Project Dolphin – A Comprehensive Action Plan

2022-2047

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1 Executive Summary

Dolphins are charismatic species that have always evoked human curiosity, along with being an integral part of our cultural milieu. However, they are in need of immediate conservation effort to safeguard their future, and the future of human society. Hon'ble Prime Minister Shri Narendra Modi, has initiated a very timely and important step towards ensuring a future for dolphins in the country, by announcing the idea of 'Project Dolphin' on 15th August, 2020. The Project Dolphin is envisaged to bring both River Dolphins and Marine Dolphins under its conservation program. This project aims to address existing conservation concerns and to empower the stake holders to participate in conservation of dolphins. This includes a multi-pronged approach involving forest department, fisheries department, fishermen and other stakeholders, through science based conservation. The river and marine ecosystem is the lifeline for the most marginal people in the country, apart from several threatened and endangered fauna. This document is a guiding framework to ensure the conservation of not only aquatic biodiversity, but the livelihoods of people dependent on natural resources. Dolphin acts as an umbrella species, whose conservation will result in the wellbeing of associated habitat and biodiversity, including humans. This effort is truly in line with our conservation philosophy of '*Vasudhaiva Kutumbikam*'.

Globally, there are 92 species of cetaceans, of which 43 species are dolphins. Of these, the river dolphins, represented by four species that are the least known and most endangered of all the cetaceans (Reeves & Martin, 2009). In India, the river dolphins are represented by South Asian river dolphin or the Gangetic dolphin (*Platanista gangetica*) that have two sub species *P. g. gangetica* and *P. g. minor*. Apart from these 30 species of Coastal and Marine dolphin have been reported from Indian coast. The Irrawaddy dolphin (*Orcaella brevirostris*) is found mostly in the estuaries and brackish water lakes, and remaining are 29 species are marine species.

The South Asian River dolphin is the only living member of the superfamily Platinistoidea. Of the two subspecies of the South Asian River dolphin, Gangetic dolphin (*P. gangetica gangetica*) and the Indus river dolphin *(P. gangetica minor*) that occur in geographically distinct river systems, viz the Ganga and the Indus basins respectively. Coastal species like the Indian Ocean humpback dolphin (*Sousa plumbea*), the Indo-Pacific finless porpoise (*Neophocaena phocaenoides*), Irrawaddy dolphins (*Orcaella brevirostris*), along with at least three species of baleen whales; blue (*Balaenoptera musculus*), Bryde's (*Balaenoptera edeni*) and humpback whales (*Megaptera novaeangliae*) are found in areas of high overlap with anthropogenic activity and are some of the most vulnerable Marine dolphins along the Indian coast. The South Asian river dolphins are riverine umbrella species and indicator of healthy river ecosystem. Similarly, Marine dolphins play critical roles in ecosystem functioning, at the same time these animals are extremely vulnerable to anthropogenic pressures and sudden environmental changes affecting major life history events like foraging and breeding success.

In India, the dolphins are protected under Schedule I of the Wild Life (Protection) Act, 1972. On October 5, 2009, the Government of India declared the Gangetic dolphin as the National Aquatic Animal and a formal notification was issued on May 10, 2010. To conserve the South Asian River dolphin in India, a Conservation Action Plan (CAP) was prepared for a duration of 10 years from 2010 to 2020. Despite being a comprehensive plan, this plan focused only Gangetic dolphin, and did not include other dolphin species found in the country. The CAP outlays the actionable strategies and the authorities which would implement them, but the plan did not envision the need for a centralized integrated mechanism to address the problems in a long run. The CAP did not focus on problem

specific planning and did not address inter-state and inter-departmental coherence and coordination. In view of these, the Hon'ble Prime Minister advised to initiate country wide conservation programme, addressing conservation issues of all freshwater and Gangetic dolphin. He also suggested that conservation efforts should be in line with sustainable livelihood development. In response to this MoEFCC initiated process of consultation in 2021 and Hon'ble Union Minister of Environment, Forest and Climate Change Shri Bhupendra Singh Yadav held a meeting at ICFRE, Dehradun on 28th April 2022 and directed the Ministry of Environment, Forest and Climate Change to finalize a project for conservation of the dolphins. Hon'ble minister suggested that three type of areas: natural, agriculture and human should be identified.

He further elaborated that ways to conserve the natural areas should be devised so as to make the dolphin pride of the local communities.

Tropical river ecosystems are the only habitat for the river dolphins, and hence for conservation of dolphins a comprehensive approach, which considers the ecological function, stakeholder participation and adaptive management is urgently needed. Considering increasing anthropogenic pressures in the marine environment and the overarching effects of global climate change, there is a pressing need to gather long-term systematic information on population trends, distribution, and space use of Marine dolphins along Indian waters. To formulate strategies for dolphin conservation intensive consultations and discussions were held with subject experts and stakeholders. During these consultations, a problem tree approach was adopted to frame basic thematic groups for formulation of the objectives. The problem-solution tree analysis revealed six thematic areas such as species mortality, alteration of riverscape, engage and empower the local communities, reduce pollution, policy and address knowledge gaps through systematic research and monitoring and develop supportive institutional mechanisms that can provide sustainable solution measures.

Indian waters spanning across the Arabian Sea to the Bay of Bengal form the habitat of approximately thirty species of cetaceans (whales, dolphins and porpoises). Cetacean species play critical roles in ecosystem functioning, at the same time these animals are extremely vulnerable to anthropogenic pressures and sudden environmental changes. Long term dedicated research on marine cetaceans in Indian waters is still in its nascence, majority of the data on the documented species are based on opportunistic sighting events and stranding data.

Coastal species like the Indian Ocean humpback dolphin (*Sousa plumbea*), the Indo-Pacific finless porpoise (Neophocaena phocaenoides), Irrawaddy dolphins (Orcaella brevirostris), along with at least three species of baleen whales; blue (Balaenoptera musculus), Bryde's (Balaenoptera edeni) and humpback whales (Megaptera novaeangliae) are found in areas of high overlap with anthropogenic activity and are some of the most vulnerable cetaceans along the Indian coast. The Irrawaddy dolphins in Chilika have already been classified as Vulnerable under the IUCN red list. Recent IUCN assessment has placed Indian Ocean humpback dolphins under Endangered and Indo-Pacific finless porpoises under Vulnerable, further pushing the need for monitoring these species' populations. The humpback whale population found along the Arabian sea are supposedly part of the distinct and endangered Arabian Sea population, that has been subject to heavy whaling in the 1960s. While population estimates for ASHW across their entire range- from Oman to west coast of India- are unknown, estimates indicate a population no greater than 250 mature individuals (Pomilla et al. 2014).

Considering increasing anthropogenic pressures in the marine environment and the overarching effects of global climate change, there is a pressing need to gather long-term

systematic information on population trends, distribution, and space use of cetaceans along Indian waters. All these data are essential when designing dedicated policies for long-term conservation of these animals.Coastal and oceanic cetacean species face similar direct threats in the form of accidental mortality in fisheries bycatch and mortalities due to vessel strikes and propeller injuries. Indirect threats include habitat degradation or loss due to intensifying fisheries and resource competition, increasing vessel traffic, chemical and noise pollution, infrastructural development, and oil and gas exploration. It is crucial to develop robust method for monitoring status of marine cetaceans, address issues of net entanglement, pollution, unsustainable fisheries, identification of conservation areas and people participation for improving their livelihood and conservation of marine life. **This report is a comprehensive action plan. For more details, please refer to annexure I , where review and actionable points are explained in detail**

2 Introduction

Dolphins are charismatic species that have always evoked human curiosity, along with being an integral part of our cultural milieu. However, they are in need of immediate conservation effort to safeguard their future, and the future of human society. Hon'ble Prime Minister Shri Narendra Modi, has initiated a very timely and important step towards ensuring a future for dolphins in the country, by announcing the idea of 'Project Dolphin' on 15th August, 2020. The Project Dolphin is envisaged to bring both River Dolphins and Marine Dolphins under its conservation program. This project aims to address existing conservation concerns and to empower the stake holders to participate in conservation of dolphins. This includes a multipronged approach involving forest department, fisheries department, fishermen and other stakeholders, through science based conservation. The river and marine ecosystem is the lifeline for the most marginal people in the country, apart from several threatened and endangered fauna. This document is a guiding framework to ensure the conservation of not only aquatic biodiversity, but the livelihoods of people dependent on natural resources. Dolphin acts as an umbrella species, whose conservation will result in the wellbeing of associated habitat and biodiversity, including humans. This effort is truly in line with our conservation philosophy of '*Vasudhaiva Kutumbikam*'.

Globally, there are 92 species of Cetaceans, of which 43 species are dolphins (Perrin, 2022; Jefferson et al., 2011). Of these, the river dolphins, represented by four species that are the least known and most endangered of all the cetaceans (Reeves & Martin, 2009). In India, the river dolphins are represented by South Asian river dolphin or the Gangetic dolphin (*Platanista gangetica*) that have two species *P. gangetca* and *P.minor*. Apart from these 30 species of coastal and marine dolphins have been reported from Indian coast (Afzal et al. 2008). The Irrawaddy dolphin (*Orcaella brevirostris*) is found mostly in the estuaries and brackish water lakes, and remaining 29 species are marine.

This proposal aims to initiate national level conservation programme addressing both riverine and marine dolphins found in the Indian sub-continent.

3 Vision

Conserve and establish ecologically functional socio-culturally valued populations of the dolphins within their historic range, ensure ecological integrity of their habitat, minimize threats, and promote sustainable livelihood of people.

4 Goals

1) Secure dolphin population in its range
2) Control factors for dolphin mortality

Since, the Indian sub-continent has two distinct groups of dolphins viz. the freshwater and the marine, the document outlines the objectives and the conservation activities for them in different section. First section provides brief introduction, threats, and conservation actions for the South Asian river dolphin, while the second section outlays the brief introduction of the marine cetaceans and the conservation actions for them.

5 River Dolphins

River dolphins are the only living members of the superfamily Platinistoidea. Ganges river dolphin (*P. gangetica*) and the Indus river dolphin *(P. minor*) occur in geographically distinct river systems, viz the Ganga-Brahmaputra and the Indus basins (Braulik et al., 2021). It was suggested that these river dolphins have evolved from marine platinistid ancestors which inhabited the sea, and when sea penetrated low lying areas of South Asia during Miocene, they entered the continent. As sea-levels receded, dolphins continued to persist in the freshwater river system (Hamilton et al., 2001). Over time, as the connection between Ganga Brahmaputra river systems and the Indus river system became contentious, the populations started diverging from each other, and have evolved into the two species that exist today.

River dolphins are characterized by a long rostrum, almost non-existent dorsal fin. Males are smaller than females in both the subspecies (Kasuya, 1972). They have rudimentary eyes, and adaptation for turbid waters and rely largely on acoustic communication for not only movement but also foraging and other life history traits. Being aquatic mammal, they respire through blow hole which is a longitudinal slit (Jefferson, Webber, & Pitman, 2008). The respiratory system of cetaceans is modified to allow complete gas exchange during the short surface intervals during dives (Ito et al., 1967; Ponganis et al., 2003; Bagnoli et al., 2011). Gangetic river dolphins surface for a very limited time, with an average of 1.26 (SD + 0.23) seconds above water, and an average 107.3 (SD + 46.8) seconds time under water, making it very difficult to observe (Wakid & Braulik, 2009).

Anderson (1878), noticed that *Platanista* are slow growing species and usually give birth to one individual at a time, which sometimes varies to two individuals. The gestation period was recorded to be about 8-9 months and the young are born between April and July. The calf is born at a small size compared with that of oceanic dolphins (Kasuya 1972). Based on crude estimates, dolphins may live up to 28 years of age (Kashuya, 1972). The male Gangetic dolphin may attain the sexual maturity at about 10 or slightly less years and at the body length about 170 cm or less, whereas female Gangetic dolphin attains sexual maturity between 170 and 200 cm in body length (Kashuya, 1972). However, in terms of physical maturity, Kashuya (1972) estimated that female Gangetic dolphin attains physical maturity at around 250 cm body length, which is larger than male. Kashuya (1972) assumed two peaks in the parturition season for Gangetic dolphins, one in the early winter and the other in the early summer, which indicates the gestation period of Gangetic dolphin as about one year.

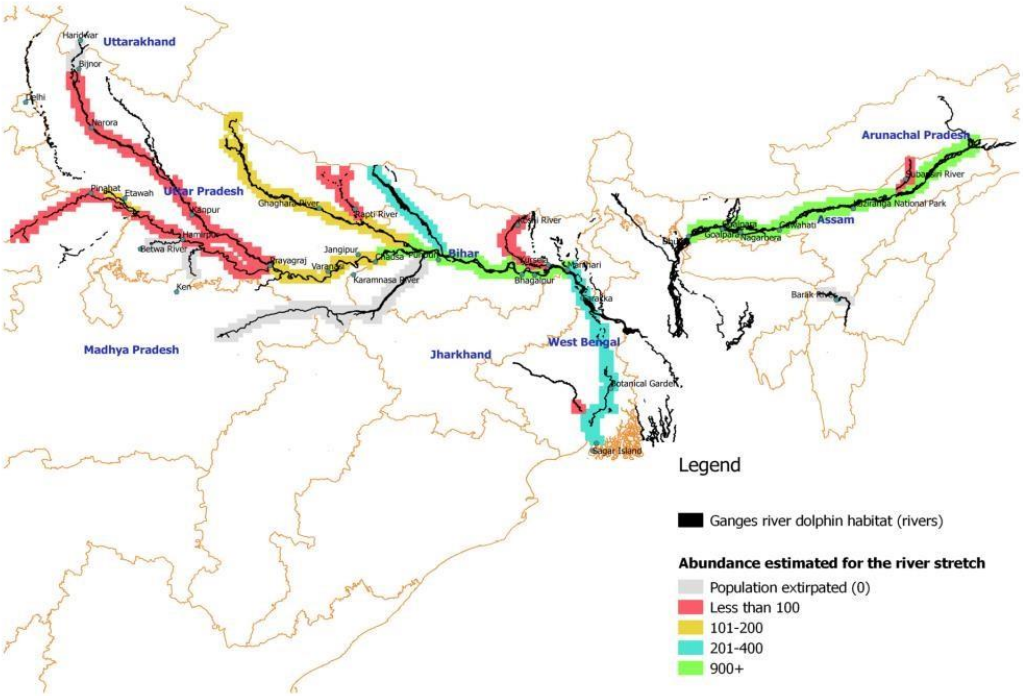
Given the very low surfacing time, traditional monitoring and abundance estimation methods are difficult to implement. Hardly anything is known regarding their habitat preference in detail, or their breeding habitat, movement ranges and prey preference. Few studies have suggested that being a gape limited predator, they prefer fish of size classes 3-30cm (Sinha et al. 1993, Choudhary et al. 2006; Kelkar et al., 2010). From recent studies, it is understood that they prefer confluences, meanders and mid-channel islands (Sinha et al., 2002; Qureshi et al., 2019). Apart from river morphology, flow is also deterministic of dolphin presence, as it influences the microhabitat and prey present in the area (Qureshi et al., 2019). However, there is a need to address these large knowledge gaps, without which apt conservation actions will fail.

