



BIODIVERSITY CONSERVATION AND GANGA REJUVENATION



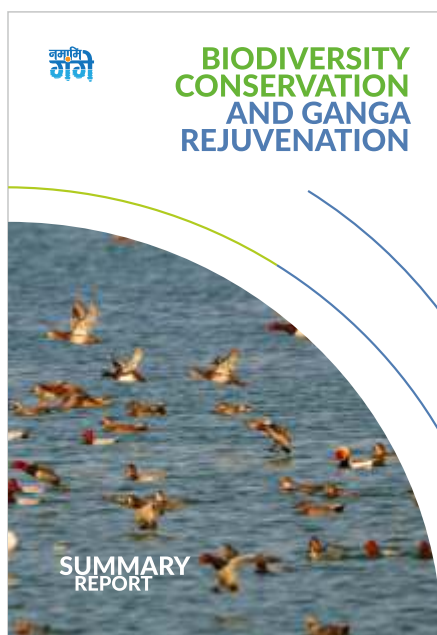
SUMMARY
REPORT



Biodiversity Conservation and Ganga Rejuvenation

SUMMARY REPORT





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Citation: Hussain, S.A. and Badola, R. (Eds.) (2020). Summary report. Biodiversity Conservation and Ganga Rejuvenation. Ganga Aqualife Conservation Monitoring Centre. Wildlife Institute of India, Dehra Dun. 137 pp.

© Ganga Aqualife Conservation Monitoring Centre,
Wildlife Institute of India, Dehradun,
March 2020



ACKNOWLEDGEMENTS

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District Administrations of Ganga districts

State veterinary departments

Support staff

Ganga Praharis, local community members, frontline forest staffs

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भारत सरकार



Minister for Jal Shakti
Government of India

गजेन्द्र सिंह शेखावत
GAJENDRA SINGH SHEKHAWAT



I am very happy to write this message to commemorate this Summary Report on the project "Biodiversity Conservation and Ganga Rejuvenation".

This report gives a brief of the activities, outcomes and scientific findings of this project. The key findings and conservation planning methods developed is based on robust scientific data and is novel to river conservation science. Efforts to mobilise, train, educate and garner local communities and other stakeholders' support has been exemplary.

The Rescue and Rehabilitation centres across the Ganga River states have been playing crucial role in controlling poaching and trade in aquatic species. It is very encouraging that the Wildlife Institute of India was able to deliver beyond what was expected from this project, giving new hope that our national river, the Ganga, could indeed be nirmal and aviral again. I wish them the best of luck for Phase II of the project which is extended to the entire Ganga basin.

Gajendra Singh Shekhawat
Union Minister of Jal Shakti



Messages

मंत्री

पर्यावरण, वन एवं जलवायु परिवर्तन
सूचना एवं प्रसारण और
भारी उद्योग एवं लोक उद्यम
भारत सरकार



Minister
Environment, Forest & Climate Change
Information & Broadcasting and
Heavy Industries & Public Enterprises
Government of India

प्रकाश जावड़ेकर
PRAKASH JAVADEKAR

I am very pleased to know that the National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti (MoJS) has prepared the Biodiversity Conservation Plan for our national river Ganga under the Namami Gange Mission. Aquatic biodiversity conservation in the Ganga basin is of utmost importance. I am happy that the Wildlife Institute of India (WII), Dehra Dun, an autonomous Institution under the Ministry of Environment, Forest and Climate Change (MoEFCC), is implementing this project and has done an excellent job in mapping the distribution of aquatic life and mobilizing local communities for Ganga conservation. The Ganga Aqua Life Conservation Monitoring Centre at WII has developed the capacity of the Forest Departments of the Ganga states and is providing decision-support to NMCG as well as MoEFCC. The project has demonstrated that Ganga conservation is a societal movement backed by robust scientific information.

I hope that this report will be a guiding tool and inspiration for other projects and agencies adopting a multi-disciplinary approach with stakeholder involvement. I believe that WII will carry out similar work of scientific rigour not only in the Ganga basin, but also in other rivers across the country.



Prakash Javadekar

रतल लाल कटारिया
Rattan Lal Kataria



जल शक्ति
और सामाजिक न्याय एवं अधिकारिता
राज्य मंत्री
भारत सरकार
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MINISTER OF STATE FOR
JAL SHAKTI AND SOCIAL JUSTICE &
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MESSAGES

The "Biodiversity Conservation & Ganga Rejuvenation" project has come to an end after more than 3 years of ground-breaking research by the Wildlife Institute of India. The project has shown great results, and this report summarizes the findings and outcomes of its six intertwined components as separate chapters. The Ganga Aqualife Conservation Monitoring Centre established at the Wildlife Institute of India has been playing a major role in spearheading Ganga river research and conservation efforts across the country. The Ganga Prahari cadre established through the project exhibits the principles of community-based conservation and strives for sustainable livelihood generation and economic growth for the people in the basin. I am sure that the team will put forward the same amount of effort in the Phase II of the project with the support of NMCG.

Rattan Lal Kataria



यू. पी. सिंह, आई. ए. एस.
U.P. Singh, IAS
सचिव
Secretary



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जल शक्ति मंत्रालय
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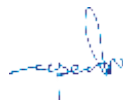
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जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
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MINISTRY OF JAL SHAKTI
DEPARTMENT OF
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RIVER DEVELOPMENT &
GANGA REJUVENATION



The current state of the environment across the globe warrants novel approaches to conservation and enhanced scientific rigour, especially for freshwater systems. The outcome of the "Biodiversity Conservation and Ganga Rejuvenation" project as evidenced by its many accomplishments over the years and now through this Summary Report, shows a glimmer of hope for the Ganga River. The project is unique in the sense that it perfectly balances biology, ecology and management planning of the river whilst maintaining local community support. The Ganga Prahari cadre developed under this project has become an epitome of community-based conservation. I congratulate the Wildlife Institute of India for their efforts and I hope that they will deliver similar results in the second phase of the project wherein they will tackle the whole Ganga Basin.


U.P. Singh



Improving ecology and flow in the river Ganga in addition to pollution abatement has been fundamental to our approach to Namami Gange mission. Key importance has been given to biodiversity conservation from scientific as well as community perspective. The "Biodiversity Conservation and Ganga Rejuvenation" project carried out by the Wildlife Institute of India aimed to tackle this issue through a scientific lens and with the involvement of multiple stakeholders. This publication summarises the findings and outcomes of the Phase I of the project. The project has made significant impact at the ground level through biodiversity surveys, community mobilization especially through Ganga Praharis and livelihood development and mass conservation education. The scientific findings of the project will be instrumental in making required interventions to strengthen river governance and management in the country.


Rajiv Ranjan Mishra



PREFACE

For centuries, rivers have been subject to human use and misuse leading to their degradation and loss of biodiversity. This issue is magnified in the case of large rivers that support a large number of human population as rivers provide a suite of ecosystem services essential to humans. The Ganga River is one such large river that is also one of the most threatened rivers in India. The last few decades have witnessed human actions driving its degradation leading to changes in its water quality, quantity and ecological productivity. Changes in the range and migration patterns of several aquatic species, such as the Gangetic dolphins and hilsa, have been observed due to man-made barriers along the river. Positive reinforcements such as the creation of Protected Areas, have played a vital role in the conservation of several aquatic species and their habitats. But this is not enough to overcome the damage and sustain the added pressure from rapid population increase and demands for resources.

Modern problems should have advance solutions, aided by the best of science and technology and through cohesive and collaborative efforts.

With this in mind, the project “Biodiversity Conservation and Ganga Rejuvenation” was envisaged to prepare a holistic restoration plan for the Ganga River through the support and involvement of stakeholders of all the Ganga states. The project was executed by a large team of scientists and researchers with diverse expertise, within a time-span of three years.

From the initial inauguration to the culmination, the project has strived towards achieving the most strategic conservation plan for the Ganga River. To support the planning process, the project has worked through six interlinked but yet diverse components, each with a different approach but with the common goal of Ganga conservation. These six components inclusive of their activities, findings and outcomes are summarized in different chapters of this report. Chapter 1 provides background of the project and briefly describes outcomes of the project. Chapters 2 to 9 provide insight into each of the six components, including separate chapters on genetics and ecotoxicological studies. Chapter 10 summarizes the achievements of the project vis-à-vis the 17 Sustainable Development Goals of the United Nations. The outputs of the project, in terms of technical reports, manuals, training guides, popular articles, information booklets and brochures is annexed in ‘list of annexures’.

As the project concluded, the Wildlife Institute of India was given a bigger responsibility of extending the work into the Ganga basin with the support of the National Mission for Clean Ganga, as Phase II of the project. We are sure that the expertise and experiences of the team will make a huge difference in achieving similar results at the basin scale. It should be kept in mind that the overall goal is to achieve sustainability in the basin and to do that we need to carve out the pathways for implementation, and the roles and responsibilities of each governing body and others involved. For this, we need to make sense of science and scientific data, and convert it into a language understood by all.

**Syed Ainul Hussain
Ruchi Badola**



01

INTRODUCTION

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1.1

Global river conservation scenario

Freshwater ecosystems comprising of rivers, streams, inland wetlands, lakes, ponds, marshes, and swamps, covering 0.8% of the Earth's surface (Balian et al., 2008) harbour at least 9.5% of all animal species, nearly 6% of all described species and one-third of all vertebrate species (Dudgeon et al., 2006; Balian et al., 2008; Strayer and Dudgeon, 2010). These systems are threatened by complex interactions among multiple human-induced drivers and their associated ecological alterations (Craig et al., 2017). Fragmentation of river connectivity through dams and barrages, physical alteration of river banks through infrastructure development, pollution and over-exploitation of biotic resources are direct drivers of habitat loss and species decline (MEA, 2015). In effect, 48% of the world's rivers are moderately to severely impacted by flow alteration, morphological modification, habitat



fragmentation and degradation and pollutant flux (WWF, 2016; Schmutz and Moog, 2018).

Additionally, 80% of the global population lives in areas where either incident human water security or biodiversity threat exceeds the 75th percentile (Vorosmarty et al., 2010). More than 80% of global wastewater goes untreated, resulting in severe organic pollution in and around one-seventh of all rivers and severe to moderate salinity pollution in about one-tenth of all rivers (UNEP, 2016). Climate change affect hydrologic and thermal regimes of rivers, directly impacting freshwater ecosystems and human water use (van Vliet et al., 2013). Furthermore, climate change will likely exacerbate impact of other drivers, increasing challenges for conservation and restoration (Dudgeon et al., 2006; Ormerod et al., 2010).

As a result of increased habitat degradation, freshwater megafauna populations have declined by 88% from 1970 to 2012 and megafishes exhibited the greatest global decline (94%) (He et al., 2019). Given escalating global trends in human

population, resource use and development pressures with the added impacts of climate change, these systems will remain under threat well into the future and trigger higher rates of species extinction (Stephen et al., 2007). This scenario necessitates systematic conservation efforts to halt or reverse declining trends (Dudgeon et al., 2006).

Ecological studies have proved that there is a correlation between species diversity and ecosystem stability, as well as productivity (Duffy et al., 2007; McIntyre et al., 2016). Unless appropriate actions are taken to maintain this diversity, ecosystem processes will be disrupted (Pressey, 2007) severely affecting human well-being (Turner et al., 2012). With increasing evidences for the ecological, economic and social losses associated with loss of freshwater systems, especially rivers (Vorosmarty et al., 2010), conservation planners are turning to solutions for ecological restoration of rivers (Lake et al., 2007; Palmer et al., 2014).

River conservation issues in India

India has about 4% of the world's freshwater reserve with unique assemblages of aquatic and semi-aquatic fauna that supports nearly 18% of the global human population. A major part of this reserve is constituted by 20 river basins, including the Ganga-Brahmaputra-Barak system that accounts for about 60% of the total surface water resources (NIH, 2019).

Increasing demands for water in the domestic, industrial and agricultural sectors, have led to extremely water stressed river basins, as is evident by the national per capita annual water availability that reduced from 1,816 m³ in 2001 to 1,544 m³ in 2011 (CWC, 2016). In addition, 5,264 completed and 437 under-construction large dams in India (CDSO, 2019) have fragmented the river basins. Assessment of dam-based impacts on large river systems reveal that the Ganga-Brahmaputra basin is moderately fragmented, however, the river basins in the peninsular region are highly fragmented (Nilsson et al., 2005).

Furthermore, around 61,948 million litres per day (MLD) sewage is generated from Class I cities and Class II towns in and around these river basins, of which only 37% is treated. In addition, micro- and macro-plastics, persistent xenobiotic, Endocrine Disruptive Substances (EDSs) pose toxicological risk to both aquatic diversity and humans (Moore, 2006). The Inland Water Authority of India (IWAI) has recognized 111 national waterways across major rivers to cater to the increasing demands for low cost transportation. However, large vessel movement will increase river traffic, increasing metabolic stress and stress hormonal levels in aquatic species (Panov et al., 2009; Dey et al., 2019).

Given the fundamental importance of freshwater to society, governments around the world have enacted legislation, policies and regulations to protect these ecosystems from a variety of human activities (Craig et al., 2017). In this line, the Government of India (GoI) enacted several laws and policies for protecting its rivers and initiated several national level programmes for the conservation of the Ganga River. The launching of the Ganga Action Plan (GAP) in 1985 initiated river restoration programme in India. GAP was later expanded to cover other rivers under the National River Conservation Plan (NRCP), implemented by the National River Conservation Directorate (NRCD) of the Ministry of Jal Shakti (then known as the Ministry of Water Resources). GAP I and II were largely limited to water quality maintenance without giving due importance to other ecological functions of the river such as flow, distribution and abundance of flora and fauna of conservation significance and ecosystem services. Moreover, under GAP, community participation and sensitization were not encouraged and the perceptions of the riverside communities were not built into the restoration process (Bhargava, 1992). The scenario changed after the commencement of the flagship *Namami Gange* Programme by GoI to spearhead Ganga conservation. The importance of conservation of aquatic wildlife while actively engaging riverside communities and other stakeholders in the restoration process was recognized and the National Mission for Clean Ganga was established as an authority under the Ministry of Jal Shakti.



