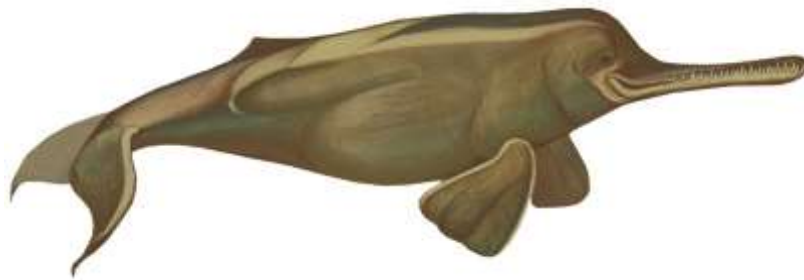


**Exploratory Study of Civil Structures Developed on
the Embankment of Rivers near Nayabasti, Baidi and
Kalakunda Areas and their Potential Impacts on
Dolphin Conservation and Ecofriendly
Promotional Strategy**



Final Report

By

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**Submitted to
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Executive Summary

This draft report contains the results of the study on status of migratory dolphin in the Kulariya branch of Karnali and Mohana river and feeder streams. It also embodies major findings of field investigation and laboratory analyses of dolphin environment in relation with Rani Jamara Kulariya Irrigation Project (RJKIP) project are presented. An attempt has been made to present base line information on dolphin status, ecology and migratory trend. This report also makes exploratory study of civil structures on the embankment of rivers and their potential impact on dolphin conservation and eco-friendly tourism promotional activity.

The study reveals that Karnali river and its tributaries below Chisapani offer an excellent habitat of dolphin supporting many species of fishes (long distance migratory, short distance migratory and resident fishes) having food, medicinal and recreational values. The project area also support broad spectrum of microscopic aquatic animals contributing natural food chain. The fish and aquatic life of project area support the life of local fisherman by providing them self-employment such as fishing opportunity, additional income and supplementary animal protein.

Construction civil structure on embankment of Karnali river near RJKIP project area at the downstream of Nayabasti and Baidi area will have some moderate impacts on the dolphins and fishery resources. The civil structure do not directly interfere dolphin migration routes but to some extent there will be some impact in habitat at downstream of Dhungana Tole which can be mitigated by planting tree and creating small water balancing holding reservoir. Among several mitigation measures proposed are the ecological restoration of dolphin habitat, creation of dolphin rehabilitation centre for protection of stranded dolphins have been suggested to mitigate harmful impacts of the project. Some other measures include the release of sufficient environmental flow from irrigation network below Dhungana Tole that meet water requirements of different species of fishes. Suggestions are also made for banning of harmful fishing gears affecting fish, dolphin and crocodiles survival. Besides these there should be regulation and control of fishing of fishermen and fish contractors. Suggestions are also made for promogulating of fishing laws and regulation of mesh size of gill net and drift nets for reducing dolphin by-catch. Furthermore, it has been suggested to develop series of dry season deep pools or storage desilting reservoirs for water regulation for the benefit of migratory dolphins.

Considering the benefit of the RJKIP, potential environmental impacts of civil structure are not severe. The cost of implementing appropriate habitat restoration measure by establishing small balancing reservoir is not costly for endangered dolphin. The project is eco-friendly and provides plenty irrigation water, electricity and economic activity of the peoples of the region and uplift their living standard. The program related to civil structure will promote eco-friendly environmental restoration of the dolphin habitats and side by side boost ecotourisms and dolphin conservation by improving habitats of riverside.

1. Introduction

The Karnali is one of the largest rivers of Nepal. It originates on the Tibetan Plateau. After flowing through the Mahabharata mountains in a number of long bends, it cuts a gorge through the Churia Hills in a north-south direction and emerges on the Terai plain. Its drainage covers 43,000 km² in Nepal, and its total discharge is about 25,000 m³/sec at peak summer flow. The catchment area at Chisapani is about 42,890 km².

A very good dolphin habitat occurs in a stretch of about 50 km between Kulariya branch of Karnali river and Mohana river and feeder streams Kanda and Pathraiya. The description of physical characteristics based upon observation made by Shrestha (1986) and observation during present survey. Near Tikapur the river is 150-175 m wide and at Chisapani 75-100 m. The river is deep throughout the year, with gorges, pools, oxbows. The water level is lowest between January and March and highest in August and September; the range of level is 2-3 m. Mean current speed is about 0.3-0.7 m/sec at low water phase and 0.9-2.6 m/sec at high water phase. Surface temperatures in the winter range from 13-16°C and in the summer from 30-33°C. Air temperature ranges from 23-39°C. Visibility as measured with a Secchi disk was 1.3 m in November and 1.8 m in January. Chemical composition of the water varies seasonally; details are given in Shrestha (1986, 2019). The water is neutral or semi-acidic, with high concentrations of oxygen and dissolved minerals. The banks of Mohana and Pathraiya rivers are composed of loose sand alternating with stone and gravel. These two rivers support migratory fishes such as mahseers, giant catfishes and river carps such as rohu and mrigals.

2. Objectives of Study

The specific objective is to study ecology of dolphin in rainy season of monsoon in Mohana river and its feeder streams Kanda, Pathraiya to determine their mobility near civil work developed by RJKIP. The study will include the following.

- i. To make inventory survey of river habitat and record changes occurring due to river training work and civil work activity.
- ii. Determine specific aspect of monsoonal migratory ecology, social life, behaviour, mobility of dolphins and their fish prey around field site.
- iii. Determine possible key environmental factors, cues and signals that trigger monsoonal movement.
- vi. To recommend suitable methodology and technology to ensure survival of dolphin and their unmolested existence.

- vii. Recommend long-term study migratory dolphins survival near threatened habitats impacted by human activity (fishing and extensive water use).

At present residual dolphin population is declining very fast due to shrinkage of habitat, overfishing, dewatering effects and impact of agricultural insecticides. Therefore, there is urgent need to find out ways and means to conserve dolphins. The present work will seek to address and find solutions of the problem.

3. Literature Review

The first ever scientific status survey of dolphin in Nepal was conducted in the Karnali river of Nepal by Shrestha (1983). Similarly, Mohan (1989), Smith and Sinha (2004), and Behera (2006) contributed on Ganges river dolphins of Indo-Gangetic plains.

Shrestha (1995) published result of the study of Ganges river dolphin in the Koshi river of Nepal for the first time in his book “The Ganges River Dolphin”. Sinha (2000) contributed on conservation status of dolphin in the Ganges of India and Nepal. Shrestha (2006) studied dolphin stranding in Babai river of Nepal. Behera (2006) studied Gangetic dolphin in rivers of India. Choudhary (2007) contributed on status of dolphin in Koshi river of Nepal. Shrestha (2010-2012) made extensive study migration of dolphin in the Koshi river, Bashir (2010) examined socio-economic factor for threatening survival of dolphin in upper Ganges. Bashir (2010) reported declining situation of Gangetic dolphin in the water front of India, Nepal border. Khatri et al (2010) studied post-monsoon study of Ganges river dolphin in Koshi river. Garg et al., (2013) pleaded mercy for river dolphins. Shrestha (2010-2014) study migratory ecology and life history of dolphins in the Koshi river of Nepal made efforts for to produce lively publicity material in form of pamphlets, brochure and books in Nepalese language to spread conservation message of dolphins among the riverside people of Nepal. Government of Nepal (GON 2010) reviewed problem of modernization of Rani Jamara and Kulariya Project (RJKIP).

In spite of these authentic investigations cited above a few investigator addressed centrality of dolphin conservation problem in Nepal. This report aims to examine dolphin habitats of Karnali river and Mohana river with reference to potential impact of civil structure in Kulariya branch of Karnali and Mohana river.