5.1 Gangetic Dolphin – population status and distribution

Prior to the initiation of water resource development activities in the Ganga River during the 19th century, the Gangetic river dolphin was distributed between 77°E and 88°E, throughout the Ganga, Brahmaputra/Meghna and Karnaphuli rivers and their tributaries in India, Nepal and Bangladesh (Sinha et al., 2000). In the Ganga River, their distribution ranged from Bijnor to the Sundarbans, and in the Yamuna River, the species was reported up to Delhi in the month of May (Anderson, 1878; Sinha et al., 2010) (Figure 3.1). During the late 19th century, about 10,000 Gangetic river dolphins were estimated to be thriving in the Ganga River and its tributaries (Anderson, 1878); however, Sinha and Kannan (2014) estimated their population to be 3526 individuals during the early 2000s. This was later reported to have dropped to 1800 individuals including the population in the river tributaries by the beginning of the 21st century (Behera et al., 2008; Bashir et al., 2012; estimated between 1200- 1800 by IUCN, 2006; less than 2000 by Mazumder et al., 2014; Smith and Braulik, 2012).

The dolphin populations have been reported to have had a decline of 1/3rd of its population in just 4 generations (Paudel and Koprowski, 2020). Reports have noted the possibilities of more than 50% decline only between 1944 and 1974 (Smith, Braulik and Sinha, 2012). Beyond that, at least 500 known mortalities have occurred since 1980, a considerable proportion from by-catch in the fishing net and intentional killing. Recent studies have also shown a decline of at least 26% of the population over 12 year period in the Brahmaputra region alone (Wakid, 2007; Paudel et al., 2015). The most recent estimation in the Ganga river basin along with its tributaries stand at 2644 and in Brahmaputra along with its tributaries stand at 987 (survey in 2017-2018 by Qureshi et al., 2018) indicating at least a 50-65% loss since the 19th century.

Presently, the Gangetic river dolphin ranges in most of the large tributaries in the Ganga Basin: the Chambal, Ramganga, Yamuna, Gomti, Ghaghara, Rapti, Son, Gandak, Mahanandaand Kosi, besides the main channel of the Ganga. In the Brahmaputra valley, it ranges in the major tributaries such as the Tista, Adadhar, Champamat, Manas, Bhareli, Subhansiri, Dihang, Dibang, Lohit, Disang, Dikho and Kulsi rivers (Figure 1). Dolphins in the main channel of the Ganga were split into two subpopulations in 1975, when the Farakka Barrage was commissioned. Today they occur in 5 subpopulations within India, the Brahmputra, Bijnor–Narora, Narora–Kanpur Barrage, Kanpur Barrage – Farakka, and Farakka to Ganga Sagar. Anderson also confirmed the presence of the species from Gangetic delta and the Sundarbans, his records also confirm the absence of the species from the northern rocky reaches of Ganga and Yamuna and complete absence of the dolphin from southern peninsular rivers (Anderson 1878).



Population estimate based on last survey in the stretch

Figure 1: Distribution of Gangetic river dolphin in the Ganga-Brahmputra basin

5.2 Indus dolphin -Population status and distribution

The Indus river dolphin was found in approximately 3400 km of Indus River and its tributaries, from the foothills of Himalayas to the limits of tidal zone in Pakistan (Reeves et al. 1991). The continuum of its distribution has beenfragmented into sub-populations. One such population is reported from Punjab (India) in 2007 between Beas city and Harike Barrage and is believed to be the only surviving Indus River dolphin population in India. Recent estimates reveal that the Indus River Dolphin now occupies only one fifth of its former range (Reeves et al. 1991). The Indus River dolphin is currently found in the Beas River, with a population of between 68 individuals in India, and about 1800 in Pakistan (Kanwar et al., 2019; WWF-Pakistan, 2018). The population within India is precariously low, and requires concerted conservation attention. An 80% decline in distribution range of Indus river dolphin has been documented (Figure 2) (Braulik et al. 2014). Indus River Dolphin sharing common habitat with the reintroduced population of critically endangered Gharial since 2017.

To conserve the biological diversity, Punjab Wildlife Department declared 185 Km long stretch along Beas river (Amritsar) as conservation reserve in 2017, that is considered first of its kind in the country. This restricts fishing, and hunting in the river Beas and the river water is expected to be used for breeding various species of fish including dolphins and other organisms like Gharials and Otters. Based on several surveys, Khan et al., 2016 have found that dolphins were found migrating towards upstream during high flows as the increased water levels create new suitable habitat patches, whereas low flows restrict them to the only remaining habitats downstream. Persistence of dolphins, even in low density in this isolated small stretch of River Beas is indeed a good sign, but intensive fishing and increasing pollution

remain a matter of concern. Dolphin populations are most vulnerable during the low-water season when habitat is limited dolphins selected locations in the river with significantly greater mean depth, maximum depth, cross-sectional area, and hydraulic radius. Dolphins were also recorded with higher frequency at river constrictions and at confluences. Channel crosssectional area was the most important factor affecting dolphin presence and abundance, with the area of water below 1m in depth exerting the greatest influence. Indus dolphins avoided channels with small cross-sectional area (<700m2), presumably owing to the risk of entrapment and reduced foraging opportunities.

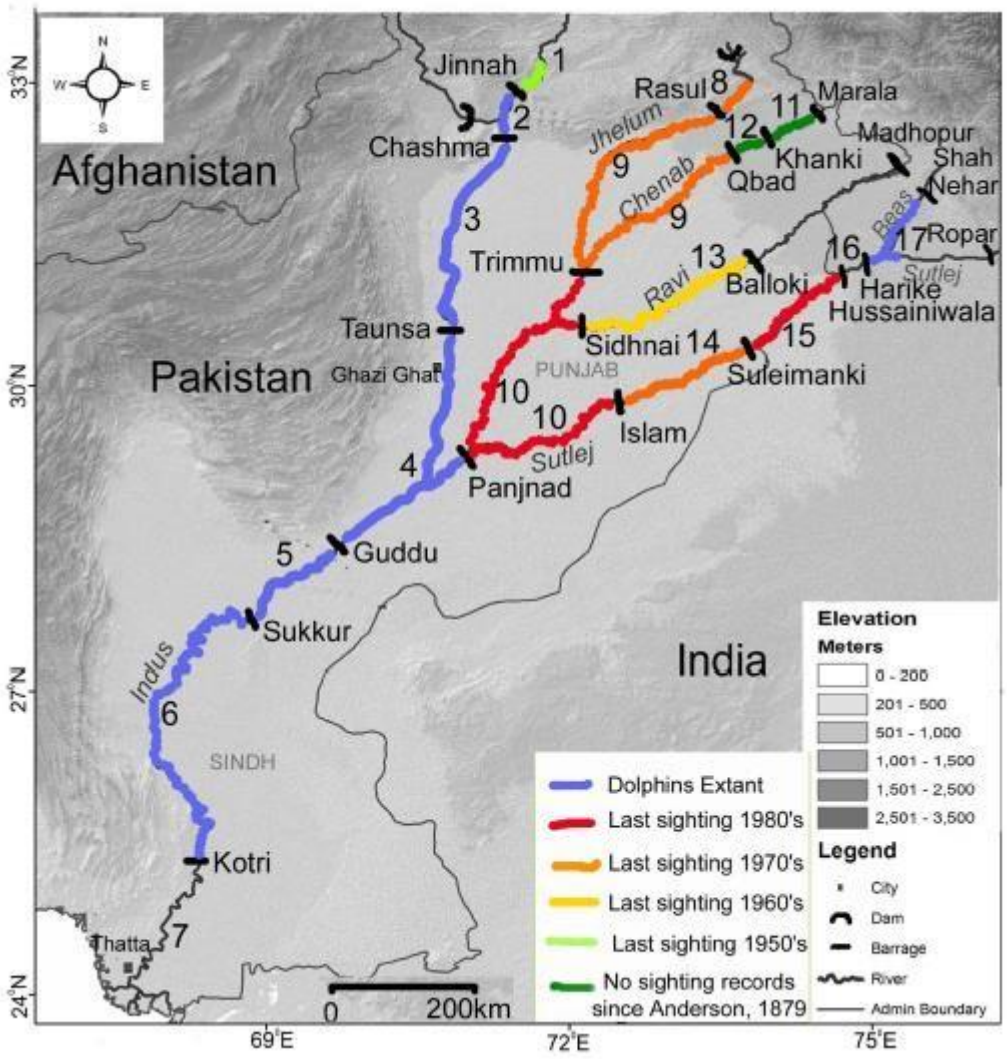


Figure 2: Distribution of Indus river dolphin in India and Pakistan (Source: Braulik et al., 2014)

To secure this critically low population, and to make sure that we do not witness another extinction, there needs to be prey-base assessment and enhancement, regulation of commercial fishing and destructive fishing practices, Infrastructure to support conservation initiatives. Minimizing the impact of dam and barrages and maintaining the minimum flow requirement in the rivers all through the year.

5.3 Threats

The river dolphin is the sole living representative of the family *Platanistidae* (Rice, 1998) and therefore its extinction would mean not just the loss of a single species, but loss of an entire mammalian family regarded as a sister taxon to all other cetaceans. The major drivers of population decline and range reduction of the species can be attributed to habitat loss related to increasing water demands, impoundments such as dams and barrages (Smith et al., 2010; Chaudhary et al., 2012; Braulik et al., 2014), deliberate killing for oil (Sinha et al., 2000; Smith & Reeves, 2000) and mortality in fishing gear (Kelkar et al., 2010). The synergistic impact of all the stressors moved the species from the Vulnerable category to the Endangered category of the IUCN Red List in 2004 (IUCN, 2016). The habitat fragmentation may lead to isolated populations, inbreeding depression and genetic bottleneck (Sinha et al., 2000), and local extirpation of populations as already evident in stretches such as downstream Bhimgoda barrage to upstream Bijnor barrage, above the Gandak Barrage, above the upper and lower Sarda barrages and the upper Son River.

Apart from those continuing threats, the species is vulnerable to long term climate change impacts such as sea level rise and increased salinity in the lower Ganga. Report of bioaccumulation of Organochlorine and bodylines a cause concern about hormonal and endocrinal effects (Kannan et al. 1993, 1994; Kannan, 1997, 2005; Senthilkumar et al., 1999) and may affect reproductive capacity.

A series of projects planned under the National Waterways within the provisions of the Indian National Waterways Act, 2016. The stretch from Sagar, Haldia to Prayagraj is declared as National Waterways 1 and will have two fixed jetties and 19 floating terminals. The project has raised concerns regarding the possible negative impacts of these developments and the associated vessel traffic, alteration in the underwater acoustic environment, dredging and pollution. Initial findings of CAMPA-Dolphin project showed behavioural change and stress to river dolphins at areas with large vessel movements and subsequent underwater noise.

5.4 Conservation actions

The South Asian River dolphins are enlisted in Schedule I of the Wild Life (Protection) Act, 1972, and their habitat get incidental protection, where the rivers pass through a Protected Area (PA). However, the Vikramshilla Dolphin Sanctuary was the first PA to provide protection to the habitat of Gangetic river dolphin. The Harike Conservation Reserve is the recently notified PA for Indus dolphin conservation. Besides, the Hastinapur Wildlife Sanctuary, the Kacchua Wildlife Sanctuary, the National Chambal Sanctuary, Valmiki Tiger Reserve, Katerniaghat Wildlife Sanctuary, Kaziranaga National Park, provide incidental protection to the dolphins.

The international treaties and notification of the conservation areas such as Ramsar sites, also gives international recognition to the sites, for their conservation significance. The Upper Ganga Ramsar Site thus recognizes the stretch of the Ganga River as a critical habitat for wildlife, including the Gangetic dolphin.

To conserve the Gangetic Dolphin across its range, a Conservation Action Plan (CAP) was prepared for a duration of 10 years from 2010 to 2020 (Sinha et al., 2010). Despite being a

comprehensive plan, this plan focused only Gangetic river dolphin, and did not include other dolphin species found in the country. The CAP outlays the actionable strategies and the authorities which would implement them, but the plan did not envision the need for a centralized integrated mechanism to address the problems in a long run. The CAP did not focus on problem specific planning and did not address inter-state and inter-departmental coherence and coordination. In view of these, the Hon'ble Prime Minister advised to initiate country wide conservation programme, addressing conservation issues of all freshwater and marine dolphins. He also suggested that conservation efforts should be in line with sustainable livelihood development. MoEFCC initiated the process of plan development and consulatations were done with stake holders and draft plan was prepared (Appendix 1). Hon'ble Union Minister of Environment, Forest and Climate Change Shri Bhupendra Singh Yadav chaired a meeting held at ICFRE, Dehradun on 28th April 2022 and directed the Ministry of Environment, Forest and Climate Change for finalizing the action plan. Hon'ble minister suggested that three type of areas: natural, agriculture and human should be identified. He further elaborated that ways to conserve the natural areas should be devised so as to make the dolphin pride of the local communities.

The river ecosystem is a connected and dynamic system, they provide habitat and essential ecosystem services for survival of many life forms. These systems are influenced by multitude of stakeholders. These riverine ecosystems are the only habitat for the river dolphins, and hence for conservation of dolphins a comprehensive approach, which considers the ecological function, stakeholder participation and adaptive management is urgently needed. To formulate strategies for dolphin conservation intensive consultations and discussions were held with subject experts and stakeholders. During these consultations, a problem tree approach was adopted to frame basic thematic groups for formulation of the objectives. The problem tree analysis revealed six thematic areas such as species mortality, alteration of riverscape, sustainable use of resources by local communities and their contribution to river conservation, reduce pollution, policy framework and address knowledge gaps through systematic research and monitoring and develop supportive institutional mechanisms that can provide sustainable solution measures. Accordingly target objectives were set as follows:

5.5 Objectives

The following objectives are proposed for the Project Dolphin:

1. Control direct mortality of Gangetic river dolphin.
2. Minimize the alteration of river ecosystems.
3. Engage and empower the local communities and other stakeholders for promoting sustainable resource use in the rivers and associated water bodies.
4. Reduce pollution level in rivers
5. Address knowledge gaps through systematic research and monitoring. 6. Develop supportive institutional mechanisms

5.6 Approach and Strategies

For each of objective, strategies, actions and methods are briefly outlined and are presented in table 1 in a logical framework format.