Conservation issues of Ganga River and its biodiversity

The Ganga River forms one of the largest river basins in India and passes through three distinct biogeographic zones viz., Himalaya (West Himalaya - 2B), Gangetic Plains (Upper Gangetic Plain - 7A and Lower Gangetic Plain - 7B) and Coasts (East Coast - 8B). A smaller stretch of the Ganga River, in Jharkhand state, also borders the Deccan Peninsula (Chhota Nagpur - 6B) (Rodgers & Panwar, 1988). The geo-climatic variations gave rise to unique biotic assemblage with globally conservation significant species such as Gangetic dolphin (*Platanista gangetica gangetica*), three species of otters viz., smooth-coated otter (*Lutrogale perspicillata*), Eurasian otter (*Lutra lutra*) and small-clawed otter (*Aonyx cinereus*), three crocodilian species viz., gharial (*Gavialis gangeticus*), mugger (*Crocodylus palustris*) and estuarine crocodile (*Crocodylus porosus*), and at least 13 species of freshwater turtles including Red-crowned roofed turtle (*Batagur kachuga*), several species of fishes such as Ganges shark (*Glyphis gangeticus*), Ganges stingray (*Himantura fluviatilis*), mahaseer (*Tor* sp.), hilsa (*Tenualosa ilisha*), and several species of endemic freshwater crabs. In addition to these species, obligate aquatic species like waterbirds and island nesting birds comprises an important component of the basin. However, anthropogenic activities such as water extraction, water pollution and over exploitation of riverine resources leading to habitat degradation, are driving these aquatic species in peril (WII-GACMC, 2018).



Biodiversity hotspot

Species of mammals	5
Species of migratory & breeding birds	307
Species of crocodilians	3
Species of turtles	13
Species of amphibians	90
Species of fishes	190

43% of Indian population

44 Important Bird Areas

Protected areas

Along mainstream	6
In Ganga States	43

2 Biosphere Reserves

One Ramsar site
30 potential Ramsar sites

Passage through five states

The Ganga basin is the most densely populated river basin in the world (Misra, 2011), supporting around 43% of the Indian population, with an average population density of over 700 individuals/km² and over 1,000 individuals/km² near the deltaic zone (Sanghi and Kaushal, 2014). There are 30 cities, 70 towns and thousands of villages located along the banks of the Ganga River (Behera et al., 2013). The Upper Ganga has undergone immense structural changes and any further change would undermine the ecological integrity of the river along with its religious and recreational values. Agricultural intensification along the riverbanks and on the river islands, and sand mining in the Middle Ganga have altered the habitats of island-nesting birds and turtles. Lower Ganga is also highly modified by the Farakka Barrage. Flow alterations and changes in salinity regimes in the estuarine areas has resulted in changes in species assemblage. Impacts of climate change are exacerbating these threats in the form of an unpredictable flow regime and changes in both the upstream and

downstream distribution ranges of species (WII-GACMC, 2018). Indiscriminate use of synthetic chemicals in agriculture and healthcare has led to increased persistent pollutants, such as heavy metals and other EDSs, that interferes with the hormonal and immune systems of aquatic species through bioaccumulation and biomagnification along the food chain. Evidence of bioaccumulation and biomagnification has been documented in the food web of the Gangetic dolphin (WII-GACMC, 2018).



2,525 km

Basin extending
to 11 states

Largest river basin
in Indian subcontinent

High religious, cultural
and economic significance

Biodiversity Conservation and Ganga Rejuvenation

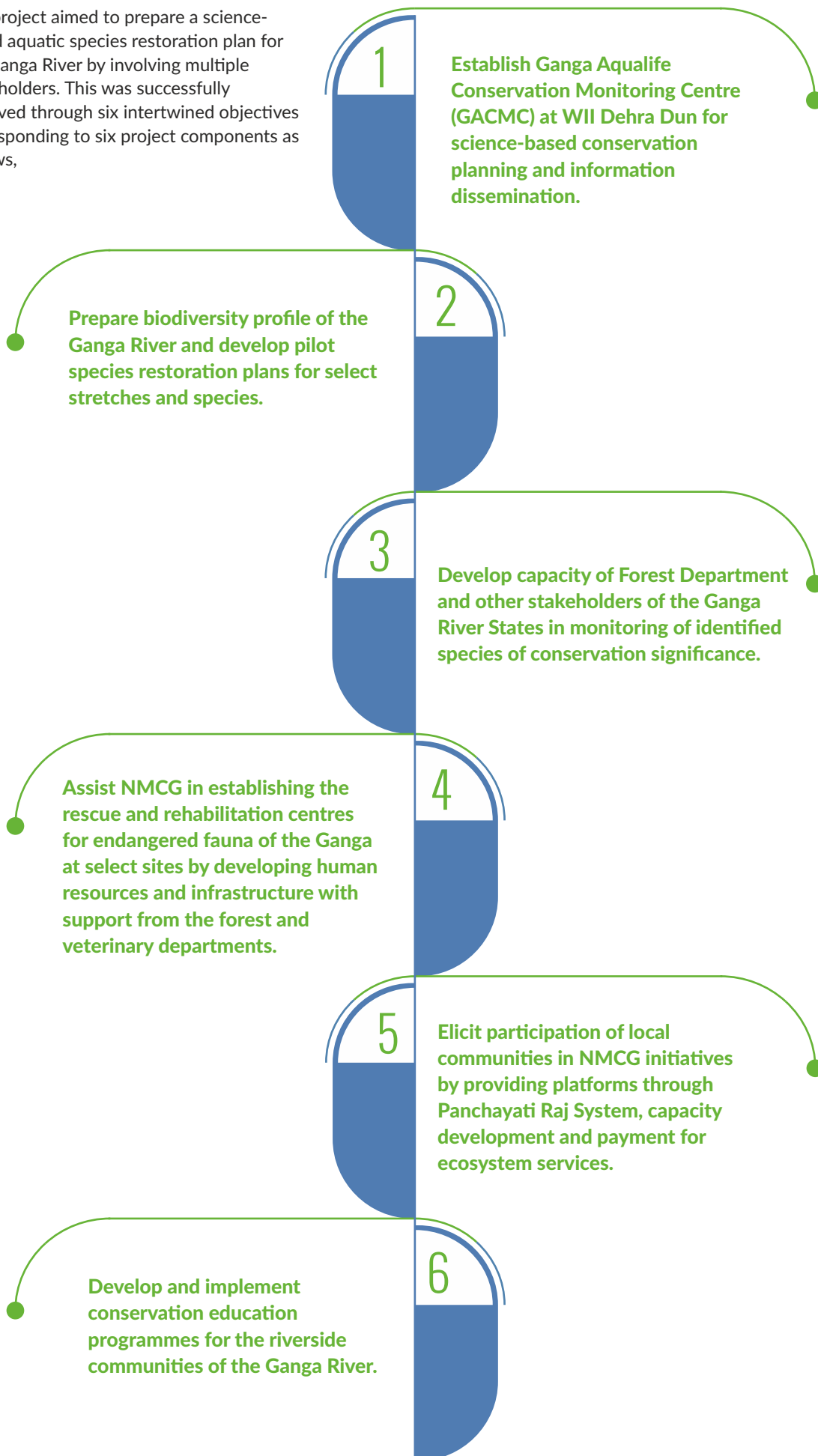
The Wildlife Institute of India (WII), Dehra Dun, an autonomous institute under the Ministry of Environment, Forest and Climate Change (MoEFCC) is an apex institute for biodiversity conservation in India. As a knowledge partner to NMCG, the institute was entrusted with the "Biodiversity Conservation and Ganga Rejuvenation" project with a vision to restore the biodiversity value of the Ganga River. In line with the vision of Namami Gange programme, the project aims to ensure that, by 2020, a significant reduction of threats to the species diversity of the Ganga River, which are either currently endangered or are likely to become endangered in the foreseeable future, is achieved.

River conservation planning is a complex issue owing to the connected nature of rivers, non-feasibility to conserve entire rivers and non-inclusivity of its habitat features. The economic and social constraints in the human-dominated Ganga basin further complicates planning. Considering these issues, WII adopted a multistage systemic approach to outline river conservation strategies and derived the most feasible approach in the context of human-dominated river basins (Hussain et al., 2020).



1.5 Aims and Objectives

The project aimed to prepare a science-based aquatic species restoration plan for the Ganga River by involving multiple stakeholders. This was successfully achieved through six intertwined objectives corresponding to six project components as follows,



Methodological framework

The project adopted a systematic conservation planning framework for river conservation that comprised of eight focal areas.

1

Establishment of GACMC

GACMC was established at WII as a resource repository and conservation planning body of NMCG to spearhead conservation of the Ganga River and its biodiversity.

2

Consolidation of existing information

Extensive literature review was carried out on the Ganga River, as well as on the historical and current state of its biodiversity. The information was collated and disseminated to various stakeholders through electronic and print media, including social media sites.

3

Mapping distribution and abundance of species of conservation significance and river habitat assessment.

The ecological assessment strategy was formulated based on literature review and reconnaissance survey. Five ecological surveys were conducted from Rishikesh in Uttarakhand to Nurpur in West Bengal to determine the distribution and abundance of species of conservation concern. The river condition was also evaluated based on habitat features, water quality and anthropogenic influences using state-of-the-art tools and techniques, such as sonar and acoustic doppler based depth and flow profiler, probe-based water testing kit, mobile based application for data collection and GIS tool for river habitat and biodiversity mapping.

4

Identification of indicator species/communities to designate areas with high biodiversity value

Indicator species were identified based on literature review and their seasonal abundance and distribution were mapped in the geo-spatial domain. High biodiversity value areas were identified by overlaying species distribution and anthropogenic activity maps.

5

Capacity development of Forest Departments and other stakeholders

To sustain on-ground conservation and ecological monitoring activities, capacity of Forest Department and other stakeholders were developed. Training curricula were prepared targeting different stakeholder groups on modules such as monitoring of aquatic wildlife, management planning of wetlands, community involvement in conservation and conservation education. Spearhead teams from five Ganga States were established and trained.





6

Establishment of rescue and rehabilitation centres

Addressing emergent situations, such as rescue of species in distress and their safe rehabilitation, is a crucial part of the species restoration process. Existing infrastructures at Narora and Sarnath in Uttar Pradesh, and Barrackpore in West Bengal were evaluated for their strategic location, confiscation history and sustainability. The facilities were refurbished to make state-of-the-art rescue and rehabilitation centres. Officials and frontline staff from the Forest Department, Veterinary Department, Narora Atomic Power Station and local communities were trained to enhance their veterinary and husbandry capacity, and deal with emergent situations as first responders.

7

Elicit participation of local communities

Local communities were mobilised through awareness, livelihood skill development and creation of a platform for active involvement in the restoration process. To ensure on ground sustainability of the efforts, a cadre of motivated volunteers called *Ganga Praharis* was established. Linkages were established with agencies working on livelihood development to align livelihoods of the local communities with river conservation objectives. Village-level microplanning approach was used to institutionalize the conservation efforts and to internalize biodiversity conservation in village level development.

8

Building a larger constituency for Ganga and biodiversity conservation

Nature interpretation centres were established at three locations in Uttar Pradesh. These interpretation centres are contributing to the conservation of the Ganga River and its biodiversity by enriching people's awareness and understanding of the biological and socio-cultural heritage of the river. The centres are building a larger constituency for Ganga and its biodiversity conservation.



The Project was launched at a national platform in Haridwar on 7th July, 2016, in the presence of Shri Nitin Gadkari, Former Hon'ble Union Minister of Water Resources, River Development and Ganga Rejuvenation, Dr. Mahesh Sharma, Former Hon'ble Minister of Environment, Forests and Climate Change, and Sushri Uma Bharti, Former Hon'ble Union Minister of Drinking Water and Sanitation. The Project was also launched simultaneously in the Ganga River states at Narora, Sarnath, Bhagalpur and Sahibganj, and later in Kolkata (Annexure 1.1).

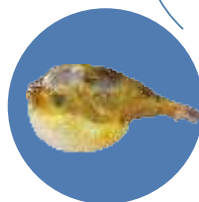
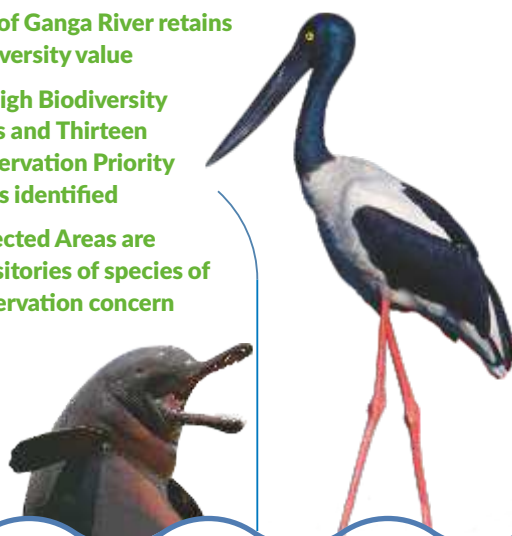
Five ecological Surveys, pre and post monsoon, from Devprayag to Nurpur, covering 2,200 Km



49% of Ganga River retains biodiversity value

Six High Biodiversity Areas and Thirteen Conservation Priority Zones identified

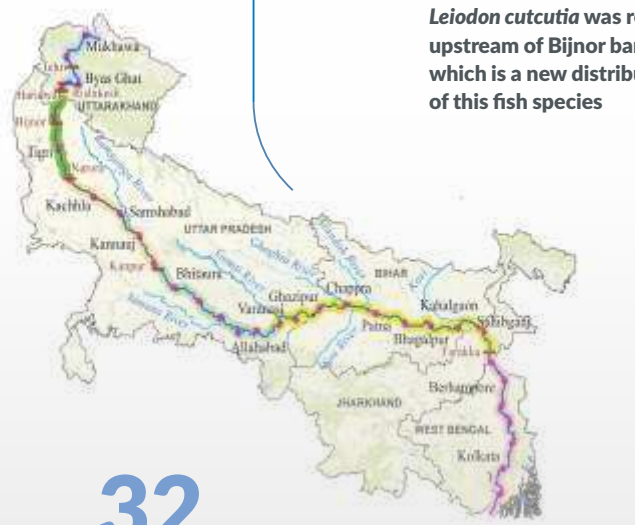
Protected Areas are repositories of species of conservation concern



Leiodon cutcutia was recorded upstream of Bijnor barrage, which is a new distribution range of this fish species



Golden mahseer from Bhagirathi and Ganga rivers have similar gene pool, while the golden mahseer of Alaknanda river has a different gene pool.