4. Background of Information of Project Area

Present project areas include Baidi and Dhungana Tole of Ward No. 7 and Kalakunda area of Ward No 8 of Tikapur (Fig. 1 and 2) and field activities were conducted as given in Annex-I.

During the surveys and collection of representative fish species serving as dolphin fish good were collected from these project sites. The people living near the Mohana riverside and government official at check post were interviewed and asked for information about sightings of dolphins. They were shown photographs of the dolphin to avoid confusion with crocodiles and large fishes that inhabit the river. The reports by these casual observers were treated with some caution. For capture of fishes, cast nets, seine (Chatijal) and gill nets were used. Water sample from river Mohana, Kanda and Pathraiya were collected for laboratory as analysis and fixed in HCl *in situ*.

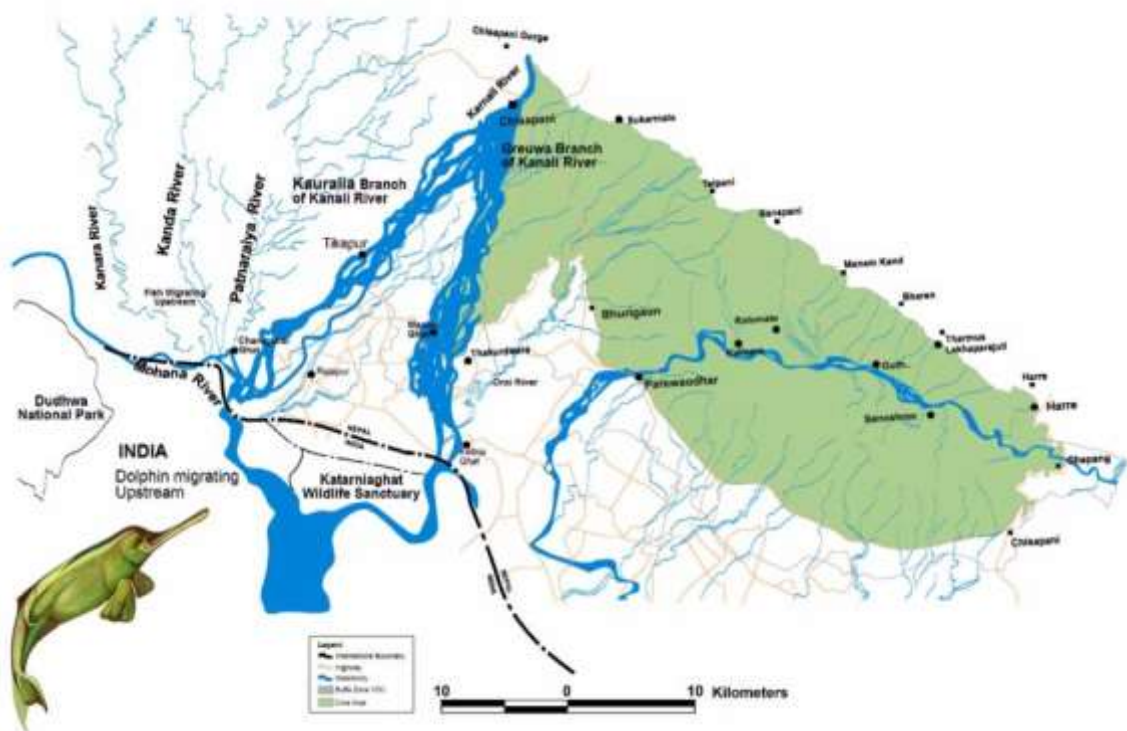


Fig. 1. Showing Study Area of Karnali and Mohana River Basin



Fig. 2. A Glimpse of Study Project Area with Civil Work in Progress

Table 1. Showing GPS coordinate taken During Dolphin Survey in River Karnali

Place	Coordinates
Chisapani Pitmari Station near Karnali Gorge	N28° 39' 12.7" E81° 17' 14.7"
Karnali Bridge	N28° 38' 25.30" E81° 17' 04.04"
River Kulariya near Jagatpur	N28° 33' 07.1" E81° 10' 53.0"
Kulariya river near Rani irrigation Intake	N28° 32' 39.4" E81° 10' 18.0"
Kulariya river, near Pathbar	N28° 32' 31.6" E81° 11' 12.9"
Tikapur Park (Kulariya River)	N28° 29' 20.6" E81° 07' 51.3"
Daulatpurghat (Kulariya River)	N28° 28' 31.4" E81° 07' 01.0"
Chaugurdighat (Kulariya River)	N28° 25' 18.9" E81° 02' 29.9"
Naya Basti- Baidi	N28° 27' 18.5" E81° 01' 29.3"
Mohana River near Khakraula	N28° 26' 11.8" E81° 01' 59.5"
Gairi Nala	N28° 27' 36.8" E81° 01' 05.3"
Pathraiya River and Kanda River near Dhungana Tole	N28° 27' 28.3" E81° 01' 09.5"
Kalakunda	N28° 26' 42.0" E81° 01' 11.5"

5. Sample Biography and Life History

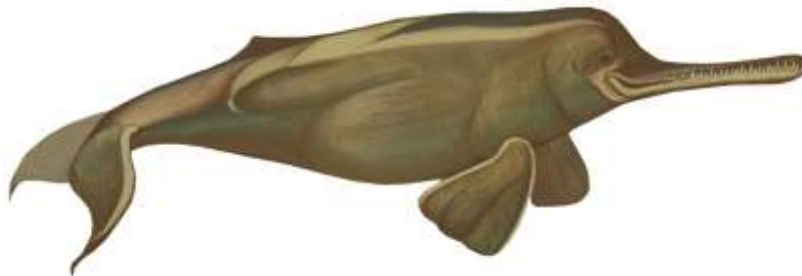
GANETIC DOLPHIN

Order: Cetacea

Platanista gangetica (Roxburgh)

Classification

Class	:	Mammalia
Order	:	Cetacea
Suborder	:	Odontoceli
Family	:	Platanistidae
Genus	:	<i>Platanista</i>
Species	:	<i>gangetica</i>



Present distribution

Gangetic dolphins are known to occur in all Ganga, Brahmaputra and Indus river systems. They are not known to enter salt water. In Nepal they have been sighted in the Koshi River, Karnali, Mahakali and Narayani river. Population in these rivers is drastically reduced.

Past distribution

In historical times, thousands of dolphin distributed all over Karnali feeder streams. Dolphins also occurred in great abundance in Mahakali (Sarada), Koshi and Narayani river systems.

Status: Endangered. Very small population declining in number.

Estimated number: Minimum count 12 but information from local people indicate migratory population varies from 20-30 more.

Breeding rate in wild: One young every year.

Reason for decline: Disturbance by man, indulging habitat modification and overfishing some might have been killed by fisherman using drift net and trammel net.

Protection measure already taken: Fishing in dolphin habitat is prohibited after the establishment of Bardia National Park.

Protective measure proposed: Public education, water management and research study are vital for dolphin survival. Increased protection of river confluence areas, including ban of stone mining and movement of ferry boat. Establishment of dolphin sanctuary and captive breeding.

Breeding potential in captivity: Unknown

6. Dolphin Survey Method

A transect or sample area was established to monitor daily and periodic movement of dolphin. It is a simple procedure to establish number of transect of straight lines across the river channel perpendicular to flow. Such transects were established at different sites which became reference point for future observation.

