1. The Divisional Forest Officer, Burdwan Division.
2. The Divisional Forest Officer, Durgapur Division.
3. The Chief Financial Officer, ESSAR Oil and Gas Exploration and Production Ltd.

Chief Conservator of Forests
South East Circle, West Bengal

Government of West Bengal
Directorate of Forests
Divisional Forest Officer, Burdwan Division
Golapbag, P.O. - Rajbati, Dist. - Purba Bardhaman – 713104.
Phone: 0342-2659507; Fax: 0342-2659507 * E-mail: dfobdn@yahoo.co.in

No. *2362 /8-* *;* *dated,* *Burdwan,* *the* *11 /07/2023.*

To : **The Principal Chief Conservator of Forests &**
Chief Wild Life Warden, West Bengal.

Through The Chief Conservator of Forests, South East Circle, West Bengal.

Sub : **Submission of Wildlife Management Plan for diversion of 12.5492 ha. of Forest land for your kind approval.** revised

Ref : **1. This office's letter no. 2195/8- dt. 22.06.2023.**
2. CCF/SE Circle office's memo no. 1397/SEC/2M-10 dt. 28.06.2023.
3. PCCF WL & CWLW's memo no. 1811/WL/2M-33/2015 dated. 05.07.2023.
4. CCF/SE Circle office's memo no. 1487/SEC/2M-10 dt. 11.07.2023.

Sir,

In enclosing herewith, I am submitting Wildlife Management Plan for Diversion of 12.5492 ha. of Forest land in favour of ESSAR Oil & Gas Exploration & Production Ltd. under Burdwan and Durgapur Forest Division for your kind approval.

Enclo: As stated above.

Divisional Forest Officer,
Burdwan Division.

No. *2362 (2) /8-* *;* *dated,* *Burdwan,* *the* *11 /07/2023.*

Copy forwarded for kind information to:

1) The Divisional Forest Officer, Durgapur Division.
2) The DGM, ESSAR Oil & Gas Exploration & Production Ltd. Durgapur.

Divisional Forest Officer,
Burdwan Division.

Wildlife Conservation Plan for Diversion of 12.5492 Ha. of Forest Land in favour of ESSAR OIL & GAS Exploration & Production Ltd. under Burdwan and Durgapur Forest Division

Paschim Bardhaman District West Bengal

Prepared by:

Divisional Forest Officer, Burdwan Division

&

Durgapur WINGS

The report is prepared by Durgapur Wildlife Information and Nature Guide Society as per the work order of Essar Oil and Gas Exploration and Production Ltd. (EOGEPL).

Initially submitted on: 10/10/2022
Revised version submitted on: 22/6/2023

Name of the Work: Preparation of Wildlife Conservation Plan of EOGEPL

Society ref no. WINGS/REP/2022/01

PROJECT TEAM:

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CONTENTS

1 INTRODUCTION

It is very ingenuous to think that management of wildlife habitat or populations is not essential. Extreme alterations in the landscape have substantially changed the potential carrying capacity for many species from historic times. Current problems including habitat loss and degradation, fragmentation of habitats, the spread of exotic floral and faunal species, pollution, and human disturbance among others, are all contributing to loss of species diversity and abundance.

Wildlife Conservation Plan (WCP/WLCP) or Wildlife Management Plan are required for Biodiversity Management and wildlife protection in and near a project area. The plan's main objective is to provide a relatively stress-free habitat for wildlife in the impact area and meet the basic needs of resident wildlife. The WCP uses sustainable and scientific management of the area's natural wealth to provide safeguarding measures and wildlife protection from unsavoury elements and carry out developmental activities without affecting these resources. Therefore, biodiversity conservation and management plans are formulated in a way that can provide need-based, site-specific, and participatory eco-development inputs to local stakeholders for reducing their resource dependency on forests and for eliciting their support towards conservation in the area.

Wildlife Conservation/Management plans are crucial for the proper management of wildlife habitats, populations, and associated recreational activities. A management plan is a description of the short-term objectives and long-term goals that will be met by manipulation of habitat, wildlife populations, and people and how these objectives and goals will be reached. Historically, management plans have focused primarily on increasing abundance of game species and maximizing recreational opportunities associated with these species. Currently, Conservation or management plans address threatened and endangered species and habitats, nongame species that are not classified as rare, overall biodiversity, and quality and abundance of game species populations.

1.1 ABOUT COAL BED METHANE (CBM)

Coal bed Methane (CBM), is an eco-friendly natural gas, stored in coal seams, generated during the process of the coalification. It generally refers to the methane gas produced from coal seams. Unlike conventional reservoirs, coal seams are the source, trap, and reservoir for Coalbed Methane (CBM). CBM exploration and exploitation has an important bearing on reducing the greenhouse effect and earning carbon credit in preventing the direct emission of methane gas from operating mines to the atmosphere. Further, extraction of the CBM through degassing of the coal seams prior to mining of coal is a cost-effective means of boosting coal production and maintaining safe methane level in working mines. Moreover, Methane explosions are common in Underground Coal Mines due to the threat of methane gas release from the coal seams. Extracting methane prior to mining eliminates threat of explosions. Thus, the Coal Bed Methane extraction will help in eliminating the risk of explosions leaving the coal seams safer for mining operations. The uses of CBM includes its usage in industries. for the production of cement, methanol, etc., usage in steel plants as well as rolling mills, may be used as a feedstock for fertilizers and also in the generation of power.

To extract the methane, CBM operators drill wells into coal seams and pump out formation water (produced water). Removing the ground water from the formation is necessary to produce CBM, as the water removal reduces the pressure and allows the methane to release from the coal to produce flowing natural gas. Extraction of CBM involves few of the below major steps followed internationally like 1. Drilling 2. Logging & Perforation 3. Stimulation 4. Completion. However, it requires specific skills and analysis at each step for optimum completion and healthy extraction. The complete cycle of a CBM project involves CBM Extraction, Processing and Transportation to utility places.

Natural gas has assumed a significant role in power generation, industrial applications, residential heating and in some cases as a transport fuel as well. Since, the natural gas is cleaner fuel the contribution of air pollution in the atmosphere is negligible when compared to conventional fuels like Coal & Furnace Oil. Durgapur Industrial Belt is categorized as severely polluted area by Ministry of Environment and Forest due to rapid industrialization (Steel, Power, Fertilizer etc.) and the usage of conventional fuels like Coal and fuel oil which emit higher amount of Carbon Dioxide and Sulphur Dioxide into the atmosphere. The usage

of Coal Bed Methane as cleaner fuel will significantly improve the ambient air quality levels in the surrounding areas.

1.2 ABOUT ESSAR OIL AND GAS EXPLORATION AND PRODUCTION LIMITED (EOGEPL)

Essar Oil and Gas Exploration and Production Limited (EOGEPL) was awarded block RG (East)-CBM-2001/1 covering an area of approx. 500 sq. km. under the CBM-I Round, contract signed on 26th July 2002. EOGEPL holds 100% participating interest in the block. The Petroleum Exploration License (PEL) was issued by the Government of West Bengal on 29th March 2005 (block effective date). It covers an area of 500 sq. km. approximately and is situated in the eastern-most part of the Raniganj Coalfield and falls largely in Paschim Bardhaman district (90% approximately), West Bengal. The block is bounded by Latitudes: 23° 21'45'' and 23°41'12'' N and Longitudes: 87°14'40'' and 87°28'46'' E. It lies in Survey of India Topographical Sheet Nos: 73 M/2, M/3, M/6 & M/7 (1: 50,000). Out of the total block area of 500 sq.km, identified fairway area favourable for CBM extraction is around 200 sq. km. In that fairway Essar has planned to drill around 500 wells to optimally exploit the resources economically. As within the fairway of 200 sq. km, around 60 sq. km of the area is covered by forest and thus a huge number of resources are locked-up beneath the forest cover.

1.3 ABOUT THE CONSTRUCTION OF THE NEW WELL PADS

Essar Oil and Gas Exploration and Production Limited (EOGEPL) is planning to construct few newer well pads in this region under Durgapur and Burdwan Forest Division. The details of their location along with area is given below.

Table 1: Proposed CBM well pads with land details in Forest Area of Burdwan Forest Division

Sl. No.	Pad Name	Mouza	Area proposed for diversion (wellpad+ approach road+ pipeline) (in ha.)
1	EDH-356	Akandara	0.7735
2	EDN-360	Bandra	0.4200
3	EDN-361	Bandra	0.4350

4	EDE-326	Bistupur	0.4465
5	EDE-330	Bistupur	0.6000
6	EDE-333	Bistupur	0.7940
7	EDI-338	Bistupur	0.4260
8	EDI-343	Bistupur	1.4540
9	EDN-348	Keshabpur	0.8500
10	EDN-349	Keshabpur	0.7475
11	EDN-363	Keshabpur	0.4200
12	EDI-355	Malandighi	0.6875
13	EDN-362	Rajkusum	0.4160
		Tilakchandrapur	0.1440
14	EDN-358	Tilakchandrapur	0.6800
15	EDN- 132 & 360 (Pipeline)	Bandra	0.856
16	EDE-307 Approach Road	Bistupur	0.1075
17	EDE-127	Bistupur	0.0705
	Approach Road	Saraswatiganj	0.0470.
	Total Area		**10.3750**

Table 2: Proposed CBM well pads with land details in Forest Area of Durgapur Forest Division

Sl. No.	Pad name	Mouza	Area proposed for diversion (wellpad+ approach road+ pipeline) (in ha.)
1	EDD-365	Gopedanga	0.5147
2	EDC-241	Parulia	0.9595
3	EDI-411	Banshia Approach Road	0.3775

4	EDD-248	Baragaria Approach Road	0.0975
5	EDD-364	Gopedanga Approach Road	0.2250
	Total Area		**2.1742**

Table 3: total land area for forest diversion proposal of CBM raniganj project, durgapur

Sl. No.	Forest division	Area (in ha.)
1	Burdwan	10.3750
2	Durgapur	2.1742
	Total	**12.5492**

Table 4: Area under 10 km buffer zones of the well pads. The 10 km. buffer zone is calculated by dividing the well pads into three clusters and 10 km. area is taken from the centre of the clusters.

Cluster no.	Pad name	Mouza	Areas under 10 km buffer zone	Forest divisions and ranges in the buffer zone
1	EDN- 360, EDN- 361, EDN- 348, EDN- 349, EDN- 363, EDN- 362, EDN- 358	Bandra, Keahabpur, Rajkusum, Tilakchandrapur	Malandighi, Paschim Gangarampur, Bamunara, Kanksa, Panagarh, Debsala, Dihipara	Burdwan Division-. Panagarh & Durgapur Ranges Durgapur Division- Ukhra Range
2	EDE- 326, EDE- 330, EDE- 333, EDE- 338,	Malandighi, Bistupur, Saraswatiganj	Laudoha, Gourbazar, Joydev Kenduli, Gourangapur, Balijuri	Burdwan Division- Durgapur Range

	EDE- 343, EDI-355, EDE- 127			Durgapur Division- Ukhra Range
3	EDD- 365, EDC- 241, EDI- 411, EDD- 248, EDD- 364, EDH- 356	Gopedanga, Parulia, Akandara	Laudoha, Balijuri, malandighi, Benachity, Ukhra	Durgapur Division- Ukhra Range
Unclustered	EDC- 241, EDI-411	Parulia, Banshia	Gopedanga, Laudoha, Ukhra, Benachity	Durgapur Division- Ukhra range

According to the above-mentioned tables, this 12.5492 ha. Forest area where the new well pads will be constructed constitutes the Project Area (PA) and the 10 km area surrounding this Core Zone/Project Area will constitute the Buffer Zone or Project Impact Area (PIA). This study is concerned with the preparation of Wildlife Conservation Plan (WLCP) of Essar Oil and Gas Exploration and Production Limited (EOGEPL) and its adjoining 10 km area (buffer or project impact area). Located between the junction of Chhotanagpur plateau and Gangetic plain, Durgapur was once upon a time mostly a forested landmass. Due to gradual industrialisation, most of the forested land has been gradually converted to township and industry. Still, the city has a lot of greenery and diverse array of habitats, which supports a great biodiversity. The previous work on biodiversity of this area can be found in (Gauntlett 1985; Dey et al. 2013; Nayak and Roy 2016; Gayen et al. 2017, 2021; Adhurya et al. 2019; Ghosh 2020).

The execution of the project for extraction is likely to have several adverse effects on the wildlife as well as its habitat, underground water along with environment in general, the village communities which are dependent upon the forest areas proposed for diversion for their livelihood and day to day requirements. It is also the responsibility of any industry to assess periodically the impact of their running project on the surrounding wildlife and environment; and also, to help the concerned government authorities to protect the prevailing wildlife and their habitat. Keeping all this in view a Wildlife Conservation Plan is hereby

submitted for the different endemic, endangered and scheduled flora & fauna present at the project area and its surrounding 10 km radius. The wildlife conservation plan in turn will also help Essar Oil and Gas Exploration and Production Limited (EOGEPL) to obtain EC for their future project and many other areas. The detailed methodology, impact on soil and wildlife and proposed conservation plan is discussed in the later sections.

Figure 1: A picture of a well pad.

Figure 2: Surrounding area of a well pad

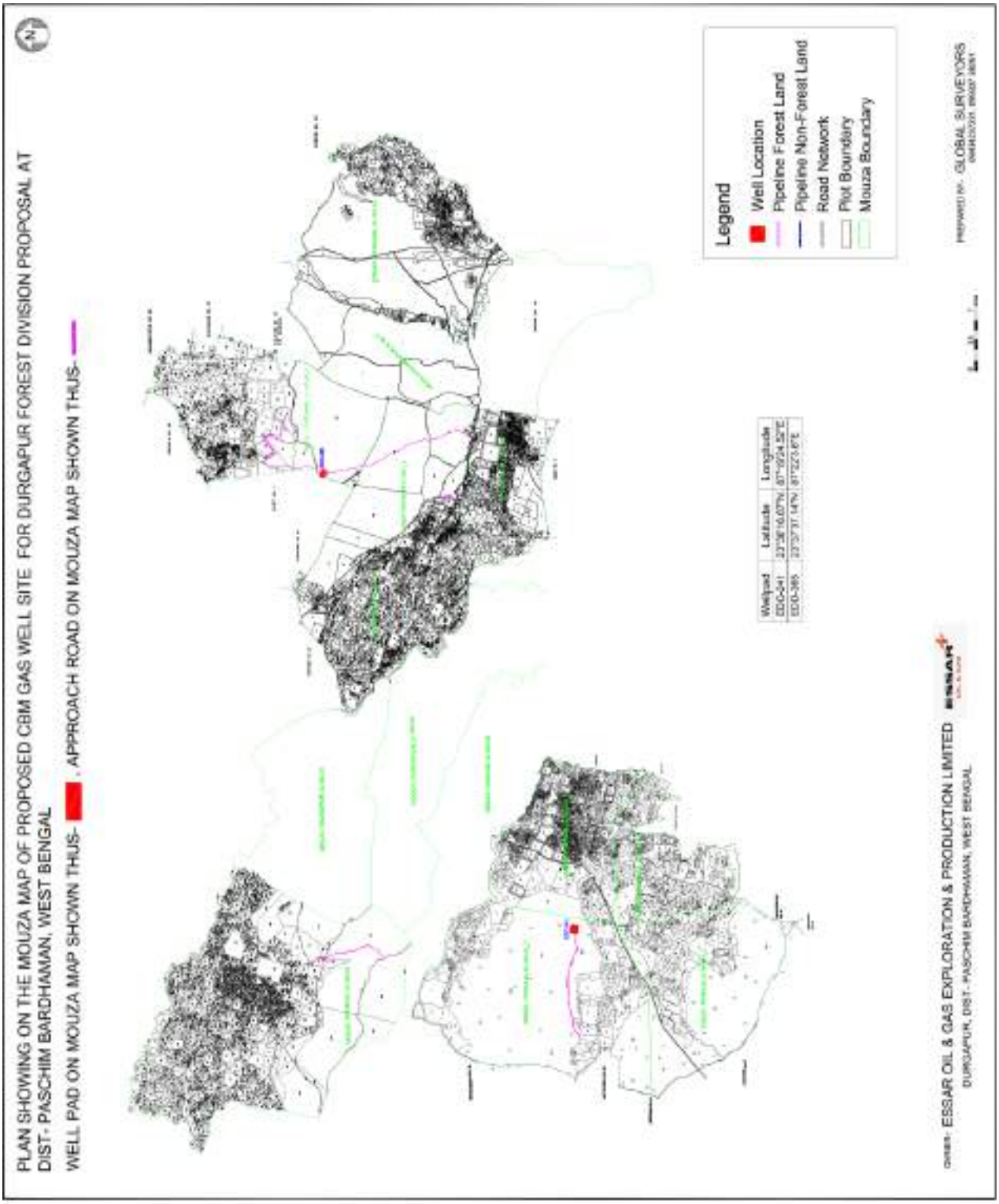


Figure 3: Plan showing the mouza map of proposed CBM gas well sites for Durgapur Forest division proposal.