1. Control direct mortality of Gangetic river dolphin.

Action 1.1 Assess current status and distribution of dolphin in its range

To know the current population status, periodic monitoring of the population and habitat will be carried out every three years interval. This will be done through utilization of combined visual and acoustic survey methods. Depending on the river morphology different methods like boat in tandem, double observer and single boat methodology may be used for a population estimation (Qureshi et al 2021).

Action 1.2 Create scientifically managed network of Conservation Priority Areas (CPA) for protection of dolphins

During the estimation of population status, distribution will also be mapped. The stretches of the river with high abundance of the dolphins and the potential dolphin habitats will also be mapped. These stretches of the rivers will enable the mangers and other stakeholders in delineating the CPAs. These CPAs may be protected and managed by multi-agency partnership for dolphin conservation.

Action 1.3 Establish rescue and rehabilitation centres along the river for dolphins in distress.

For establishing the rescue centres, strategic locations will be identified and the possibility of upgrading the existing infrastructure for such centres will be explored. After the identification and upgradation of the infrastructure, training will be provided to the staff for maintenance of rescue centres (Eg. Vetenarians, Forest staffs, ground staff). Additionally, a Quick Response team (QRS) will also be established, which would consist of the local community and trained personals for handling the rescue operations in a timely manner.

Action 1.4 Establish joint protection mechanism of fishery and forest departments for reducing mortalities of dolphin.

One of the major cause of the dolphin mortality is net entanglement during fishing. The fisheries department is the key stakeholder for fishing activities, they execute the fisheries law and hence have the power to influence the fishermen. While, the Forest/Wildlife department

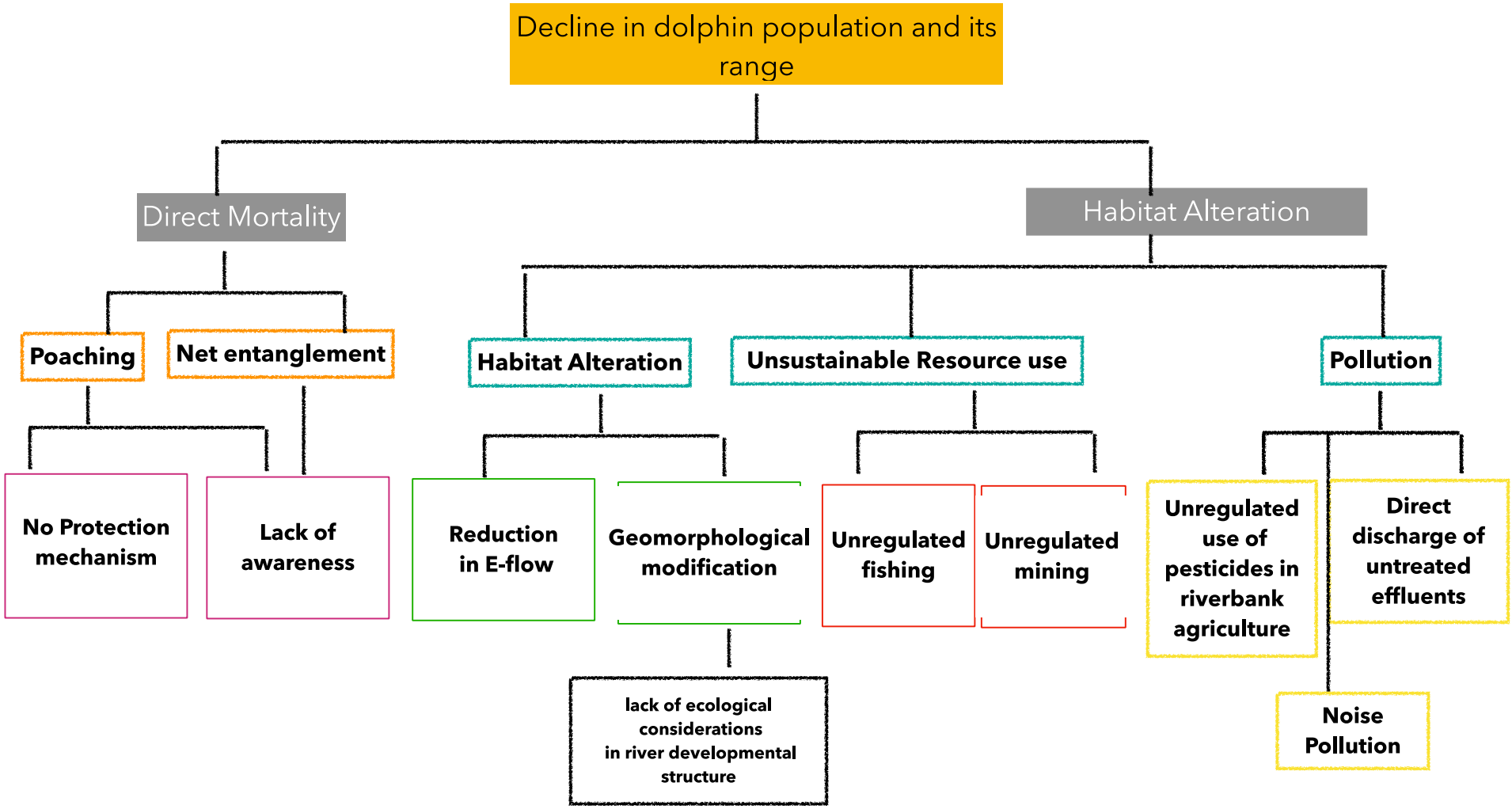


Figure 3: Problem tree for declining dolphin population in its range

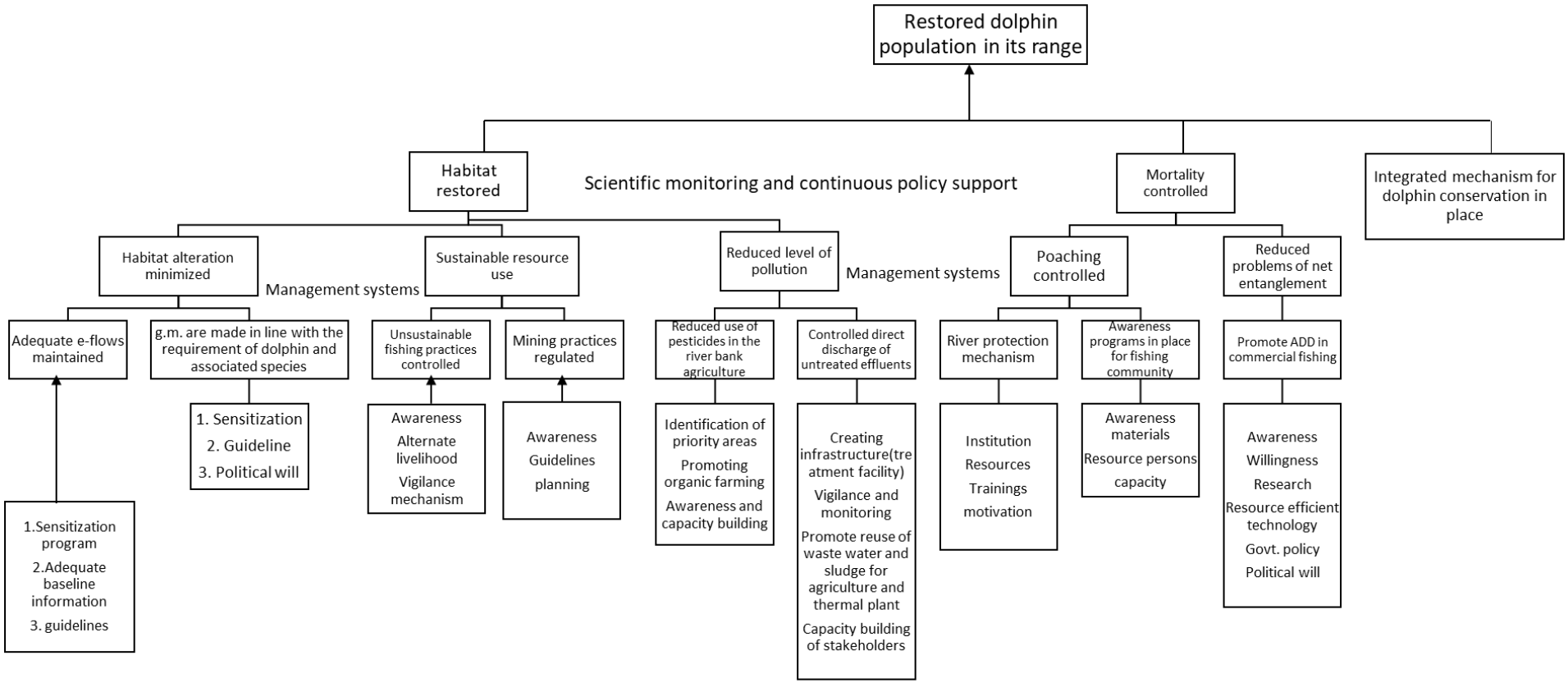


Figure 4: Solution tree for restoring dolphin population in its range and for long-term conservation

are mandated for protection of the dolphin. Hence, a joint protection mechanism for the fishery and forest departments is needed. The development of a comprehensive training modules for both the department and organization of regular training for the interdepartmental staffs will be done. Similarly, the capacity development activity will be carried out for all the personals in all the concerned departments and governing authorities.

Action 1.5 Create infrastructure for protection of dolphin

To address and reduce dolphin mortality a supportive infrastructure and monitoring mechanism is needed. The infrastructure such as the well equipped survey boats, instruments (Under water acoustic instruments such as A-tags, CPODs, FPODs, ADCP, Hydrophones, under water sonars, YSI, Drones etc) help in better monitoring of the species. The availability of a well-equipped support vehicles with necessary equipment can help in the rescue of the species. There is also a need to establish Central and Regional forensic and analytical labs for monitoring health of the species and its habitat. Developments of software applications like online and mobile apps for monitoring and reporting of critical events like dolphin entanglement and poaching may also be needed. In addition, a network of monitoring groups or first responders comprising of the forest department, veterinarian, local administration, line agencies, and local community (like *Ganga Prahari* in Ganga, Dolphin conservation network in Brahmaputra) is needed.

Action 1.6 Develop capacity of fisheries department, forest department, veterinarians, local communities and other stakeholders to address injury/mortality of dolphins.

The local/regional rescue groups/first responders need to be trained in rescuing dolphin and other associated aquatic species in distress. For this, stakeholder specific modules for training and capacity building of various department such as the fisheries, forest, veterinarians, local communities and other stakeholders for handling the situations like dolphin mortality, injuries, stranding will be done. This will be followed by training /capacity building workshops for the stakeholders for handling the monitoring and reporting various aspects of dolphin mortality.

Action 1.7 Promote technological interventions as Acoustic Deterrent Device, for reducing net entanglement

Technology play a very important role in the conservation of the species. Development of the technological interventions to reduce net entanglement such as the use of Deterrents, the Pingers, Alterative or eco-friendly fishing gears – with standard grading systems (Eg. ISI marks) etc. can prevent the dolphin mortality in their range. The promotion and implementation of technologies among the fisherman communities such as certified markets, Buy back Schemes, Subsidiary schemes for deterrents can help in promoting a positive response towards the dolphin conservation in the fisherman community. Together with this, the organization of capacity building/awareness programmes for local communities to use of eco-friendly fishing gears and their importance in reducing accidental entanglement of dolphins can help in reduce the dolphin mortality rate.

2. Minimize the alteration of river ecosystems.

Action 2.1 Enable the existing & proposed Dams/ Barrages and other instream constructions dolphin friendly

Dams can adversely impact the hydraulic regime, surface water quality and habitat where they are located. The sitting construction and operation of these facilities have a variety of impacts on the river system. Many rivers have been physically altered to manage the impact of high water flows and minimized flood damage by constructing embankments reinforcing the banks. Waterways have often being historical catalyst for urban growth. Large containers and ferry services required deep and open waterways and harbor areas. Studies will be carried out to assess the impact of human population on river ecology and implement policies to negate increasing developmental activities. Mitigation strategies for physical alteration pressures should be undertaken as restoration projects such bank restoration. Consultation with R&D organizations such as IITs should be done to develop a consensus plan, keeping the ecological aspects in mind. Science and technology should be advanced for conservation. Exploring innovative techniques as conservation measures in high dolphin priority areas to mitigate the adverse impact of existing dams/ barrages/ other river constructions on dolphin habitat would help in restoring critical dolphin habitat. Prepare and implementing guidelines for development activities at a national level.

Action 2.2 Frame supportive policies and guidelines for River development projects /constructions

Habitat conservation includes both protection and restoration of the habitat. Policy research should be in place to address the habitat conservation challenges. Policy contributes immensely in protection, restoration of habitats supporting resilient and thriving river biota, dependent communities and economies. Continual evaluation of the effectiveness of the policies should be done, and adaptive measures should be incorporated accordingly. All concerned authorities should bring forth riverscape scale and ecosystem based approaches while developing policies and eco-safety guidelines for all the River Development Projects (RDP) (Eg: Safety measurement taken for minimizing the effect during construction phase). Furthermore draft policy should be amended as laws to regulate river development projects (RDP) and exploring possibilities of declaring no construction zone.

Action 2.3 Prepare management plans for the Conservation Priority Areas (CPA) for maintaining their ecological integrity

Due to large scale river construction projects and river traffic, some stretches of the dolphin occupied river have been degraded. Because of dynamic nature of river ecosystem, interventions need to be carefully planned and implemented. The long-term objective of this plan is to ultimately expand the conservation initiatives to Conservation Priority Areas (CPA) in the light of increasing anthropogenic influences. During the plan period, the processes should be initiated through generation of baseline information, creation of awareness in surrounding villages, some trust building activities and building network with major institutions and concerned department. However, the ultimate challenge, is to ensure that management actions taken are underpinned by reliable scientific information, coordination and unified thinking of various stakeholders, so that it could support immensely while preparing management plans for the Conservation Priority Areas (CAP). Therefore, management plan

of Conservation Priority Areas (CPA) should be done with capacity building programmes and stakeholders trainings.