Surveys were conducted along Karnali and Mohana river and their tributaries (Table 1). Intensive surveys were carried out on foot or by rowboat along the channel of rivers as described by Shrestha (1995). During each survey, the river was covered twice, once moving upstream and once downstream. In addition, isolated sightings were made at various times from different important points. In the Karnali and Mohana river surveys, dolphins were counted from the banks of the river directly using 7 x 35 binoculars and a 50 D Canon Digital SLR camera fitted with a 100-500 mm telephoto lens equipped with continuous burst shooting facility. The surveys were made from both banks of the river simultaneously, with two observers on each bank recording surfacing and diving times with a tape recorder and counting the dolphins. When conditions were suitable, a video camera and underwater video camera with tele lenses were used to record surface activity; the videos were examined to confirm counts of surfacing and under water activity of dolphins. Observations were made from river bank and an elevated cliff. Polaroid sunglasses were used to combat the intense glare on the river at mid-day. Six to ten survey points were used; all were covered in a single day, during daylight hours. At each survey point one to two hours were spent for recording activity. The dolphins were counted only after considerable time had been spent observing size, shape, colour and natural marks of the individual animals, to avoid counting the same individuals. Different fish species of Kanda, Pathraiya and Mohana rivers were collected and identified by adopting methods described by Shrestha (2019) in his book "Ichthyology of Nepal – A Study of Fishes of the Himalayan Waters".

7. Habitat Characteristics and Distribution of Dolphin

I. Chisapani Gorge near Chisapani Bridge

The Karnali river the banks are largely boulder strewn and sandy, formed by the soil erosion of the adjacent land. The river is very deep and depth varies from 30 to 125 m. Most of the banks are steep and basin shape not used for extensive agriculture. In such type of habitat dolphin food fish is plentiful. As deeper part of the gorge encased by rock and boulder provides protection to fish and dolphin, this section was once core habitat off dolphin in past now highly disturbed by vehicle passing over the bridge and irrigation infrastructure and power driven boat traffic.

II. Tikapur to Daulatpur

The Karnali river near Tikapur to Daulatpur contains ideal habitat of migratory dolphin and mahseer. The river section is flat covered with gravel and sands. It also contains rocks and pebbles and gravels of all sizes supporting high density fish fry and fingerlings. Here Karnali river break into sister channel creating extensive fishing islands serving as monsoon resort of dolphin near Daulatpur. Some part of this habitat is highly disturbed by the movement of power boat trafficking and fishing activities. According to local people this area serves as permanent habitat of dolphins.

III. Daulatpur to Chaugurdighat

Karnali river is hydrographically unique in Chaugurdighat near Indo Nepal border. At this place Karnali river meet its feeder stream such as Mohana river which is monsoon resort of dolphin. We saw two surfacing dolphins near Kulariya bridge connecting Dansinghpur to Rajapur. Here, game fish such as Mahseer weighing 25-30 kg and giant catfish weighing 50 to 100 kg are commonly landed. According to local people about 10-15 dolphin school gather here in monsoon flood.

IV. The Kulariya river (Branch of Karnali river) near its confluence site with Mohana river

The river section is flat covered with gravel and sands. It also contains rocks and pebbles and gravels of all sizes supporting high density fish fry and fingerlings. Here Karnali river break into sister channel creating extensive fishing islands serving as monsoon resort of dolphin near Mohana. Some part of this habitat is highly disturbed by the movement of power boat trafficking and fishing activities. According to local people this area serves as permanent habitat of dolphins.

V. The Mohana river near its confluence site with Pathraiya river at Dhungana Tole

The section support high density of migratory fish during June to September but it is dry in winter Here dolphin exhibit fish follow migration Shrestha (2010). Dolphins are often seen hunting and chasing Jalkapoor (*Clupisoma garua*) carps of *Labeo dero* and *Labeo rohita* species. Here fresh water shad or catfish *Clupisoma garua* is well represented. Besides this Tenger catfish (*Mystus tengara*) and Giant

catfish (*Bagarius bagarius*) are well represented in this section (see Annex II). The Mohana river is major tributary of Kulariya branch of the Karnali river. In this river fishing intensity is very high from March to September. We saw no dolphin near Dhungana Tole as river contained little water almost knee deep. Local people estimate 20-40 migrating dolphins in the Mohana river during rainy season of monsoon.

8. Ecology, Behaviour and Migratory Trends of Dolphin and Other Aquatic Life

8.1. Dolphins Association with Otter, Turtle, Crocodile, Water Birds and Key Environmental Factors

The Karnali river is an excellent laboratory for the study of migratory river dolphin (*Platanista gangetica*), mugger crocodile (*Crocodilus palustris*) and gharial crocodile (*Gavialis gangeticus*) and game fishes mahseer (*Tor putitora*) and giant catfish (*Bagarius bagarius*) and many others. During present investigation the consultant travelled extensively in Karnali and Mohana watershed making field observation in different section and collecting data related to key environmental factors responsible for dolphin migration.

The Mohana river near Khakraula bridge where game fishes such as mahseer, river carps, eels upstream with predatory dolphins in peak monsoon. Also in the pool areas of Mohana support bulk of migrating fishes such as major carps and catfishes undergo seasonal upriver and downriver migration in wet monsoon and dry winter season respectively. The expansion of irrigated agriculture in this area add considerable load of pollution and due to use of pesticides and herbicide in the river water bodies. These pollutants have been detrimental healthy growth of fish community and sustenance of top predator as Gangetic dolphin. Although civil structure to be constructed near Baidi, Dhungana Tole, Kalakunda and Khakraula do not directly effect on existing dolphin population but it will affect the fish food of both dolphin and crocodile. So to maintain abundance of dolphin, crocodile and fish food fishes raised nearby hatchery should be released each year to enrich fish food in confluence site of Kanda and Pathraiya river, near Dhungana Tole.

Rainfed and intermittent tributaries of the Mohana river high biogenic capacity serving as refugia for predatory dolphins, crocodiles, otter (*Lutra perspicilata*) and freshwater shark or Giant catfish (*Bagarius bagarius*). The sister channel of Mohana river also serve as spawning and nursery ground of broad spectrum of resident major carps such as rohu, catla, mrigal and catfishes. According to fishermen of Khakraula river migratory dolphins enter Nepal from Katarniaghat (India) and get sometimes stranded in Mohana river and Pathraiya river. So dolphin rescue centre should be established near embankment. For feasibility and desirability will need further research.

Because of high turbidity of water; the behaviour of dolphins below the water surface was not clearly observable at this time. Water level of the Mohana river system decrease from October to April. So in dry period most dolphins and their fish prey migrate downstream to Katarniaghat to

eke out critical condition. But rainy season of monsoon (June - September) dolphin arrive with spawning run of fishes in monsoon. During low water phase of the river (November-January) fishermen use drift net, gill net, that cause steep decline of fish biomass and force dolphin for enter into deeper water pools of Katerniaghat of India where they easily avoid easily fisherman net.

According to the fishermen and cow herders of Mohana watershed monsoon flood brings school of catfishes such as Suhjana (*Sperata seenghala*), rohu (*Labeo angara*), minnow (*Salmostoma bacaila*), jalkapoor (*Clupisoma garua*) enter the spawning assembly of the Mohana river for broadcasting their spawn in June and July. The ascending spawning migration to Dhungana Tole from Mohana river takes place between June 15 to July 25. As this event take place in high flood period of monsoon, fishes are safe to deposit spawn only in the sandy and gravel bed of Mohana, Kanda and Pathraiya river. Support many fish eating predators including dolphins, and water birds, Indian river tern (*Sterna aurantia*), Large cormorant (*Phalacrocorax carbo*), Darter (*Anhinga rufa*), otter (*Lutra lutra*) and turtles (*Nilssonia gangeticus*) can be seen enjoying feasting of fishes. To observe fishing activity of these animals will be delightful for every tourists. In peak monsoon they spend there feeding spree and travel back and forth to Mohana in the same day.