Microhyla nilphamariensis was reported for the first time in the Ganga River.

32

Intensive monitoring sites established



Reviewed over
3,500 books, journal
articles, chapters
Published peer
review papers and
popular articles

Trained and
established
spearhead
teams



73 Forest Department officials part
of the Spearhead Team

736 persons trained in ecological
monitoring, wetland and river
conservation, community
participation and conservation
education



4,196 Turtles rescued
and successfully
rehabilitated.

4,776 Turtles were
released into their
natural habitat

12,000+
Stakeholders sensitized
on Ganga conservation

A network of first
responder and citizen
scientist established



Established
rescue and
rehabilitation
centres

Narora, Sarnath,
Bhagalpur,
Barrackpore,

Trained and sensitized on
handling of aquatic species

69 Veterinary
officers

214 Local community
members

232 Forest officials

Digital training
database
established



Initiated Bal Ganga Prahari Programme



1,010 household surveys

173 MoAs with village Panchayats



64 Schools identified as part of Bal Ganga Prahari Programme

8,000+ school children sensitized



962 Meetings with PRI



Digital Microplanning
12 village level microplans developed



Ganga Prahari cadre

1,290 Individuals Registered

Synergistic alliance developed with government and non-government agencies i.e. SFDs, NPCIL, PNB-RSETI, USHA, HESCO, ILSP, DST-SEED, ENVIS

35 livelihood trainings conducted

21 livelihood centres established

16 youth groups and 18 Self Help Group (SHGs) strengthened

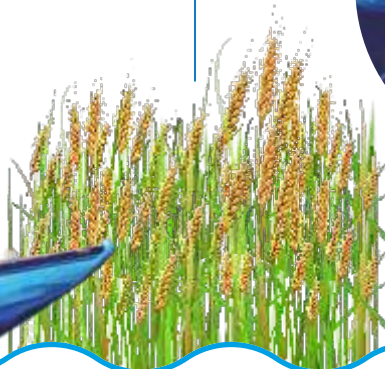
Floating livelihood centre – “Jalaj” established at Varanasi. This model was adopted by District Administration in Jharkhand as well.

22 Ecosystem Services indentified

Established interpretation centres in Kanpur, Varanasi and Sarnath

Established eco-clubs in Uttarkashi, Dehradun, Haridwar and Varanasi

Created puppet shows



107 Ganga Prahari Mentor



54 Pravasi Ganga Prahari from 17 countries

Monetary value of 8 ecosystem services evaluated



Published books, brochures,
posters, manuals and poem books
under 'Vibrant Ganga' series



72,000+
Stakeholders
reached along
the Ganga River

55,910
views of
NMCG_
WII
webpage



1,411 followers



284 followers



YouTube

126 subscribers
with 13,944 views



Ganga ki baat
Season 1,
11 episodes



Coverage In



मल्लम् शिवम् सुन्दरम्



13 TV interviews,
4 episodes in
three TV series

Ganga Aqualife Conservation Monitoring Centre

A centre of international importance for aquatic
wildlife and natural resource conservation
supporting NMCG, Ministry of Jal Shakti.

Providing institutional support to line agencies
and other stakeholders viz., State Forest
Departments, District Administration, NPCIL,
SPMG etc.

65 trained and experienced project personnel are:

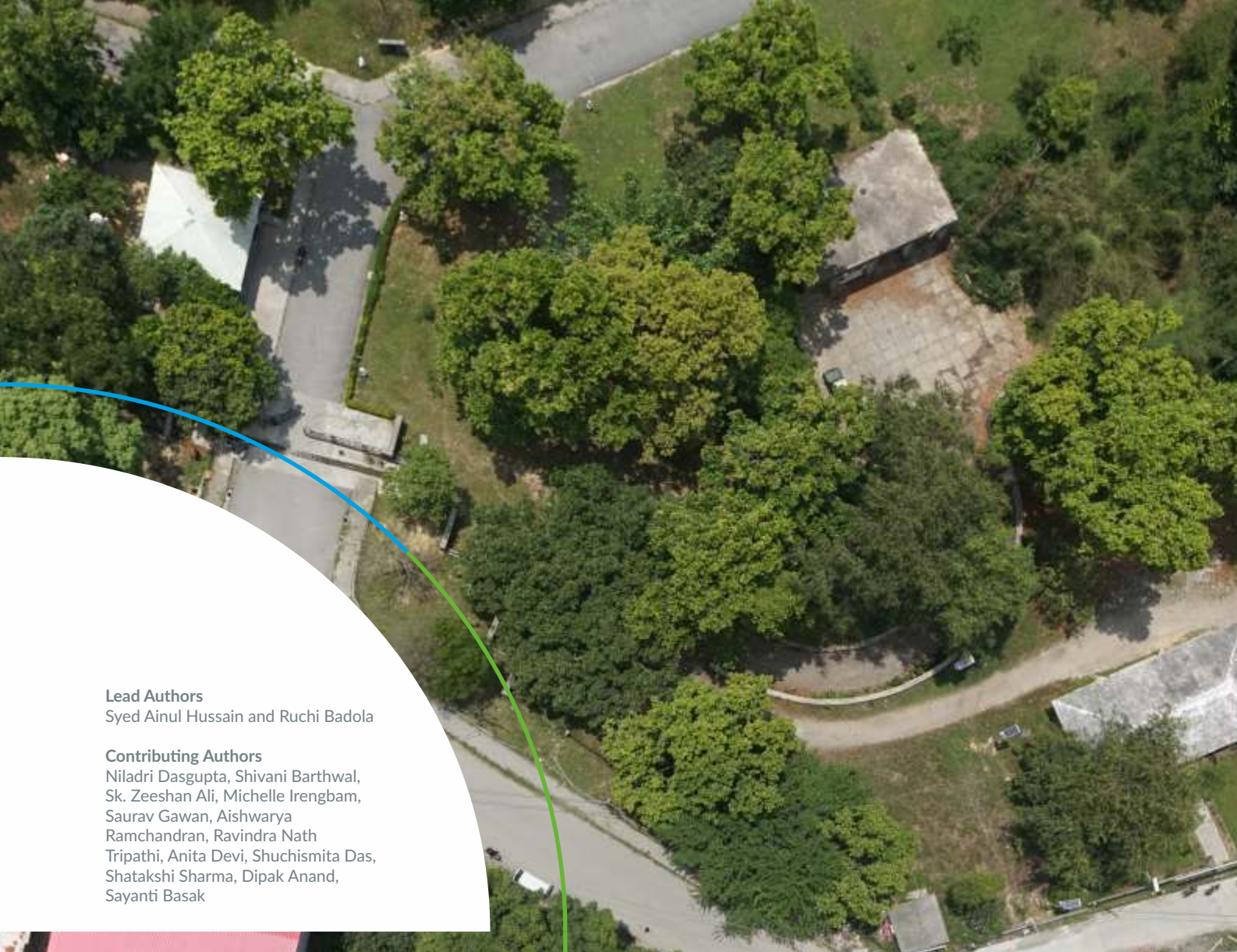
- Conducting ecological assessment
- Training and sensitizing stakeholders
- Rescuing and rehabilitating species of
conservation concern
- Ensuring community participation
- Creating awareness amongst the masses

International
collaborations for
research, training
and workshops



Orientation workshop for officials of Forest
Departments of Myanmar, Malaysia and
Bangladesh, and their induction as
Pravasi Ganga Prahari





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Sayanti Basak

ESTABLISHMENT OF GANGA AQUALIFE CONSERVATION MONITORING CENTRE

02

2.1 Introduction

Ecological restoration enhances biodiversity value and associated ecosystem services (Palmer et al., 2007). Maintenance of habitat connectivity, seasonal flow variability, augmenting habitat suitability and addressing issues related to unsustainable resource use are some of the parameters for successful ecological restoration of a river or a stream (Lake et al., 2007). The Aichi targets of the Convention on Biological Diversity have set priorities for threatened freshwater taxa occurring outside the present global Protected Area network (Raghavan et al., 2016). However, success would rely on science-based systematic conservation efforts at the national, state and local levels (Hussain et al., 2020).

As the Ganga passes through a continuous geo-climatic gradient from its headwaters to mouth, a diverse array of services is derived that cater to multiple stakeholders and enhance local and national economies. However, rapid human population growth and resulting dependence on natural resources has altered the river habitat and threatened aquatic wildlife, necessitating urgent restorative actions.



Considering the enormity of the Ganga River and non-feasibility of legally protecting the entire river, systematic conservation planning is the most feasible option (Hussain et al., 2020). Systematic conservation planning requires prioritization of select stretches of a river based on their biodiversity and habitat suitability through participatory planning and collaborative implementation of strategies, decisions and actions that secure the long-term survival and favourable conservation status of biodiversity (Kukkala and Moilanen, 2013). However, owing to the incomplete biological information available for any river basin, setting conservation priorities is a challenging task (Poiani et al., 2001). Nevertheless, the fragmented state of the Ganga basin, high degree of habitat loss and its cultural and economic significance aggravates the urgency to conserve remaining habitats — the refuges that can act as repositories of source populations.

To address these problems, conservation planners have developed alternative methods to identify and prioritize conservation areas or stretches within a river basin. A common approach for prioritization involves identification of umbrella species and their habitat requirements, wherein conservation areas are

selected based on the existing and potential habitat of these species and their connectivity, which would provide sufficient habitat variability to confer protection to a large number of naturally co-occurring species of conservation concern (Launer & Murphy, 1994).

In view of the ongoing discussion, the first component of the project aimed to spearhead science-based systematic restoration planning of the Ganga River and its aquatic wildlife.

Objectives

1. Build up a scientific knowledge base on aquatic wildlife of Ganga River Basin in accordance with the objectives of the proposed Ganga Knowledge Centres through literature review and field observations.
2. Disseminate the knowledge on Ganga to the public and scientific community through print and electronic media.
3. Promote sustainable utilization of goods and services provided by the riverine ecosystem by developing stake of local communities in conservation efforts in consonance with the Indian cultural and socio-economic milieu.
4. Develop national guidelines for considering the needs of aquatic fauna in planning and execution of water development, and promote these guidelines.
5. Develop a centre of international importance on aquatic wildlife and natural resource conservation.

Methodology

A centralised laboratory facility and resource repository on the Ganga River and its biodiversity, namely the Ganga Aqualife Conservation Monitoring Centre (GACMC) was created in WII to spearhead conservation of the river and its key aquatic fauna. Information on the state of biodiversity and river habitat condition were consolidated by an extensive literature review and a digital database was created for data assessment.

Ecological surveys were carried out from Rishikesh to Nurgpur in West Bengal during 2017 to 2019, covering pre-monsoon and post-monsoon seasons. The occurrence and distribution of key aquatic fauna such as Gangetic dolphin, otters, migratory waterbirds, resident breeding birds, mugger, gharial and freshwater turtles, were recorded using standard wildlife census techniques. Habitat conditions in terms of bank features, water depth, flow, river morphology and water quality were recorded using latest tools and techniques, such as Doppler flow profiler, sonar based depth meter and electro-probe based water testing kit. Anthropogenic influences in terms of physical alteration, presence of linear structure, water abstraction/diversion, agriculture, sewage inflow, and exploitation of biotic resources were also recorded. Maps of species distribution, habitat features and anthropogenic activities were prepared using state-of-the-art GIS tools and techniques; and high biodiversity value areas were designated by overlay method. The information was further analysed by following the systematic conservation planning approach on the basis of biodiversity value, habitat condition and anthropogenic influence to obtain conservation priority zones.

Key findings

1

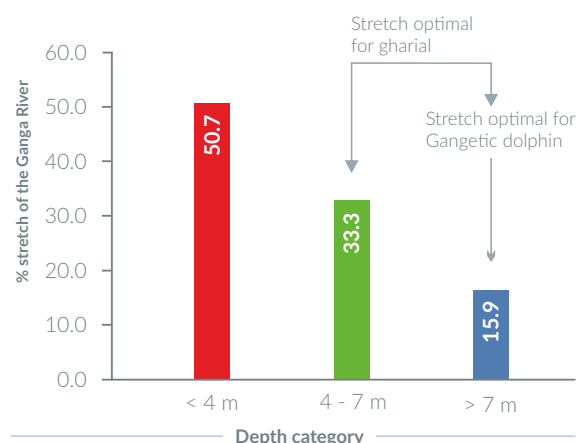
The Ganga River passes through three distinct Biogeographical Zones, namely Himalaya (West Himalaya - 2B), Gangetic Plains (Upper Gangetic Plain - 7A and Lower Gangetic Plain - 7B) and Coasts (East Coast - 8B). A smaller stretch of the Ganga River in Jharkhand also borders the Deccan Peninsula (Chhota Nagpur - 6B). The geo-climatic variability and distinct habitat mosaic give rise to unique floral and faunal assemblages. The river provides habitat for five species of mammals, 307 migratory and island nesting birds, three crocodilians, 13 turtles, 90 amphibian and 190 fishes. The integrity of the Ganga River ecosystem is lost due to morphological alteration by run-of-the-river hydro projects, fragmentation due to dams and barrages, reduced flow due to water abstraction-storage-diversion, water pollution, unsustainable extraction of fish, sand and other resources, and poaching, which threaten the biodiversity and their habitat.