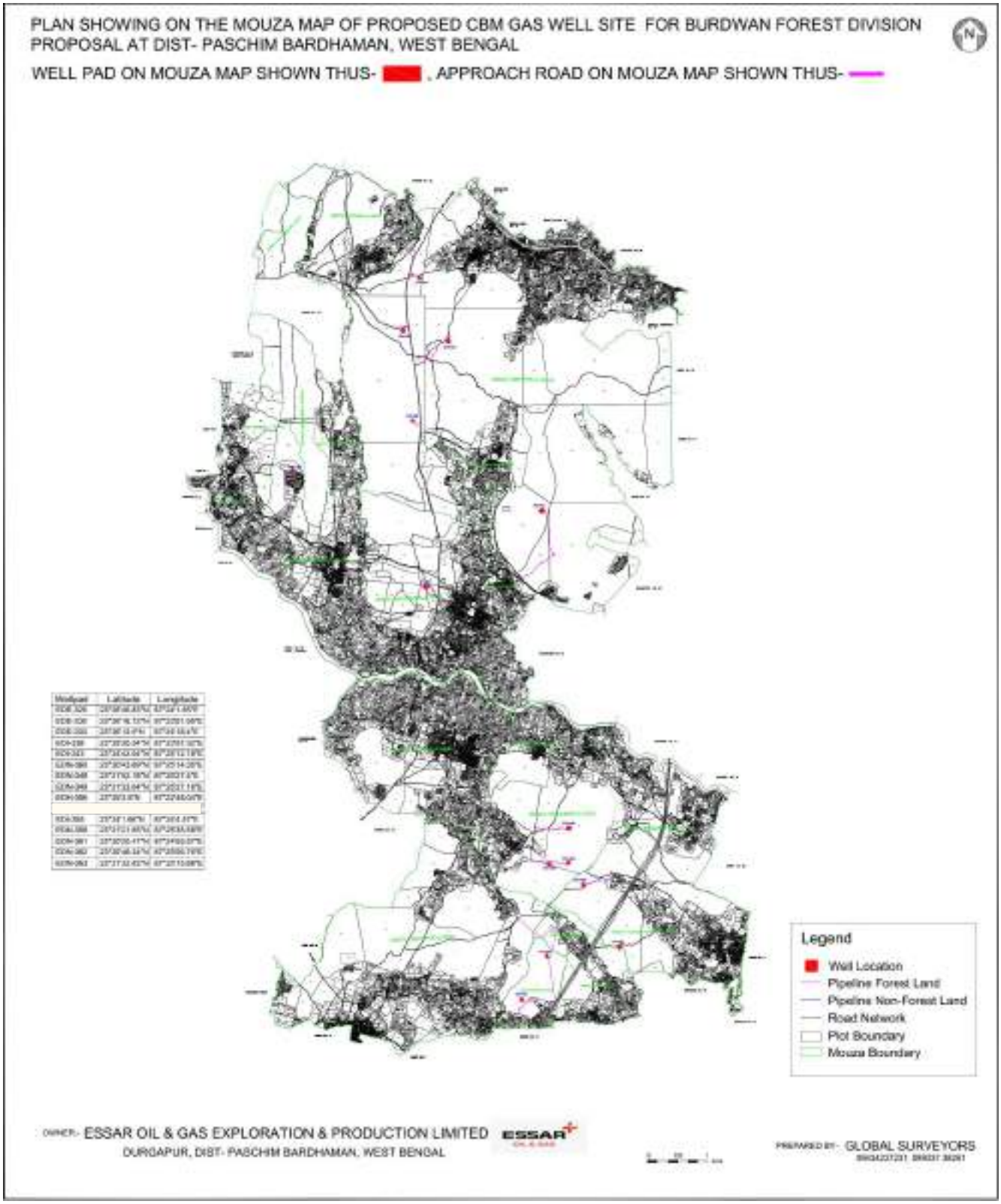


Figure 4: Plan showing the mouza map of proposed CBM gas well sites for Burdwan forest division proposal.

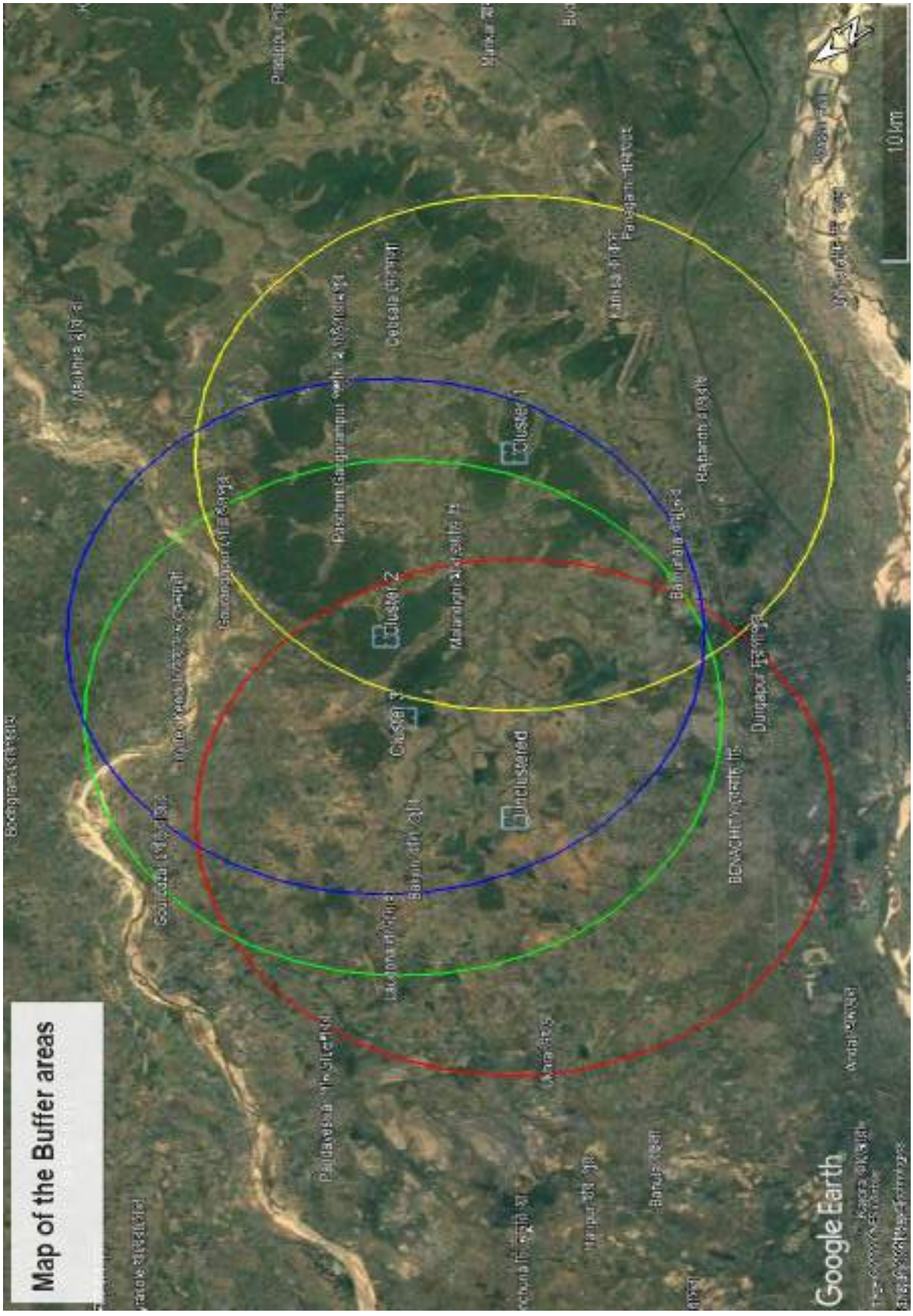


Figure 5: Map of the 10 km PIA from the centroid of the clusters as defined in Table 4. Yellow indicates cluster 1, blue indicates cluster 2, green indicates cluster 3 and red indicates unclustered.

2 METHODOLOGY

2.1 SITES VISITED

For a large study area, it is very difficult to conduct census over all area. To overcome this problem, it is better to go for sampling and survey. Random sampling is one of the popular methods to remove human biasness. Choosing study location with random sampling with computer may give some coordinates which is difficult to access due to some barrier like large water body, lack of roads etc. To overcome this issue, the study sites were selected based on information from satellite imagery. All project areas and five sites for each cluster of project impact area (10 km around project area) were chosen as study site.

2.2 SAMPLING AND IDENTIFICATION

Sampling of fauna was performed with the help of standard equipment (binocular, camera and recorder) and the sampling of flora was done using standard protocols. The photographs (for both flora and fauna) and audio (for fauna like birds, mammals, and amphibians) were identified using proper field guides and web materials.

2.3 THREAT ASSESSMENT AND DEVELOPMENT OF CONSERVATION PLAN

Survey data were served as the baseline data for threat assessment. Importance will be given for following cases:

1. Presence of threatened species: Importance was given for threatened species as per IUCN red list category and species listed in schedules of The Wildlife (Protection) Act, 1972. Conservation strategies are suggested based on threats observed at the field and habitat use pattern of the species.
2. Presence of species enriched patches: Important patches with high faunal and floral diversity was marked and suggested for conservation. Conservation plan for these patches is suggested as per observed diversity, habitat use pattern and threats assessed.

2.4 DURATION OF THE VISIT

Rapid surveys were conducted between 28.9.2022 to 4.10.2022

2.5 REFERRED RECORDS

1. Operative working plan of Paschim Bardhaman District.
2. The Forest (Conservation) Act, 1980
3. The Environment (Protection) Rules, 1986 and its amendments
4. The Wildlife (Protection) Act,1972
5. The Biological Diversity Act, 2002
6. EIA Notification, 2006 and its amendments
7. IUCN Red List of Threatened Species ver 4.1
8. eBird (https://ebird.org/home)
9. India Biodiversity Portal (https://indiabiodiversity.org/)
10. iNaturalist (https://www.inaturalist.org/)
11. Biodiversity of West Bengal (https://bdwb.wildwingsindia.in/)

3 PROJECT IMPACT

3.1 ANTICIPATED DEGRADATION OF FOREST RESOURCE

3.1.1 Model Adopted for Quantification of Anticipated Degradation

This Plan aims at creating proper habitat for the wildlife and to ameliorate the adverse effects of coalbed methane (CBM) well-pad drilling, approach road and pipeline construction and operation. The ideal model for the purpose could be to achieve the forest cover with minimum 0.8 crown density. At present the forests within the impact area are mostly open with crown density of 0.3 to 0.4. The desired density can be achieved by strengthening protection along with planting in the gaps and also protection from fire.

3.1.2 Qualitative Changes in Wildlife Habitat Pattern

There are several forest lands within the zone of influence. Due to the well-pad construction and transportation operations, there is perceived to be disturbance in the

surrounding forest areas, particularly in the forests situated in the impact zone and the biotic pressure which was once exerted over the said project area is shifted to the surrounding areas. Along with movement of existing faunal species, Collection of fuel wood, small timber and other non-timber forest products (NTFP) by the local people is also shifted to the surrounding areas which will create heavy pressure on the adjoining forest areas. Grazing pressure of the cattle is also shifted to these forests. These forest blocks will come under additional biotic pressure. Therefore, the wildlife habitat in these forest areas is likely to be disturbed.

3.1.3 Physiographic Change of the Habitat

No significant physiographic change is noted in the area, except for the fact that some clogged waterways can lead to emergence of new water bodies, containing polluted water.

3.2 PERCEIVED THREATS DUE TO PROJECT IMPLEMENTATION

3.2.1 Threats to forest Flora

There is local demand for fuel wood, grazing of cattle, collection of small timber, building materials and NTFP. Some portions of the materials were being collected from the forest areas of the project concerned. Now after operation of the project, these biotic pressures will be shifted to the adjoining forests.

3.2.2 Threats to Forest Fauna

The forest areas proposed for diversion have rich biodiversity with the presence of many threatened and protected species within this region. With the project sites proposed to be constructed within the forest land, there is likely to be disturbance to the existing faunal species. Due to the project implementation, human-wildlife conflict and fragmentation of wildlife habitat are certainly the major threats.

There are frequent reports of venomous and/or non-venomous snakes in and around the proposed CBM well-pad campus. Poor knowledge about snakes and their importance in biodiversity conservation may lead to killing or injuring them whenever they enter the CBM

well pads. Increased anthropogenic activities within the forest for CBM exploration and transportation would lead to disturbance of habitat, habitat fragmentation, species straying and aggravate the human-wildlife conflict.

Due to the implementation of the project the threats to wildlife can be perceived as:

1. *Direct Threat:* Habitat fragmentation & degradation
2. *Indirect Threat:* Increased human-wildlife conflict.

3.3 VEHICULAR TRAFFIC AND ITS IMPACT

3.3.1 Probable Increase in Vehicular Traffic

No data on vehicular traffic movement are available from the project area. However, during the initial project implementation phase, there will be movement of heavy drill machines and other equipment and during the remaining project phase there will be movement of staff and vehicles for regular day to day activities and monitoring of the project. Since the project CBM well sites are located deep into the forest areas, such kind of movement is likely to cause disturbance to the existing flora and fauna and chances of accidental roadkill cannot be ruled out.

3.3.2 Impact on Flora and Fauna

The movement and operation of the above vehicles will result in the following problems:

- A work force will move in and around the project area creating moderate disturbance.
- Movement of several heavy vehicles and other heavy equipments, particularly while setting up the CBM well-pads, will produce large quantities of dust and noise.
- The dust generated due to vehicular transportation on the approach roads, particularly on those constructed with *murrum*, will settle on the plant leaves, and inhibit the growth of plants.

Similarly, the fauna present in and around the project area will be affected. The following may be the perceived impact:

- The movement of the heavy vehicles and machineries will generate a lot of noise creating panic among the wild animals.
- The vehicular lights will scare the animals. The movement of the vehicles may also cause accidental death of the animals, particularly herpetofauna.