8.2. Dolphin Behaviour at Pools near Mohana Bridge

According to local fishermen dolphins arrive from Indian water front to Mohana river between June and September. This part of the river was considered as a refuge for feeding resting and rearing young dolphins. During this October survey 3 individuals were observed at Mohana river. We could not see dolphin at the confluence site of Kanda and Pathraiya river as expected near civil structure due to receding level of water.

The adult female dolphin was distinguished by a long curved beak and pale brown colour. The young dolphin or calf were pale brown in colour and seen closely with mother. There were difference in surfacing behaviour pattern between adults and calves. Calves surface out of the water more frequently than adult to fulfil high oxygen needs exposing their beak and melon. At several occasion adult male surfaced vertically exposing its beak and head above water cherishing many spectators from Mohana bridge sometimes adult dolphins surface at interval of 40 to 55 seconds and by making parallel dives to water surface. As young dolphin needs much oxygen and surfaced for aerial respiration between 30-35 seconds. At three occasions adult dolphin displayed fish catch over water surface of Mohana near bridge by holding the fish on it powerful beak. People looking from Mohana bridge were excited by this scene.

8.3 Ecological Implication of dolphin Habitat Degradation due to Extraction of Sand and Gravel

In past the river dolphins were found all round the year at confluence site of Kanda and Pathraiya river near Dhungana Tole but now they visit this spot only in monsoon period. The traditional fishing gears such as gill net (Fasi jal), drift net, current net (floating gill net), filtering dip net (Heluka, Deki), drag net (Chaudijal) and fish screens are very harmful to dolphin and its prey species (Impactogram - 2). The sand and gravel extraction is major cause of habitat degradation. Each year large quantities of sand are extracted from Mohana river. The sand extraction has reduced spawning den of fishes by smothering of benthic life and reducing algal bloom serving as food for plankton. Furthermore over siltation reduced biological food productivity of the river by preventing sunlight penetration. Such ecological degradation has serious impact on fertilised developing eggs and newly hatched fish which grow into young generation of fish on which dolphin depends. So effort for dolphin habitat restoration of RJKIP should be directed to maintain water level, water quality, banning of gravel sand and stone extraction. For rescuing baby dolphin from drowning in sand extraction pit more public awareness is vital.

Table 2. Analysis of Spatial and Temporal Feature of Dolphin Habitat in the River Karnali

AQUATIC HABITAT		RIVER MORPHOLOGY			
LATERAL CONTINUUM	LAND AND WATER INTERCHANGE AREA	HABITAT CHARACTERISTICS OF KARNALI AND MOHANA RIVER			
		MACRO HABITAT CHARACTERISTICS RIVERINE FLOOD PLAIN POOLS			
		RIFFLES	→	USED AS ESCAPE COVER AND SPAWNING DEN	
		GRAVEL BARS			
		ISLANDS			
		SHELTERED RIVER BANK WITH SAND BARS FLANKED BY TREES			
		WATER STRETCH CONTINUOUSLY CONNECTED TO MAIN RIVER AND, SIDE ARMS AND BRANCHED CONDITION IN UP RIVER AND DOWN RIVER			
		BACKWATER AREAS AND OX-BOWS WITH OR WITHOUT PERMANENT CONNECTION TO RIVER. HABITATS STRONGLY INFLUENCED BY WAVE ACTION OF FLOOD BY, RECONNECTING ABANDONED CHANNELS			
		BACKWATERS WITHOUT PERMANENT CONNECTION TO RIVER. RARELY INFLUENCED BY FLOODS		→ USED AS ESCAPE COVER	
		AREAS OF FLOODPLAIN GRASSLAND/MARSH SUBJECT TO PERIODIC INUNDATION. (CHARACTERIZED BY SEASONAL HIGH WATER TABLES)			
SWAMP					
MARSH					
TERRESTRIAL HABITAT		RIPARIAN / FLOODPLAIN WOODLAND			

8.4. Dolphin Migration and Key Environmental Factors: Migratory Route and Season

The Ganges dolphins do not permanently inhabit a particular area. They do not have definite migratory route. The rainfall appear to be key environmental factor that guide migration. They move upstream during rainy season of monsoon rains and downstream in the dry season of winter particularly November to January. Their numbers vary in different season.

Gangetic dolphins have been found in water as cold as 8°C (Pelletier and Pelletier, 1980) and as warm as 33°C (Jones, 1982). In Nepalese rivers, migrations of the dolphins are observed to move 5-10 kms in winter and 10-20 kms during the monsoon flood. Dolphins do have their favourite areas or coves (Table 2). During rainy season, they stay in the feeder streams, where water is relatively clear and density of fish is high. In the winter dry season, they join in main river cradles at downstream where flow is low and fish density is quite high. In the high and mid water phase of monsoon they stay in confluence sites of large and small rivers. Dolphins migrate long distance during the mating season (March and April). They select deep water pools or gorges with feeble current for mating purpose. Usually feeding migration often takes place between June to August and breeding migration from February to June.

8.5. Population Trend

All rivers of Nepal have not been systematically and thoroughly surveyed for the presence of dolphin. There is no reliable basis for a good estimate of the overall population size. The surveys of the relatively pristine habitat in the Kulariya branch of Karnali and Mohana river yielded a maximum count of about 22 to 30 dolphins in the monsoon rains. It must be emphasized that this is an extremely rough estimate; some dolphins could have been missed in the surveys, especially during the monsoon season.

According to local people estimate there are more than 40 dolphins in Kulariya branch of Karnali river. The migratory school of dolphins arrives each year from India particularly Kateriaghat (India) to Mohana river corridor. They arrive during rainy season of monsoon between June and July from Katernighat. Both Karnali river and Mohana river are now considered as an ideal monsoon refuge area for migratory dolphins.

9. Impact Analysis

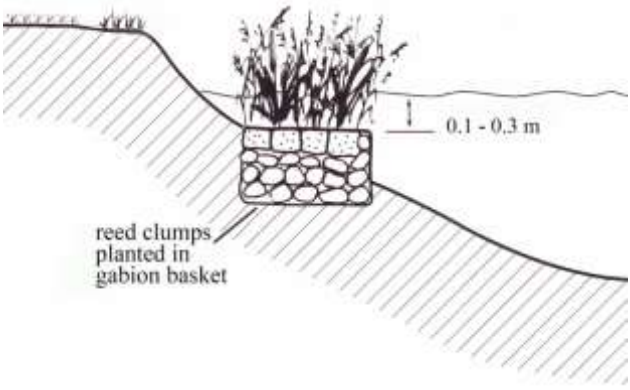
9.1. Impact on Dolphin

The river Karnali forks into two branches namely Kulariya and Girwa branches below Chisapani gorge near Dandajhari. A decade ago Kulariya branch had better habitat and higher density migratory fishes and dolphins than that of Girwa branch near Bardia National Park. At that time the Mohana river principal feeder stream of Kulariya teemed with migratory population of fish and dolphins. Now due to overfishing, climatic changes and irrigation developmental activities dolphin fish migratory runs becoming sporadic. In past two decades, fishermen, farmers and cow herders used to see schools of dolphins following fishes and chasing them up to far upper reaches of Mohana and its feeder streams such as Kanda and Pathraiya river near Dhungana Tole area. But now such mass migration of dolphin and fish are no longer seen turned almost into rare sight. Due to the impact of deforestation, climatic changes and developmental activity such as construction of irrigation weirs; water diversion work, road building, stone mining, embankment stabilizing operation affecting habitat. All these activity causing over silting in river bed at the same time rendering whole river shallower and unproductive than ever making unfit for the survival dolphins and its fish prey. If proper conservation action is not taken to there will be no longer status quo migratory dolphins and food fishes such as mahseers, eels and catfishes (Annex – II). The possible impact of civil structures developed on the embankment of two rivers near Nayabasti, Baidi and Kalakunda areas (Fig. 3) and their potential impacts on dolphins and possible mitigative eco-friendly promotional strategy are presented in impactograms 1A, 1B and 2.