2

Of the 600 higher vertebrate aquatic fauna of the Ganga River, 6% are enlisted in the RET categories of the IUCN Red List. These include four mammalian, 13 bird, two crocodilian, eight turtle, one amphibian and seven fish species. These species have undergone population decline in the recent past due to changes in habitat features, such as morphology and flow regime of the river (Annexure 2.1 & 2.2).

3 Hydrology assessments revealed channel depth as a major limiting factor for the distribution of species. 15.9% to 49.2% of the studied river stretch had a suitable depth available, annually, for the umbrella species viz., the Gangetic dolphin and gharial (Figure 2.1).

Figure 2.1 Percent suitability of the Ganga River for priority aquatic species in terms of water depth



4 Ganga is under pressure due to a multitude of co-occurring drivers. Upper Ganga has undergone major structural changes due to the construction of dams, barrages and run-of-the-river hydroelectric projects that restrict and/or divert its flow, and is unlikely to revert to its natural hydrological patterns. Construction of further hydroelectric projects in this stretch will compromise the ecological, religious and recreational values of the river (Annexure 2.1).

5 Middle and Lower Ganga has high anthropogenic influence in the form of wastewater discharge, sand mining, and higher percent of built-up and agricultural areas that negatively affect species assemblage (Annexure 2.1).

6 Ecological assessment revealed that 49% of the mainstem Ganga still retain high biodiversity value in terms of presence of priority species such as the Gangetic dolphin, otters, gharial and mugger, and breeding evidence for island-nesting birds such as the Indian skimmer (Annexure 2.1 & 2.2). The High Biodiversity Areas were divided into six disjointed high biodiversity stretches (Figure 2.2) (Annexure 2.1 & 2.2).

7 Conservation priority zones (CPZs) delineated within the five high biodiversity stretches of the Middle and Lower Ganga (Figure 2.3). These were identified based on high species assemblage, enabling habitat conditions, and minimal anthropogenic influences. These zones are concentrated either along Protected Areas (PAs), or along river confluences (Table 10.2).

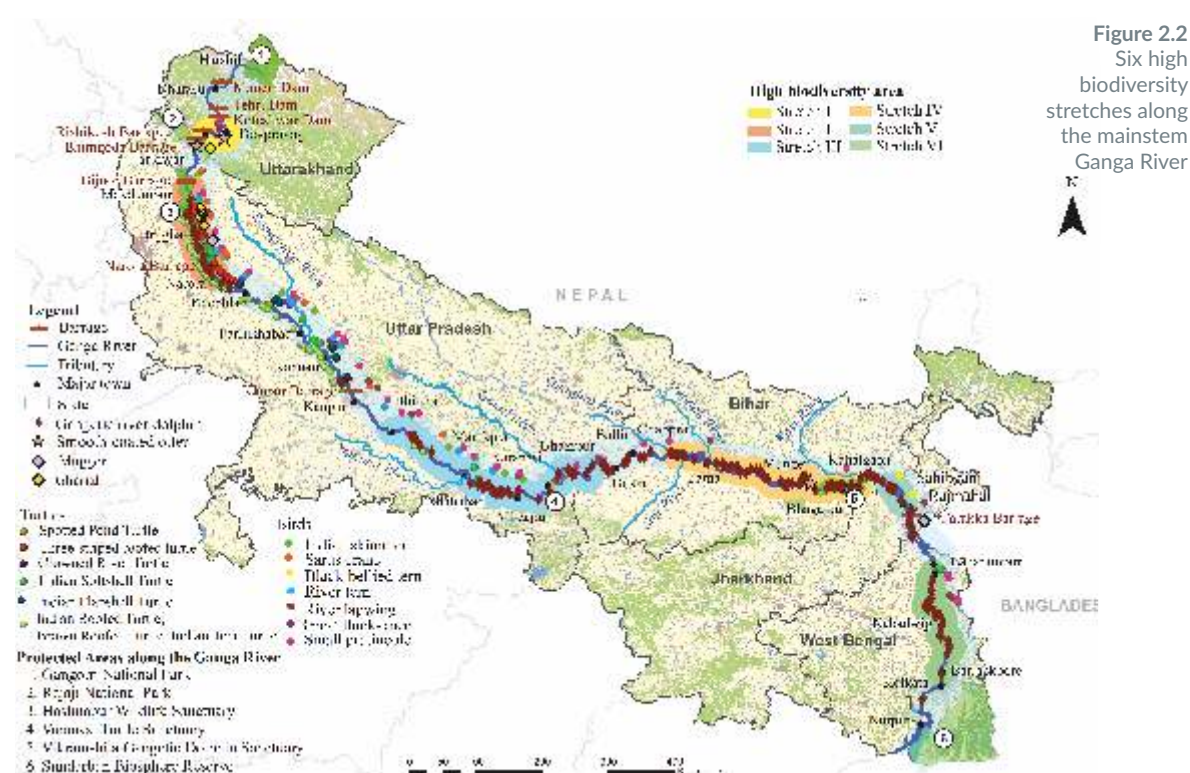


Figure 2.3

Conservation
Priority Zones
(CPZs) along
the mainstem
Ganga River

Dams and Barrages

- a. Maneri Dam
- b. Tehri Dam
- c. Koteswar Dam
- d. Rishikesh Barrage
- e. Bhimgoda Barrage
- f. Bijnor Barrage
- g. Narora Barrage
- h. Kanpur Barrage
- i. Farakka Barrage

Legend

- Barrage
- Ganga River
- Tributary
- High biodiversity stretch
- Protected Area
- Major town
- State boundary

CPZ Legend

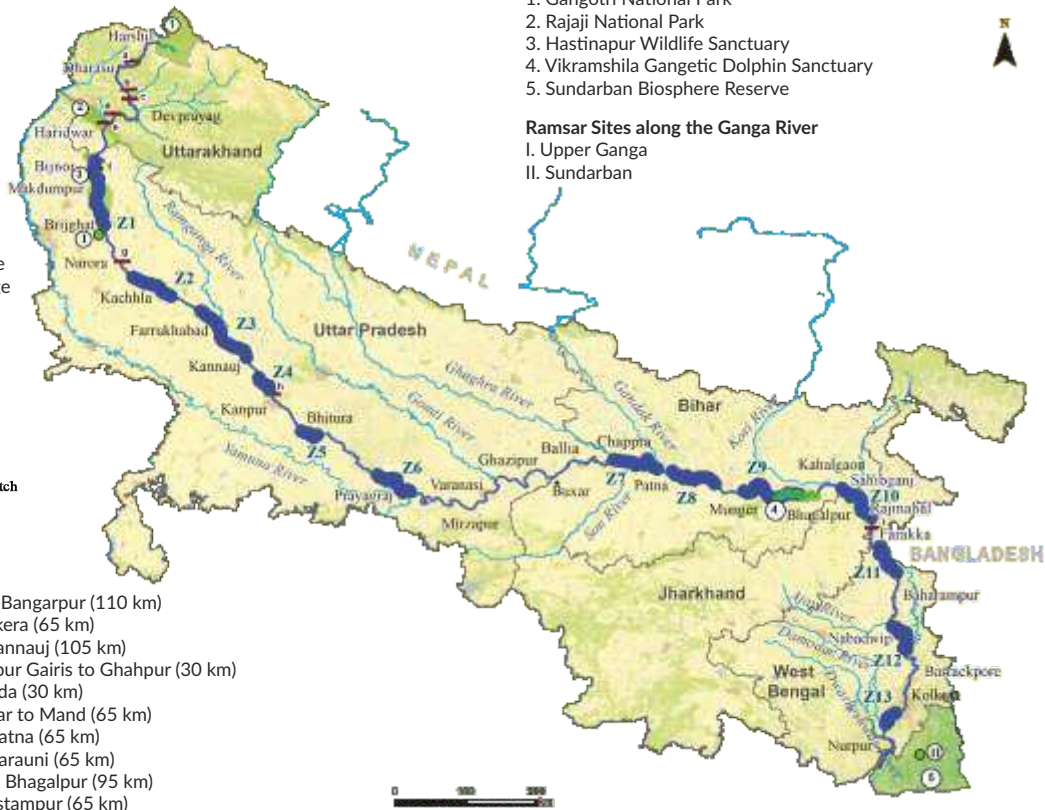
- Z 1 Abusaidpur to Bangarpur (110 km)
- Z 2 Sisaiganj to Rikera (65 km)
- Z 3 Kaimganj to Kannauj (105 km)
- Z 4 Saharia Salempur Gairis to Ghahpur (30 km)
- Z 5 Haripur to Tanda (30 km)
- Z 6 Gospur Kachhar to Mand (65 km)
- Z 7 Revelganj To Patna (65 km)
- Z 8 Raghupur to Barauni (65 km)
- Z 9 Shahbegpur to Bhagalpur (95 km)
- Z 10 Jot Tali to Rostampur (65 km)
- Z 11 Amuha to Maliapara (65 km)
- Z 12 Char Brajanathpur to Jaluidanga (75 km)
- Z 13 Maheshtala to Burul (30 km)

Protected Areas along the Ganga River

- 1. Gangotri National Park
- 2. Rajaji National Park
- 3. Hastinapur Wildlife Sanctuary
- 4. Vikramshila Gangetic Dolphin Sanctuary
- 5. Sundarban Biosphere Reserve

Ramsar Sites along the Ganga River

- I. Upper Ganga
- II. Sundarban



8

Pas provide relatively undisturbed habitats along the Ganga River and are repositories of species of conservation concern. PAs along the Ganga account for less than 10% of the total river, thus, most habitats of aquatic species are not protected along the river (Figure 2.4) (Annexures 2.1 & 2.2). Therefore, increasing protection along exist ing PAs, increasing PA cover through a comprehensive design strategy such as hierarchical protection strategy, and buffering existing PAs through soft measures are recommended (Annexure 2.1).

Figure 2.4

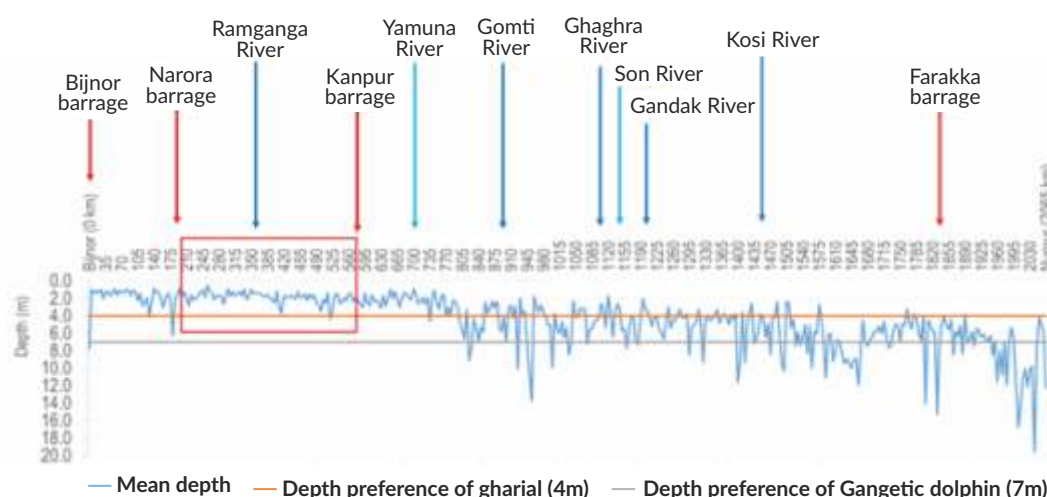
Protected
Areas
along the
mainstem
Ganga
River



9 Confluences provide essential connectivity for priority species, and enable lateral exchange of water, nutrient and biota (Annexure 2.1). River confluences are 'ecologically sensitive' areas (ESA Notification, 1989) and also act as corridors. These confluences should be protected as eco-sensitive area (ESA) under the purview of Environment (Protection) Act, 1986, and Environment (Protection) Rule, 1986, as a Conservation Reserve under the purview of Wild Life (Protection) Act, 1972, or a Ramsar site as per Criterion 3 of the Ramsar Sites Criteria (Annexure 2.1).

10 Spatial variations in channel depth restrict species distribution and assemblage. Low depth prevailed from downstream of Narora barrage till Kanpur (Figure 2.5).