3.4 IMPORTANT HABITATS

Habitat conditions of the proposed CBM well pad areas and neighbouring areas are poor. Many threatened animals and plants were observed during the study and full checklist can

be found in Section 4. The threat to the wildlife as observed is discussed in previous part of this chapter. Hence, the steps need to be taken to stop further degradation of wildlife habitat. Further, some important habitats for the wildlife have been identified because of our field survey. These sites need proper conservation to preserve its enriched biodiversity:

- **Bijra airstrip (23°35'02.3"N 87°20'20.1"E)**: Bijra forests and grasslands between CRPF camp and IQ city (23°33'58.9"N 87°20'28.3"E) supports more than 100 species of birds and diverse number of insects, some important mammals like grey wolf, Bengal fox, Golden Jackals etc. The area includes some grasslands, some DSP owned lands and some forest owned lands. Further, this area is home to two near threatened avian species: Black-headed ibis and Alexandrine Parakeet. Diverse habitats and Kunur river help to support a great diversity in this area. Apart from that most of the Scheduled I fauna in the checklist found in this area.
- **Madhaiganj-Kalipur forest (23°39'41"N 87°20'0.2"E):** The forest and the forest edges between Madhaiganj and Kalipur supports large packs of Grey Wolves, Golden Jackals etc. Black-naped Hare are also commonly found in the region. Threatened species like Woolly-necked Stork and flagship species such as Indian Peafowl are also found among the avifauna, along with several raptors. Striped Hyena has been sighted occasionally by the locals. The forest is also home to many native trees and herbs, including medicinal plants.
- **Gourangapur grassland (23°36'27.56"N 87°27'23"E):** This grassland at the forest edge is home to several important avifaunal species such as Black Francolin, Indian Peafowl. Important migratory species such as large flocks of Crested Buntings make this their winter foraging ground.
- **Bandra-Sadhumara forest (23°30'15.32"N 87°25'04.83"E):** Situated near the project sites of Bandra and Sadhumara, this area supports exceptionally high number of native plants, many of which are not commonly distributed now. This area is home to several parasitic plants including terrestrial orchids. Among the rare trees found in the region include *Psydrax dicoccos*, which is listed as Vulnerable under the IUCN RedList. Several species of herpetofauna are also found near the temporal water pools and among the leaf litter on the moist forest floor. The region is also home to important mammalian fauna such as Grey Wolves and Golden Jackals among others.

4 FLORA AND FAUNA OF THE PROJECT AREA AND ADJOINING 10 KM BUFFER ZONE

4.1 LIST OF FLORA

A total of 254 angiosperms including 233 dicots and 20 monocots, 2 gymnosperms, 11 Pteridophytes and 2 Bryophytes were recorded from the 10 km radius of the project sites. The WPA schedule was not still developed for plants. So that, IUCN Threatened Category is given here. As per the IUCN, there are no threatened species observed but 3 species are Near Threatened. These species (see checklist) need proper conservation measures.

4.1.1 List of Dicotyledonous Angiospermic plants

Table 5: List of Dicotyledonous Angiosperms in Essar project sites and the Buffer Area (Area enclosed under 10 km radius)

Sl. No.	Scientific Name	Local Name	Family	Habit	Medicinal Status
1	*Miliusa tomentosa*	Hoom	Annonaceae	Tree	Y
2	*Miliusa velutina*	Bon Sal	Annonaceae	Tree	Y
2	*Polyalthia cerasoides*	Kudumi	Annonaceae	Tree	Y
3	*Polyalthia suberosa*	Amjum	Annonaceae	Tree	Y
4	*Cleome aspera*	Holud Hurhurey	Cleomaceae	Herb	Y
5	*Cleome gynandra*	Sada Hurhurey	Cleomaceae	Herb	Y
6	*Cleome rutidosperma*	Beguni Hurhurey	Cleomaceae	Herb	-
7	*Cleome viscosa*	Holud Hurhurey	Cleomaceae	Herb	Y
8	*Shorea robusta*	Shaal	Dipterocarpaceae	Tree	Y
9	*Anogeissus latifolia*	Dhaw	Combretaceae	Tree	Y
10	*Combretum roxburghii*	Atandi	Combretaceae	Shrub	Y
11	*Terminalia arjuna*	Arjun	Combretaceae	Tree	Y
12	*Terminalia bellirica*	Bohera	Combretaceae	Tree	Y

13	*Terminalia chebula*	Horitoki	Combretaceae	Tree	Y
14	*Terminalia elliptica*	Asan	Combretaceae	Tree	Y
15	*Aegle marmelos*	Bael	Rutaceae	Tree	Y
16	*Citrus grandis*	Batabi Lebu	Rutaceae	Tree	Y
17	*Murraya koenigii*	Karipata	Rutaceae	Tree	Y
18	*Abelmoschus crinitus*		Malvaceae	Herb	Y
19	*Abelmoschus Manihot*	Aibika	Malvaceae	Herb	Y
20	*Abutilon indicum*	Petari	Malvaceae	Herb	Y
21	*Bombax ceiba*	Simul	Malvaceae	Tree	N
22	*Corchorus aestuans*	Bonpat	Malvaceae	Herb	Y
23	*Grewia asiatica*	Falsa	Malvaceae	Shrub	Y
24	*Grewia hirsute*	Kukurbichha	Malvaceae	Shrub	Y
25	*Helicteres isora*	Avartani	Malvaceae	Tree	Y
26	*Malvastrum coromandelianum*	Coromandel Berela	Malvaceae	Herb	Y
27	*Melochia corchorifolia*	Bilpat	Malvaceae	Herb	N
28	*Sida acuta*	Berela	Malvaceae	Herb	Y
29	*Sida alnifolia*	Berela	Malvaceae	Herb	Y
30	*Sida cordata*	Berela	Malvaceae	Herb	Y
31	*Sida cordifolia*	Berela	Malvaceae	Herb	Y
32	*Sida rhombifolia*	Berela	Malvaceae	Herb	Y
33	*Thespesia lampas*	Bon Kapas	Malvaceae	Shrub	Y
34	*Triumfetta rhomboidei*	Bon Okra	Malvaceae	Shrub	Y
35	*Urena lobata*	Bon Okra	Malvaceae	Shrub	Y
36	*Urena sinuate*	Bon Okra	Malvaceae	Herb	Y
37	*Aphanamixis polystachya*	Pithraj	Meliaceae	Tree	Y
38	*Azadirachta indica*	Neem	Meliaceae	Tree	Y
39	*Swietenia mahagoni*	Mahogony/Mehogoni	Meliaceae	Tree	N
40	*Ziziphus mauritiana*	Kool	Rhamnaceae	Tree	Y
41	*Ziziphus nummularia*	Bhui Kool	Rhamnaceae	Herb	Y
42	*Ziziphus oenoplia*	Shia Kool	Rhamnaceae	Tree	Y
43	*Madhuca longifolia*	Mohua	Sapindaceae	Tree	Y
44	*Schleichera oleosa*	Kushum	Sapindaceae	Tree	Y
45	*Litchi chinensis*	Lichu	Sapindaceae	Tree	N
46	*Mangifera indica*	Aam	Anacardiaceae	Tree	Y
47	*Buchanania lanzan*	Piyal	Anacardiaceae	Tree	Y
48	*Moringa oleifera*	Shojney	Moringaceae	Tree	Y

49	*Diospyros melanoxylon*	Kendu	Ebenaceae	Tree	Y
50	*Alysicarpus rugosus*	Bon-badam	Fabaceae	Herb	N
51	*Clitoria ternetea*	Aporajita	Fabaceae	Herb	Y
52	*Crotalaria pallida*	Jhunjhuni	Fabaceae	Herb	Y
53	*Crotalaria prostrata*	Chhoto Jhunjhuni	Fabaceae	Herb	Y
54	*Butea monosperma*	Palash	Fabaceae	Tree	Y
55	*Dalbergia sisoo*	Shishu	Fabaceae	Tree	Y
56	*Desmodium gangeticum*	Salporni	Fabaceae	Shrub	Y
57	*Grona heterocarpos*	Mohini	Fabaceae	Shrub	Y
58	*Grona triflora*	Hangshapadi	Fabaceae	Herb	Y
59	*Phyllodium pulchellum*	Ghora Chabuk	Fabaceae	Shrub	Y
60	*Polhillides velutina*	Prasniporni	Fabaceae	Herb	N
61	*Senna sophera*	Kalkashundo	Fabaceae	Shrub	Y
62	*Cassia fistula*	Bandorlathi	Fabaceae	Tree	Y
63	*Tephrosia pumila*	Chhoto Neel	Fabaceae	Herb	N
64	*Tephrosia purpurea*	Bon Neel	Fabaceae	Herb	N
65	*Tephrosia strigosa*		Fabaceae	Herb	N
66	*Tephrosia villosa*	Loma Neel	Fabaceae	Herb	N
67	*Mucuna pruriens*	Alkushi	Fabaceae	Tree	Y
68	*Tamarindus indica*	Tentul	Fabaceae	Tree	Y
69	*Mimosa pudica*	Lojjaboti	Fabaceae	Herb	Y
70	*Mimosa rubicaulis*	Shiakanta	Fabaceae	Shrub	N
71	*Albizia lebbeck*	Shirish	Fabaceae	Tree	N
72	*Pterocarpus santalinus*	RoktoChondon	Fabaceae	Tree	Y
73	*Millettia pinnata*	Koronjo	Fabaceae	Tree	Y
74	*Senegalia catechu*	Khair	Fabaceae	Tree	Y
75	*Lagerstroemia microcarpa*	Tana Jarul	Lythraceae	Tree	N
76	*Woodfordia fruticosa*	Dhatriful	Lythraceae	Shrub	Y
77	*Olax scandens*	Koko Aru	Olacaceae	Shrub	Y
78	*Debia ovatifolia*		Rubiaceae	Herb	N
79	*Dentella repens*	Bhuipat	Rubiaceae	Herb	Y
80	*Gardenia latifolia*	Jojongondha	Rubiaceae	Tree	Y
81	*Hymenodictyon orixense*	Bhui Kodom	Rubiaceae	Tree	Y
82	*Ixora brachiata*		Rubiaceae	Tree	Y
83	*Meyna laxiflora*	Moyna Kanta	Rubiaceae	Spiny Shrub	Y
84	*Mitracarpus hirtus*	Kinnar	Rubiaceae	Herb	Y
85	*Mitragyna parvifolia*	Keli Kadam	Rubiaceae	Tree	Y
86	*Morinda citrifolia*	Noni	Rubiaceae	Tree	Y

87	*Morinda pubescens*	Noni	Rubiaceae	Tree	Y
88	*Morinda tinctoria*	Hurdi	Rubiaceae	Shrub	Y
89	*Neolamarckia cadamba*	Kadam	Rubiaceae	Tree	Y
90	*Oldenlandia affinis*		Rubiaceae	Herb	N
91	*Oldenlandia corymbosa*	Khetpapra	Rubiaceae	Herb	Y
92	*Oldenlandia diffusa*	Khetpapra	Rubiaceae	Herb	Y
93	*Oldenlandia pinifolia*		Rubiaceae	Herb	N
94	*Pavetta indica*	Bon Jui	Rubiaceae	Shrub	Y
95	*Paederia foetida*	Gendal	Rubiaceae	Herb	Y
96	*Psydrax dicoccos*		Rubiaceae	Tree	Y
97	*Spermacoce articularis*		Rubiaceae	Herb	Y
98	*Spermacoce exilis*		Rubiaceae	Herb	N
99	*Spermacoce hispida*		Rubiaceae	Herb	Y
100	*Spermacoce ocymoides*	Kinnar	Rubiaceae	Herb	Y
101	*Spermacoce pusilla*		Rubiaceae	Herb	Y
102	*Tamilnadia uliginosa*	Piralo	Rubiaceae	Tree	Y
103	*Wendlandia thyrsoidea*	Shola	Rubiaceae	Tree	Y
104	*Flacourtia indica*	Bainchi	Salicaceae	Shrub	Y
105	*Cocculus hirsutus*	Doilota	Menisperma ceae	Herb	Y
106	*Tinospora sinensis*	Guloncho	Menisperma ceae	Shrub	Y
107	*Celastrus paniculatus*	Jyotishmoti	Celastraceae	Shrub	Y
108	*Antidesma bunius*	Sheyal Boka	Phyllanthace ae	Tree	Y
109	*Antidesma ghaesembilla*	Khudi Jam	Phyllanthace ae	Shrub	Y
110	*Bridelia retusa*	Koshai	Phyllanthace ae	Tree	Y
111	*Bridelia verrucosa*	Nil Jhunjhuni	Phyllanthace ae	Tree	Y
112	*Breynia oblongifolia*		Phyllanthace ae		
113	*Breynia quadrangularis*		Phyllanthace ae		
114	*Breynia vitis-idea*	Bhita Shalpoti	Phyllanthace ae	Tree	Y
115	*Flueggea virosa*	Shikori	Phyllanthace ae	Shrub	Y
116	*Glochidion ellipticum*		Phyllanthace ae	Tree	Y
117	*Glochidion lanceolarium*	Bhauri	Phyllanthace ae	Tree	N

118	*Phyllanthus airy-shawii*		Phyllanthaceae	Herb	Y
119	*Phyllanthus amarus*	Bhui Amla	Phyllanthaceae	Herb	Y
120	*Phyllanthus maderaspatensis*		Phyllanthaceae	Herb	Y
121	*Phyllanthus reticulatus*	Pankushi	Phyllanthaceae	Shrub	Y
122	*Phyllanthus urinaria*	Bhui Amla	Phyllanthaceae	Herb	Y
123	*Acilepis ornata*	Bahari Koromtila	Asteraceae	Herb	N
124	*Acmella ciliata*	Bon Genda	Asteraceae	Herb	Y
125	*Acmella oleracea*	Bon Genda	Asteraceae	Herb	Y
126	*Acmella paniculata*	Suryakanya	Asteraceae	Herb	Y
127	*Acmella radicans*	Bon Genda	Asteraceae	Herb	Y
128	*Ageratum houstonianum*		Asteraceae	Herb	Y
129	*Blumea axillaris*		Asteraceae	Herb	Y
130	*Blumea eriantha*		Asteraceae	Herb	Y
131	*Blumea flava*		Asteraceae	Herb	Y
132	*Blumea lacera*	Kuksim	Asteraceae	Herb	Y
133	*Blumea oxyodonta*	Kanta pata	Asteraceae	Herb	Y
134	*Blumea sinuata*		Asteraceae	Herb	Y
135	*Centipeda minima*	Hanchane Lata	Asteraceae	Herb	Y
136	*Chromolaena odorata*	Boro Siyalmuti	Asteraceae	Herb	Y
137	*Cyanthillium cinereum*	Kuksima	Asteraceae	Herb	Y
138	*Eclipta prostrata*	Keshraj	Asteraceae	Herb	Y
139	*Eleutheranthera ruderalis*		Asteraceae	Herb	N
140	*Elephantopus scaber*	Hostipod	Asteraceae	Herb	Y
141	*Emilia sonchifolia*	Mechitra	Asteraceae	Herb	Y
142	*Gnaphalium affine*		Asteraceae	Herb	Y
143	*Gnaphalium pensylvanicum*	Chheto	Asteraceae	Herb	Y
144	*Gnaphalium polycaulon*		Asteraceae	Herb	Y
145	*Grangea maderaspatana*	Namuti	Asteraceae	Herb	Y
146	*Helichryum luteoalbum*	Jabor Lota	Asteraceae	Herb	Y
147	*Lagascea mollis*	Reshmi Pata	Asteraceae	Herb	Y
148	*Launaea asplenifolia*	Tikadana	Asteraceae	Herb	Y
149	*Mikania micrantha*	Rabon Lata	Asteraceae	Herb	Y