GENERAL IMPACTOGRAM – 1A

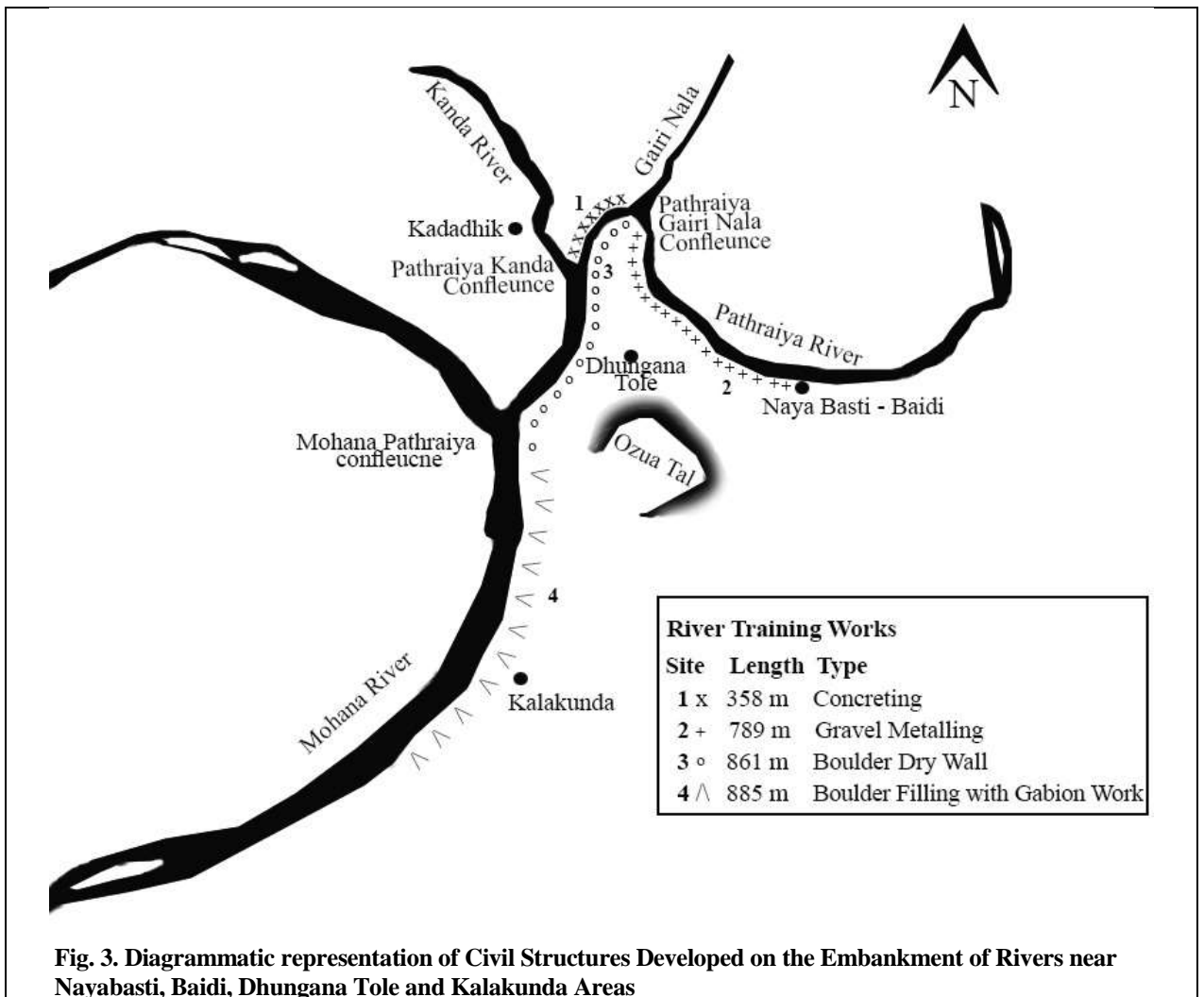
SHOWING IMPACT OF CIVIL STRUCTURE ON DOLPHIN HABITAT

S.N.	Impact Scenario	Mitigation Measures
1.	<p>Impact of Civil Structure and Soil Filling Activity on Dolphin and Crocodile Habitats</p> <p>Gabion works, Gravel metalling, boulder dry wall will affect migratory dolphins and crocodiles. Such structures indirectly affect dolphin resting pool nearby and basking and nesting crocodiles living in rivers Kanda, Pathraiya and Mohana. Particularly river embankment habitat of Nayabasti, Baidi, Dhungana Tole, Kalakunda and Khakraula area are directly and indirectly affected if proper mitigation measures are not taken near civil structures development areas.</p>	<p>As far as possible the engineering structure without iron wire should be used for construction of gabion structure. The concrete wall on right bank of Pahtraiya river will affect nesting and basking habitat of crocodile. This area also supports pools and rapids suitable for migratory dolphins. So Pathraiya river embankments near Gairi Nala need habitat restoration. For this purpose low wall should be installed in the river</p>

	 <p>reed clumps planted in gabion basket</p> <p>0.1 - 0.3 m</p> <p>Showing Typical Revetment Combining Reed Banks with Stone</p>	<p>bank for basking area of crocodile (morning sun basking activity). As far as possible low boulder should be installed to enhance basking activity of crocodile in left bank of Gairi Nala and Pathraiya confluence. The boulder wall in river bank is to be carefully developed for encouraging nesting activity of crocodile. Steep boulder wall is not favourable for heavy bodied crocodile for clinging. Moderately inclined wall permit crocodile to stay in sunshine for long hours. Sometimes heavy bodied crocodile may fall down if wall is made angle of 60 to 80 degree. Gabion wall with steep angled slope will discourage basking activity which affect health of crocodile due to lack of constant solar radiation in winter.</p>
<p>2.</p>	<p>Impact of Pollution and Loss of Spawning Gravel in the Life of Game Fishes (Mahseer and other river carps and Bagarid Catfish)</p> <p>Both seen and unseen biotoxic chemicals from agricultural areas particularly irrigated rice fields spill into the river water of Kanda, Pathraiya and Mohana river, where through complex chemical interactions (they can become dilute, as solution of pollution is dilution). The scientific understanding is needed to local people how these lethal chemical reduce fish production capacity of river and hastens eutrophication by reducing oxygen and BOD. Conservationist of the area must understand intricate process of fresh water food chain and they must explain to local people. The natural process of purification will take years. Fish spawn or fertilized egg deposited in gravel bed of river bank may die due to leaching of biocides from rice fields and fish poison.</p>	<ul style="list-style-type: none"> - To replenish fish loss due to impact of agrochemical pesticide, pollution and modification of gravel bed habitat due to civil structure, hatchery produced local fish fry of rhou, mrigal and vakur produced in nearby fish hatchery should be released at the confluence site of Kanda and Pathraiya rivers. To promote greenery massive tree planting in riverside are to be made (Annex – III). - Embark antipollution abatement activities in pollution affected areas.
<p>3.</p>	<p>Impact of Erosion of River Bank</p>	<p>Tree planting to suit bioengineering model</p>
<p>4.</p>	<p>Encroachment, Fishing Pressure (over fishing), Impact of Passive Nets and Traps on Gangetic Dolphin, Otter, Crocodiles</p> <p>The river banks between Mohana and Karnali is encroached by Tharu and Musher fishing communities. Gill net fishing is widely used in pools of Mohana river below Dhungana Tole. Both fishermen, river dolphin and otter rely upon the river stock for fish,</p>	<ul style="list-style-type: none"> - Replenish fish loss in the river hatchery produced fish or fries captured from nearby Ozuwa Tal should be released in confluence site