Action 2.4 Capacity building /sensitization programme for the agencies/ staff involved in river development programme

The stakeholders involved in river development programme have different tasks, skills, and visions that must be considered when formulating the capacity building/sensitization programme and taking advantage of potential synergies. All these diverse perspectives allow for the capacity development programme to have a more holistic vision of the conservation goals. Staff and local communities involved in river development programme will be required to be trained in various river conservation issues. Participants must be empathetic towards each other and be involved in bilateral communications. Sensitization programmes conducted should also be assessed and updated to provide relevant services. Additionally, regular reporting and evaluation on number of conservation sensitive activities done by sensitized stakeholders must be taken into consideration.

Action 2.5 Create ecological baseline for the River system & supporting monitoring system

Historical data on abundance and distribution of species act as a potential tool in conservation and management practices. Collating relevant information on the dolphins and associated fauna from various sources and creating an ecological baseline would help in scientific research of the species and boost management. Therefore it is imperative to establish dolphin centric database management system and a centralized digital knowledge bank on dolphins, their habitat and associated species and periodic update on this database is also of utmost importance.

Objective 3 Engage and empower the local communities and other stakeholders for promoting sustainable resource use in the rivers and associated water bodies

Action 3.1 Promote livelihood programme for fishing and related dependent communities through alternative and sustainable natural resource use. With increasing population density along riverscape, humans are in direct competition with the existing natural resources and biodiversity. The baseline socio-economic studies have revealed the poor economic conditions, lack of awareness, skills and education are some of the major concerning factors. Thus, the first and foremost step is to identify and develop a stakeholder platform for dialogue and sustenance of conservation actions. Developing a stakeholder platform is an iterative process of identifying stakeholders, their interests, building trust, empowering weak stakeholders and, for powerful stakeholders, to accept new rights and roles for other stakeholders. As per national biodiversity education strategies, the possible action plan of Indian states "Train communities in innovative conservation practices and multiple skills to practice alternative livelihood options to enhance their role in conservation". National Mission for Clean Ganga in its Phase II focuses on education and communication for conservation of a species and its habitat through the involvement of river dependent community.

Action 3.1.a Promote Local fishery cooperatives

States should adopt the recommendations in their fisheries policy and law. It is better to promote self-regulation by the fishermen and community managing the resources by having targeted awareness programs and forming fishery cooperatives.

Action 3.1.b Create temporary fish protection zones (time and area)

The "ecosystem approach to fisheries" (EAF) is an extension of conventional fisheries management recognizing more explicitly the interdependence between human well-being and ecosystem health and the need to maintain ecosystems productivity for present and future generations" (Cury et al. 2005, Rice et al. 2005, Jennings 2005, Murawski 2007, Cotter et al. 2009). It provides a comprehensive framework to decision-making for aquatic resources. The relationship between river ecosystem functioning and conservation of fish biodiversity is closely associated with river management. Establishment of temporary fish protection zones with community-based managements will be one of the most effective conservation measures for fish biodiversity and enhancing productivity. All fisheries laws have provisions for fish sanctuaries and Hilsa sanctuary in West Bengal is one such example.

The fishing ban season of April to Mid-July in Brahmaputra-Assam, while in Ganga and its tributaries in Bihar and West Bengal, Uttar Pradesh, Madhya Pradesh, and Rajasthan its June to August. Ensuring the fish season ban is observed through awareness programs and promote alternative through government schemes. Propagate the species artificially and culture it in ponds for subsequent seeding of the depleted river stock (Malhotra et al., 1969). In the main Ganga and most of its tributaries, extensive stretches get dried up leaving water in a few deep pools providing shelter to the fishes and turtles in some tributaries even for Ganges dolphin and gharial.

Action 3.2 Put in place a system for regulated mining practices in the river ecosystem, through supportive policy, legal and administrative framework.

There is a need to educate the river side communities regarding river bed mining regulations, so that they are aware of the legal implications. To regulate the mining activities in the aquatic system it will be important to identify the river stretches with high mining activities. These areas also has to be mapped taking into consideration river bed mining rules and regulations to develop species habitat conservation strategies. Strict implementation of these regulations and a regular monitoring system of the offenses and violation of rules, in high priority river bed mining stretches will be ensured by the support & cooperation of the responsible government agencies viz. MoEFCC, Ministry of Jal Shakti, Ministry of mines, Land & revenue department etc. Implementation of the regulations can be strengthened through increasing manpower and technology in respective govt. bodies.

Action 3.3 Organize a series of awareness, sensitization and capacity building programme for local communities.

There is a need to identify target groups which are heavily dependent on the river system, and have no alternative sources of livelihood. The core idea of this intervention is to improve understanding of river side communities about river ecology and its biodiversity in order to

empower them for protect and preserve their river's future. Mainstreaming river side community which faces danger of losing their land and livelihood due to river floods and river bank erosion. Engaging younger generation towards conservation requires conservation awareness and environment education programs, inclusion of education departments in spreading conservation initiative across dolphin range states is need of the hour. Inclusion of aquatic biodiversity in school curriculums, especially in dolphin range states is needed. There is also a need to create a positive narrative amongst children regarding dolphin and other associated biodiversity. A citizen science model for schools, where students are actively involved in understanding river biodiversity, with practical experience and motivation is needed. Science clubs in dolphin hotspots, with regular interaction amongst peers and experts from across the country would do well to sensitize students.

Action 3.4 Involve local communities and other stakeholders in protection and management of river ecosystem.

Awareness campaigns for identifying threats, and especially with fishermen and river side communities is needed to not only engage with the community to ensure the conservation of aquatic biodiversity, but also understand threats existing and the road blocks that exist to eliminate these threats. Currently, there are several models in place, for example, the *Ganga Prahari* programme by the National Mission for Clean Ganga, Dolphin conservation network by Aaranyak, and Dolphin *mitra* by WWF. In all these programs, local community networks are built, which engage with different stake holders, enable a platform for dialogue and awareness, as well as for information gathering. Such community initiatives are absolutely essential, and will play a pivotal role for any conservation program.

Action 3.5 Sensitize local communities and other stakeholders for minimising mortality due to net entanglements and ghost nets.

Awareness generation regarding river dolphins among the riverside local community will be crucial to conserve the species in its habitat. It will be crucial to create a network involving local communities, where regular trainings are conducted to prepare them for immediate course of action during dolphin entanglements, or strandings which will include quick response and reporting to the rescue & rehabilitation team. According to the study conducted by Wildlife Institute of India on ghost nets in the state of West Bengal it was revealed that disposal of damaged nets directly into the river or banks is prevalent. The riverside community has to be sensitized regarding the consequences of disposing damaged nets in the river and also to promote recycle and reuse of damaged fishing gears.

Action 3.5 Popularise Dolphins with general citizens

It is important for general public to relate to Dolphins, to generate interest and garner support for conservation in the long-term. Awareness will also help in ensuring people undertake dolphin friendly activities in their day to day activities. Popularising dolphins through a variety of means, like public media engagement, using animations for younger citizens, and engagement through social media should be undertaken.

Objective 4: Reduce pollution level in rivers

Action 4.1 Establish adequate functional infrastructure for treatment of industrial and municipal waste water discharge.

Due to a lack of conveyance infrastructure (household connectivity, sewer lines, sewage pumping stations), 62 % untreated wastewater which discharged into natural drainage systems (rivers and canals), causing pollution in downstream areas impacting the life of aquatic flora and fauna. To manage that we need to construct new STPs/ ETPs/ WWTPs and urgent need to upgrade the existing STPs/ ETPs/ WWTPs to mitigate the current as well as per future demand. To enhance proper management of untreated and partially discharge municipal and industrial origin, need to create proper network of household connectivity, sewer lines, sewage pumping stations that connects to the STPs/WWTPs and ETPs. In addition, the project aims to implement various awareness Programmes to educate governing authorities on the proper management and operation of STPs, ETPs, and WWTPs.

Action 4.2 Identification, tapping, and monitoring of high priority drains in critical dolphin range, using community based digital monitoring tools

Many heavily contaminated drains discharge their effluent directly into river systems with no monitoring. To address such issues, monitoring officials/agencies must identify the drains with the highest priority based on the toxins they transport and the volume of toxic waste they discharge directly into the river system. The next step is to minimize these high priority drains by intercepting and redirecting them to STPs/WWTPs and ETPs for appropriate treatment before dumping them into the river system. The last phase of the objective is to deliver awareness workshops to various stakeholders to educate them about the harmful effects of these drains on the river and its aquatic biota, as well as how to monitor it.

These drains need to be monitored using a digital platform and portal, with a combined task force of citizens and authorities responsible. This will ensure a good feedback mechanism enabling functionality.

Action 4.2 Ensure effective functioning of above infrastructure using supportive legal instruments and promoting good practices

For the proper operation of the aforementioned responsibilities, a cadre of agencies capable of evaluating the effective operation of STPs/ETPs/WWTPs and high priority drains should be necessary. In order to monitor the proper operation of treatment plants, there is an urgent need to enhance the present in-house laboratory facilities in all existing, under construction, and prospective STPs/ETPs/WWTPs. The government should promote the use of cleaned wastewater and sludge in agriculture and other industrial processes. It will help to minimize industry' dependence on the river system. The final phase of this objective's is to provide training and workshops to various stakeholders in order to make them aware of the significance of their work to the protection of river systems.

Action 4.3 Reduce the use of pesticides in river bank agriculture through adoption of green agriculture practices (organic farming, certification, hydroponics)

To reduce the pollution load of harmful pesticides, awareness and training programs for regional farmers must be prioritized. These programs must include comprehensive information about the use and effects of toxic pesticides, as well as the benefits of eco-friendly agricultural practices such as integrated pest management, mixed intercropping systems, organic agroforestry systems, hydroponics etc. Information on various government-supported schemes and subsidies should also be included in training Programmes to encourage farmers to adopt eco-friendly agricultural techniques. To improve tracking of controlled use of pesticides the training programs should also be conducted for other significant stakeholders such as state/district administration, and gram panchayats.

Action 4.4 Using technological advances for reducing noise pollution

River dolphins completely rely on echolocation for their movement, foraging and other activities. Therefore, the underwater soundscape is extremely important for optimal survival. Technological interventions like acoustic bubble curtains can help in this while undertaking construction or development activities on the river.

Another technological intervention is dolphin safe engines, which can reduce the amount of sound produced while maintaining efficiency of fuel. Dolphin safe engines also would ensure less mortality due to engine hits.

Action 4.5 Holistic ecological risk assessment that includes population level risk assessment at critical dolphin habitat to evaluate the effect of Emerging Contaminants (ECs) & Endocrine disrupting compounds (EDCs)

Aquatic life threshold guidelines values and dolphin health indices should be developed to ensure a healthy ecosystem for the restoration of dolphin populations, taking into account various approaches such as, but not limited to, water/sediment chemistry, controlling factors of bioavailability, bioaccumulation, and bio-magnification, and in situ biological (acute and chronic toxicity testing) effects to predict the adverse biological effects caused by contaminated water/sediment to dolphin or its prey-base. This holistic ecological risk assessment should be supplemented by ongoing and expanded long-term monitoring for current water-quality assessment and trend analysis of Emerging Contaminants (ECs) and Endocrine Disrupting Compounds (EDCs).

Objective 5 Address knowledge gaps through systematic research and monitoring.

Action 5.1 Establish a conservation breeding centre to ensure safety of genetic diversity, and secure the future of river dolphins in India

River dolphins have slow population growth, and therefore, any decline will result quickly in population crashes or extinctions. Following declines, population recovery will be extremely slow. Therefore, it is important that we need to secure the future of the river dolphins in India. The Yangtze river dolphin that recently went extinct was beyond the point of recovery, and therefore, conservation breeding that was started was too late and did not help in

securing this species. Time is now ripe to establish the conservation breeding of Ganges river dolphins. Also, currently there is representation of all genepools (from Ganga and Brahmputra), and therefore it would be apt to establish a breeding centre with representation from all genepools. Collaboration with experts like Oceanografic institute, Spain and other cetacean experts needs to be planned, selection of suitable sites, and exchange of expertise needs to be initiated.

Action 5.2 Establish a network of institutions for conducting research and monitoring programmes

The research on dolphins in India is at a nascent stage, the behaviour, biology and ecology are yet to be understood completely. May research institutions have carried out research in the past and are conducting research presently too on the dolphins. This information needs to be shared through a proper set-up. Also there is need to use the expertise of the institutions involved in other aspects of aquatic research, such as geo morphological studies. Thus there is a need to establish a network of institutions for conducting research and monitoring programmes.

Action 5.3 Conduct research and monitoring on the ecology of Gangetic dolphin and its habitat

Some of the prominent areas of research which needs exploration are

1. Aquatic species and their habitat
   The fresh water habitats are the most threatened habitats globally and their biodiversity is declining at a commensurate rate. To conserve and maintain these ecosystems various methodologies are being adopted to restore or enhance the waterbodies but evaluating their effectiveness is both time consuming and expensive. Identifying a group of organisms (Surrogate, Indicator) that can be used to determine the health of the ecosystem or to infer the past or present environmental conditions are commonly used in conservation decision making and offer a means of choosing and tracking the effectiveness of management approaches, with the premise that, if the surrogate is protected and conserved, there will be wider biodiversity and ecosystem benefits.

2. Hydro-geo morphological studies
   The river systems being dynamic undergo large seasonal fluctuations in flow, course, depth, width, sediment load etc. Although rivers are adjusted to an array of discharge processes and most rivers exhibit morphologies that are related to high-magnitude floods, understanding these processes is a tedious task and many hydraulic engineers and earth scientists have contributed to this aspect of the river. The major questions addressed in the Indian fluvial geomorphology are hydrology of monsoonal rivers, forms and processes in alluvial channels, causes of avulsion, channel migration and anomalous variations in channel patterns, dynamics of suspended sediment, and the geomorphic impacts of floods.

3. Ecological assessments for analysing threats and its effects on species occurrence and distribution

Surveys for the occurrence and distribution of the Gangetic dolphin were conducted in sporadic and disjunct locations that were unable to predict long term population trends and range reduction of the species in its range. For systematic conservation planning of the species and identification of conservation priority and monitoring areas, range wide and continuous ecological surveys are needed. A network of forest officers, local administration and volunteer is also needed to get the information of the mortality of the species due to natural as well as unusual causes. This information will also help in to identify the conservation priority areas and establishment of rapid response team.

4. Zoonotic diseases in the river ecosystem
   Dolphins have been postulated to be responsible for an apparent geographic expansion of the disease in humans. The improvement and eventual resolution of zoonotic diseases seemed to depend on vigorous, antibiotic therapy, surgical debridement of the abscesses, improvement in water quality and improvement in the animal's diet. Considering the spread of zoonotic diseases in the river ecosystems it is a prerequisite to undertake studies on microbiota of dolphins could provide important data on animal and environmental health.