150	*Mikania scandens*	Tara Lata	Asteraceae	Herb	Y
151	*Sonchus asper*	Kantak Dudhi	Asteraceae	Herb	Y
152	*Sonchus oleraceus*	Jungli Dudhi	Asteraceae	Herb	Y
153	*Sonchus wightianus*	Dudhi	Asteraceae	Herb	Y
154	*Sphaeranthus indicus*	Murmuri	Asteraceae	Herb	Y
155	*Synedrella nodiflora*	Renaldi	Asteraceae	Herb	Y
156	*Tridax procumbens*	Tridhara	Asteraceae	Herb	Y
157	*Xanthium strumarium*	Ghagra	Asteraceae	Herb	Y
158	*Nymphoides indica*	Chandmala	Menyanthaceae	Aquatic Herb	Y
159	*Dregia volubilis*	Juktiful	Apocynaceae	Climber Tree	Y
160	*Alstonia scholaris*	Chhatim	Apocynaceae	Tree	Y
161	*Hemidesmus indicus*	Anantamul	Apocynaceae	Herb	Y
162	*Calotropis gigantea*	Akondo	Asclepiadaceae	Shrub	Y
163	*Calotropis procera*	Chhoto Akondo	Asclepiadaceae	Shrub	Y
164	*Erycibe paniculata*	Bironga	Convolvulaceae	Shrub	Y
165	*Ipomoea aquatica*	Jol Kolmi	Convolvulaceae	Herb	Y
166	*Ipomoea carnea*	Dhol Kolmi	Convolvulaceae	Herb	Y
167	*Ipomoea obscura*	Kura Kolmi	Convolvulaceae	Herb	N
168	*Rivea hypocrateriformis*	Bon Pui	Convolvulaceae	Herb	Y
169	*Datura metel*	Dhutro	Solanaceae	Herb	Y
170	*Nicotiana plumbaginifolia*	Bon Tamak	Solanaceae	Herb	Y
171	*Solanum nigrum*	Bon Begun	Solanaceae	Herb	Y
172	*Solanum sisymbriifolium*	Kanta Begun	Solanaceae	Herb	Y
173	*Solanum torvum*	Goth Begun	Solanaceae	Herb	Y
174	*Solanum virginianum*	Kontokari	Solanaceae	Herb	Y
175	*Solanum xanthocarpum*	Kontokari	Solanaceae	Herb	Y
176	*Andrographis echioides*	Banchimany	Acanthaceae	Herb	Y
177	*Andrographis paniculata*	Kaalmegh	Acanthaceae	Herb	Y
178	*Barleria cristata*	Jhinti	Acanthaceae	Shrub	Y
179	*Barleria prionitis*	Pit Jhinti	Acanthaceae	Shrub	Y

180	*Dicliptera chinensis*	Panitira	Acanthaceae	Herb	Y
181	*Dicliptera paniculata*	Nasabhanga	Acanthaceae	Herb	Y
182	*Eranthemum roseum*	Nil Basak	Acanthaceae	Shrub	Y
183	*Hemigraphis hirta*	Buripana	Acanthaceae	Herb	Y
184	*Hygrophila auriculata*	Kulekhara	Acanthaceae	Spiny Herb	Y
185	*Hygrophila difformis*	Kulekhara	Acanthaceae	Herb	Y
186	*Hygrophila ringens*	Kalghas	Acanthaceae	Spiny Herb	Y
187	*Hygrophila triflora*	Kulekhara	Acanthaceae	Spiny Herb	Y
188	*Justicia adhatoda*	Basak	Acanthaceae	Shrub	Y
189	*Justicia gendarussa*	Kalo Basak	Acanthaceae	Shrub	Y
190	*Justicia quinqueangularis*		Acanthaceae	Herb	N
191	*Nelsonia canescens*	Paramul	Acanthaceae	Herb	Y
192	*Ruellia prostrata*	Potpoti	Acanthaceae	Herb	Y
193	*Ruellia suffruticosa*	Potpoti	Acanthaceae	Herb	Y
194	*Ruellia tuberosa*	Potpoti	Acanthaceae	Herb	Y
196	*Rungia pectinata*	Pindi	Acanthaceae	Herb	Y
197	*Anisomeles indica*	Gobura	Lamiaceae	Herb	Y
198	*Clerodendrum indicum*	Bamonhati	Lamiaceae	Shrub	Y
199	*Clerodendrum infortunatum*	Ghentu	Lamiaceae	Shrub	Y
200	*Hyptis suaveolens*	Bon Tulsi	Lamiaceae	Herb	Y
201	*Leonotis nepetifolia*	Bhut Bhairab	Lamiaceae	Herb	N
202	*Leucas aspera*	Dron Pushpa	Lamiaceae	Herb	Y
203	*Ocimum basilicum*	Babui Tulsi	Lamiaceae	Herb	Y
204	*Plectranthus barbarus*	Kailash	Lamiaceae	Herb	Y
205	*Pogostemon benghalensis*	Jui Lata	Lamiaceae	Herb	Y
206	*Tectona grandis*	Shegun	Lamiaceae	Tree	Y
207	*Vitex negundo*	Nishinda	Lamiaceae	Shrub	Y
208	*Utricularia aurea*	Jhanjhi	Lentibulariaceae	Aquatic Herb	N
209	*Utricularia bifida*	Chhoto Jhanjhi	Lentibulariaceae	Herb	N
210	*Mirabilis jalapa*	Shondhyamoni	Nyctaginaceae	Shrub	Y
211	*Antigonon leptopus*	Onontolota	Polygonaceae	Liana	Y
212	*Croton bonplandianus*	Bon Tulsi	Euphorbiaceae	Herb	Y
213	*Ficus benghalensis*	Botgachh	Moraceae	Tree	Y

214	*Ficus heterophylla*	Bollam Dumur	Moraceae	Tree	Y
215	*Ficus hispida*	Kak Dumur	Moraceae	Tree	Y
216	*Ficus racemosa*	Jogyo Dumur	Moraceae	Tree	Y
217	*Ficus religiosa*	Oshwottho	Moraceae	Tree	Y
218	*Artocarpus heterophyllus*	Kanthal	Moraceae	Tree	Y
219	*Streblus asper*	Shyaora	Moraceae	Tree	Y
220	*Argemone mexicana*	Shiyalkanta	Papaveraceae	Spiny Herb	Y
221	*Spathodea campanulata*	Rudrapalash	Bignoniaceae	Tree	Y
222	*Barringtonia acutangula*	Hijawl	Lecythidaceae	Tree	Y
223	*Careya arborea*	Kumbhi	Lecythidaceae	Tree	Y
224	*Ailanthus excelsa*	Mohaneem	Simaroubaceae	Tree	Y
225	*Turnera ulmifolia*	Chhotokolkey	Passifloraceae	Herb	Y
226	*Holoptelea integrifolia*	Cheelbeel	Ulmaceae	Tree	Y
227	*Drosera burmannii*	Suryosisir	Droseraceae	Herb	Y
228	*Drosera indica*	Chhoto Suryosisir	Droseraceae	Herb	N
229	*Nelumbo nucifera*	Podmo	Nelumbonaceae	Aquatic Herb	Y
230	*Nymphaea alba*	Sada Shapla	Nymphaeaceae	Aquatic Herb	Y
231	*Nymphaea nouchali*	Sada Shapla	Nymphaeaceae	Aquatic Herb	Y
232	*Nymphaea pubescens*	Shapla	Nymphaeaceae	Aquatic Herb	Y
233	*Nymphaea rubra*	Lal Shapla	Nymphaeaceae	Aquatic Herb	Y

4.1.2 List of Monocotyledonous angiospermic plants

Table 6: List of Dicotyledonous Angiosperms in Essar project sites and the Buffer Area (Area enclosed under 10 km radius).

Sl. No.	Scientific Name	Local Name	Family	Habit	Medicinal Status
1	*Phoenix sylvestris*	Khejur	Arecaceae	Thorny Tree	Y
2	*Borassus flabellifer*	Tal	Arecaceae	Tree	Y
3	*Caryota urens*	Bon-khejur/ Bon-supari/	Arecaceae	Tree	Y

		Chaur			
4	*Colocasia esculenta*	Kochu	Araceae	Herb	Y
5	*Typhonium trilobatum*	Kharkon/Ghat Kochu	Araceae	Herb	Y
6	*Pontederia crassipes*	Kochuripana	Pontederiaceae	Aquatic Herb	N
7	*Pontederia hastata*	Chhoto Kochuripana	Pontederiaceae	Aquatic Herb	N
8	*Pontederia vaginalis*	Pani Kochu	Pontederiaceae	Aquatic Herb	N
9	*Lemna minor*	Khudipana	Lemnaceae	Aquatic Herb	Y
10	*Asparagus racemosus*	Shotomuli	Asparagaceae	Shrub	Y
11	*Cyperus rotundus*	Mutha-ghash	Cyperaceae	Herb	N
12	*Cyperus alternifolius*	Nagormutha	Cyperaceae	Shrub	N
13	*Eulophia explanata*	Orchid	Orchidaceae	Herb	N
14	*Geodorum densiflorum*	Orchid	Orchidaceae	Herb	N
15	*Planaginorchis plantaginea*	Orchid	Orchidaceae	Herb	N
16	*Vanda tessellata*	Orchid	Orchidaceae	Terrestrial Herb	N
17	*Smilax zeylanica*	Orchid	Smilaceae	Shrub	Y
18	*Curculigo orchioides*	Talmuli	Hypoxidaceae	Herb	Y
13	*Phragmites karka*	Ulukhagra	Poaceae	Aquatic Shrub	N
14	*Saccharum spontaneum*	Kashfool	Poaceae	Shrub	N
15	*Saccharum munja*	Munja Ghash	Poaceae	Shrub	N
17	*Dendrocalamus strictus*	Baansh	Poaceae	Herb	N
18	*Cynodon dactylon*	Durba-ghash	Poaceae	Herb	N
19	*Thysanolaena latifolia*	Phooljharugach	Poaceae	Shrub	N
20	*Chrysopogon aciculatus*	Chorkanta	Poaceae	Herb	N

4.1.3 List of Other Plants

Table 7: List of other Angiosperms, Pteridophytes and Bryophytes in Essar project sites and the Buffer Area (Area enclosed under 10 km radius).

Sl. No.	Scientific Name	Local Name	Family	Habit	Medicinal Status
Other Angiosperms (other than Monocots and Dicots)					
1	*Aristolochia indica*	Ishwarmul	Aristolochiaceae	Herb	Y
Pteridophytes					
2	*Cheilanthes tenuifolia*	Fern-gachh	Pteridaceae	Fern/Herb	Y
3	*Pteris vittata*	Fern-gachh	Pteridaceae	Fern/Herb	Y
4	*Christella dentata*	Fern-gachh	Thelypteridaceae	Fern/Herb	Y
5	*Lygodium flexuosum*	Bhootraj	Lygodiaceae	Fern/Herb	Y
6	*Marsilea quadrifolia*	Shushni Shaak	Marsileaceae	Amphibious herb	Y
7	*Azolla pinnata*	Kutipana	Salviniaceae	Amphibious herb	N
8	*Salvinia molesta*		Salviniaceae	Amphibious herb	Y
9	*Adiantum philippense*		Adiantaceae	Fern/Herb	N
10	*Asplenium nidus*		Aspleniaceae	Arboreal Fern	N
11	*Ophioglossum reticulatum*		Ophioglossaceae	Fern/Herb	Y
Bryophytes					
12	*Riccia cavernosa*	Riccia	Ricciaceae	Liverwort	N
13	*Riccia gangetica*	Riccia	Ricciaceae	Liverwort	N

Figure 6: Sal Shorea robusta

Figure 7: Akondo Calotropis gigantea

Figure 8: Kadam Neolamarckia cadamba

Figure 9: Berela Sida cordata

Figure 10: Rudrapalas Spathodea campanulata

Figure 11: Falsa Grewia asiatica

4.2 LIST OF FAUNA

A total of 11 Amphibians, 120 birds, 49 butterflies, 18 mammals and 15 reptiles were recorded from the study sites. No threatened and WPA Scheduled-I species found for Amphibia. Among birds, there are 2 Vulnerable species, 1 Near Threatened species and 5 WPA Scheduled-I species. There is no IUCN Threatened butterfly observed but 3 WPA Scheduled-I butterflies found. Among mammals, 1 species found Endangered, 1 species Near Threatened and 2 species WPA Scheduled-I. No observed reptiles found to belong at IUCN Threatened Category, but there are 2 WPA scheduled-I species.

4.2.1 List of Amphibians

Table 8: List of Amphibian (frog) species in Essar project sites and the Buffer area (area enclosed under 10 km radius).

Sl. No.	Scientific Name	Common Name	Family	WPA Schedule	IUCN Status
1	*Duttaphrynus melanostictus*	Common Indian Toad	Bufonidae		LC
2	*Duttaphrynus stomaticus*	Marbled Toad	Bufonidae		LC
3	*Euphlyctis cyanophlyctis*	Skittering Frog	Dicroglossidae		LC
4	*Euphlyctis hexadactylus*	Green Pond Frog	Dicroglossidae	IV	LC
5	*Fejervarya orissaensis*	Orissa Cricket Frog	Dicroglossidae		LC
6	*Hoplobatrachus crassus*	Jerdon's Bull Frog	Dicroglossidae	IV	LC
7	*Hoplobatrachus tigerinus*	Indian Bull Frog	Dicroglossidae	IV	LC
8	*Minervarya agricola*	Granulated Cricket Frog	Dicroglossidae		LC
9	*Uperodon globulosus*	Indian Balloon Frog	Microhylidae		LC
10	*Uperodon taprobanicus*	Indian Painted Frog	Microhylidae		LC
11	*Polypedates maculatus*	Common Indian Tree Frog	Rhacophoridae		LC

Figure 12: Marbled Toad Duttaphrynus stomaticus

Figure 13: Common Indian Toad Duttaphrynus melanostictus

Figure 14: Indian Bull Frog Hoplobatrachus tigerinus

Figure 15: Painted Frog Uperodon taprobanicus

Figure 16: Indian Tree Frog Polypedates maculatus

4.2.2 List of Birds

Table 9: List of birds of Essar project sites and the Buffer area (area enclosed under 10 km radius).