	<p>shrimp and crab for their survival. Gillnet fishermen affect survival of Gangetic dolphin in many ways. It is recorded that Current Jal (synthetic net) in flooded river appear deadly since they are not easily seen visually and acoustically in highly flooded turbid water by dolphin. Peak flood period is migration time, in this period dolphin loses its sonar ability and get entangled in nets. Due to murky runoff young dolphin become easy victim of fisherman. It also become target of fishermen collecting medicinal dolphin oil. Dolphin population are declined due to interaction of oil hunters and fishermen living in riverside. They also compete with dolphins for limited fishery resources in dry season of winter (December-January). Low water of winter attracts drift net fisherman from India and engage stretching gill nets for capturing juvenile dolphin as bycatch. Drift nets of 5-10 cm mesh size are often stretched across the river at night to capture dolphin. The interview with locals reported occasional incidence of dolphin entanglement in drift net at Chaugurdighat and stranding incidents at Gairinala irrigation canal near Dhungana Tole.</p>	<p>of Kanda and Pathraiya river of Dhungana Tole area.</p> <ul style="list-style-type: none"> - Regulate mesh size of gill nets - Protect nesting sites of crocodile sand otter in river banks. - Ban of netting around Dhungana Tole and Kalakunda areas. Regulate only cast net in the area. - Regulate mesh size of fishing net and instruct fishermen to release small size fishes of low commercial value. - Restore or rehabilitate old spawning areas by making spring fed gravity water supplies
<p>5.</p>	<p>Impact of Pollution and Loss of Spawning Habitat of Dolphins, Game Fishes (Mahseer and other river carps and Bagarid Catfish) on Riverine Flood Plain</p> <p>Dolphin Viewing Tower near Dhungana Tole is littered with plastic material of all kinds and food stuffs cans and glass bottles of all kinds. Discarded stale food stuffs also thrown by tourists pollute Kanda and Pathraiya rivers in many ways. They also add high load of faecal contamination in river water at Dhungana Tole every year.</p>	<ul style="list-style-type: none"> - Removing biodegradable and degradable garbage and clean around dolphin viewing tower area of Dhungana Tole. The garbage pollution affects growing fish fry and fingerlings directly. - Biodegradable, discarded food stuff and non-degradable plastic material and cans affect nesting and basking site of crocodile. So dolphin conservation center should take care and educate tourist for proper use plastic items. - Start pollution abatement program - Developing open river dolphin park at Khakraula section of Mohana river near Mohana bridge for conserving migratory dolphin. For this water monitoring of water quality is vital.

		<ul style="list-style-type: none"> - To replenish fish loss due to impact agrochemical pesticide pollution and habitat modification due to oversilting, hatchery produced fish fry of local fishes such as rhou, mrigal, vakur should be released time and again in the confluence site of Kanda and Pathraiya rivers. - For keeping riverbank clean mass environmental education is to be mounted.
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IMPACTOGRAM – 1B

SUMMARY AND PROJECTION OF OBSERVATION FOR RESTORING AND SAFEGUARDING ECOFRIENDLY ENVIRONMENT AT EMBANKMENT AREA

S.N.	Impact Scenario	Mitigation Measures
1.	Impact of concreting work on right bank of Patheriya river at Bajani, Kandadik municipality (358 m length)	The floodplain of the right bank Pathraiya river embankment is largely covered with sand low marginal vegetation. The river morphology exhibit slow run shallow water pool and rapids with eroded banks not much suitable for survival of dolphin, otter, turtle and crocodile. Extensive tree/scrub planting within and on flood banks for improving habitat. Such an effort will provide hiding cover and escape areas of crocodile and otter. This area has moderate or negligible environmental impact.
2.	Impact of Gravel metalling work on the left bank of Nayabasti to Dhugana Tole Municipality (789 m length)	Pathraiya river bank is frequented with pool and rapids serve as temporary habitat of dolphin and crocodile during rainy season of monsoon. Here the density of fish prey is medium. Fish fry are seen in river bank spawning areas they have great potentiality of growing into adult fish. Extensive tree and scrub planting / bush layering within and on flood banks for improving or restoring habitat. Such an effort should be made to provide hiding cover and escape areas of terrestrial and semiaquatic crocodile and otter. It is an overfished zone therefore Dolphin in this area are vulnerable so drift and gill net must be banned. This area may be regarded as moderate environmental impact zone.
3.	Impact of Boulder dry wall at Dhungana Tole Municipality (446+415=861 m length)	Both Pathraiya and Kanda river join in Dungana Tole area make beautiful confluence site which is regarded as dolphin monsoon resort in past but now this riverside are disturbed by fishing activity and supports very little fish food to support dolphin and crocodile in during rainy season of monsoon. Therefore presence of dolphin is occasional in Dungana Tole, which depends on migratory run of dolphin population from India to Mohana river. Boulder packing with reeds and grasses in sloping boxes should be done to boost habitat quality.
4.	Impact of downstream boulder filling with gabion work Kalakunda to Khakraula (885 m length)	The river morphology of Kalakunda is nearly same as DhungnaTole but this section holds deep water with slow run rapids in both banks are eroded and covered tall elephant grass, shrubs and open overgrazed area by cattle. Dolphins and crocodiles are seen in pools and rapids of the river. Fish foods are plentiful here for survival dolphin and crocodiles. This is an overfished area therefore dolphins in the area are vulnerable due to frequent use of drift net and gill net for fishing. Such fishing activity at night must be banned. Concrete lining in this area should be carefully planned to protect sandy gravel bed serving as spawning ground of principal fish such mrigal (<i>Crrihina mirgala</i>) and vakur (<i>Labeo catla</i>) To enhance cattle watering and steps are made to make easy approach to riverside. This area may be regarded as high environment impact zone.

IMPACTOGRAM - 2
IMPACTOGRAM SHOWING SEQUENTIAL EFFECT OF OVERFISHING ACTIVITY

Scenario of Anthropogenic Activity and Use of Harmful Fishing Gears	Harmful Fishing Activity and Sequential Impact on Dolphin
1. Use of spear mounted in long bamboo pole with retrievable rope	Harpoon surfacing dolphin along pool showing triangular back or hump and belly and get mortally wounded, scar difficult to heal
2. Use of rolling hooks used to fisherman and angler fishing mahseers	Injure dolphin along beak and melon, leave scare on melon and abdomen area.
3. Setting fine meshed gill-net across the river	Entanglement, young dolphins cause drowning and death, most of them die due to suffocation and dawning effects and shock distress.
4. Drift net and drag net setting across the river	Increase incidence of dolphin by-catch and force them to enter wrong places such as fishermen traps and nets. Drift net entangle adult dolphin at night and fisherman take home for oil extraction
5. Noise produced during the construction and repair of Irrigation canal an embankment due to movement of machine	Interfere sonar ability of dolphins and disturb crocodile, otter daily activity.
6. Stone mining, removal of rocks, stones and gravel from river banks.	River pollution, change in composition of microscopic food or benthic life, alter habitat and spawning ground of fishes make reduce abundance of insect food, shrimp and carb in river. Ultimately, reduce fish diversity impair dolphin food chain. Gravel and sand removal affect algal bloom on and productivity, kill all life history stages of fish and disrupt food chain of dolphin, otter and game fish such as mahseer and Jalkapoors which will disappear for ever.
7. Releasing deadly fish poison, herbs in water for fishing	Affect respiration of young and inexperienced dolphins force them to go shallow water where fishermen spear them by tridents and kill them.
8. Dynamiting pools and oxbows of river during dry season	Injure pregnant dolphins and gravid female crocodile.
9. Chasing dolphin and encircling them to bamboo mat screen trap banging conical fish traps	Injure baby dolphins and juvenile crocodile and otters.