Figure 2.5
Channel depth profile of the Ganga River from Bijnor to Nurgur

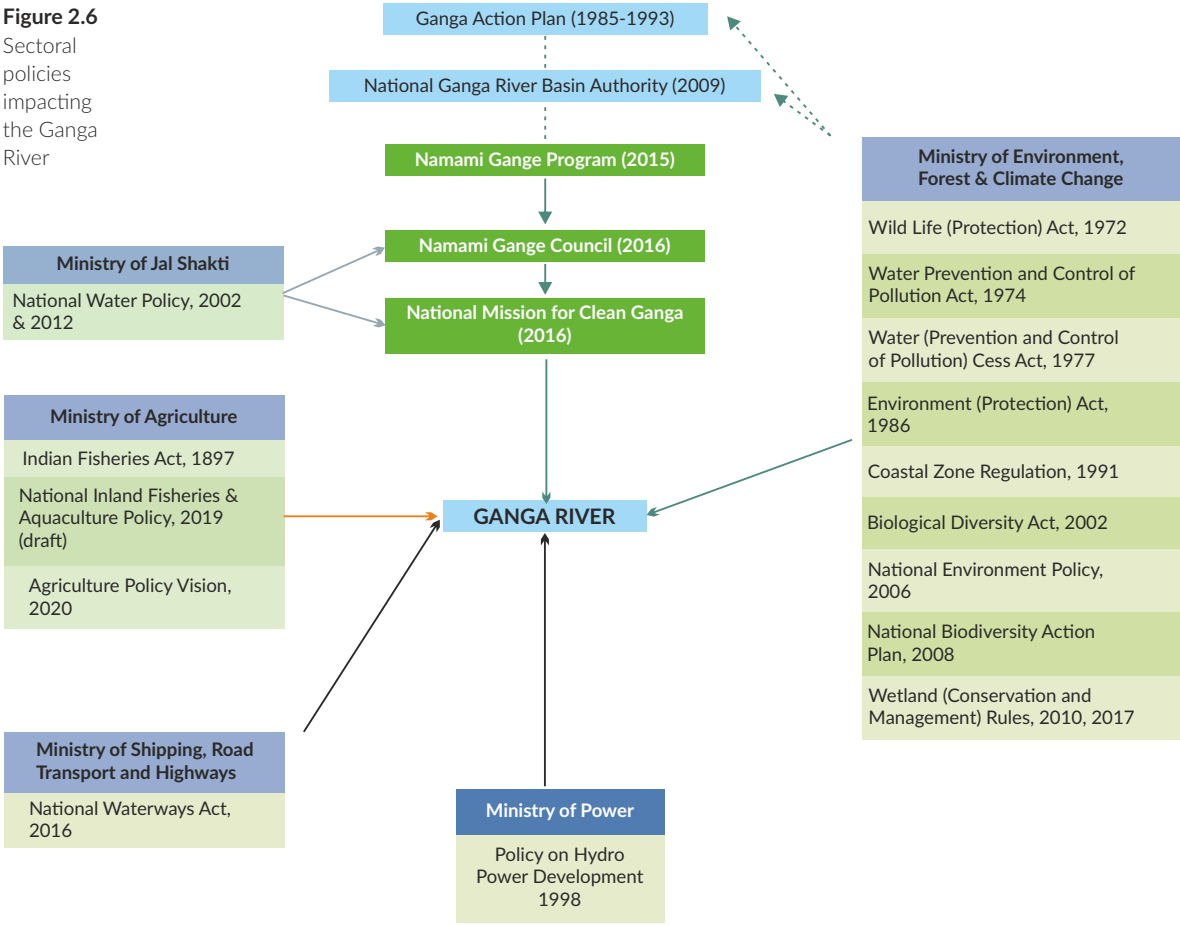


11 Being a dynamic river system, the Ganga has far-reaching impacts on the lives of people, who are either affecting or getting affected by any decision concerning the management of the river. Thus, community engagement and stakeholder involvement is critical, particularly in areas with high anthropogenic influence in the form of built-up or agricultural areas. Restoration in these areas should focus on enhancing riparian cover and stricter regulations on fishing and sand mining, and community involvement. Technological interventions for enhancing crop productivity without increasing agricultural area or water use should be emphasized (Annexure 2.1 & 2.3).

12 Indian policies applicable to rivers are scattered among various government sectors. The policies of these sectors are contradictory and contextualized around different disciplinary settings, which are a barrier to Ganga conservation (Hussain et al., 2020). Addressing these policy issues require a shared understanding of key concepts of river conservation to facilitate conservation planning (Figure 2.6) (Annexures 2.4 & 2.5).



Figure 2.6
Sectoral
policies
impacting
the Ganga
River



13 Rivers, an integral part of faunal habitats, are not represented in the national database of PAs and are protected incidentally only when they flow inside terrestrial PAs, with a few exceptions. This lack of representativeness of riverine ecosystems in the PA network has also led to a mismatch between the degree of protection accorded to species and its habitat that serves as a roadblock for protecting the species (Hussain et al., 2020) (Table 2.1) (Annexures 2.4 & 2.5).

14 Recognising the need for habitat protection in the mainstem Ganga River, a 140 km stretch downstream of Newada in Prayagraj district to Adalpur in Mirzapur district, was proposed as a priority stretch for aquatic wildlife conservation under the purview of the Wild Life (Protection) Act, 1972, which is presently under consideration.

Table 2.1 Protection status of the species and their range along the Ganga River

Species	Common name	Protection status		Extent of habitat in the Ganga (Km)	Habitat protected (%)
		IUCN Red List	IWPA Schedule		
<i>Platanista gangetica</i>	Gangetic dolphin	EN	I	137	7.0
<i>Lutrogale perspicillata</i>	Smooth-coated otter	VU	II	187	8.9
<i>Aonyx cinereus</i>	Eurasian otter	VU	I	109.5	9.3
<i>Lutra lutra</i>	Smalle clawed otter	NT	II	18	8.0
<i>Gavialis gangeticus</i>	Gharial	CE	I	137	8.1
<i>Crocodylus palustris</i>	Marsh crocodile/Mugger	VU	I	137	5.8
<i>Rynchops albicollis</i>	Indian skimmer	VU	NL	137	9.4

EN - Endangered; VU - Vulnerable; NT - Near Threatened; CR - Critically Endangered; NL - Not Listed

15 Umbrella species-based conservation approach is effective in landscape level conservation and it garners support from different stakeholders as most of these species have established their significance. Thus, an action plan for the Gangetic dolphin conservation was prepared for 2020-2030 focusing on the recovery of the species and conservation of its habitat (Annexure 3.2). Seven thematic areas such as species and habitat, public awareness and training, research and monitoring, policy and legislation, promotion of conservation, community engagement, and long-term financing were identified as action targets; and nine target objectives were formulated for a ten year period (2020-2030).

16 A pilot scale 'Wetlands and Water Conservation Programme' was undertaken to restore eight select wetlands and urban water bodies with high ecological, social and cultural significance, in the water stressed districts of Sambhal, Bulandshahr, Hardoi and Varanasi in Uttar Pradesh, Vaishali and Bhagalpur in Bihar, and Hooghly in West Bengal, through community involvement and low cost investment.

17 178 Ganga Praharis, 248 local volunteers, 492 school and college students, five temple priests and nine teachers actively participated in the wetland restoration process through cleanliness drives, awareness campaigns, rallies and drawing competitions (Figure 2.7) (Annexure 2.11).

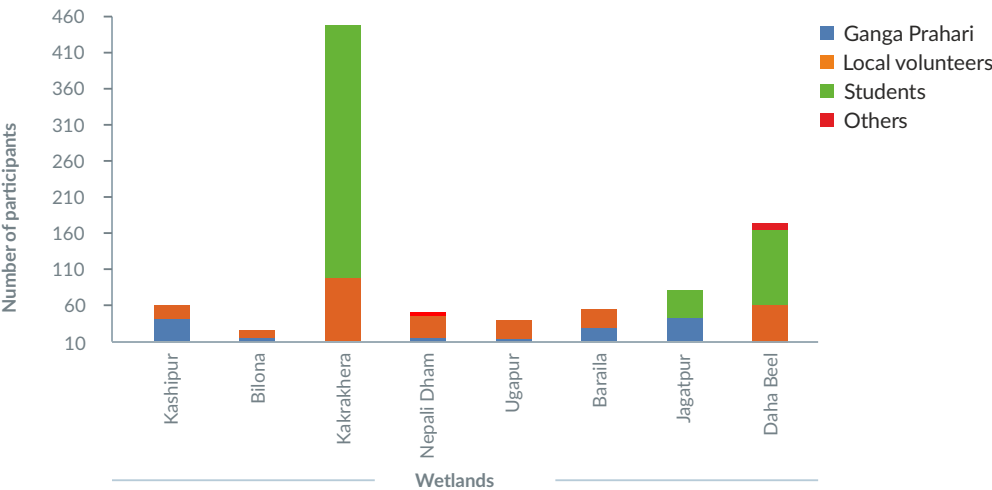


Figure 2.7 Local community member's participation in the restoration of the wetlands along the Ganga River

18 GACMC, as a centralized knowledge repository, is disseminating information through both print and digital media. Print media includes books, brochures and booklets published under the "Vibrant Ganga series" (Annexures 2.6 to 2.10), while the digital media includes webpages, social media (Facebook and Instagram), television and radio channels at local, regional and national levels. The Centre is also providing scientific and timely support to the Ministry of Jal Shakti, NMCG, SPMGs and Forest Departments in evidence-based decision-making for Ganga River conservation.

19 A mobile application called "Ganga Data Collector" was developed for ease of data collection. Data includes habitat information, water parameters, socio-economic characteristics and species-specific information. The application is being used by WII researchers and trained Ganga Praharis for ecological data collection at the basin scale (Annexure 2.12).

Ganga Praharis and local community volunteers restoring the Kashipur wetland in Bulandshahar, Uttar Pradesh



Outcomes

1. GACMC is established at WII, Dehra Dun, as a centralized knowledge repository and nodal agency for policy support on biodiversity and Ganga River conservation.
2. A team of 65 trained and experienced project personnel are conducting ecological assessments, ensuring community participation and supporting NMCG and Ministry of Jal Shakti in Parliamentary queries, RTI questions, and other legal queries on issues concerning the Ganga River and its biodiversity.
3. GACMC is providing institutional support to the line agencies and other stakeholders, NMCG, SPMG, NPCIL, NGOs, Forest Departments, Ganga Vichar Manch, Ganga Task Force, universities, colleges and schools.
4. Extensive information on the Ganga River and its biodiversity has been consolidated for the first time and is available on digital platform for easy access and dissemination.
5. The resources are extensively referred in various platforms of NMCG, Forest Departments, universities, colleges and schools for scientific study and awareness.
6. In a first-of-its-kind approach, GACMC adopted systematic conservation planning for the Ganga River, where ecological surveys were carried out with state-of-the-art scientific tools and techniques such as laser-based distance measurement units for channel width determination, sonar-based channel depth estimation, Doppler-based river flow determination, GPS and GIS technology in combination with the local knowledge of the riverside communities.



7. Numerical algorithm was created with the field information to assess the ecological condition of the Ganga River, and in turn, conservation priority zones were identified as first step towards systematic conservation planning and as a decision support tool for various stakeholders such as NMCG, Ministry of Jal Shakti and Forest Departments.
8. The Government of Uttar Pradesh recognised the importance of habitat protection, and among the priority zones (WII-GACMC, 2018), recommended a 40 km stretch of the Ganga in Uttar Pradesh for inclusion in the PA network.
9. Based on the recommendations in the Action Plan for Gangetic dolphin, 'Project River Dolphin' is being proposed to the Ministry of Environment, Forest and Climate Change to ensure long-term survival of the species and conservation of its habitat.
10. The pilot Water and Wetland programme was established as a local level, cost effective, sustainable and rapid model for restoration of wetlands. The model demonstrated that active participation of local community in the conservation process can ensure sustainable solution to water security in the country.
11. The systematic approach of 'Biodiversity Conservation and Ganga Rejuvenation' project has been recognized as a successful model for river conservation and a basin-scale project 'Planning and Management for Aquatic Species Conservation and Maintenance of Ecosystem Services in the Ganga River Basin for a Clean Ganga' is being entrusted to WII for a five year period. The project has been initiated with ecological surveys in the Ganga River and its major tributaries.
12. The National River Conservation Directorate (NRCD) also recognised the effectiveness of the river conservation approach adopted by WII and has entrusted it with a project dealing with biodiversity conservation of Indian rivers.



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BIODIVERSITY PROFILE OF GANGA RIVER

03

3.1 Introduction

The Ganga River drains an area of approximately 10,87,300 km² in India and Nepal. Over the past few decades, rapid human population growth in the Ganga basin has resulted in an increase in energy and water demand, agricultural development, urbanization and industrialization, with extensive use of water for irrigation, industry and public supply. Construction of dams, barrages and run-of-the-river hydropower projects have altered the physical habitat, impaired habitat connectivity, reduced flow and fragmented population of aquatic species. Stretches of the Ganga River are polluted with macro- and micro-plastics, sewage, untreated industrial discharge, persistent pollutants from industrial and agricultural sources, and nutrient-rich runoff from agricultural fields. Furthermore, the climate change scenario models forecast melting headwater glaciers and changes in rainfall patterns, which would pose serious threats to the availability of river water throughout the year, as well as alter drought and flooding regimes. Riverine impoundments and reservoir-induced habitat fragmentation impede natural migration of aquatic fauna, particularly fishes,



which results in spatially isolated populations and probable genetic fragmentation. The persistent pollutants bioaccumulate along the food chain and manifest in hormonal disruptions.

The health condition of rivers can easily be inferred based on the abundance of aquatic life in and around river stretches, as higher diversity of species indicates presence of good habitat conditions and minimal human interferences, and good health and well-being of the aquatic ecosystem. In this regard, indicator species or communities have been used globally for monitoring the health of an aquatic ecosystem (McDonough et al., 2012). Species profiling of an ecosystem, thus, is a crucial part of systematic conservation planning, which allows for identification of: 1) species needing targeted conservation efforts, 2) areas with good ecological health and 3) areas that need restorative measures. In addition, assessment of genetic connectivity and diversity, and eco-toxicological studies of select indicator species can provide vital insights into the river habitat conditions and pinpoint root-causes. The findings of the genetic assessment and eco-toxicological implications are presented in Chapters 4 and 5, respectively.

In order to restore the ecological integrity of an aquatic ecosystem, it is essential to have the knowledge of species occurrence, distribution and habitat characteristics, which will help in identifying specific stretches with suitable condition for restoration, and continuous monitoring. A successful river restoration project therefore, should be based on ecological character, which is a combination of its geomorphic, hydrological and biological aspects, and provide a means of verification to evaluate effectiveness of conservation intervention (Rosenberg and Resh, 1996). The second component of the project aimed to derive the state of biodiversity in Ganga River and prepare species specific restoration plans.