Sl. No.	Scientific Name	Common Name	Family	WPA Schedule	IUCN Status
1	*Accipiter badius*	Shikra	Accipitridae	I (3)	LC
2	*Elanus caeruleus*	Black-winged Kite	Accipitridae	I (3)	LC
3	*Milvus migrans*	Black Kite	Accipitridae	I (3)	LC
4	*Pernis ptilorhynchus*	Oriental Honey Buzzard	Accipitridae	I (3)	LC
5	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Acrocephalidae	IV	LC
6	*Acrocephalus stentoreus*	Clamorous Reed Warbler	Acrocephalidae	IV	LC
7	*Aegithina tiphia*	Common Iora	Aegithinidae	IV	LC

8	*Alaudalaraytal*	Sand Lark	Alaudidae	IV	LC
9	*Alcedo atthis*	Common Kingfisher	Alcedinidae	IV	LC
10	*Cerylerudis*	Pied Kingfisher	Alcedinidae	IV	LC
11	*Halcyon smyrnensis*	White-throated Kingfisher	Alcedinidae	IV	LC
12	*Pelargopsis capensis*	Stork-billed Kingfisher	Alcedinidae	IV	LC
13	*Dendrocygna javanica*	Lesser Whistling Duck	Anatidae	IV	LC
14	*Mareca strepera*	Gadwall	Anatidae	IV	LC
15	*Nettapus coromandelianus*	Cotton Teal	Anatidae	IV	LC
16	*Tadorna ferruginea*	Ruddy Shelduck	Anatidae	IV	LC
17	*Apus affinis*	Little Swift	Apodidae	IV	LC
18	*Cypsiurus balasiensis*	Asian Palm Swift	Apodidae	IV	LC
19	*Ardea alba*	Great Egret	Ardeidae	IV	LC
20	*Ardea cinerea*	Grey Heron	Ardeidae	IV	LC
21	*Ardea intermedia*	Intermediate Egret	Ardeidae	IV	LC
22	*Ardea purpurea*	Purple Heron	Ardeidae	IV	LC
23	*Ardeola grayii*	Indian Pond Heron	Ardeidae	IV	LC
24	*Bubulcus ibis*	Cattle Egret	Ardeidae	IV	LC
25	*Egretta garzetta*	Little Egret	Ardeidae	IV	LC
26	*Ixobrychus cinnamomeus*	Cinnamon Bittern	Ardeidae	IV	LC
27	*Nycticorax nycticorax*	Black-crowned Night-Heron	Ardeidae	IV	LC
28	*Artamus fuscus*	Ashy Woodswallow	Artamidae	IV	LC
29	*Caprimulgus asiaticus*	Indian Nightjar	Caprimulgidae	IV	LC
30	*Charadrius dubius*	Little Ringed Plover	Charadriidae	IV	LC
31	*Vanellus indicus*	Red-wattled Lapwing	Charadriidae	IV	LC
32	*Vanellus malabaricus*	Yellow-wattled Lapwing	Charadriidae	IV	LC
33	*Anastomus oscitans*	Asian Openbill	Ciconiidae	IV	LC
34	*Leptoptilos javanicus*	Lesser Adjutant	Ciconiidae	IV	VU
35	*Cisticola juncidis*	Zitting Cisticola	Cisticolidae	IV	LC
36	*Orthotomus sutorius*	Common Tailorbird	Cisticolidae	IV	LC
37	*Prinia hodgsonii*	Grey-breasted Prinia	Cisticolidae	IV	LC
38	*Prinia inornata*	Plain Prinia	Cisticolidae	IV	LC
39	*Prinia socialis*	Ashy Prinia	Cisticolidae	IV	LC
40	*Columba livia*	Rock Pigeon	Columbidae	IV	LC

41	*Streptopelia chinensis*	Spotted Dove	Columbidae	IV	LC
42	*Streptopelia decaocto*	Eurasian Collared Dove	Columbidae	IV	LC
43	*Treron phoenicopterus*	Yellow-footed Green Pigeon	Columbidae	IV	LC
44	*Coracias benghalensis*	Indian Roller	Coraciidae	IV	LC
45	*Merops orientalis*	Green Bee-eater	Coraciidae	IV	LC
46	*Merops philippinus*	Blue-tailed Bee-eater	Coraciidae	IV	LC
47	*Corvus splendens*	House Crow	Corvidae	V	LC
48	*Dendrocitta vagabunda*	Rufous Treepie	Corvidae	IV	LC
49	*Centropus sinensis*	Greater Coucal	Cuculidae	IV	LC
50	*Clamator jacobinus*	Pied Cuckoo	Cuculidae	IV	LC
51	*Eudynamys scolopaceus*	Asian Koel	Cuculidae	IV	LC
52	*Hierococcyx varius*	Common Hawk Cuckoo	Cuculidae	IV	LC
53	*Dicrurus macrocercus*	Black Drongo	Dicruridae	IV	LC
54	*Amandava amandava*	Red Munia	Estrildidae	IV	LC
55	*Euodice malabarica*	Indian Silverbill	Estrildidae	IV	LC
56	*Lonchura malacca*	Tricoloured Munia	Estrildidae	IV	LC
57	*Lonchura punctulata*	Scaly-breasted Munia	Estrildidae	IV	LC
58	*Falco tinnunculus*	Common Kestrel	Falconidae	IV	LC
59	*Glareola lactea*	Small Pratincole	Glareolidae	IV	LC
60	*Hirundo rustica*	Barn Swallow	Hirundinidae	IV	LC
61	*Hirundo smithii*	Wire-tailed Swallow	Hirundinidae	IV	LC
62	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	Jacanidae	IV	LC
63	*Metopidius indicus*	Bronze-winged Jacana	Jacanidae	IV	LC
64	*Lanius cristatus*	Brown Shrike	Laniidae	IV	LC
65	*Lanius schach*	Long-tailed Shrike	Laniidae	IV	LC
66	*Argya caudata*	Common Babbler	Leiothrichidae	IV	LC
67	*Argya striata*	Jungle Babbler	Leiothrichidae	IV	LC
68	*Schoenicola striatus*	Bristled Grassbird	Locustellidae	IV	VU
69	*Psilopogon asiaticus*	Blue-throated Barbet	Megalaimidae	IV	LC

70	*Psilopogon haemacephalus*	Coppersmith Barbet	Megalaimidae	IV	LC
71	*Psilopogon lineatus*	Lineated Barbet	Megalaimidae	IV	LC
72	*Anthus hodgsoni*	Olive-backed Pipit	Motacillidae	IV	LC
73	*Anthus rufulus*	Paddyfield Pipit	Motacillidae	IV	LC
74	*Motacilla alba*	White Wagtail	Motacillidae	IV	LC
75	*Motacilla cinerea*	Grey Wagtail	Motacillidae	IV	LC
76	*Motacilla citreola*	Citrine Wagtail	Motacillidae	IV	LC
77	*Motacilla maderaspatensis*	White-browed Wagtail	Motacillidae	IV	LC
78	*Motacilla tschutschensis*	Eastern Yellow Wagtail	Motacillidae	IV	LC
79	*Copsychus fulicatus*	Indian Robin	Muscicapidae	IV	LC
80	*Copsychus saularis*	Oriental Magpie Robin	Muscicapidae	IV	LC
81	*Eumyias thalassinus*	Verditer Flycatcher	Muscicapidae	IV	LC
82	*Ficedula albicilla*	Taiga Flycatcher	Muscicapidae	IV	LC
83	*Saxicola maurus*	Siberian Stonechat	Muscicapidae	IV	LC
84	*Cinnyris asiaticus*	Purple Sunbird	Nectariniidae	IV	LC
85	*Leptocoma zeylonica*	Purple-rumped Sunbird	Nectariniidae	IV	LC
86	*Oriolus kundoo*	Indian Golden Oriole	Oriolidae	IV	LC
87	*Oriolus xanthornus*	Black-hooded Oriole	Oriolidae	IV	LC
88	*Pandion haliaetus*	Osprey	Pandionidae	I (3)	LC
89	*Chrysomma sinense*	Yellow-eyed Babbler	Paradoxornithidae	IV	LC
90	*Passer domesticus*	House Sparrow	Passeridae	IV	LC
91	*Microcarbo niger*	Little Cormorant	Phalacrocoracidae	IV	LC
92	*Francolinus pondicerianus*	Grey Francolin	Phasianidae	IV	LC
93	*Phylloscopus fuscatus*	Dusky Warbler	Phylloscopidae	IV	LC
94	*Phylloscopus inornatus*	Yellow-browed Warbler	Phylloscopidae	IV	LC
95	*Phylloscopus trochiloides*	Greenish Warbler	Phylloscopidae	IV	LC
96	*Dinopium benghalense*	Black-rumpedFlameback	Picidae	IV	LC
97	*Ploceus philippinus*	Baya Weaver	Ploceidae	IV	LC
98	*Tachybaptus ruficollis*	Little Grebe	Podicipedidae	IV	LC

99	*Psittacula eupatria*	Alexandrine Parakeet	Psittaculidae	IV	NT
100	*Psittacula krameri*	Rose-ringed Parakeet	Psittaculidae	IV	LC
101	*Pycnonotus cafer*	Red-vented Bulbul	Pycnonotidae	IV	LC
102	*Pycnonotus jocosus*	Red-whiskered Bulbul	Pycnonotidae	IV	LC
103	*Amaurornis phoenicurus*	White-breasted Waterhen	Rallidae	IV	LC
104	*Fulica atra*	Common Coot	Rallidae	IV	LC
105	*Gallinula chloropus*	Common Moorhen	Rallidae	IV	LC
106	*Porphyrio poliocephalus*	Grey-headed Swamphen	Rallidae	IV	LC
107	*Actitis hypoleucos*	Common Sandpiper	Scolopacidae	IV	LC
108	*Calidris temminckii*	Temminck's Stint	Scolopacidae	IV	LC
109	*Gallinago gallinago*	Common Snipe	Scolopacidae	IV	LC
110	*Tringa ochropus*	Green Sandpiper	Scolopacidae	IV	LC
111	*Athene brama*	Spotted Owlet	Strigidae	IV	LC
112	*Otus bakkamoena*	Indian Scops Owl	Strigidae	IV	LC
113	*Tyto alba*	Barn Owl	Strigidae	IV	LC
114	*Acridotheres ginginianus*	Bank Myna	Sturnidae	IV	LC
115	*Acridotheres tristis*	Common Myna	Sturnidae	IV	LC
116	*Gracupica contra*	Asian Pied Starling	Sturnidae	IV	LC
117	*Sturnia malabarica*	Chestnut-tailed Starling	Sturnidae	IV	LC
118	*Sturnia pagodarum*	Brahminy Starling	Sturnidae	IV	LC
119	*Pseudibis papillosa*	Red-naped Ibis	Threskiornithidae	IV	LC
120	*Upupa epops*	Common Hoopoe	Upupidae	IV	LC

Figure 17: Ashy Woodswallow Artamus fuscus

Figure 18: Yellow-wattled Lapwing Vanellus malabaricus

Figure 19: Lesser Adjutant Leptoptilos javanicus

Figure 20: Rose-ringed Parakeet Psittacula krameri

Figure 21 Osprey Pandion haeliatus

Figure 22: Wire-tailed Swallow Hirundo smithii

4.2.3 List of Butterflies

Table 10: List of butterflies of Essar project sites and the Buffer area (area enclosed under 10 km radius).

Sl. No.	Scientific Name	Common Name	Family	WPA Schedule	IUCN Status
1	*Spialia galba*	Indian Grizzled Skipper	Hesperiidae		NE
2	*Udaspes folus*	Grass Demon	Hesperiidae		NE
3	*Suastus gremius*	Indian Palm Bob	Hesperiidae		NE
4	*Borbo cinnara*	Rice Swift	Hesperiidae		NE
5	*Amblypodia anita*	Purple Leaf Blue	Lycaenidae	I (4)	NE
6	*Jamides celeno*	Common Cerulean	Lycaenidae		NE

7	*Catochrysops strabo*	Forget-me-not	Lycaenidae		NE
8	*Lampides boeticus*	Pea Blue	Lycaenidae		LC
9	*Castalius rosimon*	Common Pierrot	Lycaenidae		NE
10	*Zizeeria karsandra*	Dark Grass Blue	Lycaenidae		LC
11	*Pseudozizeeri amaha*	Pale Grass Blue	Lycaenidae		NE
12	*Chilades lajus*	Lime Blue	Lycaenidae		NE
13	*Danaus chrysippus*	Plain Tiger	Nymphalidae		LC
14	*Danaus genutia*	Striped Tiger	Nymphalidae		NE
15	*Tirumala limniace*	Blue Tiger	Nymphalidae		NE
16	*Euploea core*	Common Crow	Nymphalidae		LC
17	*Elymnias hypermnestra*	Common Palmfly	Nymphalidae		NE
18	*Melanitis leda*	Common Evening Brown	Nymphalidae		LC
19	*Mycalesis perseus*	Common Bushbrown	Nymphalidae		NE
20	*Neptis hylas*	Common Sailer	Nymphalidae		NE
21	*Neptis jumbah*	Chestnut-streaked Sailer	Nymphalidae	I (4)	NE
22	*Moduza procris*	Commander	Nymphalidae		NE
23	*Euthalia aconthea*	Common Baron	Nymphalidae		NE
24	*Symphaedra nais*	Baronet	Nymphalidae		NE
25	*Phalanta phalantha*	Common Leopard	Nymphalidae		NE
26	*Ariadne merione*	Common Castor	Nymphalidae		NE
27	*Junonia almana*	Peacock Pansy	Nymphalidae		LC
28	*Junonia atlites*	Grey Pansy	Nymphalidae		NE
29	*Junonia hierta*	Yellow Pansy	Nymphalidae		LC
30	*Junonia iphita*	Chocolate Pansy	Nymphalidae		NE
31	*Junonia lemonias*	Lemon Pansy	Nymphalidae		NE
32	*Junonia orithya*	Blue Pansy	Nymphalidae		NE
33	*Hypolimnas bolina*	Great Eggfly	Nymphalidae		NE
34	*Hypolimnas misippus*	Danaid Eggfly	Nymphalidae	I (4)	LC

35	*Acraea terpsicore*	Tawny Coster	Nymphalidae	NE
36	*Pachliopta aristolochiae*	Common Rose	Papilionidae	LC
37	*Papilio demoleus*	Common Lime	Papilionidae	NA
38	*Papilio polytes*	Common Mormon	Papilionidae	NE
39	*Graphium agamemnon*	Tailed Jay	Papilionidae	NE
40	*Graphium doson*	Common Jay	Papilionidae	NE
41	*Catopsilia pomona*	Common Emigrant	Pieridae	NE
42	*Catopsilia pyranthe*	Mottled Emigrant	Pieridae	NE
43	*Eurema hecabe*	Common Grass Yellow	Pieridae	NE
44	*Leptosia nina*	Psyche	Pieridae	NE
45	*Ixias marianne*	White Orange-tip	Pieridae	NE
46	*Appias libythea*	Striped Albatross	Pieridae	NE
47	*Cepora nerissa*	Common Gull	Pieridae	NE
48	*Delias eucharis*	Common Jezebel	Pieridae	NE
49	*Pareronia hippia*	Indian Wanderer	Pieridae	NE

Figure 23: Purple Leaf Blue Amblypodia anita

Figure 24: Danaid Eggfly Hypolimnas misippus


Figure 25: Common Palmfly Elymnias hypermnestraFigure 26: Grass Demon Udaspes folus

4.2.4 List of Mammals

Table 11: List of mammals of Essar project sites and the Buffer area (area enclosed under 10 km radius).

Sl. No.	Scientific Name	Common Name	Family	WPA Schedule	IUCN Status
1	*Canis aureus*	Golden Jackal	Canidae	II (1)	LC
2	*Canis lupus*	Grey Wolf	Canidae	I (1)	LC
3	*Vulpes bengalensis*	Bengal Fox	Canidae	II (1)	LC
4	*Semnopithecus entellus*	Hanuman Langur	Cercopithecidae	II (1)	LC
5	*Felis chaus*	Jungle Cat	Felidae	II (1)	LC
6	*Urva edwardsii*	Indian Grey Mongoose	Herpestidae	II (1)	LC
7	*Hyaena hyaena*	Striped Hyaena	Hyaenidae	III	NT
8	*Lepus nigricollis*	Black-naped Hare	Leporidae	IV	LC
9	*Bandicota bengalensis*	Lesser Bandicoot Rat	Muridae	V	LC
10	*Bandicota indica*	Greater Bandicoot Rat	Muridae	V	LC
11	*Rattus norvegicus*	Brown Rat	Muridae	V	LC
12	*Rattus rattus*	Black Rat	Muridae	V	LC
13	*Mus musculus*	House Mouse	Muridae	V	LC
14	*Pteropus giganteus*	Indian Flying Fox	Pteropodidae	IV	LC
15	*Funambulus pennantii*	Asian Palm Squirrel	Sciuridae	IV	LC

16	*Suncus murinus*	Asian House Shrew	Soricidae		LC
17	*Hystrix indica*	Indian Crested Porcupine	Hystricidae	IV	LC

Figure 27: Asian House Shrew Suncus murinus

Figure 28: Indian Flying Fox Pteropus giganteus

Figure 29: Jungle Cat Felis chaus

Figure 30: Black-naped Hare Lepus nigricollis

Figure 31: Golden Jackal Canis aureus

Figure 32: Grey langur/ Hanuman langur Semnopithecus entellus

Figure 33: Indian Grey Wolf Canis lupus

Figure 34: Road killed Golden Jackal

4.2.5 List of Reptiles

Table 12: List of reptiles of Durgapur Steel Plant zone and the Buffer area.