5. Ecological and ethological aspects of aquatic species
   Sustaining biodiversity is important to protect the health of environment. Some aquatic organisms (bacteria and fungi) continually break down harmful toxins that we flush into our sewage systems or discard directly into our rivers and streams, underwater plants provide oxygen, food and shelter and some species are important ecological indicator for overall marine or riverine health.Aquatic species behavioural information is vital for the effective management of commercial aquaculture facilities, as most physiological and environmental changes are able to modify animal behaviour. However, the behavioural variations in aquatic population are difficult to measure because the aquatic species are very sensitive in nature and can be stressed easily. Behavioural responses of some organism have been used for aquatic toxicological monitoring. Significant advancement of technological tools for quantifying behaviour makes it more approachable to study and understand the relationship between animal behaviours and physiological and ecological consequences.

6. Identification of indicator species
   Rivers are at risk from multiple factors, including water quantity degradation, modification of habitat, overexploitation of riverine resources, climate change and increasing invasive species population. Sometimes degradation of freshwater ecosystem is measured using ecological indicators, such as mammalian carnivores, waterbirds, macro-invertebrates, fishes and macrophytes. River dolphins are ecological indicator of freshwater ecosystem that helps to monitor and conserve rivers. Gangetic dolphin tissue contains micropollutants, such as organochlorine, organotin compounds, and perfluorine containing chemicals, which are below detectable levels in river water or other invertebrates and fishes that suggest dolphins may be the suitable candidate for sentinel and flagship species of river ecosystem that will help to understand about the water quality of that habitat.

7. Impact of development

   Construction of dams and barrages can create physical barriers to dolphin movements along river's main stem. Four barrages were built on the middle and lower stretch of Ganga River, however proper evidences of dolphin movements across these barrages are lacking. Stretch between Haldia and Varanasi of the Ganga River and Sadiya-Dhubri stretch of the Brahmaputra River has been declared as the National Waterways-1 (NW1) and National Waterways-2 (NW-2) respectively, for movement of large shipping vessels. It may affect in dolphin behaviour that can lead to stress, alteration in prey-base and increase accidental mortality by propeller collision. There is increasing evidence that underwater noise can compromise the foraging behaviour of marine species including fish and invertebrates. A limited number of studies have investigated the effects of sound exposure on the foraging behaviour and prey capture rates of marine mammals, and have inferred that these might have longer-term fitness consequences.

8. Socio-economic and cultural dimensions of management of river systems

   Riverscape conservation and management policies can be understood from socioeconomic and cultural differences. Profound changes in societal relations to rivers have taken place throughout human history. Intimate relations to waterways are an integral part of hunter-gatherer life. Early agricultural exploits and hydraulic civilizations developed along river systems. Water fuelled the Industrial Revolution, as humans asserted their authority over rivers through adoption of a command-and-control approach to river management. Moves towards an era of river repair in recent decades seek to address environmental damage. Underlying knowledge bases and perceptions of a healthy river reflect societal relations to rivers, shaping what it means to 'Find the Voice of the River' at any given place and time.

9. Resource use conflict and their resolution

   Over the last century due to increasing human population the riverine ecosystems have suffered from severe human interventions which have resulted in habitat loss and and degradation. The associated higher requirement for water particular in the areas of the river where heavy demand is placed due to social pressures to provide infrastructure and employment for people living in the region, and economic pressures for agricultural enterprises seeking to expand or relocate have increased the pressures on the river systems.

   Many tropical river systems are threatened by land use changes, or modifications in hydrological regime require effective management policies and implementation to protect them. The improved quantification of available water resources, hydrological, biogeochemical and ecological linkages at systems scales, understanding and valuing ecosystem processes and services, and projecting the effects of long-term climate change are the major factors that are required to be assessed.

10. Policy research

    The interactions between environmental and social issues are "mediated through culture, economy and politics, and are constructed and re-constructed through conflict. Public

policies devised to deal with environmental problems are outcomes of socio-political interactions (from cooperation to conflict) between various actors with different values and resources and in a changing social, political, economic, and environmental context. Through these socio-political interactions, societal and policy goals are identified, tradeoffs between competing objectives and resource allocations are established, and decisions are enforced. Scientific research has proven that apex predators are indispensable elements of healthy ecosystems and that the major goals of policy should be the full protection of river dolphins. Given the socio-political context in India, bringing up strict conservation laws through national regional government cooperation could strengthen the legal protection of aquatic flora and fauna. The implementation of such policies in the reform process would help in achieving the desired sustainable conservation goals.

11. Toxicological studies

    There is lack information on long term impact of pollution on dolphins, although few studies had reported elevated levels of heavy metals, DDT and immunotoxin chemicals, such as butyltins and perfluorinated chemicals, have been found in the tissues of Gangetic river dolphins. Therefore a comprehensive study on Identification, tapping, and monitoring of high priority drains in critical dolphin range is a prerequisite to assess population level risk assessment. Streambeds are an integral part of the river ecosystem. They provide habitat to a vast array of aquatic and benthic organisms as well as facilitate the bio-degradation and transformation of organic matter and vital nutrients. Increasing anthropogenic influence introduces multiple stressors to the stream networks resulting in pollution of streambeds, which in turn, have detrimental effects on the overall stream ecosystem health. There is a huge gap in the current understanding of streambed pollution and its impacts, and the widely practiced streambed pollution mitigation strategies lack a holistic approach. In this comprehensive review, we first synthesize the state-of-the-art knowledge of conventional and emerging forms of contaminants, their overall impacts on stream ecosystem functions, and present future directions to comprehend the problem of streambed pollution

12. Use of advanced technology

    Technological advances offer ample opportunity for the conservationists, scientists, and the general public the advantage to better understand the ecology of underwater species such as dolphins, their habitats, and the threats they can face. The recent introduction of low-cost, data-logging acoustic receivers has provided opportunities for tracking marine organisms over small (hundreds of metres) and large scales (hundreds of kilometres). This technology provides many advantages for studying aquatic animal movement patterns, activity levels, or habitat use. Use of technology can potentially improve management and decision making to achieve conservation goals.

Objective 6: Develop supportive institutional mechanisms

Action 6.1 Establish a Central Dolphin Conservation Authority for management of dolphin related issues in the country

A National Authority for dolphin conservation needs to be set up, as a statutory body under the Ministry of Environment Forest & Climate Change. The proposed authority would work towards dolphin conservation throughout their range in the Indian subcontinent and in accordance with the provisions of the Wildlife (Protection) Act, 1972. The authority would oversee the execution of the Project Dolphin, and thus would ensure the protection and long term survival of the dolphins, throughout their range. The proposed "Authority" is conceptualized as a centralized co-ordination agency for information generation, dissemination and dialogue between various sectors and state governments, towards Dolphin conservation. The Authority would guide and support a range of activities inclusive of sciencebased monitoring of dolphins and their habitat through the adoption of the latest technology, involving multiple stakeholders.

Action 6.2 Establish a multitier institutional mechanism for programme implementation at National, state, district and local level

A multitier institutional mechanism under the Central Dolphin Conservation Authority is needed for execution of the Project Dolphin. This multitier mechanism will have representation from the national, state, district and local administration. The Central Authority will be the governing body and would oversee the disputes/clashes of the various stakeholders.

Action 6.3 Establish a Dolphin cell at Wildlife institute for coordinating research and conservation related activities

To ensure coordination of activities of the dolphin action plan, and all research and conservation related activities, a dedicated cell on the lines of Tiger and Elephant cell needs to be established with appropriate manpower at Wildlife Institute of India.

Table 1: Logical framework for strengthening the Gangetic dolphin population in India

Goal: 1. To secure long term survival of Gangetic dolphin population

	Strategies/Actions	**Objectively verifiable indicators (OVI)**	**Means of verification (MOV)**	**Assumptions**	**Agencies responsible**
Objective 1	**Control direct mortality of Gangetic river dolphin**				
1.1	Assess current status and distribution of dolphin population in its range	Population and distribution of dolphin	Ecological mapping of the river showing distribution of species.	Adequate fund and trained personnel are available for population estimation	MoEFCC and State Forest departments
1.2	Create scientifically managed network of Conservation Priority Areas (CPA) for protection of dolphins	Number and extent of river stretches with abundance of dolphin population. No. of dolphin conservation areas established and managed	River maps Government notification/ orders for establishment of dolphin conservation priority areas	Adequate trained human resources and database available	MoEFCC, State Forest departments, local NGO's, and institutions
1.3	Establish rescue and rehabilitation centres along the river for dolphins in distress.	Number of functional rescue centres at strategic locations Number of animals rescued and released	Number of rescue teams in working Data base of rescue centres	Trained personnel, adequate funds and infrastructure available for establishing rescue centres	MoEFCC and State Forest departments, IWAI, WII

1.4	Establish joint protection mechanism of fishery and forest departments for reducing mortalities of dolphin.	Number of joint patrolling units established. No. of functional joint patrolling units	Joint patrolling records. Database of Dolphin mortality	Coordination among the participating agencies	MoEFCC and State forest and fishery dept.

1.5	Create infrastructure for protection of dolphin	Extent of infrastructure facilities created for patrolling units	Available records at various monitoring stations of fisheries and forest department.	Adequate capacity among the stakeholders Stakeholders involved are updating the database	State forest dept., Local administrations
1.6	Develop capacity of fisheries department, forest department, veterinarians, local communities and other stakeholders to address injury/mortality of dolphins	A system of training programmes for different stakeholder in place Number training programmes/ Workshops conducted Number of persons trained in different categories	Data base of training centres Training impact in field	Stakeholders willing to participate	State Forest department., Ministry of Ports, Shipping and Waterways, Inland Waterways Authority of India (IWAI), Local Administrative Authority (Panchayat)
1.7	Promote technological interventions as Acoustic Deterrent Device, for reducing net entanglement	No. of new technological interventions Impact of these interventions for reducing net entanglements Number of schemes promoting use of technology	Records about new technological interventions. Number of people using the technology	Availability, accessibility and use of ease of the technology. Actual reporting	Dept. of Science and Technology, Fisheries dept.

Objective 2: Minimize the alteration of river ecosystems					
2.1	Enable the existing & proposed Dams/ Barrages and other instream constructions dolphin friendly	Number of dams/barrages where mitigation measures have been implemented. Effectivity of mitigation structures	Adequate impact assessment are done for such construction and post construction. Records from CWC	State and Transboundary river water management agencies are willing for such measures. Political will	Ministry of Jal Shakti. MoEFCC, CWC
2.2	Frame supportive policies and guidelines for River development	Policy document prepared and used	Government notifications/directives	Political will Cross-sectoral coordination	Ministry of Jal Shakti
	projects /constructions	Guidelines document prepared.			
2.3	Prepare management plans for the Conservation Priority Areas (CPA) for maintaining their ecological integrity.	Number of management plans prepared and implemented Extent of minimum e-flow	Examination of records of implementing agency (Forest Department/District administration) River flow database	Funds are available. Implementing agency are motivated to prepare management plans	MoEFCC and State Forest Department, Ministry of Jal Shakti, Ministry of Agriculture, Ministry of industries
2.4	Capacity building /sensitization programme for the agencies/ staff involved in river development programme.	Number of capacity building and sensitization program organized. Number of persons trained Training impact in the field	Training data base of training centres/ institutes Qualitative surveys of field personnel.	The stakeholders are willing to participate and there is continuous coordination among different agencies	Multi departmental effort and involvement

2.5	Create ecological baseline for the River system & supporting monitoring system.	A central database repository developed	Initial and periodic surveys to generate baseline information Retrieved reports on data submitted by different field agencies to the central authority.	Database is regularly updated Data is shared by the agencies to the central authority.	MoEFCC, Forest department, local NGO's, WII
Objective 3: Engage and empower the local communities and other stakeholders for promoting sustainable					
3.1	Promote livelihood programme for fishing and related dependent communities through alternative and sustainable natural resource use. A. Promote local fishery cooperatives B. Create temporary fish protection zones (time and area)	Number of livelihood Programmes in place Number of beneficiaries using alternate livelihood programmes Extent of resource use Framework for fishery cooperatives establishment Identifying fish protection zones and time frames	Records of implementing agencies Field surveys of beneficiary families Ecological surveys Field surveys	Acceptance by local communities Adequate and timely available resources Necessary support from concerned departments Acceptance of local communities	Multi-departmental
3.2	Put in place a system for regulated mining practices in the river	Stretches of high mining activities identified and mapped.	Mining and offence records of concerned districts	Continued political support	MoEFCC, Ministry of Jal Shakti, Ministry of Mines

	ecosystem, through supportive policy, legal and administrative framework.	Area under regulated mining Number of violations		Continued support from concerned departments	
3.3	Organize a series of awareness, sensitization and capacity building programme for local communities.	Number of programmes conducted Number of stakeholders sensitized. Support of local community	Official records Community surveys	Willingness of local communities to participate Continued support from concerned local institutions	MoEFCC, Ministry of Jal Shakti, State Biodiversity board, State Forest Department, WWF
3.4	Involve local communities and other stakeholders in protection and management of river ecosystem.	Number of local institutions/ communities participating in river protection/ management programmes	Official records Community surveys	Motivated local communities and other stakeholders are available in the region	Ministry of Panchayati Raj, Local Administrative dept., Ministry of Rural development
3.5	Sensitize local communities and other stakeholders for minimising mortality due to net entanglements and ghost nets.	Number of awareness programmes Number of community initiatives for checking the mortality due to entanglement/ghost nets	Official records Community surveys	Local communities and other stakeholders willing to participate.	MoEFCC, State Forest departments, local NGO's, and institutions
Objective 4 : Reduce pollution level in rivers					

4.1	Establish adequate functional infrastructure for treatment of industrial and municipal waste water discharge.	Percentage of industries with functional treatment facilities Percent of households connected to the STPs Level of discharge of untreated waste.	Reports of SPCBs and Municipalities Eco-toxicological surveys	Adequate funds available for this Strict implementation of guidelines/protocols	MoEFCC, Municipal agencies/ Ministry of Jal Shakti/CPCB/SPCB

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4.2	Identification, tapping, and monitoring of high priority drains in critical dolphin range	Number of priority drains identified based on pollutants load, and flow Interception and diversion of priority drains to STPs/ETPs/WWTPs	Municipality Records Water quality	Govt. commitment to divert identified priority drains to STPs/ETPs/WWTPs	Ministry of Jal Shakti, MoEFCC, Central/State Pollution Control Board (CPCB/SPCB), in collaboration with multiple competent research institutions