2.2 Objectives

1. Derive the empirical relationships between river conditions and ecological status of the major species so as to determine the desired future state.
2. Derive the current trend in genetic variability and gene flow of the critically endangered and endangered species, which might have been disrupted due to fragmentation of the longitudinal connectivity of the river (Chapter 4).
3. Assess the concentration of key pollutants in species of conservation significance that may affect their long-term survival (Chapter 5).
4. Map the areas of high species diversity in GIS domain where natural regeneration of wildlife population can be augmented,
5. Identify indicator species/communities that could be used for monitoring the ecological health of the Ganga River.
6. Develop an aquatic species restoration plan and demonstrate species restoration in a selected stretch of Ganga.

2.3 Methodology

A reconnaissance survey was carried out during pre-monsoon 2017, from Devprayag to Nurgpur, to assess the biodiversity, habitat conditions and anthropogenic activities. Based on geomorphology, habitat condition, water availability and physical properties of water, the entire study stretch was categorized into six habitat zones (Table 3.1). Thirty two intensive monitoring sites were selected as representative of six habitat zones. Information was collected on biodiversity parameters — aquatic plant diversity, occurrence and diversity of invertebrates, fishes, turtles, crocodilians, water and water associated birds, otters and Gangetic dolphin; and habitat conditions — bank features and water quality. Standard monitoring protocols were developed for different taxa. Biodiversity profile of the Ganga River was created, which included aquatic plants, invertebrate taxa and higher vertebrate taxa. Based on the condition of the habitat, species occurrence and distribution, strategic locations were identified to formulate restoration plans for species of conservation concern.

Table 3.1
Habitat Zones
identified in the
Ganga River

S. No.	Habitat Zones	Length of the zone	From-to
1.	HZ 1	310	Gangotri - Haridwar
2.	HZ 2	235	Haridwar - Narora
3.	HZ 3	320	Narora - Kanpur
4.	HZ 4	445	Kanpur - Varanasi
5.	HZ 5	685	Varanasi - Farakka
6.	HZ 6	530	Farakka - Ganga Sagar

3.4 Key findings

- 1 A total of 289 plant species were recorded from the six habitat zones. Among them, 56% were terrestrial and aquatic herbaceous plants. Of the 289 plant species, 56% were herbs, 21% trees, 10% shrubs, 7% grasses, reeds and sedges, and 6% climbers were recorded. 67% of the plant species were native and remaining 33% were exotic, with tropical American and tropical African origin. Highest numbers of exotic species were observed in HZ 4 and HZ 5, followed by HZ 3 (Figure 3.1). Exotic and invasive species dominated (more than 50%) in disturbed areas near Kanpur, Prayagraj, Jiaganj and Ballia in Uttar Pradesh, Kahalgaon in Jharkhand, and Haldia in West Bengal. Plant species richness and diversity were highest in HZ 1, followed by HZ 6 (Figure 3.2) (Annexure 3.1).



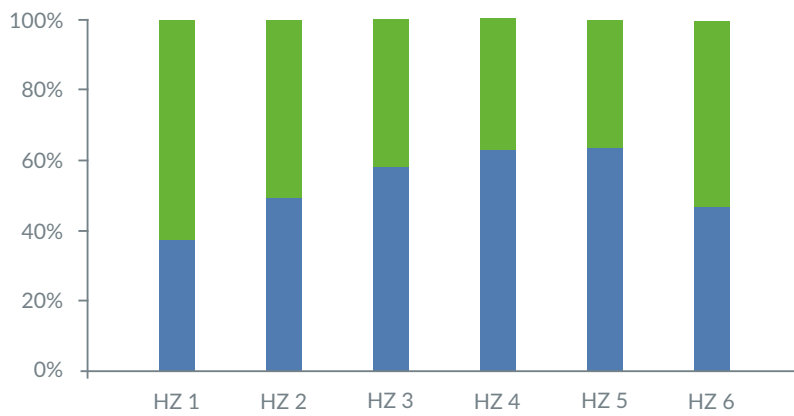


Figure 3.1
Percentage contribution of native and exotic species in each habitat zone

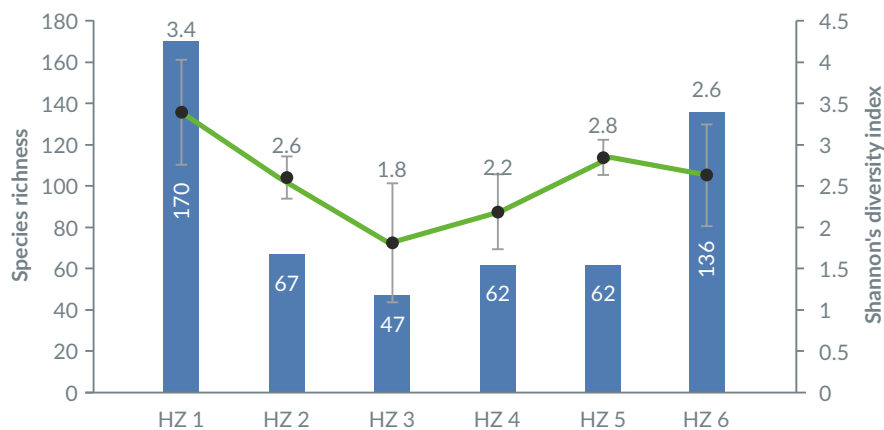
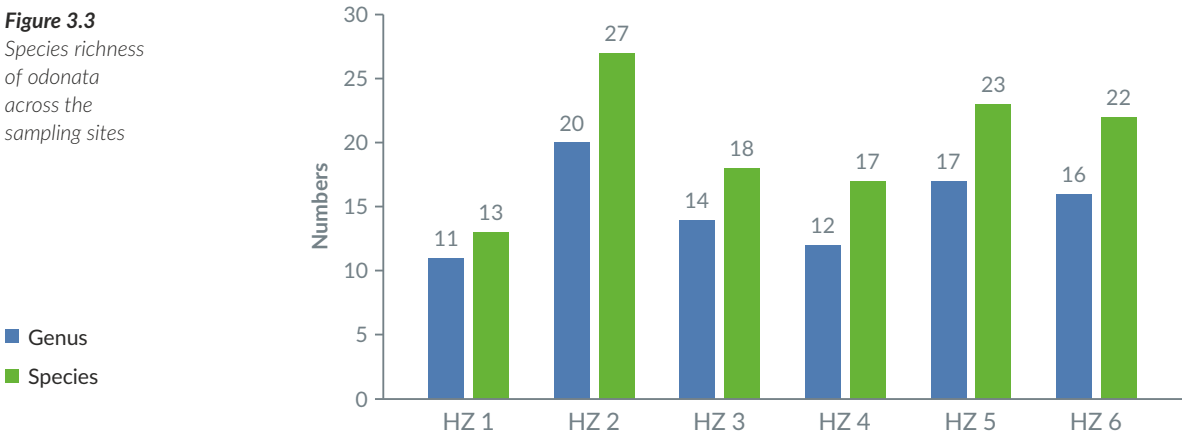


Figure 3.2 Species diversity and richness of the river bank vegetation

2 Odonata (dragonflies and damselflies) were identified as indicator species of the aquatic ecosystem. 37 species of odonates were recorded from the study area, which was higher than previous records. Off these, 16 species are listed under the RET category of the IUCN redlist, which calls for conservation

action through research and awareness dissemination. The richness and diversity of aquatic invertebrate species was highest in HZ 2 followed by HZ 5, 3 and 4 (Figure 3.3). The species diversity and richness was governed by water quality parameters, such as pH, total dissolved solid, conductivity and salinity (Annexure 3.1).

Figure 3.3
Species richness
of odonata
across the
sampling sites



3 A total of 125 fish species were recorded across 32 intensive monitoring sites along the Ganga River. Among them, eight species were exotic. The distribution of golden mahseer (*Tor putitora*) was restricted between Harshil and Haridwar, while hilsa (*Tenulosa ilisha*) was only recorded below Farraka barrage (Annexure 3.1). Maximum species richness was recorded from HZ 2, which is higher than the previous records (Figure 3.4).

4 *Leiodon cutcutia* was recorded upstream of Bijnor barrage, which is a new distribution range of the species.

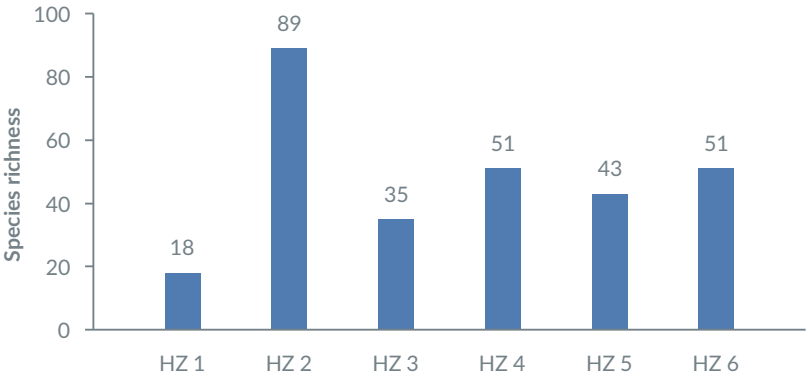


Figure 3.4 Species richness of fishes across the sampling sites



5 A total of 10 species of amphibians (frogs) and 20 species of reptiles (snakes and lizards) were recorded from the study sites. *Microhyla nilphamariensis* was reported for the first time from the Ganga River.

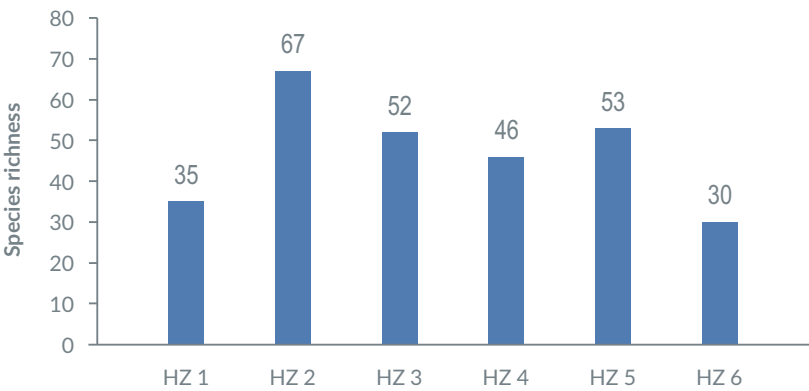
7 Among the 13 species of turtles reported from the Ganga River, 11 species were sighted in the survey area. Distribution of turtles was mostly restricted to HZ 2, 3 and 4 within Uttar Pradesh. Brown-roofed turtle (*Pangshura smithii*) was the dominant species. Highest species richness was observed in HZ 2.

6 Common Asian toad (*Duttaphrynus melanostictus*), skittering frog (*Euphlyctis cyanophlyctis*), and cricket frog (*Fejervarya* sp.) were found throughout the study sites. Highest richness of herpetofauna was observed in HZ 2. Species richness was relatively low in HZ 4 and 5 (Annexure 3.1).



8 A total of 86 species of waterbirds were recorded across 32 survey sites along the Ganga River, with high levels of divergence in waterbirds composition along the upper, middle and lower stretches. HZ 2 had highest waterbird species richness followed by HZ 5 and HZ 3 (Figure 3.5) (Annexure 3.1).

Figure 3.5
Species richness of waterbirds across the sampling sites



9 Gangetic dolphin sightings were highly clustered and followed clumped distribution. Of the 32 monitoring sites, Gangetic dolphins were sighted in 11 and 12 sites during both pre and post monsoon surveys, respectively. Gangetic dolphin occurrence was found to be positively influenced by dissolved oxygen and channel depth, and was negatively influenced by fishing and human activities. Dolphins were encountered in HZ 2, 5 and 6 during 2017 and 2018, with higher encounter rates for HZ 5 and 6 (Figure 3.6) (Annexure 3.1).

10 HZ 2 marks the ecotone between two biogeographic Zones viz., the Himalaya (2B) and the Gangetic Plain (7A), and thereby exhibits pronounced edge effect. The zone is a 235 km stretch from Haridwar to Narora and encompasses the Hastinapur Wildlife Sanctuary and Upper Ganga Ramsar site. Being a landscape level ecotone and part of a Protected Area, the zone exhibits unique biotic assemblage, high biodiversity and species richness (Annexure 3.1). Recognizing the high ecological value, a stretch from Balawali to Makdumpur Khadar (150 km) within HZ 2, is designated as Conservation Priority Zone (CPZ 1) for focused conservation action (Annexure 1.3).

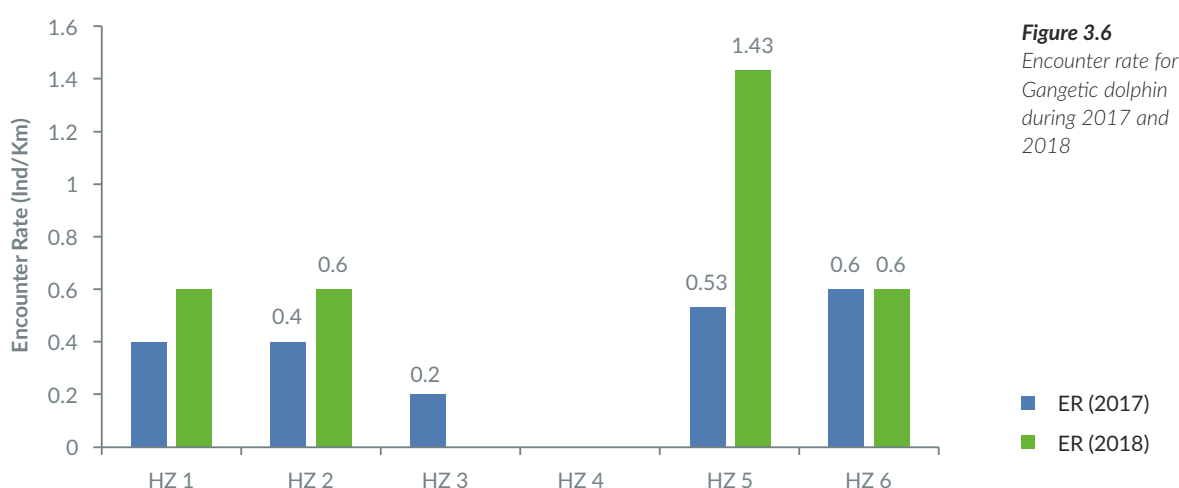


Figure 3.6
Encounter rate for
Gangetic dolphin
during 2017 and
2018

11 The information on the biodiversity and habitat characteristics was consolidated, and restoration plans for species of conservation concern such as golden mahseer, Indian skimmer, sarus crane and Gangetic dolphin were developed (Annexure 3.4).