Sl. No.	Scientific Name	Common Name	Family	WPA Schedule	IUCN Status
1	*Calotes versicolor*	Oriental Garden Lizard	Agamidae		LC
2	*Sitana spinaecephalus*	Spiny-headed Fan-throated Lizard	Agamidae		NE
3	*Amphiesma stolatum*	Buff-striped Keelback	Colubridae	IV	NE
4	*Atretium schistosum*	Olive Keelback	Colubridae	II (1)	LC
5	*Dendrelaphis tristis*	Bronzeback Tree Snake	Colubridae	IV	NE
6	*Fowlea piscator*	Checkered Keelback	Colubridae	II (1)	NE
7	*Lycodon aulicus*	Indian Wolf Snake	Colubridae	IV	NE
8	*Ptyas mucosa*	Common Rat Snake	Colubridae	II (1)	NE
9	*Bungarus caeruleus*	Common Krait	Elapidae	IV	NE
10	*Naja kaouthia*	Monocled Cobra	Elapidae	II (1)	LC
11	*Hemidactylus flaviviridis*	Northern House Gecko	Gekkonidae		NE
12	*Hemidactylus cf. parvimaculatus*	Spotted House Gecko	Gekkonidae		NE
13	*Python molurus*	Indian Rock Python	Pythonidae	I (2)	NE

14	*Varanus flavescens*	Golden Monitor	Varanidae	I (2)	LC
15	*Daboia russelii*	Russell's Viper	Viperidae	II (1)	NE

Figure 35: Common Krait Bungarus caerulus

Figure 36: Common Wolf Snake Lycodon aulicus

Figure 37: Russell's Viper Daboia russelii

Figure 38: Gecko Hemidactylus parvimaculatus

5 CONSERVATION PLAN FOR THREE SCHEDULE I SPECIES

5.1 CURRENT AVAILABLE KNOWLEDGE FOR INDIAN GOLDEN JACKAL

5.1.1 Introduction

Indian subcontinent is home to only one species of jackal i.e., the Golden Jackal. It is a small sized canid closely related to wolves, foxes, and wild dogs. They are one of the most widespread canids in India as well as in West Bengal. As the name suggests, the coat is golden brown with a bit of mottled fur in between. In winter, however depending on the region, a darker coat can be seen. Golden jackals can be found in a wide range of habitats starting from dry deciduous forests, and semi-arid regions to agricultural lands and close to human settlement. The Golden jackal has long, pointed ears and long hair. The coat of the animal is rather coarse and not very long. The tail is fluffy and long. Being the largest species of jackal, this animal, however, has lighter tread, shorter tail, more slender build, and a narrower, more pointed muzzle, compared to other jackal species.

The Golden jackal can often be confused with other members of the Canid family like wolf, fox, and wild dogs. Compared to these wolves, the jackals have shorter legs, tail, and snout. They are distinctively smaller in size as well. The coat colour might be similar to the wolves of India in some regions, but commonly they have a beige – yellow coloured coat as compared to the dusky coat in the wolves. The easiest way to differentiate them from the jackals is to look at the tail, which is not bushy, but pretty slim. Bengal fox is the smallest member of the canid family in India. They have distinctively large ears, an elongated muzzle, and a bushy tail. But the most distinctive way of distinguishing the two is that the Bengal fox has a bushy tail with a black tip at the end, and white ears from the inside.

5.1.2 Geographical and Ecological Distribution in West Bengal

Golden Jackal is one of the most common Canid in $WB.$ It can be found in almost all districts of the state where there is suitable habitat for them. They can be mostly found in a wide range of habitat starting from dry deciduous forests, and semi-arid regions to agricultural lands and close to human settlement. In South Bengal they can be mostly found in Purulia, Bankura,

Burdwan, Birbhum, Midnapore, Howrah, Kolkata, 24 Parganas, Hooghly, Nadia, Murshidabad and Jhargram.

5.1.3 Behaviour

Jackals are big-time scavenging machines. They will salvage whatever they can from a carcass, as quickly as possible. These are mostly tiger/leopard kills. But they are also expert hunters when it comes to small-sized prey like a Chital fawn. They are fast, agile, and resilient chasers. The Golden Jackals are generally not pack hunters and stay in pairs. The pair hunts and scavenges together. But there have been a few records of jackals in packs, mostly grown-up pups. These are monogamous species, so they will mate for life. The pups are reared in a den. However, a jackal will have multiple dens with multiple openings for a faster escape route. The pair will defend the territory together from other jackals.

5.1.4 Feeding

Golden jackals are omnivores. These opportunistic foragers have a rather diverse diet. They feed on a wide variety of animal species such as young herbivores, hares, reptiles, ground birds and their eggs, fish, frogs as well as insects. The usual diet of Golden jackals also includes various fruits. During the winter months, they frequently eat rodents and in addition to that they can also consume carrion.

5.1.5 Reproduction

Golden jackals have a monogamous mating system with females, fiercely defending the territory from other females. Breeding season takes place at the beginning of February or at the end of January and lasts for about a month. After the gestation period of 63 days, the female gives birth in a den within the pair's territory. One litter can yield 1-9 babies, with an average of 2-4 pups. The female nurses the young for about 8 weeks, after which they are weaned. Females reach reproductive maturity during the first year of their lives while male jackals become reproductively mature within 2 years.

5.1.6 Conservation Status

It has been listed as Least Concern under IUCN Red List of Threatened Species owing to its huge geographical distribution and its ability to thrive in wide array of habitats. Golden Jackal has been listed in Schedule I of the Wildlife Protection Act, 1972.

5.1.7 Importance in Nature

Carnivore such as Golden Jackals are important in maintaining and regulating ecosystems. Through hunting they keep the prey population in check which in turn is helping in ecosystem balance. Golden jackals play an important scavenging role by eating garbage and animal carrion around towns and villages. They benefit agriculture by preventing increases in the number of rodents and lagomorphs.

5.1.8 Distribution, Population and Abundance Estimation

5.1.8.1 Map of suitable habitat areas with distribution status of species in South Bengal

Golden Jackals are one of the most common canid species present in West Bengal and it can be found in good numbers in all the districts of South Bengal due to its adaptive ability in a wide range of habitats. The suitable habitat analysis as per a recent study show that the highest suitable regions for Indian grey wolf was found to reside in Bankura and West Midnapore having 2341 sq.km and 2199 sq.km respectively followed by Purulia (2059 sq.km). Other districts like Burdwan and Birbhum show mid suitability in terms of habitat for Golden jackal whereas East Midnapore, Haora, Nadia, Hooghly and other districts were found to be less suitable for the species as per the Habitat Analysis study (Figure 36).

5.1.8.2 Estimation of population in the demarcated area of conservation by trap cameras, DNA analysis, sightings etc.

As per a recent study conducted by Zoological Survey of India in association with the Forest Department of West Bengal found that among the three districts surveyed, the encounter rate (no. of signs/km) was highest in Hooghly (0.87±0.08) and it was lowest in Jhargram (0.13±0.06) (Figure 4.21).Whereas in all the forest divisions that were surveyed, the ER (no. of signs/km)

of Golden Jackal (*Canis aureus*) was highest in Howrah-Hoogly forest division (0.87±0.08) followed by Nadia-Murshidabad (0.81±0.16), Bankura north (0.63±0.12), Purba Medinipur (0.61±0.08), Bankura South (0.42±0.10), Kangsabati North (0.42±0.12), Kangsabati South (0.36±0.08), Purulia (0.33±0.06), Medinipur (0.30±0.06), Burdwan (0.26±0.06), Rupnarayan (0.19±0.10), Kharagpur (0.19±0.05), Birbhum (0.18±0.05), Jhargram (0.13±0.06) and Durgapur (0.06±0.04) forest division (Figure 37).

5.1.8.3 Spatial pattern of conflict and threats in the individual sites

The previous study in South Bengal showed that the Spatial pattern of Human-Indian grey wolf conflict indicates that most of the high intensity conflict zones were located in the far western regions with some medium level of conflict zones in the southern portion of the study landscape. Human presence, elevation, cattle density and railway lines in the region are found to have a positive relation with the conflict. The conflicts mostly include livestock attack in those areas by Indian Grey Wolf whereas human attacks are almost nil in all these areas. As a result of this cattle attacks, sometimes they are killed by humans (the numbers are very much low) in the regions where they are present in South Bengal (Figure 38).

5.2 CURRENT AVAILABLE KNOWLEDGE FOR INDIAN GREY WOLF

5.2.1 Description of species

The Indian grey wolf is one of the top carnivore species distributed in the open grasslands of peninsular India. It inhabits thorn forests, scrublands, arid and semi-arid grassland habitats in India. Indian Grey Wolf is medium in size around 3 ft (91 cm) in length and the tail adds about 11-20 in (29-50 cm). It lacks a luxuriant winter coat due to it living in warmer conditions. Indian wolves have short, thin fur in summer, though the hair on the back remains long even in summer which is thought to be an adaptation against solar radiation. The fur is generally greyish-red to reddish-white with grey tones. The hairs are grizzled with black, particularly on the back, which sports a dark V-shaped patch around the shoulders. The limbs are paler than the body, and the underparts are almost completely white. Pups are born sooty-brown, with a milk-white patch on the chest that fades with age.

5.2.2 Geographical and Ecological distribution in West Bengal

Grey wolves are mostly distributed in South Bengal. They are mostly found in thorn forests, scrublands, arid and semi-arid grassland habitats, which are a characteristic feature of the western part of South Bengal. It is reported from Purulia, Bankura, Jhargram, Birbhum, West Midnapore and Paschim Bardhaman districts of the state.

5.2.3 Behaviour

Indian wolves generally live in smaller packs rarely exceeding 6-8 individuals. They are also relatively less vocal and have rarely been known to howl. Indian wolves are territorial and hunt during the night. Each member of the pack will hunt for its own food, however, when targeting big prey such as antelopes, they prefer to hunt in pairs.

5.2.4 Feeding

Indian grey wolf is generally carnivorous and one of the apex predators in agro-pastoral ecosystems in India. Recent studies reveal that due to their presence in the areas nearer to the human habitation, these wolves primarily subsist on livestock. Besides scavenging the wolf also predates livestock like goats, sheep, and cattle calves.

5.2.5 Reproduction

Indian wolves are monogamous and mate for life. They tend to breed from mid-October to late December. Females give birth to 5-6 pups in holes or ravines. The gestation period usually lasts around 62-75 days. The pups are born blind and their eyes open after 9-12 days of birth. The entire pack usually helps in caring for new-borns and when pups are around 3 months old, they are ready to leave the den. Indian wolves become reproductively mature after around 2 years of age.

5.2.6 Conservation Status

They are considered Least Concern in the IUCN Red List of Threatened Species owing to their large distribution and ability to thrive in wide variety of habitats. India Grey Wolf is listed on Schedule I of the Wildlife Protection Act, 1972.

5.2.7 Importance in Nature

Feeding upon a wide variety of animal species, Indian wolves may control the numbers of their populations, thus benefiting different animal and plant species of their range.

5.2.8 Distribution, Population and Abundance Estimation

5.2.8.1 Map of suitable habitat areas with distribution status of species in South Bengal

The Indian Grey Wolf can be found in only the western regions of South Bengal mostly in the districts of Purulia, Bankura, both the Bardhaman districts, Birbhum, West Midnapore and Jhargram as per the recent sightings done by various locals, photographers, citizen scientists in the recent time. Not much is known about their presence in the southern districts like Howrah, Hooghly, Kolkata, 24 Parganas and East Midnapore.

The suitable habitat analysis as per a recent study show that the highest suitable regions for Indian grey wolf was found to reside in Bankura and West Midnapore having 3,040 sq.km and 2,557 sq.km respectively followed by Purulia (1324 sq.km), Birbhum (1162 sq.km) and Burdwan (817 sq.km).

5.2.8.2 Estimation of population in the demarcated area of conservation by Trap Camera, DNA Analysis, Sightings etc.

As per a recent study conducted by Zoological Survey of India in association with the Forest Department of West Bengal found that out of the total ten districts studied, the encounter rate (no. of signs/km) was highest in Purulia (0.25±0.06) and it was lowest in Birbhum (0.19±0.05).

5.2.8.3 Spatial pattern of conflict and threats in the individual sites

The previous study in South Bengal showed that the Spatial pattern of Human-Indian grey wolf conflict indicates that most of the conflict hotspots were in the far western regions of the study landscape mostly in the districts of Purulia, Bankura, Birbhum, Burdwan, West Midnapore and Burdwan. The study also found that among the topographic predictors elevation was found to have a positive correlation with the spatial distribution of human-Wolf cases, within the study area whereas among the anthropogenic predictors, distance to road and the cattle density was found to be the most influential variables. The conflicts mostly include livestock attack in those areas by Indian Grey Wolf whereas human attacks are almost nil in all these areas. As a result of this cattle attacks, sometimes they are killed by humans (the numbers are very much low) in the regions where they are present in South Bengal.

5.3 CURRENT AVAILABLE KNOWLEDGE FOR STRIPED HYENA

5.3.1 Description of species

Of the four extant hyena species, Indian Striped Hyena is the only hyena species found in the Indian Subcontinent. They primarily inhabit semi deserts, scrub forests, woodlands, grasslands, acacia bushlands, rocky terrain, and tropical savannas. Striped Hyenas generally measure between 1 – 1.15 metres in length excluding the tail (which measures 12.5 inches) and stand 0.66 – 0.75 metres at the shoulder. Males weigh between 26 – 41 kilograms (57 – 90 pounds) and females weigh 26 – 34 kilograms (57 – 75 pounds). They have a big head with dim eyes, a thick gag, and huge pointed ears and solid jaws. They are grey to straw coloured with a black muzzle and black coloured stripes on their head, torso and legs which provides them camouflages properly in tall, dry grass. have a black patch on their throat. The distinguished striking highlights on the hyena are the legs: the front legs are much longer than the hind legs. This offers hyenas their unmistakable stroll.

5.3.2 Geographical and Ecological distribution in West Bengal

Striped Hyena is limited to only the Western region of West Bengal primarily in Purulia, Bankura, Jhargram and Paschim Bardhaman districts.

5.3.3 Behaviour

Striped Hyena is nocturnal spending most of their daytime in their den resting. They are solitary or found in group of 1 and 2, with territories of individual overlapping each other. They do forage alone, however. When there is plenty of food, a mother may share her den and hunting ranges with her adult daughters. Young females who have not yet reproduced or found their own home range sometimes help with the raising of their mother's and sisters' cubs. This species forages at night and is only active during the day if the weather is rainy, cloudy, or stormy. They sleep or rest in large caves or will sometimes use dense vegetation for cover. Striped hyenas are typically quiet but will screech loudly or growl and then roar if seriously threatened. They will call to their cubs, responding to their whines by feeding them. They raise their impressive manes when threatened or upset, which makes them appear

nearly double the size, to make enemies back off. They are territorial creatures and scent-mark their territorial boundaries as a warning to their rivals.

5.3.4 Feeding

Striped hyenas are primarily scavengers and eat mainly carrion and human refuse. They scavenge medium and large-sized mammals, such as wildebeests, zebras, gazelles, and impalas. They will eat bones from carcasses after the meat has gone. They will also sometimes kill small animals such as rodents, hares, reptiles, and birds. They are also known to eat insects, fruits (oil willow fruits), melons and dates.