9.2 Human Induced Pressures, Water Pollution and Disruption of Food Chain of Riverine Floodplain

The agricultural activities along the river bank pose threat for existing dolphin population. In Nayabasti, Kanda and Pathraiya rivers, both the banks are used for agricultural purposes. Through agricultural run-off of toxic chemicals aldrin, dieldrin etc. happen to spill into the river water. The pollutants entering into the dolphin habitats are harmful to dolphins, crocodiles and fish both directly and indirectly through food chain. The pollutants spilled in the river are lethal to many organisms as zooplanktons, shrimps, snails and fish fries, which are a part of food cycle of dolphins.

10. Recommendation

10.1. Recommendation for Advocacy and Policy for Dolphin Survival and Promotion of Ecotourism

Gangetic dolphins are symbol of nature conservation plays an important role in promotion of ecotourism as charismatic intelligent animal so we have to strive to save them for posterity. It also remove and eat away lazy injured fish and enhances healthy growth of fish population dolphin remove aging fish as well as diseased fish with stunted growth and helps to maintain entire fish school in healthy and operative condition. It keeps check and balance of fish population by weeding undesirable rough fishes such as *Heteropneustes*, *Clarias* and *Channa* species. Dolphin also consume large amount of benthic life such as shrimp, crab and mollusc. It also helps to control liver fluke disease carrying vectors such as snail and slug population and keep the river ecosystem well balanced. In absence of practical dolphin rescue policy and conservation action in Nepal and India waterfronts, the existing residual population may become extinct in near future. So if feasible dolphin river park or sanctuary is to be developed at surplus irrigation water release area. For this further research inventory will be needed.

10.2. General Recommendations

1. Maintain river flow and surplus riparian water release for benefit of dolphin, turtle, otter, crocodile and fishes and continue research for habitat restoration for the survival endangered aquatic and terrestrial wildlife.
2. Public education and awareness programme for fishermen, cow herders, rural people living in riparian areas at the downstream of Karnali and Mohana river and feeder streams

3. Linking dolphin conservation activities to livelihood improvement of the people living near core dolphin habitats of RJKIP near Baidi, Dhungana Tole, Kalakunda, Khakraula, Chaugurdighat, Daulatpur, Tikapur and Rajapur etc.
4. Develop people door to door programme to encourage fisherman for intensive pond fish culture activity to reduce fishing pressure in the rivers and discourage dolphin poaching activities.
5. Conduct regular dolphin survey to determine core area of dolphin sighting and promote ecotourism to alleviate livelihood of people.
6. Plan to initiate massive tree plantation near embankment protection area by gardening and educate people for cattle rearing, growing vegetables, weaving and other income generating activities (Annex – III).
7. Educate people for scientific use of alternative protein from cow, buffalo and other meat sources in order to stop over fishing and for avoidance of fish from regular meal.
8. Encourage co-operative societies to loan fishermen and increase cash income in Baidi to Kalakund area.
9. Discourage unscientific use of pesticide and herbicides by keeping constant vigilance and control.
10. Total ban of destructive fishing nets, gears and fishing practices for conserving migratory dolphins.
11. Promote recreational fishing by promoting angling, rafting and initiate other eco-friendly tourism activities near Tikapur and Bardia National Park.
12. Provide safe passage to cattle to riverside for watering and wallowing.
13. Install stepped fish passages along irrigation canal to facilitate fish movement in irrigation channel.
14. Explore possibility of creation of fish and dolphin sanctuary for public awareness and fish conservation in RJKIP premises.
15. Develop facility to hold stranded dolphin and rescue operation plan.

10.3. Special Research Recommendation

Further long term study should be carried out to determine the following aspects migratory fish and dolphin behaviour during high and low water phase of the Mohana, Kanda, Patheriya and Karnali rivers.

1. Study Fish and Dolphin habitat identified by present study in detail pre-monsoon, monsoon and post-monsoon period to relate them with seasonal hydro biological cycle of the Mohana river and feeder streams. Study feasibility and desirability of open river park or dolphinarium in riverside.

3. Determine suitable water level and flow conditions necessary for the dolphin and healthy growth and survival of fertilized egg, fry and fingerlings in dry season winter.
7. Determine beneficial and harmful fishing methods and gear used by fishermen to impose ban and regulate fishing laws and control.
8. Make detailed study of migratory trend of dolphin and stranding potential of dolphin in monsoon flood.
9. To study feasibility and desirability of fish propagation in lakes near Mohana river to replenish fish loss or fish taken in fisherman net.
10. Find out bio-engineering ways and means to restore habitat loss or damaged by erosion, pollution, human activities and river training embankments work by applying novel techniques.

10.4. Limitation of study

Due to time and budgetary limitation impact study conducted in a very limited area of embankments work of RJKIP project so impact prediction is restricted to embankments areas lying between Nayabasti to Khakraula only, other areas lying far beyond could not be documented. The research finding and conclusion drawn from this study may not represent migratory dolphin status in whole Mohana river and feeder streams. Projection of observation is limited to Kanda, Pathriya and Mohana river up to the confluence site of Karnali river. Study made during second week of October may not assume to cover wet season of monsoon. A separate study is recommended for this purpose. As civil works were not complete during field visit, so predictions were made for impact of civil works at embankment areas of Kauralia branch of Karnali and Mohana river. Overall analysis made from field survey, literature review and interview, underwater video technology is considered sufficient to meet present level of objectives of project.

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Annex - I

Field Activities

Date	Activity	Mode of Travel	Number of Dolphin Seen	Remark
Oct. 13, 2019	Flight from Kathmandu to Nepalgunj. Trip to Baidi to be familiar with dolphin habitat. Visited Baidi and Dhunga Tole dolphin view tower are to be familiar with project activities	Air, jeep	-	Visited field on the basis of information provided by local people. Standardizing field and camera equipment and meeting community groups.
Oct. 14, 2019	Trip to Baidi, Dhungana Tole, Mohana river for dolphin survey and exploration	walking		Meeting with dolphin conservation group of Dhungana Tole, local fishermen and cow herders to understand their experience in dolphin sighting.
Oct. 15, 2019	Field Trip to different sections of Baidi, Dhungana Tole and, Kalakunda for dolphin sighting examine fish foods	Jeep and walking	-	Meeting land owner to gain information about land tenure system.
Oct. 16, 2019	Trip to Kalakunda and Khakraula to observe migratory dolphin	Boat and jeep	-	Dolphin migratory trend and fishing activity, intense local people were found using current jal and rolling hooks. Test fishing carried out to examine fish density
Oct. 17, 2019	Visited Khakraula Hatbazar to meet fishermen and observe fisherman activities	Jeep and walking	Two dolphins were seen	Observation made from suitable high points and boats used in the river bank
Oct. 18, 2019	Observe fishermen activity, netting across the river for capturing existing fish species in Mohana river	By walking, boat and jeep	-	Record made for dolphins fish chasing activity into shallow water and deep water injured fish capture attempt were made surrounding nets.
Oct. 19, 2019	Return to Kathmandu	By air		Assemble field data and start writing draft and final report