3.5 Outcomes

- 32 intensive monitoring sites were established along the mainstem Ganga River and relationship of abundance of species of conservation significance with current habitat conditions was derived.
- These sites will act as long term monitoring sites to detect temporal alterations in the ecological status of the river stretches in a cost effective manner.
- Based on the species sensitivity towards habitat quality and disturbance, indicator insect (Odonate) and fish species were identified. The standardized monitoring protocols of the indicator species were published, which will aid in adopting uniform survey methodology across the rivers in India.
- On the basis of ecology and habitat requirements of species of conservation concern, ecological restoration plans were prepared. The restoration plans will aid in systematic conservation planning in the designated CPZs.



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CONSERVATION GENETICS OF SPECIES OF CONSERVATION CONCERN

04

4.1 Introduction

The Ganga River nurtures rich aquatic fauna represented by 190 fish species (ICAR-CIFRI, 2019), 13 species of freshwater turtles, 90 species of amphibians, three species of otters, Gangetic dolphin (*P. g. gangetica*), gharial (*Gavialis gangeticus*) and mugger (*Crocodylus palustris*). Rapidly increasing human population, reduction in water levels, water pollution, and construction of dams significantly affected habitat quality, abundance, and distribution of aquatic fauna (Lakra et al., 2010; Gupta et al., 2014). The dams and barrages, in particular, have reduced the flow regime of the river and have restricted movement of the aquatic species. The restricted movement of species is known to result into isolated sub-populations, which are genetically less diverse. Degradation of genetic diversity through physical isolation reduces the adaptive potential, and increases chances of inbreeding, which poses the risk of extinction of the species (Keller et al., 2002).

Dams and barrages along the Ganga are known to have restricted the movement of the aquatic species, but little is known about the impact of these barriers on genetic diversity of key aquatic species. There



have been very few scientific efforts with almost no baseline information on the genetic status of threatened/endangered aquatic species of Ganga River, which is essential for developing a science-based conservation and management strategy for species inhabiting fragmented habitats. Therefore, a study on genetic variability of aquatic species inhabiting the Ganga River was essential to identify the fitness of individuals. Thus gene flow pattern of four fish species, four turtle species and Gangetic dolphin was assessed.

4.2

Objective

1. Derive the current trend in genetic variability and gene flow of the critically endangered and endangered species, which might have been disrupted due to fragmentation of the longitudinal connectivity of the river.

4.3

Methodology

A reconnaissance survey was carried out during pre-monsoon 2017, from Devprayag to Nurpur, to assess the biodiversity, habitat conditions and anthropogenic activities. Based on geomorphology, habitat conditions, water availability and physical properties of water, the entire study stretch was categorized into six habitat zones (Table 4.1). Thirty two intensive monitoring sites were selected as representative of those six habitat zones. To access the genetic variability and gene flow pattern in these intensive monitoring sites biological samples were collected from four fish species, four turtle species, and Gangetic dolphins. It was perceived that the longitudinal connectivity of species of conservation concern has been disrupted due to these dams and barrages, which in turn might have affected the genetic structure. In this regard, the golden mahseer was taken as indicator species for HZ 1 and HZ 2. For Middle to Lower Ganga (HZ 3 to HZ 6), gene flow pattern and genetic status of Gangetic dolphin, three fish species (giant river catfish - *Spereta seenghala*, long-whiskered catfish - *Spereta aor*, goonch - *Bagarius bagarius*), and four turtle species (Indian flap shell turtle - *Lissemys punctata andersonii*, Indian

softshell turtle - *Nilssononia gangetica*, brown roofed turtle - *Pangshura smithii*, and spotted pond turtle - *Geoclemys hamiltonii*) were evaluated (Annexure 4.1).

Assessment of mitochondrial DNA region and Nuclear DNA (microsatellites) was carried out using state-of-the-art tools and techniques (Arif and Khan, 2009). The whole genomic DNA were extracted,

amplified and sequenced with their respective primers available for related species/family with Polymerase Chain Reaction. Genetic variations, gene flow pattern, population genetic structure and demographic pattern were derived and analysed using different statistical approaches.

Table 4.1
Habitat Zones
identified in the
Ganga River

S. No.	Habitat Zones	Length of the zone	From - to
1.	HZ 1	310	Gangotri - Haridwar
2.	HZ 2	235	Haridwar - Narora
3.	HZ 3	320	Narora - Kanpur
4.	HZ 4	445	Kanpur - Varanasi
5.	HZ 5	685	Varanasi - Farakka
6.	HZ 6	530	Farakka - Ganga Sagar

4.4 Key findings

- 1

The gene flow of Gangetic dolphin, turtle species such as brown roofed turtle, goonch, giant river catfish and long whisker catfish is maintained along the river, despite connectivity barriers, due to monsoonal high flows.
- 2

Moderate level of genetic diversity and gene flow were found in the samples of Gangetic dolphin along the mainstem Ganga River.
- 3

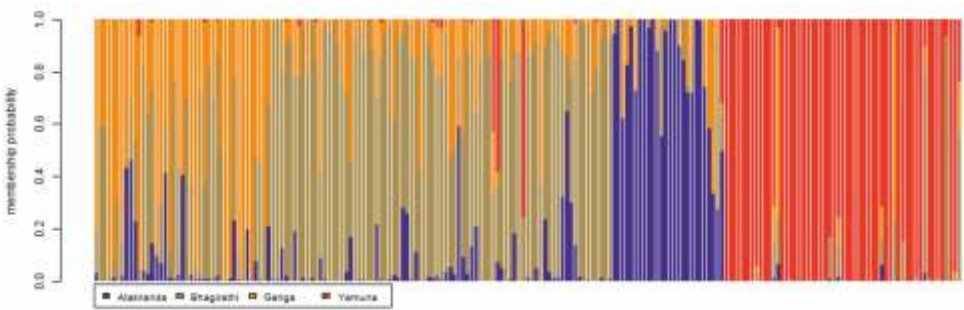
Presence of low gene diversity in Indian flapshell turtle and moderate diversity in Brown roofed turtle, Indian softshell turtle, and spotted pond turtle require species-specific in situ conservation measures.
- 4

The Tehri dam allows unidirectional migration of Golden mahaseer from Bhagirathi to Ganga River, and thus, Bhagirathi and Ganga rivers share a common gene pool of Golden mahaseer.
- 5

Srinagar dam on Alaknanda River acts as a barrier for upstream as well as downstream migration of Golden mahseer, resulting in a different gene pool in Alaknanda from the populations of Bhagirathi and Ganga rivers (Figure 4.1) (Yadav et al. 2020).
- 6

Restoring the connectivity with the Bhagirathi River would contribute to a diverse and healthier population of Golden mahseer. Further steps are needed to restore and protect the species in its native habitat, including breeding grounds such as Nayar River, through community-based conservation measures (Yadav et al. 2020).

Figure 4.1 Results of bar plot implemented in Discriminant Analysis of Principal Components (DAPC) showing structuring pattern in golden mahseer (Yadav et al. 2020).



7

High genetic variability and gene flow was observed in giant river catfish and long whisker catfish. The gene pool of both these catfishes in Ganga River is unique and is different from the Mahanadi and Brahmaputra populations (Figure 4.2).

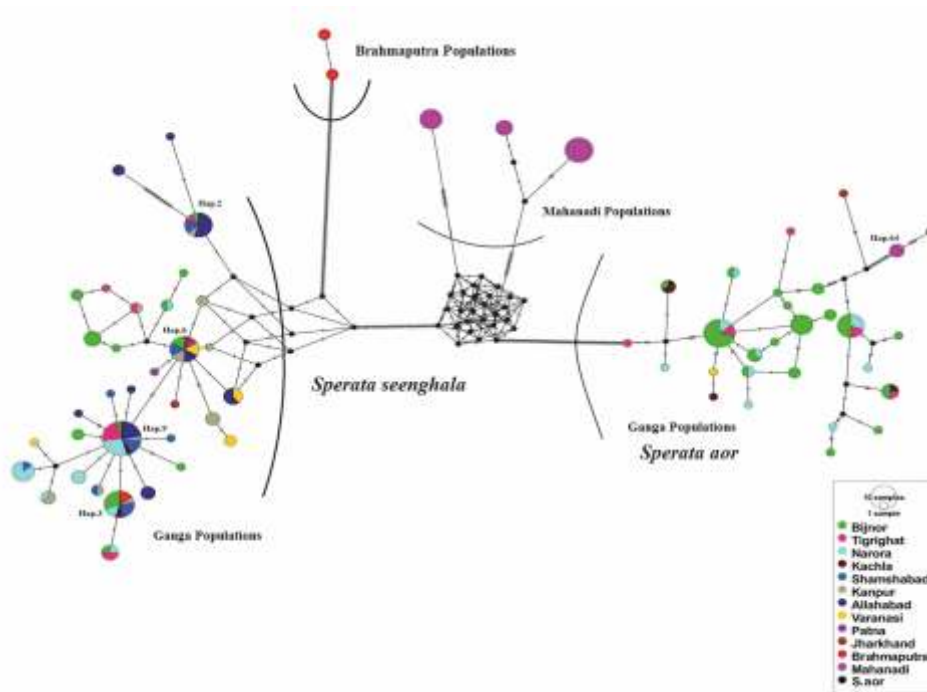


Figure 4.2
Genetic network of *Sperata* species indicates the presence of a distinct genetic cluster and a different gene pool in Ganga River

8

High genetic variability and gene flow was observed in goonch, which confirms that the gene flow is maintained throughout the Ganga River.

4.5

Outcomes

1. Genetic status and genetic diversity of select umbrella species was derived for the first time in the Ganga River, and extent of gene flow between different populations separated by barriers was established.
2. The information is crucial in strategizing dam and barrage operation to maintain connectivity during the monsoonal high flow months.
3. The information will also aid in formulating strategies to increase the lateral and longitudinal connectivity through flow augmentation, operation of existing fish ladders, and protection and increased accessibility of breeding grounds of species such as Golden mahseer.
4. The genetic databank of select species will be useful in stock identification, and molecular tracking of seizures from illegal trade.
5. The databank will create a baseline for decision support for species reintroduction and release of rescued animals in the Ganga River.
6. The information of genepool of species of conservation concern will aid in systematic conservation planning for the Ganga River.
7. Standard genetic monitoring protocols were developed for different taxa and sampling will be extended to the entire Ganga basin.



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ECOTOXICOLOGICAL STUDY OF GANGA AND ITS ENVIRONMENT

05

5.1 Introduction

The Ganga River in its course traverses through diverse geo-climatic zones and accumulates chemicals of natural and anthropogenic origins. Rivers generally have assimilation and self-rejuvenating capacity through fluvial processes of microbial degeneration, dilution, sequestration and sedimentation. The cumulative impact of burgeoning multiple resource use, land use change and discharges from various point and non-point sources are often beyond the carrying capacity of the river. The water quality of the Ganga River in and around major human settlements and industrial clusters, in terms of organic load and persistent pollutants (pesticides and heavy metals), is a matter of increasing concern.

The organochlorines pesticides (OCPs) such as DDT, HCH and Aldrin, and organophosphorous pesticides (OPPs) such as Methyl parathion and Chlorpyrifos, constitute 40% and 30% of the total insecticides that are used in agricultural sectors, annually. The pesticides and heavy metals from agricultural and industrial origins contaminate the river water through surface runoffs and effluent discharge. These



chemicals are highly toxic even in low concentrations, are persistent in the environment, can accumulate in animal tissue and affect the physiology, hormonal balance and breeding of aquatic wildlife, and cause health hazard to humans. Bioaccumulation of pesticides and heavy metals in fishes and Gangetic dolphin in the Ganga River has been reported earlier. The slow, steady and long-term exposure and bioaccumulation of these contaminants could bring about gradual and striking changes, such as decline in biodiversity, over an extended period of time. Therefore, it is imperative to assess the concentration, distribution and bioaccumulation path of these toxic compounds to identify eco-toxicological risk zones and potential human health hazard.

5.3 Methodology

On the basis of geology, hydrology, land use, wastewater discharge, demography and pesticide use, the Ganga River was demarcated into five zones, as follows.

1. Upper Zone (UZ): Uttarakhand

5.2

Objectives

1. To quantify the current status and spatial-temporal distribution pattern of select contaminants (pesticides, heavy metals, polychlorinated biphenyls and microplastics).
2. To evaluate the potential eco-toxicological risks posed by each target contaminant towards aquatic organisms in Ganga River.