5.3.5 Reproduction

Striped hyenas are monogamous, and males help females establish their den, raise the young and feed their mate when the cubs are born. Mating seasons vary with the location: in Transcaucasia, they breed from January to February, and in southeast Turkmenia, they breed from October to November. A litter numbers 1 to 4 and is born after a gestation period of 90 days. Cubs are raised in dens, caves, or shallow rock hollows. When born they are blind with their ear canals closed. In 7 to 8 days, they can open their eyes. After 3 weeks their teeth develop. They can eat solid food in a month. Weaning can be any time from 8 weeks until 12 months, while their mother teaches them foraging skills. These animals reach reproductive maturity when they are 2-3 years old.

5.3.6 Conservation Status

Striped Hyena is considered as Near Threatened in the IUCN Red List of Threatened Species and is listed under Schedule I of the Wildlife Protection Act, 1972.

5.3.7 Importance in Nature

Carnivore such as Striped Hyenas are important in maintaining and regulating ecosystems. Through hunting they keep the prey population in check which in turn is helping in ecosystem balance. They also play an important scavenging role by eating garbage and animal carrion around towns and villages. They benefit agriculture by preventing increases in the number of rodents and lagomorphs.

5.3.8 Distribution, Population and Abundance Estimation

5.3.8.1 Map of suitable habitat areas with distribution status of species in South Bengal

Striped Hyena is only known to occur in Purulia, Jhargram and West Midnapore districts of Southwestern Bengal in the recent times. There are also some scattered reports from Bankura districts as well. Some locals of Burdwan districts have also claimed to sight it but without any photographic evidence. However, Carcas of the striped hyaena was recovered from a forest road under Basudha Beat of Durgapur Range of Burdwan Forest Division. Further 2 no's striped hyaenas were rescued from Netudihi village of Baraboni Block & Churulia village of Asansol under Durgapur Forest Division The habitat analysis as per the recent study shows that the most suitable regions are found to reside in Purulia district followed by some in Bankura and West Midnapore districts. However other districts in South Bengal were not found to be suitable for this species.

5.3.8.2 Estimation of population in the demarcated area of conservation by Trap Camera, DNA Analysis, Sightings etc.

As per a recent study conducted by Zoological Survey of India in association with the Forest Department of West Bengal found that among the ten districts that were surveyed, the highest encounter rate (no. of signs/km) of Striped Hyena was observed in Purulia district and lowest in Bakura district. Whereas among the fifteen forest divisions that were surveyed, the highest sign encounter rate of Striped Hyena (Hyaena hyaena) was observed in Purulia forest division (0.11±0.04) followed by Bankura South (0.03±0.03), Bankura North (0.02± 0.02), Kangsabati South (0.01±0.01), and Kangsabati North forest division (0.01±0.01).

5.3.8.3 Spatial pattern of conflict and threats in the individual sites

The previous study in South Bengal showed that the Spatial pattern of Human-Indian grey wolf conflict indicates that Hyaena-Human conflict cases in the study area was only being observed in the most south-western portion of the landscape because of its restricted distribution in those regions only. The influence of anthropogenic predictors i.e., distance from railway lines and build-up areas was found to be one of the major positive influencers for increasing conflict in the region.

5.4 EXISTING THREATS FOR THE THREE SPECIES

5.4.1 Habitat Loss

In the present time habitat loss owing to rapid urbanisation, deforestation, conversion of forest lands into agricultural fields leads to severe habitat loss for the species living in those forested areas. Moreover, the construction of roads, railways and other activities like mining poses a grave danger for wildlife. Habitat fragmentation due to these roads and railways is also becoming a major threat in the recent times due to which the roadkill incidents are increasing day by day. The suitable habitat area available for the all the three species- Golden Jackal, Indian Grey Wolf and Striped Hyaena in the present location is heavily fragmented and is highly susceptible to loss in the near future. Forest Fires is another major constraint to the survival of the faunal species.

5.4.2 Human- animal conflict

Human-animal conflict can be considered as one of the major threats for both the decreasing of wildlife nowadays. Human animal conflicts can be of various types like crop damage, attack on the livestock, human attacks, retaliatory killings and other. With increasing urbanisation and conversion of forested lands for plantations and agricultural purposes, the suitable habitat area for the wildlife living there is decreasing in a rapid manner and so these conflicts are becoming more prevalent. In a Human dominated resource-poor landscape of southwest Bengal, wild animals such as Indian grey wolf, Golden Jackal, Striped Hyena and Wild Boar live in proximity with humans. The human settlements may serve as the food resources for them because of insufficient natural prey base in forested habitats. In the districts of Southwest Bengal, crop damage and livestock depredation are major issues which makes human wildlife conflict management a challenging task. In the present location most of the human animal conflicts includes livestock attack, human attacks, and retaliatory killings. Cattle depredation is mainly done by Indian Grey Wolves and Golden Jackals. Most of the attacks on goats and sheep occur either during grazing time or the wild animals capture them directly from the courtyard at night-time almost every day. Human attacks are quite rare in these areas and only a few have been reported in the past years. Retaliatory killing is increasing more and more in the recent times. Locals have reported the killing/lethal removal

of these study animals by them to minimize the economic losses resulted because of the animals. The antagonistic behaviour of local communities towards these species is largely because of serious economic losses caused by these species. Moreover, killing of study animals during the 'Shikar Utsab' by tribal communities as a annuals cultural practice is posing major threat in these areas in the present time. Lack of awareness among the local communities about the ecology and behaviour of these three carnivore species is making the situation more difficult.

5.4.3 Poaching and Wildlife trafficking

Poaching and Wildlife trafficking of Golden Jackal, Indian Grey Wolf and Striped Hyaena is not so commonly reported.

5.4.4 Prey base situation

Poor availability of natural prey species of large predators such as hyena and wolf are posing a great danger for these animals. Due to the decreasing number of the natural prey of these carnivore species, cattle depredation is increasing in the recent times. This decrease is mainly due to hunting and consumption by local people. Apart from that poor data base regarding the population estimation of these species is posing a major threat to the planning of management and conservation initiatives for these species.

6 GENERAL CONSERVATION PLAN

Industrial and construction activities degrade the landscape and adjoining areas to a large extent. A large stretch of land had to be either deforested or degraded for these industrial activities and construction activities. Water and dust pollution is also a hazard which crosses the project site limits and jeopardises the wildlife and human habitations in the adjoining areas. There are several public and private sector industries of varying scales inside the 10 km radius. Hence, the environmental degradations and effects on wildlife inside the project impact area (10 km radius around the CBM well-pad sites) is effectively larger than the designated area. This Management Plan therefore aims at reducing the threats the activities pose to the wildlife and environment.

Since, majority of the land in the project impact area is not owned by the Forest Department, or demarcated as Forest Land, the Divisional Forest Officers (DFOs) cannot directly introduce the interventions. However, with a view to improve the habitat for wildlife, improve the economy of the region and localities in the PIA, enhance the greenery and improve the living conditions of the residents, following measures are hereby proposed which are to be taken up by the concerned administrations.

6.1 LANDSCAPE RESTORATION AND HABITAT IMPROVEMENT

6.1.1 Preservation of priority biodiversity enriched area

The areas with the most population for the species or are experiencing severe anthropogenic pressures should be demarcated for focused conservation activities. Highest level of monitoring and conservation should be given to these areas for the sake of these species.

Based on survey and previous data collected by our society, certain sites have been identified which are key biodiversity enriched area housing several threatened mammals, scheduled birds, reptiles, and butterflies. These regions are:

1. *Bandra-Sadhumara primary forest:* This area is enriched in floral diversity. Various parasitic plants such as *Aeginetia indica*, terrestrial orchids such as *Geodorum*

densiflorum, *Plantaginorchis plantaginea*, *Eulophia explanata* have been observed here in the leaf litter of the moist forest floor. Mammals such as Grey Wolves, Golden Jackals and important herpeto-faunal diversity have also been recorded in the short study here. Exceptional biodiversity of this region appeals for conservation measure.

2. *Plantations and primary forest around Bijra-IQ City-Pardaha:* This area is rich in biodiversity with about 130 species of birds and some important mammalian species. Some interesting species found in this area includes Indian Grey Wolf *Canis lupus*, Bengal Fox *Vulpes bengalensis* and many raptors all belong to scheduled I fauna.

3. *Primary forest and grasslands on forest edges Madhaiganj-Kalipur:* The grasslands in the forest edges of Madhaiganj-Kalipur is a corridor to large packs of Grey Wolves *Canis lupus,* which are regularly sighted in the region. Apart from being home to Bengal Foxes, this area is very rich in avifauna, including raptors. The region is also home to various native flora, many of which are of ethnomedicinal importance to local villagers, including tribals. The native flora of the primary forest and of the grasslands need to be conserved and bred in an attempt to help them bounce back from the jaws of deforestation and rampant diversion for coal mining and industrialisation.

4. *Gourangapur grassland:* This grassland near Ajoy riverbed is particularly rich in avifaunal diversity, both resident and winter migratory. Various wetland birds and waders also inhabit the various marshes and ponds of this region. Proximity to the river has also helped the avifaunal diversity of the area. Various insectivorous plants such as *Drosera* spp., *Utricularia* spp. are also commonly found in this region. This region and the adjacent riverbed are under severe threat from irresponsible picnickers and plastic and noise pollution, particularly during winter. However, it must be noted that persistent awareness campaigns and Green Picnic Missions by WINGS and Forest Department have greatly reduced the noise pollution by picnickers.

It needs to be ensured that these last of the functional lungs of Durgapur remain free from further degradations resulting from anthropogenic pressure, both to maintain environmental balance, protection of the biodiversity as well as maintaining the living standard of the citizens. The conservation measure proposed to conserve this site includes:

1. Citizen awareness with the help of local NGO involved in wildlife conservation.
2. Vigilance by forest departments so that illegal hunting and cutting of old trees can be prevented.
3. The Essar Oil and forest department should bilaterally work towards habitat conservation of these areas. Most of the areas mentioned above don't need any special treatment. The only thing the concerned authority should take care of is to maintain the habitat in its existing natural form.
4. The only intervention needed is in the Gourangapur grassland patch near Deul Conservation Reserve. Though the region is situated within the 10 km radius of the project impact area, but the land is neither owned by Essar nor forest department. However, the awareness campaigns to reduce anthropogenic pressure on the forest and control noise and plastic pollution need to be persisted through joint collaboration by active involvement of local villagers.

With growing urbanisation, habitat loss and habitat fragmentation are becoming common in the recent times and without compensating this, no conservation plan can be done. To conserve the animals, its important to conserve their remaining existing habitats. Carnivores and other wildlife species move out of the forested habitats in search of food when enough food resources are not available in their natural habitat. Moreover, easy and high nutritional human food can easily motivate and habituate the wildlife species. Hence, there is a need to improve the food resources availability in their habitat and the food attractants in the human habitations should be made wildlife proof or protected. Further, studies indicates that enhancement of key feeding areas far away from human may reduce the attractiveness of food sources near human habitations. The large carnivores such as wolf are generally a very long ranging species for which they are dependent on corridors which connects their habitats. These corridors are pivotal for maintaining the genetic viability as well as protect the species from environmental influences.

6.1.2 Mixed-species Reforestation

Mixed-species reforestation needs to be taken up in various areas as part of improving greenery. Reforestation would also result in binding the soil. During reforestation, proper care

should be taken to avoid monocultures and plantations of exotic species, which though enhance greenery, but degrade the soil quality and microhabitat immensely. Reforestation would increase water retention capacity of the soil. However, reforestation should not be done at the expense of grassland, wasteland, or other habitats.

6.1.3 Gap Plantation

Trees and plants which have been cut off or died naturally leave gaps in the forest. Plantation of natural native species in those gaps should be done scientifically so that the gaps of the forest may be compensated. However, care should be taken so that the plantation is done scientifically keeping sufficient exposure for the growth of the plant. Native species only should be planted in accordance with the habitat and soil quality. In this regard two approaches are suggested. Either growth of natural flora should be supported by providing sufficient protection from forest fire/other threats, or a botanical expert should be consulted for the selection of species regarding gap plantation.

6.1.4 Rainwater harvesting

Dry dusty topsoil results in low water retention. Artificial water bodies may be dug which would improve the economy of the region. Some of these water tanks should be dug away from human habitation in the wilderness of grasslands or on forest edges so that the wild animals may visit them for relief from the torrid heat of summer.

(Detailed in Soil Moisture Conservation Plan)

6.1.5 Herbarium of Medicinal Plants

The project impact area supports a huge diversity of flora of ethnobotanical and pharmaceutical importance. An herbarium of medicinal plants including trees and herbs can be built at a suitable location near Malandighi with the help of research assistant.

6.1.6 Mitigation of Forest Fire

Next to deforestation forest fire causes the most severe damage to the forests. One single uncontrolled fire can destroy the forest wealth which foresters have toiled over years to establish. Although fire is clearly a disturbance that disrupts the development of the existing

stand, fire is a natural factor in the forest ecosystem, and its effects have been incorporated in species' adaptations and ecosystem dynamics.

Fire influences –

- geomorphic and hydrologic processes of hill slopes and stream channels
- physical and chemical properties of soil
- nutrient loss.
- biomass accumulation
- genetic adaptations of plants
- plant composition and diversity, mortality, regeneration, growth, and succession
- wildlife habitat and wildlife population dynamics
- presence and abundance of forest insects, parasites, and fungi.

(Kashian et al., 2023)

6.1.6.1 Engagement of Fire-watchers

The area proposed for diversion and the adjoining forest areas are very much prone to forest fires being a dry arid zone with a low water retention capacity. Fire accidents are an important hazard in industrial sites. Ignited fires are also an environmental hazard, particularly in the grasslands. Natural and ignited fires both pose a threat to wildlife and habitat whenever they tend to spread. Particularly during the dry spring and summer time, cases of fires of both types are very common and often severely degrade grasslands, undergrowth and trees killing many animals including Black-naped hares, reptiles (lizards and snakes), squirrels, frogs and often many birds and their chicks. The user agency proposes to bear the cost of five fire-watchers shall be employed for this dry period (January to June) to monitor the fires. The fire-fighting team will consist of *five* personnel. The team must have proper equipment and training to fight fire.

6.1.6.2 Fire-fighting equipment

Procurement of fire-fighting equipment to equip the fire-watchers to fight the fires initially before professionally trained firefighters rush in to the spot. The fire-fighting equipment should include blower, fire-fighting jackets, proper shoes, and helmets.

6.1.7 Involvement of local communities by sensitization, awareness, and development activities

Without local communities it is impossible to conserve any species. Awareness amongst the local peoples through awareness programmes or involving them in the conservation work is important. The locals should be made aware about the importance of that particular species.

6.2 MITIGATION OF HUMAN-WILDLIFE CONFLICT

There is a need to create awareness among the communities about the ecology and behaviour of the species. Since, changing human behaviour is often necessary to reduce conflicts and it can be achieved by bring the local communities onboard for conservation and management of wildlife in their locality. They develop a sense of ownership when involved in process of actions and planning strategies. Moreover, their involvement in such actions improves their understanding about the species and importance of conservation.

Removal of attractants such as waste, unsecured garbage, livestock carcasses, etc should be an integral part of any action at a fine scale or a village level. This can be done by involving the panchayti raj institutions and the Joint Forest Management Committees of the area. Further negative encounters can be avoided by understanding the behaviour of wildlife species and by following the principles of living, working, and recreating in carnivore populated areas.

Ex-gratia payment should be implemented with minimum procedural requirements. The communities should be made aware about the compensation schemes of the government in case of damage and loss done by the wildlife species.

The conflict animal found regularly involved in conflicts should be rescued and then released after aversive conditioning. Such treatments generally involve giving repeated negative stimuli to make their experience bad so the animal will avoid similar situations/interactions. However, removal, if necessary, can also be done by capturing them and releasing them far from the conflict area.