4.2	Ensure effective functioning of above infrastructure using supportive legal instruments and promoting good practices	Agency in place for evaluation of effective functioning Number of training and workshops undertaking for sensitization of different stakeholders such municipalities, industrial sectors, PWD System in place for reuse of reclaimed wastewater/sludge	Regular Audits/Monitoring Reports for status priority pollutants in wastewater/sludge Regular data on quantity of reclaimed wastewater/sludge Number of industries, and farmers using the reclaimed wastewater and sludge	Regular evaluation for STPs/ ETPs/ WWTPs for efficacy/ performance by multiple competent organization Policy upgradation & implementation Acceptability to use the reclaimed wastewater and sludge	Ministry of Jal Shakti, MoEFCC, Central/State Pollution Control Board (CPCB/SPCB), in collaboration with multiple competent research organization

4.3	Reduce the use of pesticides in river bank agriculture through adoption of green agriculture practices (organic farming, certification, hydroponics)	Number of farmers adopting green agriculture practices Extent of area under green agriculture practices	Agriculture department records Survey of farmers involved green agriculture.	Govt. bodies vigilance on tracking/ controlled use of pesticides Govt. commitment to provide subsidies on organic/ Ecofriendly Pesticides & fertilizers Willingness of the farmers to accept/adopt ecofriendly and modern agricultural practices	Ministry of Agriculture & Farmers Welfare, (Central and State), Directorate Of Plant Protection, Quarantine & Storage, Forest Department, Ministry of Panchayati Raj, Local Administrative dept., MoEFCC

4.4	Using technological advances for reducing noise pollution	Usage of bubble curtains in developmental activities on the aquatic ecosystem Use of dolphin friendly engines in all river systems	Regular monitoring and verification of effect of these apparatus on dolphins	Support from government, policy for usage of these technological interventions	Multiagency
4.5	Holistic ecological risk assessment that includes population level risk assessment at critical dolphin habitat to evaluate the effect of Emerging Contaminants (ECs) & Endocrine disrupting compounds (EDCs)	Aquatic life standards for priority contaminants/ river water quality parameters developed Dolphin health indices developed Competent organization/body for regular monitoring constituted	Number of scientific and technical reports/publications Scientific reports to support the policies for effective mitigation plans	Adequately trained personnel available Government mandate to include ECs/EDCs in National monitoring Programme Government commitment to establish, upgrade and support such facilities	MoEFCC, Central, State institution, universities and involvement Multi departments
Objective 5: Address knowledge gaps through systematic research and monitoring.					
5.1	Establish a network of institutions for conducting research and monitoring programmes	Number of institutions/ universities in the network	Records of network of institutions	Willingness of Institutions to collaborate. Funds are mobilized by the Government for such purposes	Central, State institution, universities and NGOs effort and involvement
5.2	Conduct research and monitoring on	Number of scientific reports/papers published	Research reports/ records	Funds are available	Central, State institution,
	the ecology of Gangetic dolphin and its habitat			Willingness of Institutions to collaborate	universities and NGOs effort and involvement
Objective 6: Develop supportive institutional mechanisms					

6.1	Establish a multitier institutional mechanism for programme implementation at National, state, district and local level.	Effective functioning of different institutions at different levels	Government notifications and order for establishing the committee. Implementation reports	Continuation of Policy support at Centre and state level	Multi departmental effort and involvement
6.2	Establish a Central Dolphin Conservation Authority for management of dolphin related issues in the country	Order and notification from Central Govt. authority	Baseline records of dolphin distribution Recommendation from the constituted committee of Ministry/ Dept./Institution	Adequate human and financial support is available for its functioning.	MoEFCC, Ministry of jal Shakti, Central, State institution, State Forest Departments
6.3	Establish a dolphin cell at WII for coordinating dolphin research and conservation issues	Order and notification from Central Govt. authority	Progress reports on a regular basis	Adequate human and financial support is available for its functioning.	MoEFCC, WII

Table 2: Dolphin Conservation Action Plan 2022-2030

Strategies/Actions	Tasks	Implementation areas	Timeline	Coordinating Organizations	Supporting Organizations
Objective1: Control direct mortality of Gangetic river dolphin					
1.1 Assess current status and distribution of dolphin population in its range	1. Conduct population and habitat monitoring every four years interval	Dolphin distribution range	2023-2025		WII, State Forest departments, local NGO's, and institutions
1.2 Create scientifically managed network of Conservation Priority Areas (CPA) for protection of dolphins	1. Conduct periodic ecological surveys 2. Identification of river stretches with high abundance of dolphin	Dolphin distribution range	2023-2025	MoEFCC, MoJS	WII, State Forest departments, local NGO's, and institutions
1.3 Establish rescue and rehabilitation centres along the river for dolphins in distress.	1. Identify the strategic locations for the establishment of regional rescue centre 2. Establish the rescue centres through upgradation of existing infrastructure 3. Train personnel for the upkeep and maintenance of the centres. 4. Recruit necessary staffs and manpower for maintenance of rescue centres (Eg. Vetenarians, Forest staffs, ground staff) 5. Form a Quick Response Team (QRS) for handling rescue operation	Initially for high priority areas	2024-2030	Ministry of Jal Shakti, MoEFCC, NIUA	IWAI, IITs, CSIR labs, WII, Urban planning
1.4 Establish joint protection mechanism of fishery and forest departments for reducing mortalities of dolphin.	1. Develop training modules and organize regular training for the interdepartmental staffs involved 2. Build capacity of the personnel of all the concerned departments and governing authorities. 3. Create a cadre of joint protection force	Initially across the high priority area along the distribution range of dolphins	2023 - 2030	MoEFCC, MoAFW	WII, CIFRI, State Forest Dept. and fishery dept.

1.5 Create infrastructure for protection of dolphin	1. Create/provide supportive infrastructure and monitoring mechanisms (Eg: Boats and Instruments, support vehicles with necessary equipment). 2. Establish Central and Regional forensic and analytical labs for monitoring health of the species and its habitat (Eg: Forensic cell- WII) 3. Develop applications (online and mobile apps) for monitoring and reporting of critical events (Eg: MStripes – Use of existing systems and integrating dolphin-oriented information in it) 4. Establish a network of monitoring groups. 5. Build capacity of the monitoring groups.	Initially, along the hotspots/priority areas	3 - 6 years	MoEFCC, Department of Science & Technology (GOI), Veterinary Council of India	WII, State Forest dept., Local administration, Universities
1.6 Develop capacity of fisheries department, forest department, veterinarians, local communities and other stakeholders to address injury/mortality of dolphins.	1. Develop stakeholder specific modules for training and capacity building. 2. Organize training/ capacity building workshops for the stakeholder for monitoring and reporting (Eg: IWAI, local and Commercial shipping agencies – for maintaining low speeds while crossing dolphin areas, Mandatory vigilant team while vessel crossing to reduced accidental propeller hit of dolphins) 3. Organize training workshops for forest depts to collect and handle data reports from monitoring applications.	Dolphin distribution range	3-5 years	MoEFCC, WII	State forest dept., Ministry of Ports, Shipping and Waterways, Inland Waterways Authority of India (IWAI), Local Administration

1.7 Promote technological interventions as Acoustic Deterrent Device, for reducing net entanglement	1. Develop technological interventions to reduce net entanglement (Eg: Use of Deterrents-Pingers, Alterative or eco-friendly fishing gears – With standard grading systems (Eg. ISI marks) 2. Promote and implement technologies among the fisherman communities (Eg. Certified markets, Buy back Schemes, Subsidiary schemes – for deterrents) 3. Organize capacity building/awareness programmes for local communities to use of eco-friendly fishing gears and their importance in reducing accidental entanglement of dolphins	Dolphin distribution range	5 years	MoEFCC, DST, WII, IIT	State forest departments, Fisheries dept., Universities

Objective 2: Minimize the alteration of river ecosystems					
2.1 Enable the existing & proposed Dams/ Barrages and other instream constructions dolphin friendly.	1. Identify technological interventions that minimizes the threats during construction phase (Eg: Use of deterrents to avoid accidental death of dolphins during construction, maintaining ecological flows, reducing pollutants, fish ladders for fish migration during different season). 2. Prepare and implementing guidelines for development activities at a national level. 3. Study impact of human population on river ecology and implement policies to negate it.	Initially for high priority areas	2024-2030	Ministry of Jal Shakti, MoEFCC, NIUA	IWAI, IITs, CSIR labs, WII, Urban planning

2.2 Frame supportive policies and guidelines for River development projects /constructions	1. Policy research 2. Draft policy on regulating RDP and exploring possibilities of declaring no construction zone. 3. Develop policies and eco-safety guidelines for all the River Development Projects (RDP) (Eg: Safety measurement taken for minimizing the effect during construction phase)	Main river channel and its tributaries	2023-2025	WII, CSIR institutes and Forest department	Ministry of Jal Shakti
2.3 Prepare management plans for the Conservation Priority Areas (CPA) for maintaining their ecological integrity.	1. Strengthen coordination among various stakeholders 2. Capacity building and training of stakeholders	Dolphin distribution range	2022-2025	MoEFCC,	Central, State institution & WII
2.4 Capacity building /sensitization programme for the agencies/ staff involved in river development programme.	1. To develop Stakeholder specific modules for capacity building and training 2. Regular capacity building/ sensitizing programme involving various stakeholders 3. Regular reporting and evaluation on number of conservation sensitive activities done by sensitized stakeholders	Main river channel and its tributaries	2023-2025	State and central govt, Forest department	State and central govt, Forest department, WII
2.5 Create ecological baseline for the River system & supporting monitoring system.	1. Development of dolphin centric database management system 2. Establishment of a centralized digital knowledge bank on dolphins, their habitat and associated species which will be updated regularly.	Main river channel and its tributaries	2023-2025	WII	MoEFCC, state Forest department, local NGO's, universities

Objective 3: Engage and empower the local communities and other stakeholders for promoting sustainable resource use in the rivers and associated water bodies					
3.1 Promote livelihood programme for fishing and related dependent communities through alternative and sustainable natural resource use. A. Promote fish cooperatives B. Create temporary fish protection zones	1. Promotion of sustainable fishing practices that do not have adverse impact on the prey base and not compromise local livelihood. 2. Encourage organic farming. 3. Promote development fish cooperatives 4. Create temporary fish protection zones	1. High fishing zone within dolphin occupied range 2. Critical dolphin occupied areas	2023-2025	NMCG & MoEF&CC, Ministry of Agriculture and Farmers Welfare	WII, CIFRI, NGOs, Universities, volunteers. Forest Departments, research institutes
3.2 Put in place a system for regulated mining practices in the river ecosystem, through supportive policy, legal and administrative framework.	1. Implementing the guidelines in developmental activities and revision of EIA Notification (EPA 1986). 2. Draft policy on regulating river bed mining and in stream dredging and exploring possibilities of declaring no-mining/dredging zones along dolphin occupied rivers. 3. Formation of patrolling units comprising of State Police department, Forest department staff and local law enforcement agencies, to regulate unregulated mining initially around PA's and critical dolphin habitat.	Dolphin occupied range. 1. Dolphin Occupied range	2023 2023- 2030	MoEF&CC, MoJS MoEF&CC, MoJS, Ministry of Shipping	Sate administration, Police and Forest Department, and Local administration WII, NGOs,

3.3 Organize a series of awareness, sensitization and capacity building programme for empowerment of local communities.	1. Regular sensitization programs involving various dependent communities. 2. Establish network of volunteers involving youth from dependent community 3. Create network of schools and colleges around riverscape for conducting awareness campaign to discourage harmful fishing and agricultural practices	1. Initially around High and Medium priority areas 2. Initially around PA's and critical dolphin habitat.	2023 onwards.	MoJS, MoEF&CC, IWAI, State Forest Department	WII, Agriculture and Fishery Departments, NGOs, Universities. Ganga Prahari & Dolphin Mitras
3.4 Involve local communities and other stakeholders in protection and management of river ecosystem.	1. Capacity building of the local community in protection and management of dolphins. 2. Provide recognition to local community for monitoring effort(poaching and net entanglement) (Eg: Rewards and Awards for people involved in rescue, sharing information, loss of net during rescue) 3. Create regulatory mechanism (control on use of mosquito net and regulation for Microfilament net use, Ban on manufacture & impact of microfilament nets)	Initially across the high priority area along the distribution range of dolphins	5-10 years	Ministry of Panchayati Raj, MoRD, MoC, MoT, MoEFCC	WII and State Forest Dept., Local Administrative
3.5 Sensitize local communities and other stakeholders for minimising mortality due to net entanglements and ghost nets.	1. Develop and design dissemination material, such as posters, panels, brochures, audio and video shows, puppet show 2. Integrate with existing media system and its programmes (Eg: Nadi Utsav, Namami Gange Project, Ganga ki Baat – AIR, Local media advertisements) 3. Organize sensitizing programmes for local communities and all the stakeholders in their vernacular languages (Eg. Buyback program – on submission of old nets fishermen will get concession and Proper disposal/recycling of used net)	Dolphin distribution range	3-5 years	MoEFCC, Ministry of Information and Broadcasting	WII, MoT, MoC, Local administration, NGOS, Universities
Objective 4: Reduce pollution level in rivers					

4.1 Establish adequate functional infrastructure	1. Construct/upgrade existing and new STPs/ ETPs/ WWTPs as per future demand	Urban and rural centers, Industrial	2022 - 2030	MoJS, MoEFCC and	CPCB/SPCB in collaboration with

for treatment of industrial and municipal waste water discharge.	2. Create underground sewage treatment 3. Prepare guidelines for sewage management of pit system 4. Public awareness and sensitization of governing bodies	area along the dolphin range		State Government	Public-Private Partnership (PPP)
4.2 Identification, tapping, and monitoring of high priority drains in critical dolphin range	1. Number of priority drains identified based on pollutants load, and flow 2. Interception and diversion of priority drains to STPs/ETPs/WWTPs	Urban and rural centers, Industrial area along the dolphin range	2022 - 2027	MoJS, MoEFCC, and State Government	CPCB/SPCB, Research organization such as WII
4.2 Ensure effective functioning of above infrastructure using supportive legal instruments and promoting good practices	1. Constitution of cadre of agencies responsible/involved in evaluation of effective functioning 2. Upgradation of existing in-house lab facilities in STPs/ETPs/WWTPs 3. Training and workshops undertaking for sensitization of different stakeholders	All the operational, non-operational, proposed, and under construction STPs/ETPs/ WWTPs along the dolphin range	2022 - 2025	Ministry of Jal Shakti, MoEFCC, and State Government	Central/State Pollution Control Board (CPCB/SPCB), Research organizations
4.3 Reduce the use of pesticides in river bank agriculture through adoption of green agriculture practices (organic farming, certification, hydroponics)	1. Awareness, trainings and workshops with district administration, gram panchayat and local farmers about technical understanding of pesticides, their uses and safety aspects 2. Promotion of ecofriendly and modern agricultural practices and different farmers-friendly schemes 3. Constitution of cadre of agencies responsible/involved at district/state level tracking-controlled use of pesticides	The rivers banks and island/Sand bar agriculture/ farming along the dolphin range	2022 - 2027	MoAFW, State Agriculture Departments (SADs), institutions like National Horticultural Board (NHB) and Spices Board of India	Directorate Of Plant Protection Quarantine & Storage, State Agriculture Universities (SAUs), Forest Department, MoPR, Local Administration