Annex - II

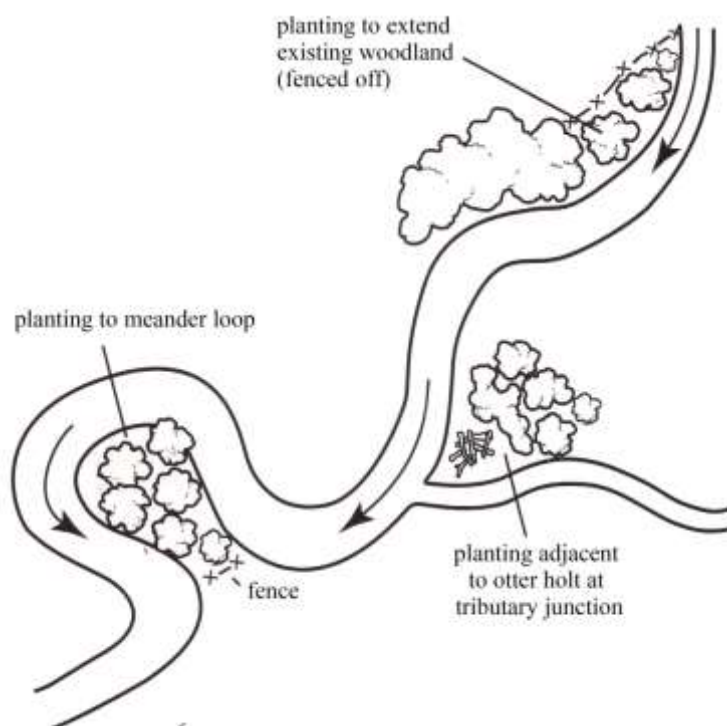
List of Size Classes of Important Food and Game Fishes in Mohana River

S.N.	Scientific Name	Common Name \ Vernacular Name	Size Class Weight Kg	Size Class Length Cm
1.	<i>Anguilla bengalensis</i> (Gray)	Freshwater eel \ Rajabam	12-20	140-200
2.	<i>Raiamas bola</i> (Ham)	Trout \ Goha	1.3- 2.5	35-50
3.	<i>Bangana dero</i> (Ham)	Kalabans \ Gurdi	5-10	60-100
4.	<i>Cirrhinus mrigala</i> (Ham)	Mrigal \ Mrigal, Naini	5.3-10.5	55-150
5.	<i>Cirrhinus reba</i> (Ham)	Reba Carp \ Mrigal	1.2-2.5	30-50
6.	<i>Labeo angra</i> (Ham)	Angra Labeo \ Thed	3-5	30-50
7.	<i>Labeo boga</i> (Ham)	Boga Labeo \ Boga Tikauli	3-8	30-50
8.	<i>Labeo catla</i> (Ham)	River Carp \ Vakur, Katlagi	5-20	60-100
9.	<i>Labeo pangusia</i> (Ham)	Pausi Kalaacha	4-8	50-60
10.	<i>Labeo rohita</i> (Ham)	Rohu	4-8	30-50
11.	<i>Tor tor</i> (Ham)	Deep bodied Mahseer \ Falame Sahar	15-40	100-200
12.	<i>Tor putitora</i> (Ham)	Golden Mahseer \ Pahale Sahar Mahseer	15-60	130-200
13.	<i>Salmostoma bacaila</i> (Ham)	Large Razorbelly Minnow \ Chilwa	0.01-0.03	8-15
14.	<i>Wallago attu</i> (Schneider)	Boharil \ Buhani	5-20	30-50
15.	<i>Glyptothorax cavia</i> (Ham)	Capre	0.03-0.05	15-25
16.	<i>Bagarius bagarius</i> (Ham)	Giant catfish \ Gouch	25-200	150-250
17.	<i>Clupisoma garua</i> (Ham)	Jalkapoor	1-1.5	30-40
18.	<i>Mystus tengara</i> (Ham)	Tengara mystus \ Tenger	0.01-0.04	9-16
19.	<i>Sperata seenghala</i> (Sykes)	River catfish, Seenghari \ Suhjana, Tenger	25-50	100-150
20.	<i>Clarias magur</i> (Linnaeus)	Magur \ Mangur, Mungar	5-15	30-65
21.	<i>Heteropneustes fossilis</i> (Bloch)	Stinging catfish \ Singhi	0.05-0.10	20-30
22.	<i>Channa maurilus</i> (Bloch & Schneider)	Asiatic Snakehead \ Garahi	8-25	40-60
23.	<i>Monopterus chuchia</i> (Ham)	Gangetic Mudeel \ Bamali, Andho Bam	5-8	50-150
24.	<i>Mastacembelus armatus</i> (Lacepede)	Tire-Track, Spiny Eel \ Gaichi, Chucho Bam	0.03-0.05	25-30

Annex - III

Recommended Long Rooted Plants Suitable for Planting in Erosion Prone and Sloppy Areas

Local name	Botanical name	Altitude range	Sites summary
Shrubs			
Dhainyaro	<i>Woodfordia fruticosa</i>	Terai – 1800 m	Hot, dry and harsh
Dhasure	<i>Colebrookea oppositifolia</i>	Terai – 1700 m	Hot, dry and harsh
Kanda phul	<i>Lantana camara</i>	Terai – 1750 m	Hot and dry
Trees			
Bakaino	<i>Melia azedarach</i>	Terai – 1800 m	Hot, dry and harsh
Chilaune	<i>Schima wallichii</i>	900 - 2000 m	Varied, dry / moist
Kalo siris	<i>Albizia lebbeck</i>	Terai - 1200 m	Hot, dry and harsh
Painyu	<i>Prunus cerasoides</i>	500 - 2400 m	Varied, dry and stony
Sal	<i>Shorea robusta</i>	Terai - 1800	Hot Humid
Simal	<i>Bombax ceiba</i>	Terai - 1800	Hot Humid
Khanyu	<i>Ficus semicordata</i>	Terai - 2000 m	Hot and dry; varied



A scenario of embankment habitat restoration by vegetation by enhancing, retaining and creating edge habitat

Annex - IV
Photographs



Pathraiya river near Dhungana Tole, a monsoonal temporary retreat of Ganges dolphin



Dhungana Tole, the confluence site of Kanda and Pathraiya rivers. River embankment with civil structure.



Rani Jamara Kulariya Irrigation project signboard at Dhungana Tole



Fish sampling at confluence site of Kanda and Pathraiya river, Dhungana Tole



Fish sampling at in Dhungana Tole river section revealed presence of game fishes such as giant catfish (*Bagarius bagarius*), giant river catfish (*Sperata seenghala*) and jalkapoor (*Clupisoma garua*) highly relished by dolphin.



Boat across Gairi Nala is a spot regarded as dolphin stranding spot in past decades.



Naya Basti Baidi embankment with rich vegetation on embankment



The topography of dolphin habitat at Naya Basti to Baidi supports ideal gravel bed habitat for spawning of migratory mahseer.



Freshly caught Mahseer (*Tor putitora*) kept for drying in sun



Surfacing Ganges River Dolphin (*Platanista gangetica*) in Mohana river



Swimming Mugger Crocodile (*Crocodylus palustris*) in Pathraiya river near Dhungana Tole



Gharial (*Gavialis gangeticus*) and Mugger (*Crocodylus palustris*) crocodiles basking in sun at bank of Mohana river



Harmful seine net locally known as current jal is used to capture most of migratory fishes.



Giant river catfish (*Sperata seenghala*) is highly relished food fish by Ganges river dolphins



Dr. Tej Kumar Shrestha lifting collected microscopic fish food from Kanda and Pathraiya river confluence site near Dhungana Tole.



Experimental sampling at confluence site of Kanda and Pathraiya river near Dhungana Tole.



Dr. Shrestha attempting to photograph surfacing dolphin at Khakraula area, Mohana river.



Dr. Shrestha observing activity of water birds from the boat near Khakraula section of Mohana river



Kalakunda riverbank is used as wallowing and watering area for domestic buffaloes.



Scenario of Kanda and Pathraiya river confluence site where dolphin observatory of Dhungana Tole is located



River Mohana and Karnali Confluence at Chaugurdighat where sport fishermen and anglers camp for fishing mahseer (*Tor putitora*) and giant catfish (*Bagarius bagarius*).