6.2.1 Prevention of Wildlife related Crime

Strict and prompt actions should be taken against any reports of Wildlife related crime by the Forest Department that will help reduce the situation.

6.2.2 Future aspect

Baseline population data and baseline data of other indicators for intervention monitoring should be prepared accordingly.

6.2.3 Prey Base Management

The decrease in the natural prey numbers in the forested areas for these carnivore species have urged them to feed on the livestock of the nearby villages which is increasing the human animal conflict. So, the natural prey base should be counted periodically and if found to decrease then prey base should be introduced in those areas. This will help to solve the problem.

6.3 ANTI-POACHING AND WILDLIFE PROTECTION

6.3.1 Conservations of mammalian fauna

We selected the mammalian fauna for the conservation based on any of the following criteria:

1. The species is resident within the area and belongs to WPA Schedule-I.

2. The species is resident within the area and may raise human-animal conflict.

Only three species fulfil these categories, these are Indian Grey Wolf *Canis lupus*, Striped Hyena *Hyena hyena and Golden Jackal Canus aureus* . Grey Wolf is found all forested patches in this district, while hyena prefers grasslands. Most of the afforested land and forested land of forest departments have direct or indirect evidence of the presence of wolves. Documentary evidence of presence of hyenas is known at locations of the forest and forest edges as well as of Golden Jackal. As per the WPA Schedule, the Grey Wolf belongs to Schedule-I category and Striped Hyena belongs to Schedule-III category and Golden Jackal belongs to Least Concern Category. All the animals have the potential to produce human-animal conflict

because they infrequently predate on livestock when their natural prey is scarce. For this reason, following interventions are proposed:

1. *Population estimation:* The first step to conserve an animal is to understand its population density, occurrence, and distribution. All the three species are shy and hence it is difficult to understand the aforesaid parameters without following proper methodology. So, its proposed to survey the aforesaid species in alternative year using camera traps, direct encounter, and indirect cues. Besides survey, understanding should be developed on the corridors used by these mammals for local migration and daily movements. The survey should be carried out under the leadership of forest department. Local NGOs working on wildlife and external experts can be consulted in this regard.

2. *Prevention of hunting of domestic animals:* Hunting of domestic animals is one of the major sources of human-animal conflict. To prevent this awareness should be spread for keeping cattle and poultries inside close shed during night. In some areas with severe concern, Essar and forest department can assist to made some of the close shed for the villagers. Selection of villages for these activities require prior baseline data collection.

6.3.2 Conservations of avifauna

The main threat received by avifauna in this area is rapid habitat loss due to urbanization and hunting by local people. During our survey in many areas trap to catch ground birds has been observed. In this perspective following measures is prescribed:

a. *Systematic bird survey:* Winter waterbird survey should be carried out in the site rich in waterbirds like Ajoy riverbed, Damodar riverbed to keep an eye on the changing bird diversity. The survey should be done under the leadership of Forest Department and the concerned department should keep the yearly data on the avian diversity. The data should be interpreted with expert to understand any threat on the avian diversity and proper step should be taken to eliminate the threat.

b. *Increased vigilance:* The forest department must increase the vigilance to keep an eye for hunting, caging and poaching of different bird species.

c. *Habitat modification:* Habitat modification should be prevented on order to prevent decline of bird diversity. Refer to section 3.5 for the important habitats.

d. *Awareness activities:* Awareness is the key to protect any kind of biodiversity. Apart from conducting awareness activities about human-wildlife conflict (including snakes), campaigns to alleviate noise and plastic pollution during winter is essential, particularly in and around Ajoy riverbed at Deul, near the Gourangapur grasslands. See the section 6.3.5 for details.

e. *Habitat improvement:* Essar in collaboration with forest department and NGOs, should take necessary actions towards scientific habitat restoration. The popular methodology like gap plantation, mixed species reforestation, waterbody creation, soil moisture enhancement etc. can be adopted. But authority must consult a scientific expert(s) working on waterbirds & wetlands to make a plan to become ensure that waterbird will be there after the habitat improvement.

6.3.3 Rescue Teams

Human-snake conflict is one of the commonest conflicts in the urban region, mostly due to lack of knowledge regarding the snakes and how to tackle the situation. Apart from snakes, sudden encounters with trapdoor spiders (Tarantula), pangolins, porcupines, hyenas, wolves, monitor lizards and jungle cats also develop lot of hue and cry, often resulting in lynching and killing of the animal. During storms and in other unfavourable conditions, chicks of birds often fall down from the nests which also need intervention of rescue team. The following interventions is proposed in this regard:

- A rescue team should be constructed by the forest department.
- Citizen should be aware about the presence of such teams. So, proper awareness about it must be spread among the citizens. Forest departments should spread handbills, leaflets and fix large banner in place to place which will include name & contact of the region-specific rescuer, contact of forest department and local NGOs working on wildlife. Additionally, the leaflet and handbill should include the content that killing and harming the wild animal is offence under Indian Wildlife Protection Act.
- Six dedicated vehicles/Bikes must be allotted to do the job of rescue, anti-depredation and fire-watching.

- Forest department should develop essential infrastructure for the job of rescue. In this case following types of cages should be purchased in adequate number: trap cage, transportation cage and squeeze cage. The cages should be maintained properly and should be replaced if it is not possible.

6.3.4 Wildlife and Snake Awareness Camps

- Regular wildlife and snake awareness camps are to be conducted regularly in various school, colleges, villages, colony areas and slums to increase sensitization and proper knowledge about the ecological and economic importance of wildlife.
- Proper knowledge about snakes, identifying venomous and non-venomous snakes, contacting local authorised snake rescuers and preliminary actions to be taken in case of snake bites are to be imparted among locals.
- Knowledge about the punishable offenses and the prospective punishments resulting from poaching, caging of indigenous birds shall also be spread.
- The awareness can be spread with handbills, posters, permanent sign boards vehicular miking, organizing seminars, photography exhibitions, drawing competitions, nature writing, nature camps, nature walks, meeting etc.
- Essar and forest departments must involve local NGOs, local body and clubs in the wildlife awareness activities.
- Awareness can also be spread through media broadcasting.

6.4 COMMUNITY DEVELOPMENT

The active cooperation of local community is essential for conservation of Forest and Wildlife. The local villagers are affected due to wildlife depredation and are also dependent on forest resources for their day-to-day survival. The upliftment of community will reduce dependence on forests and will improve the quality of life. This will have a positive impact in the conservation of wildlife. The activities proposed have been short- and long-term impacts. Increased awareness among communities will help wildlife conservation.

It is evident that at least 4000 families are directly connected with forest through the network of Joint Forest Management Communities. The community development activities will have a direct impact on their wellbeing. Plan proposes major investment on skill development and income generation activities including Drinking water facilities, community roads, awareness camps, medical camps etc.

6.5 RESEARCH AND MONITORING

- The plan proposes several research initiatives by engagement of Research Assistant for 2 years. Some of them are:
- Bio-diversity surveys and changes in the same.
- Monitoring of disturbance due to increased traffic. The road traffic causes disturbance in terms of noise and dust. The disturbances may be quantified through proper long-term research.
- Scientific studies on different environment/ecological changes in the diverted forest areas.
- Research studies to understand richness of biodiversity, habitat occupation patterns, conflict patterns etc.

7 IMPLEMENTATION AND OPERATION OF THE PLAN

The wildlife conservation plan will be implemented under the overall supervision of the Principal Chief conservator of Forests (Wildlife) and Chief Wildlife Warden of the state of West Bengal. At the field level, the Chief Conservator of forests, Southeast Circle will be responsible for the supervision and implementation of the plan.

Divisional Forest Officer, Burdwan Division and his team will constantly monitor implementation of the plan and shall maintain all records related to execution of the plan and will constantly monitor the progress of implementation. The CAMPA Section of the division will maintain the accounts of the expenditures and will be assisting the DFO in maintenance of records.

The Division office will submit periodical reports to the Principal Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden of the State of West Bengal as required through the Chief Conservator of Forests, Southeast Circle. Regular coordination meetings will be conducted with the officers of the User Agency which will be headed by The Chief Conservator of Forests, Southeast Circle.

8 BUDGET REQUIREMENT

HABITAT IMPROVEMENT

SL no	Item of Works	Unit	Rate in Rs.	Quantity	Amount In Lacs
1	Creation of grass fodder plantation of 05 hac areas including preparatory work/advance work, creation and maintenance.				
a	Advance work	Ha	17400	5	0.87
b	Creation of fodder plantation	Ha	75085	5	3.75
c	1st Year Maintenance of fodder plantation	Ha	14755	5	0.74
4	Boundary Demarcation of the forest area of the division by DGPS Survey and with establishment of boundary pillars as required. (11 Pillars / Km)	Kms	25000	24	6
5	Construction of heating pads for reptiles to prevent deaths while crossing the road. Heating pads of 4ft X 4 ft will be constructed on sides of roads	nos.	10000	10	1
6	Maintenance of Patrolling roads/Paths	Kms	25000	20	5
				Total in Lacs :	**17.36**

PROTECTION OF FORESTS AND WILDLIFE

SL no	Item of Works	Unit	Rate in Rs.	Quantity	Amount in lacs
1	Signages at animal crossing sites/Awareness signages	nos.	10000	30	3
2	Provisioning of monitoring equipment like camera, camera traps, Night Vision Binoculars, CCTVs etc including instalment and operation	Years	400000	2	8
3	Maintenance of forest roads. Forest roads up to 50 km will be maintained during the project period.	km	50000	5	2.5
4	Procurement of motorcycle for patrolling. 6 motorcycles will be procured.	nos.	150000	3	4.5
5	Procurement of fire fighting equipments (Fire Blower, Grass cutter, Boots,gloves, head gear and dress)	nos.	100000	5	5
6	Maintenance of firelines	Kms	7000	50	3.5

7	Enagagement of Forest fire watchers for 5 years	nos.	10000	60	6
8	Procurement of water tankers in the beat areas for forest under diversion as a fire protection measure	nos.	100000	5	5
				Total in Lacs :	**37.5**

MITIGATION OF HUMAN-ANIMAL CONFLICT

SL no	Item of Works	Unit	Rate in Rs.	Quantity	Amount in lacs
1	Search Light for staff and JFMC members for conflict mitigation	nos.	5000	100	5
2	Engagement of labours for handling human animal conflict in the region seasonally for over 5 years	years	140000	5	7
3	Construction of cages/ enclosures (medium) to rescue medium mammals from human habitations or from vulnerable situations.	number	50000	20	10
4	Construction of cages/ enclosures (small) to rescue small mammals from human habitations or from vulnerable situations.	number	40000	20	8
5	Installation of Solar Street Light to reduce wildlife Depredation in JFMC areas	nos.	30000	25	7.5
				Total in Lacs :	**37.5**

COMMUNITY DEVELOPMENT PLAN AND JFMC SUPPORT ACTIVITIES

SL no	Work	Unit	Rate in Rs.	Quantity	Amount in lacs
1	Income Generation Activities for JFMCs				
1b	Establishment of Sal leaf plate making centres with all machinery and store room	Nos	250000	2	5
1c	Supply of modern agriculture implements	Nos	100000	5	5
2	Supply of Drinking water facility	Nos	200000	2	4
3	Road Repairing	Kms	50000	5	2.5
4	Infrastructure support for schools in the Forest fringes	Nos	50000	10	5
5	Organizing Skill Development training and giving inputs for the members of JFMC	Nos	100000	10	10

6	Organizing Nature workshops, Awareness camps, Rallies, Medical camps etc involving JFMCs and Local NGOs	Nos	20000	5	1
				Total in Lacs :	**32.5**

WILDLIFE RESEARCH AND MONITORING

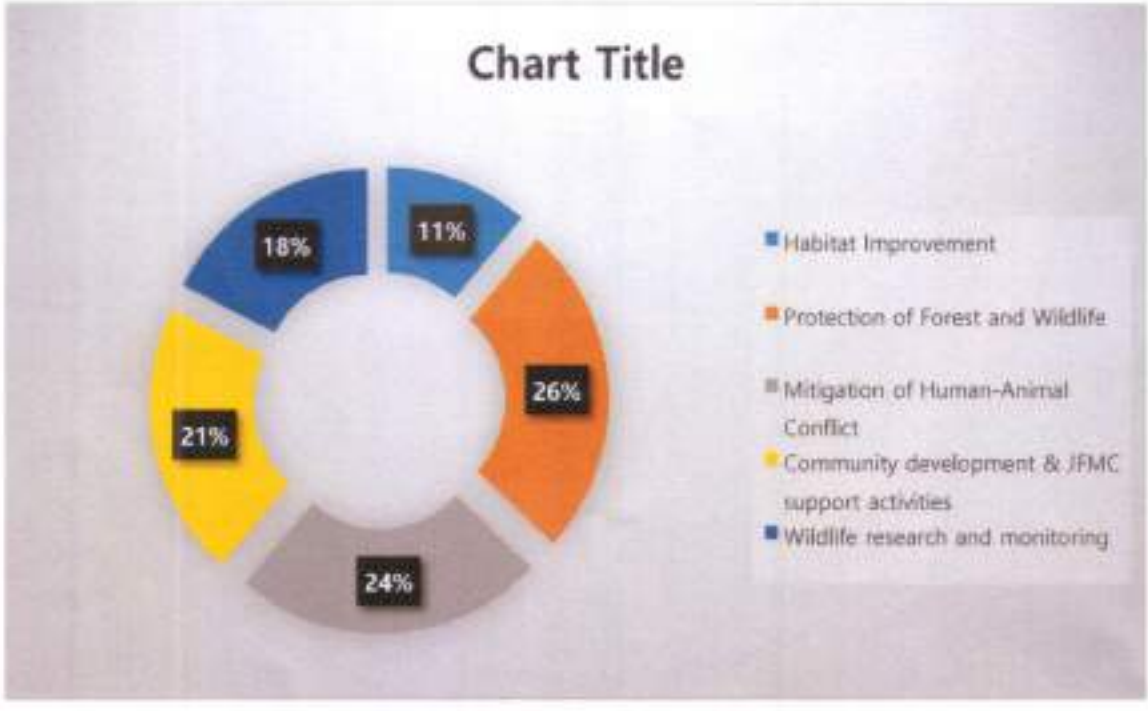
SL no	Work	Unit	Rate	Years	Amount in lacs
1	Engagement of technically qualified persons for monitoring disturbance due to project work and its impact on wildlife and possible mitigation measures. 01 No researcher @ Rs 30,000/month for 3 years (36 months)	1	30000	3	10.8
2	Population estimation of lesser carnivores in the Forest area	2	200000	4	4
3	Research Equipment's over 2 years	LS	LS	2	2
4	Procurement of camera traps	40	30000	1	12
				Total in Lacs :	**28.8**

SL No	Activity	AMOUNT [Rs in lacs]
1	**Habitat Improvement**	**17.36**
2	**Protection of Forest and Wildlife**	**37.5**
3	**Mitigation of Human-Animal Conflict**	**37.5**
4	**Community development & JFMC support activities**	**32.5**
5	**Wildlife research and monitoring**	**28.8**
A	**TOTAL**	**153.66**
B	**Contingency (2% of A)**	**3.07**
C	**Grand Total (A+B)**	**156.73**

Amount in word: Rupees One Crore Fifty-Six Lakhs Seventy-Three Thousand only.

Divisional Forest Officer
Burdwan Division

COUNTERSIGNED
Chief Conservator of Forests
South East Circle, W.B.



Divisional Forest Officer
Burdwan Division

COUNTERSIGNED
Chief Conservator of Forests
South East Circle, W.B.

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