4.4 Using technological advances for reducing pollution	Installation of acoustic bubble curtains for developmental activities Use of dolphin friendly engines	Along the dolphin range	2022 - 2027	MoJs, MoEFCC	MoJs, MoEFCC, State governments
4.5 Holistic ecological risk assessment at Dolphin critical habitat to evaluate the effect of priority pollutants such as ECs & EDCs	1. Number of joint national/international research collaborations 2. Development of Aquatic life standards for priority contaminants/ river water quality parameters Development of Dolphin Health Indices 3. Constitution of competent organization/body for regular monitoring 4. Recruitment of subject matter specialist	Along the dolphin range	2022 - 2027	MoJS, MoEFCC	National and international research institution, universities and involvement, Multidepartments

Objective 5: Address knowledge gaps through systematic research and monitoring.					
5.1 Establish a network of institutions for conducting research and monitoring programme.	1. Identify institutions and universities 2. Create a network of scientific institutes and universities for collaborative work. (Eg. WII with IWAI for monitoring habitat quality)	Dolphin distribution range	2022-2025	MoEFCC, UGC, WII	Central, State institution, universities and NGOs

5.2 Conduct research and monitoring on the ecology of Gangetic dolphin and its habitat.	1. Conduct research on basic ecology of river dolphin in its range (feeding ecology, behavioral ecology, conservation genetics, movement and range patterns, acoustics) 2. Conduct assessment of other Aquatic species and their habitat requirement in river systems (Gharials, Mugger, Otters, Turtle, Riverine birds, Fishes, Crustaceans, Mollusks, Planktons and other dependent species) 3. Carry annual monitoring in dolphin hotspots in each of its range 4. Carry out ecological assessment for analyzing threats and its effects on species occurrence and distribution (Range wise) 5. Conduct Hydro-Geomorphological studies for understanding the natural regime of the riverscape 6. Conduct study of zoonotic diseases and management in river systems 7. Study impact of pollution and its effects on riverine species and its habitat 8. Study impact of river development projects on riverine biodiversity and its system 9. Study the resource use conflict and their resolution in the riverine systems (Eg. Water use, Commercial fishing and mining). 10. Conduct research on policies and guidelines – Re-approaching the existing policies and creating	Dolphin distribution range	2022-2032	MoEFCC, MoJS	WII, state forest departments, Central, State institution, universities

	new policy frameworks for addressing site specific issues. 11. Conduct research on the use of technology in minimizing the effect and advancement in future designs involved in river development and mitigating problems 12. Conduct integrative research in riverscape planning (Natural flow regimes, sustainable developments) 13. Conduct studies on Socio-economic and cultural dimensions of management in the river systems				
Objective 6: Develop supportive institutional mechanisms					
6.1 Establish a multitier institutional mechanism for programme implementation at National, state, district and local level.	1. Identify the institutions 2. Identify and assign the tasks for each of the tiers of the committee. 3. Specify the time for periodic review meetings	Dolphin distribution range	2022-2023	MoEFCC, MoJS	State Forest Department, local administration
6.2 Establish a Central Dolphin Conservation Authority for management of dolphin related issues in the country.	1. Constitution of Steering committee 2. Prepare the gazette notification	Dolphin distribution range	2022-2023	MoEFCC, MoJS	State Forest Department, local administration
6.3 Establishment of Dolphin Cell at Wildlife Institute of India	1. Order for development of Cell 2. Assign tasks 3. Establish funding mechanism 4. Hire manpower	Dolphin distribution range	2022-2023	Wildlife Institute of India	MoEFCC, MoJS

MoAFW, Ministry of Agriculture and Farmers' Welfare; MoEFCC, Ministry of Environment, Forest and Climate Change; MoRD, Ministry of Rural Development; MoJS, Ministry of Jal Shakti; MoSDE, Ministry of Skill Development and Entrepreneurship; MoHUA, Ministry of Housing and Urban Affairs; MoCI, Ministry of Commerce and Industry; MoST, Ministry of Science and Technology; MoLE, Ministry of Labour and Employment; MoE, Ministry of Education; MoCA, Ministry of Corporate Affairs; MoFAHD, Ministry of Fisheries, Animal Husbandry and Dairying; MoC, Ministry of Culture, NIUA, National Institute for Urban Affairs

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6 Marine Cetaceans

6.1 Introduction

Indian waters spanning across the Arabian Sea to the Bay of Bengal form the habitat of approximately thirty species of cetaceans (whales, dolphins and porpoises) (Afzal et al. 2008). Cetacean species play critical roles in ecosystem functioning, at the same time these animals are extremely vulnerable to anthropogenic pressures and sudden environmental changes affecting major life history events like foraging and breeding success (Davidson et al. 2012, Avila et al. 2018).

Long term dedicated research on marine cetaceans in Indian waters is still in its nascence, though some ecological studies are currently underway (D'Souza et al. 2022, Bopardikar and Klinck 2020, Bopardikar et al. 2018, Jamalabad 2017, Modi and Mankeshwar 2022, Jog et al. 2018, Jog et al. 2021, Panicker and Stafford 2021, Sutaria 2018, Sutaria et al. 2017a, Sutaria et al. 2017b, Sutaria et al. 2015). Majority of the data on the documented species are based on opportunistic sighting events and stranding data (Sutaria et al. 2017, Sule et al. 2017).

Coastal species like the Indian Ocean humpback dolphin (*Sousa plumbea*), the Indo-Pacific finless porpoise (Neophocaena phocaenoides), Irrawaddy dolphins (Orcaella brevirostris), along with at least three species of baleen whales; blue (Balaenoptera musculus), Bryde's (Balaenoptera edeni) and humpback whales (Megaptera novaeangliae) are found in areas of high overlap with anthropogenic activity and are some of the most vulnerable cetaceans along the Indian coast. The Irrawaddy dolphins in Chilika have already been classified as Vulnerable under the IUCN red list. Recent IUCN assessment has placed Indian Ocean humpback dolphins under Endangered and Indo-Pacific finless porpoises under Vulnerable, further pushing the need for monitoring these species' populations. The humpback whale population found along the Arabian sea are supposedly part of the distinct and endangered Arabian Sea population, that has been subject to heavy whaling in the 1960s (Mikhalev 2000). While population estimates for ASHW across their entire range- from Oman to west coast of India- are unknown, estimates indicate a population no greater than 250 mature individuals (Pomilla et al. 2014).

Considering increasing anthropogenic pressures in the marine environment and the overarching effects of global climate change, there is a pressing need to gather long-term systematic information on population trends, distribution, and space use of cetaceans along Indian waters. All these data are essential when designing dedicated policies for long-term conservation of these animals.

6.2 Threats

Coastal and oceanic cetacean species face similar direct threats in the form of accidental mortality in fisheries bycatch and mortalities due to vessel strikes and propeller injuries.

Indirect threats include habitat degradation or loss due to intensifying fisheries and resource competition, increasing vessel traffic, chemical and noise pollution, infrastructural development, and oil and gas exploration.

Incidental mortalities; Bycatch

Approximately four million fishers operate an estimated 168,000 vessels across India's coastal and oceanic waters. Of these, 45% fisheries operators use gillnets of varying sizes. Gillnets, both smallscale and commercially operated are one of the major threats to cetaceans, followed closely by purse seinesnets, shore seines, and longlines in India. A study estimated that ~9,000-10,000 cetaceans are bycaught annually across India in mechanised vessels using gillnets (Yousef et al. 2009).

Oceanic as well as coastal species egspinner dolphins (Stenella spp.), Indo-Pacific finless porpoises (Neophocaena phocaenoides), Indian Ocean humpback dolphin (Sousa plumbea), Bryde's (Balaenoptera edeni) and blue whales (Balaenoptera musculus) (Yousef et al. 2009; Sule et al. 2017, Dudhat et al. 2022) are the most commonly bycaught species in Indian waters. Indo-Pacific bottlenose dolphins (Tursiops aduncus), common dolphins, Risso's dolphins, and Pantropical spotted dolphins (Stenella attenuata) have also been recorded from the bycatch (Yousef et al. 2009, Dudhat et al. 2022). Baleen whales and odontocetes have both been reported as bycatch from gillnets, whereas purse seines and longlines have primarily reported of odontocete bycatch.

6.3 Conservation Actions

Cetaceans are placed under the Schedule I of the Wildlife (Protection) Act, 1972, providing the highest protection. Killing and any form of trade of these animals is a punishable offence as per the Act.

6.4 Efforts for mitigation of bycatch

Various state governments have implemented fisheries closures for 6 to 8 weeks each year to facilitate fish recruitment, and these measures are also helping to minimize marine mammal bycatch. A 'Marine Mammal Research and Conservation Network of India' has been established to fill the gaps in research and conservation. There are multiple community based marine mammals monitoring networks which include fishers, experts, and managers across the country.

India has designated 130 Marine Protected Areas (MPAs) to protect marine mammal habitat. Recently ~10 Important Marine Mammal Areas (IMMAs) have been identified in the waters around India. Cetacean species recovery programs, such as for the Arabian Sea population of humpback whale have also been initiated at a national level. The national and state governments have invested in awareness raising programmes in relation to bycatch, and monitoring of cetacean strandings. Some state forest departments (eg Maharashtra) have recently begun incentives for releasing incidentally captured marine mammals, there are also talks for initiatives to compensate for depredation damage to fishing gears.

6.5 Sustainable management of critical marine mammals habitat

There are 24 Marine Protected Areas (MPAs) in peninsular India and more than 100 MPAs in the country's islands. The 24 MPAs of the mainland have a total area of about 8214 km^2, which is about 4 % of the total area under the entire PA network of India and less than 0.3% of the total land area of India. Some of the notable MPAs are the Gulf of Mannar Marine National

Park, Sundarbans National Park, Gulf of Kachchh National Park, Gahirmatha Marine Sanctuary, Coringa Wildlife Sanctuary and Chilika Wildlife Sanctuary.

As for the islands, the total area of the Andaman and Nicobar Islands is 4947 km2 , of which 1510 km2 is protected under the provisions of India's Wildlife (Protection) Act, 1972. There are 105 PAs in the Andaman and Nicobar Islands, and all are part of the MPA network of India. These MPAs cover about 60% of the terrestrial area of the islands and protect more than 40% of the coastal habitat. Mahatma Gandhi Marine National Park and Rani Jhansi Marine National Park are important MPAs here. In the Lakshadweep group of islands, four MPAs have been notified. India has also identified 12 protected areas as trans-boundary protected areas under the framework of the IUCN Trans-boundary Protected Area programme. Two of these sites are MPAs (Sundarbans National Park and Gulf of Mannar Biosphere Reserve). India has also designated six UNESCO World Heritage Natural sites, and Sundarbans National Park is one among them.

Along with all these conservation initiatives for MPAs, India has taken several steps towards achieving the Aichi Biodiversity Targets, especially Target No. 11 (at least 10% of coastal and marine areas are conserved in networks of protected areas) and Target No.14 (ecosystems that provide water, health, livelihoods and well-being are restored and safeguarded). Towards achieving these two targets, 106 coastal and marine sites have been identified and prioritized as Important Coastal and Marine Areas (ICMBAs) by the Wildlife Institute of India. Totally, 62 ICMBAs have been identified along the west coast of India, and 4 along the east coast. These sites have also been proposed as conservation or community reserves to increase participation of the local communities in governance. More efforts are required to secure and strengthen community participation in the management of the MPA network in India.

Ecologically or Biologically Significant Marine Ares (EBSA) of India Conservation and sustainable use of biodiversity in marine areas beyond national jurisdiction is one of central issues of the United Nations General Assembly. Therefore, the Convention on Biological Diversity (CBD), in 2008, adopted a resolution to identify 'Ecologically or Biologically Significant Marine Areas' (EBSAs) using scientific criteria in need of protection in open-ocean and deep-sea habitats. CBD has identified seven scientific criteria largely focusing on ecological or biological values such as 1) Uniqueness or rarity 2) Special importance for life-history stages 3) Importance for threatened, endangered or declining species and/or habitats 4) Vulnerability, fragility, sensitivity, slow recovery 5) Biological productivity; 6) biological diversity and 7) Naturalness of the site. Angria Bank for deep sea coral reefs and Bay of Bengal Turtle Areas for sea turtles have been identified as EBSA sites of India by experts. Government of India with support from Maharashtra Government and NGOs has initiated an action to conserve the Angria Bank EBSA.

6.6 Important Marine Mammal Areas (IMMAs) of India

In India, Chilika Lagoon, Sundarbans, Gulf of Mannar, Palk Bay, Southern Andaman Islands, Gulf of Kutch, North-east Arabian Sea Humpback Whale habitat and Sindhurdurg Kawar region have been identified as IMMA. Furthermore, coastal waters off Raigad-Ratnagiri (Maharashtra), Southwestern coast of India, Kanyakumari, Northeast Indian Ocean, Central Tamil Nadu and Pondicherry, coastal waters of Andhra Pradesh and Gahirmatha and Central

Odisha are Areas of Interest (AoI) for potential IMMAs based on further input and data (https://www.marinemammalhabitat.org/imma-eatlas/). These IMMAs are expected to strengthen our effort to achieve Aichi Biodiversity Targets No. 11

7 Goals and Objectives

The overall objective of this conservation action plan is to monitor and improve cetacean populations in Indian waters. Following objectives need to be addressed to obtain data on cetacean health and population status:

1. To gather baseline data on abundance, distribution and occurrence patterns of cetaceans across Indian coastal waters and EEZ.
2. To Identify and map high density areas and critical habitats for cetaceans
3. Quantify direct and indirect anthropogenic threats to cetaceans in critical habitats.
4. Include community and stakeholder participation in conservation and mitigation measures

8 Approaches and methodologies

8.1 Baseline data on abundance and distribution of cetaceans along the Indian Coast

Studies on abundance, species diversity and distribution of cetaceans have been undertaken across several states along the Indian coast. Vessel-based surveys are being conducted in Maharashtra to monitor coastal cetacean populations in conjunction with the state forest department (Bopardikar and Klinck 2020, Sule et al. 2016). Similar efforts have been made in Orissa (Sutaria 2008, Sutaria et al. 2017), Goa (Madhusudhana et al. 2019), Northern Karnataka (Jamalabad 2017) and Kerala (Panicker et al. 2017, Sutaria 2018). Cetacean monitoring studies have previously been conducted in the Andaman Islands (Mankeshwar and Sutaria 2019) and are ongoing in Lakshadweep (Panicker and Stafford 2021). Broadly, these studies have employed techniques like photographic mark-recapture and acoustic monitoring to study distribution, density, abundance, and occurrence patterns of cetacean species, combined with semi-structured interview surveys with local stakeholders to generate baseline data on species distribution and diversity. Robust monitoring methods need to be tested for countrywide application.

States where baseline data are present need to continue long-term monitoring and intensify efforts across coastal and oceanic waters.

8.2 Identifying critical habitats for cetaceans in Indian waters

Based on long-term monitoring and vessel surveys, habitat use can be assessed to determine areas which form important breeding and foraging grounds. For oceanic species, studying spatiotemporal occurrence patterns can help map migratory routes, especially for baleen whales. Once critical habitats and space use within these areas are mapped, these areas can be included to further strengthen IMMAs under different conservation criteria.

8.3 Quantify direct and indirect anthropogenic threats in critical habitat

Cetaceans are affected by any changes in their habitat that alter major life history events for these animals. Anthropogenic pressures such as industrial fisheries operations, intensifying vessel traffic, constant high ambient noise levels, increasing amount of pollutants in their habitat can have negative effect on the physiology of the animals inhabiting these areas. Presence of continuous stressors can affect breeding and foraging behaviour and lead to

reduced reproductive success. To study the long-term effects of these pressures, it is essential to first identify and quantify the extent of stress in an animal's habitat.

Environmental impact of human activities like coastal development, fisheries in critical cetacean habitats should be assessed. Water quality across seasons should be monitored in coastal and estuarine areas for presence of pollutants and solid waste. Fishing pressure of various gear types should be mapped and quantified in coastal and oceanic waters that overlap with high density areas of cetacean presence.

8.4 Increasing community and stakeholder participation in conservation measures

Any successful implementation of conservation efforts requires the participation of local communities. These communities should ideally be primary stakeholders in conservation initiatives. Cetacean conservation programmes should include fisheries operators, and coastal village communities along with state forest department staff, and dive tourism operators. This core network can provide valuable data on cetacean stranding events in locations researchers may not be able to access immediately. Dialogue can be initiated with coastguard and navy to report cetacean sightings, when possible, without disclosing sensitive information.

Various kinds of educational and sensitization programmes can be developed which are targeted towards specific stakeholders.

8.5 Conservation problems and proposed solutions in log frame

Although monitoring efforts and studies on cetaceans are being undertaken in India, significant knowledge gaps to address conservation concerns remain (See Table21. below). Figure 1 and 2 provide a schematic representation of the threats faced by cetaceans in Indian waters and potential solutions for the same, respectively. Table 3 and Table 4 provides a framework for long-term monitoring of cetaceans in India and a timeline for the proposed plan.

8.6 Outputs/ Outcomes

The proposed activities will ensure robust data collection for long-term monitoring of cetacean populations and their habitat to further provide scientifically sound conservation measures. Some of the proposed immediate outcomes are as follows:

1. Spatiotemporal distribution, occurrence patterns of cetaceans from across their range in Indian waters. Population level data on relative abundance from areas where it is currently lacking.
2. Identification of critical high-density habitats and visuals of the same for further developing potential conservation measures.
3. Understanding the degree of overlap between cetaceans and various anthropogenic pressures, assessing the scale of these impacts on local populations of animals.
4. A consolidated conservation action plan for cetaceans in Indian waters with community and stakeholder engagement.

Table 2. Factors contributing to threats and potential decline of cetacean populations in Indian waters

Factors	**Parameters**	**Consequences**
Factor 1	Lack of systematic data on species diversity, distribution and occurrence of cetaceans in Indian waters	Difficulty in developing species-specific conservation measures, no monitoring of spatiotemporal occurrence patterns of transient oceanic species
Factor 2	Lack of systematic data on abundance, and population trends of majority cetacean species	Difficulty in quantifying any potential impacts on future population trends due to anthropogenic factors
Factor 3	Lack of quantitative data on the scale of anthropogenic pressures in cetacean habitat across Indian waters	Developing robust mitigation measures is difficult in the absence of scientific information
Factor 4	Bycatch and fisheries interactions	Entanglement mortalities, boat strikes/propeller injuries, gear and catch depredation leading to ingestion of debris, increase in fisherdolphin conflict
Factor 5	Intensifying fishing pressure in overlapping habitat	Depletion of resources, intensifying competition for prey resources, reduced fitness of species, reduced foraging success
Factor 6	Coastal pollution, constructions and infrastructure development in overlapping habitat	Reduced fitness of species, degradation or complete loss of critical breeding/foraging areas
Factor 7	Explorations for marine resources, naval exercises	Increase in ocean ambient noise levels, negative impact of mid and high frequency sonar, and seismic surveys on physiology of cetaceans

Table 3. Long-term monitoring plan for cetaceans in Indian coastal waters and EEZ

Parameters	Objectively Verifiable Indicators (OVI)	Means of Verifications (MOV)	Assumptions/Pre-requisites
GOAL			
To ensure long term monitoring of cetaceans and their ecosystem	Adequate data on cetaceans across their range to ensure effective conservation measures	Data on distribution, abundance and diversity of cetacean species in Indian coastal waters and EEZ	Regional and national government support for effective implementation of the studies. Continuous and sustained flow of funds. Manpower for implementation of various studies
OBJECTIVES			
1. To gather baseline data on abundance, distribution and occurrence patterns of cetaceans across Indian coastal waters and EEZ.	Information on species diversity, spatiotemporal occurrence patterns and baseline data on relative abundance for cetacean species	Monitoring coastal and EEZ waters using vessel-based surveys	Logistics, funds and manpower are made available and sustained throughout study duration.
2. To Identify and map high density areas and critical habitats for cetaceans	Data and visuals on high density areas inhabited by cetaceans. Mapping of potential foraging and breeding grounds	Space use studies, vesselbased surveys, semistructured interview surveys with coastal communities	Funds and manpower are sustained throughout study duration
3. Quantify direct and indirect anthropogenic threats to cetaceans in critical habitats.	Data on types and degree of anthropogenic threats to cetaceans.	Monitoring of water quality parameters, shipping and commercial scale fisheries pressures in critical habitats	Support from industry and other relevant lobby is ensured. Funds are readily available to conduct long-term monitoring

4. Include community and stakeholder participation in conservation and mitigation measures.	Development of long-term community-based conservation approaches in conjunction with local stakeholders. Increase awareness and sensitise stakeholders regarding cetaceans and their habitats. Addressing socio-economic issues of local communities to further enhance contribution in conservation practices.	Involvement of local coastal communities, other stakeholder involvements (coastguard, navy). Sustainable alternate livelihood plans for local community.	Opinions and concerns of local fishing and coastal communities are considered, and communities are taken into confidence while implementing potential conservation measures.

Table 4: Conservation Action Plan for Cetaceans

Strategies	**Tasks**	**Implementation Areas**	**Timeframe**	**Coordinating Organisations**	**Supporting Organisations**
1. To gather baseline data on abundance, distribution and occurrence patterns of cetaceans across Indian coastal waters and EEZ.	1. Surveys to gather data on species diversity, spatiotemporal occurrence patterns and relative abundance	Coastal waters and Indian EEZ	2023-2030	MOEFCC, State Governments	State Forest Department, State Fisheries Departments, Local Universities, Local Organisations, WII and NGOs
2. To Identify and map high density areas and critical habitats for cetaceans	1. Recognise areas of high cetacean densities. 2. Quantify habitat use in high density areas	Coastal waters and Indian EEZ	2025-2030	MOEFCC, State Governments	State Forest Department, State Fisheries Departments, Local Universities, Local Organisations, WIland NGOs

3. Quantify direct and indirect anthropogenic threats to cetaceans in critical habitats.	1. Identify and quantify direct and indirect threats to cetacean populations across range and in critical habitats	Prioritize coastal waters	2023-2025	MOEFCC, State Governments, Ministry of Petroleum and Natural Gas, Indian Navy and Coast Guard	Research Organisations,WII, State Pollution Control Board, Municipal Corporations and Local Civic Body.
4. Include community and stakeholder participation in conservation and mitigation measures	1. Set up community-based monitoring networks for cetacean stranding events. 2. Sensitization of all involved stakeholders 3. Awareness workshops with tourism operators for implementing best practices protocol during dolphin watching tours.	Coastal waters and Indian EEZ	2025-2030	MOEFCC, State Governments	Local NGOs, Organisations, WII,Research Institutes

9 Project Dolphin – Cooperation from Ministries

The Ministry of Environment, Forest and Climate Change is implementing the Project Dolphin. A comprehensive Action plan in this regard has also been developed by the Ministry. The Ministry of Environment, Forest and Climate Change seeks cooperation of relevant Ministries in implementation of the Project Dolphin (details also present in Table 3).

- **Ministry of Fisheries, Animal Husbandry and Dairying:** Supporting in improving livelihood opportunities of Fisherfolks such as adopting alternative livelihood opportunities such as Aquaculture, shrimp farming, Pisciculture, etc; Enhancing fisheries conservation thereby creating adequate prey-base for Dolphins; Supporting fisheries related activities aimed at adoption of Dolphin friendly fishing practices, including by-catch reduction and un-intended entanglement of Dolphins in fishing nets and providing incentives to fisherfolk for adoption of such dolphin friendly fishing practices, under schemes such as *Matsya Sampada Yojana*.
- **Ministry of Jal Shakti** - Support through *Namami Gange* Programme; Monitoring on maintenance of water flow in rivers and management and abatement of riverine pollution; support for taking up activities relating to creating network of *Dolphin Mitra*, and providing incentives for discouraging use of Dolphin as bait and for awareness generation programmes on pollution reduction, maintain water quality, reducing release of industrial effluents to rivers, etc
- **Ministry of Tourism –** Support through promotion of Dolphin Tourism activities like financial assistance for development of tourism related infrastructures, promoting tourism circuit involving dolphin tourism with cultural, religious, historical places, training and capacity building for Dolphin tourism activities.
- **Ministry of Shipping –** Support though management of vessel movement in Rivers and marine ecosystem, with a view to be in sync with Dolphin conservation interventions, such as introducing new technologies in vessels to reduce the waste discharge into waterways and also systems to identify aquatic and marine species underwater and to warn the captains of the vessels to avoid the vessel hits etc.
- **Ministry of Earth Sciences –** Co-operation in Marine Dolphin and associated species estimation and management and abatement of marine litter and pollution activities and also supporting activities like marine Dolphin enumeration, identification of marine dolphin habitats using advanced technology etc.
- **Ministry of Defence:** Support of Coast Guard and Indian Navy in conservation initiatives for marine Dolphins.
- **Ministry of Science & Technology:** Support in developing advanced scientific tools for population assessment of Dolphins; promoting scientific research on marine mammal conservation.
- **Ministry of Culture:** Support in promoting cultural values for dolphin conservation.
- **Ministry of Agriculture and Farmers Welfare:** Support from scientific institutes like CMFRI, etc. in marine dolphin conservation.

Table 3. Linkages of Government of India's initiatives with dolphin conservation

Initiatives		**Ministry**
National Mission on Sustainable Agriculture	Soil Health Management (SHM)	MoAFW
	Paramparagat Krishi Vikas Yojana (PKVY)	MoAFW
Soil conservation	Soil and Land Use Survey of India (SLUSI)	MoAFW
Organic farming	National Project on Organic Farming (NPOF)	MoAFW
National Water Mission Repair, Renovation and Restoration (RRR) of water bodies		MoJS
Swachh Bharat Abhiyan		MoJS
National Water Mission		MoJS
Jal Shakti Abhiyan		MoJS
Atal Bhujal Yojana		MoJS
National Rural Livelihoods Mission (Deendayal Antayodaya Yojana DAYNRLM)		MoRD
National Urban Livelihoods Mission (Deendayal Antayodaya Yojana DAY-NULM)		MoHUA
Smart Cities Mission		MoHUA
Plastic Waste Management (PMW) Rules, 2016		MoEFCC
Plastic Waste Management (Amendment) Rules, 2021		MoEFCC
National Bamboo Mission		MoEFCC
National Industrial Corridor Development Programme		MoCI
Water Technology Initiative (WTI)		MoST
National Career Service (NCS)		MoLE
Companies Act, 2013 (Section 135); Companies (Corporate Social Responsibility Policy) Rules, 2014		MoCA
National Fisheries Policy, 2020		MoFAHD
Pradhan Mantri Matsya Sampada Yojana		MoFAHD
Sustainable Sand Mining Management Guidelines 2016		MoEFCC
Nadi Utsav, Ganga Utsav		MoC
	Integration with General Education	MoE
Pradhan Mantri Krishi Sinchayi Yojna	Accelerated Irrigation Benefit Programme (AIBP)	MoJS
	More Crop per Drop	MoAFW
	Har Khet Ko Pani	MoJS
	Integrated Watershed Management Programme	MoRD

National Skill Development Mission	Pradhan Mantri Kaushal Vikas Yojana (PMKVY)	MoSDE
	Jan Shikshan Sansthan (JSS)	MoSDE
	Skills Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP)	MoSDE
	Skill Loan Scheme	MoSDE
	Pradhan Mantri YUVA (PM YUVA) Yojana	MoSDE

MoAFW, Ministry of Agriculture and Farmers' Welfare; MoEFCC, Ministry of Environment, Forest and Climate Change; MoRD, Ministry of Rural Development; MoJS, Ministry of Jal Shakti; MoSDE, Ministry of Skill Development and Entrepreneurship; MoHUA, Ministry of Housing and Urban Affairs; MoCI, Ministry of Commerce and Industry; MoST, Ministry of Science and Technology; MoLE, Ministry of Labour and Employment; MoE, Ministry of Education; MoCA, Ministry of Corporate Affairs; MoFAHD, Ministry of Fisheries, Animal Husbandry and Dairying; MoC, Ministry of Culture.

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