2. Upper Middle Zone 1 (UMZ1): Balawali in district Bijnor to Yamuna confluence at Prayagraj, Uttar Pradesh
3. Upper Middle Zone 2 (UMZ2): Downstream Yamuna confluence to Gehmar in district Ballia, Uttar Pradesh
4. Lower Middle Zone (LMZ): Bihar and Jharkhand
5. Lower Zone (LZ): West Bengal

43 representative sampling sites were selected on the basis of presence/absence of agricultural and industrial belts, wastewater discharge points, and the existing monitoring stations prescribed by the Central Pollution Control Board (CPCB), India. The samples were collected during post-monsoon (October to November 2017) and post-winter (April to May 2018). The sampling sites were selected on the basis of secondary information on high historic usage, high toxicity, detection frequency, and CPCB directive. 23 pesticides (20 OCPs and 3 OPPs), nine heavy metals, 11 eleven polychlorinated biphenyls (PCBs) and microplastics were investigated.

Physio-chemical water quality parameters viz., pH, Dissolved oxygen (DO), Total dissolved solids (TDS), Conductivity, Nitrate and Ammonium were evaluated on site using calibrated digital probe meters. In total, 150 water, 150 sediment, and 160 fish samples were collected in each season to quantify the pesticides, heavy metals. Polychlorinated biphenyls were assessed in sediment samples for both the seasons and microplastics were quantified in sediment sample collected from post-monsoon season. The selected parameters were analysed in laboratory using standard protocols. The toxicological risk to aquatic species due to pesticides and heavy metals was assessed based on the risk quotient approach, and the pollutants and river stretches were categorised as high, medium, low, and negligible ecological risk.



5.4

Key findings

A.

Status of physio-chemical water quality

- 1 Significant seasonal and spatial variations were observed in the water quality parameters of the Ganga River, which demonstrates spatio-temporal variations of wastewater inflow, agricultural runoffs, flow regime and geo-physical characteristics (Annexure 5.1).
- 2 The water quality parameters from Bijnor to Narora (175 km) in Uttar Pradesh were within permissible range and species of conservation significance such as Gangetic dolphin, Smooth coated otter, Indian skimmer, gharial, and turtles were sighted.

B.

Status of pesticides

- 1 The concentration of OCPs were higher in the post-monsoon season than those in post-winter season, in both water and sediment (Figures 5.1 & 5.2). This could be explained by the high atmospheric precipitation and subsequently higher agricultural surface run-off in monsoon season, which facilitates the entry of pesticides to nearby waterbodies.
- 2 In surface water, the total OCPs concentration ranged from 0.028 to 16.228 µg/L in post-monsoon and 0.018 to 12.464 µg/L in post-winter. In sediments, the total OCPs concentration ranged from 2.753 to 703.413 µg/kg in post-monsoon and 0.726 to 57.979 µg/kg in post-winter.
- 3 H-CHLs (Heptachlors) and HCHs (Hexachlorocyclohexanes) were the dominating groups. Presence of fresh inputs of DDT in UZ, HCH (including Lindane) and Chlordane in all the zones, and Endosulfan in the LZ and parts of the middle zone indicate current use of those banned pesticides.
- 4 LZ was the most contaminated zone followed by UMZ. LMZ was the least contaminated zone.
- 5 The total OPPs concentration in water samples ranged from 0.007 to 3.238 µg/L in post-monsoon and below detection limits (BDL) to 1.523 µg/L in post-winter. In

6 Chlorpyrifos and Malathion were predominant in all the zones for both seasons.

Figure 5.1 Zone-wise seasonal pollution gradient of pesticides in water



3 For both the matrices, LZ is identified as the most contaminated zone followed by UMZ. The high levels of a few heavy metals recorded, in sediment samples, in the relatively pristine UZ could be attributed to geochemical cycling, and dispersion of rocks and soils in upper Bhagirathi and Alaknanda catchment.

Figure 5.3 Zone-wise seasonal pollution gradient of heavy metals in water

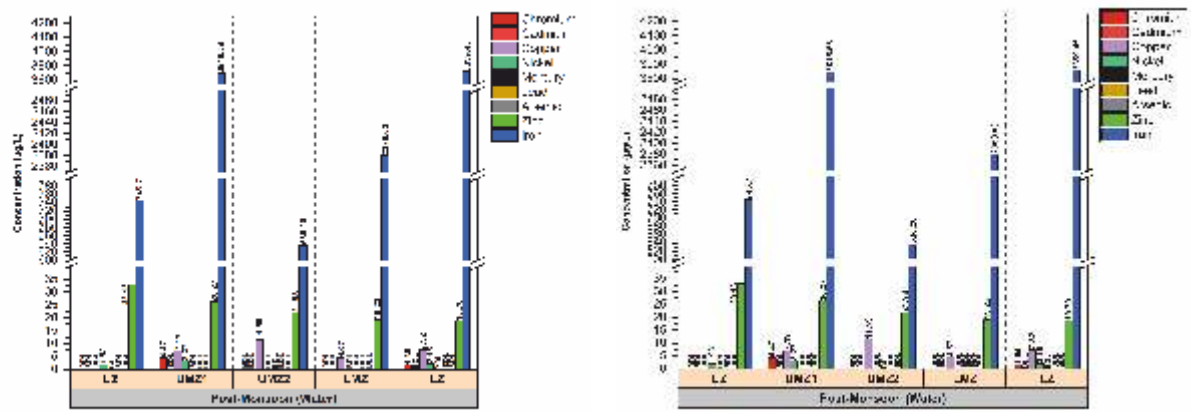
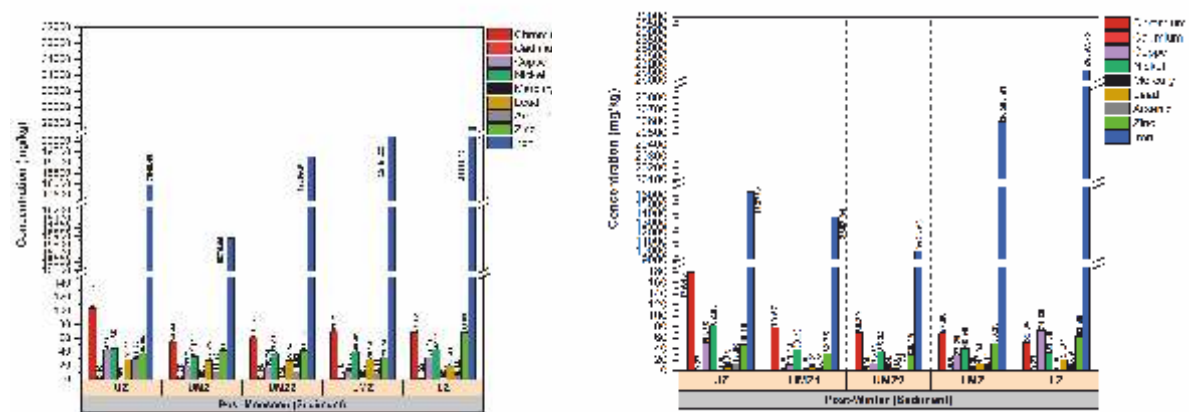


Figure 5.4 Zone-wise seasonal pollution gradient of heavy metals in sediments



D. Status of polychlorinated biphenyls (PCBs) in sediment

1 The PCBs concentration ranged from BDL to 71.49 ng/g in post monsoon and BDL to 84.76 ng/g in post winter. LMZ had highest contamination in post-monsoon while UMZ2 was most contaminated in post-winter. Sitewise, Mokama upstream in Bihar had highest PCB contamination in post-monsoon and Mirzapur in Uttar Pradesh showed maximum PCB contamination in post-winter.

2 PCB 126, considered as the most toxic PCB congener, was dominant in post monsoon. In the post-winter season, PCB 28 and PCB 52 were dominant.

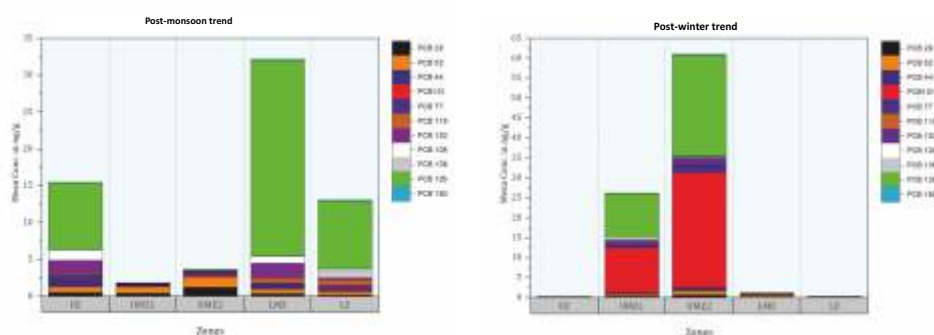


Figure 5.5
Zone-wise
seasonal pollution
gradient of PCBs in
sediments

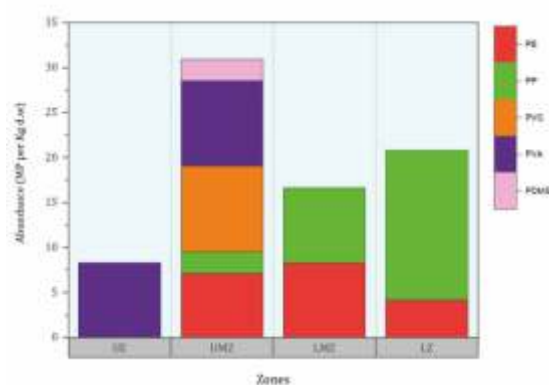


Figure 5.6
Zone-wise
abundance of
microplastics in
sediments

E. Status of Microplastics in sediment

- 62% of the sediment samples from the Ganga contained microplastics. Polypropylene was the most abundant polymer type followed by polyethylene and polyvinyl aldehyde. Highest abundance for microplastics was recorded from MZ and lowest in UZ.
- The microplastic contamination in sediment from the Ganga River was low as compared to the sediments in other rivers of the world, such as Beijiang River in China, Atoyac River in Central Mexico, and Tame River in United Kingdom.

F. Status of bioaccumulation of pesticides and heavy metals in fishes

- The zone-wise contamination status of pesticides in fish closely followed the contamination pattern observed in water and sediment matrices, indicating fresh inputs and bioavailability of these contaminants.
- High accumulation was observed in carnivorous and bottom-dwelling fish species such as rita (*Rita rita*), bata (*Labeo bata*), in UMZ and LZ.
- OCP concentrations ranged from 2.956 to 356.621 µg/kg in fish tissues. Highest concentration of OCP residues were recorded in rita collected from Tela at Bhadoi in Uttar Pradesh. The lowest concentration of OCP residues were recorded in pocha (*Salmophasia acinaces*) collected from Revalganj in Bihar.
- Highest concentration of total DDT (302.12 µg/kg) was found in tissues of rita from Tela district of Uttar Pradesh. High levels of total HCH was found in Snow trout (*Schizothorax richardsonii*) (33.52 µg/kg) from Harshil in Uttarakhand followed by Hilsa (*Tenulosa ilisha*) (31.53 µg/kg) from Batanagar, West Bengal.
- Heptachlor (H-CHL), Methyl Parathion, p,p'-DDE, Chlorpyrifos, Endrin Ketone, ?-HCH, Aldrin, and ?-HCH were the dominant OCPs detected in the fishes.
- OPPs concentrations ranged from BDL to 39.676 µg/kg in fish tissues. Highest concentration of OPP residues was recorded in hilsa from Jiaganj in West Bengal and lowest concentration of OPP residues was recorded in phasa (*Setipinna phasa*) collected from Revalganj in Bihar.

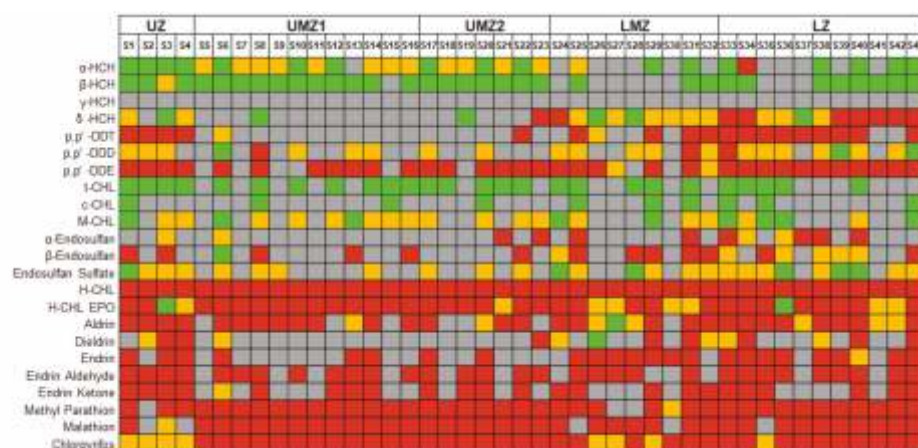
- 7 The total heavy metal concentrations ranged from 4.021 to 201.92 mg/kg. Highest heavy metal residues were recorded in Pocha from Munger in Bihar. Lowest heavy metal residues were recorded in singhara (*Sperata seenghala*) from Bijnor in Uttar Pradesh.
- 8 Mercury (0.205 mg/kg) was recorded in bacha (*Eutropiichthys vacha*) from Fatehpur in Uttar Pradesh.
- 9 High concentration of Lead was recorded in mottled eel (*Anguilla bengalensis*) (0.220 mg/kg), and Singhara (0.180 mg/kg), collected from the heavily industrialised sites of Uttar Pradesh (UMZ).
- 10 High accumulation of Chromium was noted in fishes collected from Uttar Pradesh (UMZ) and Uttarakhand with potential source linked to industries and geogenic depositions, respectively.
- 11 High levels of Arsenic (0.63-1.82 mg/Kg) were found in Hilsa from West Bengal.
- 12 The fish species with highest accumulation of contaminants suggesting risk for bio-magnification in the food-web were Snow trout from UZ(for HCHs, H-CHLs, OPPs, Nickel, and Chromium), Singhara from UMZ (for OCPs, OPPs, Copper, Chromium, and Lead), Hilsa from LZ (for Pesticides and Arsenic), Bata from UMZ (for OCPs, OPPs, Copper, Chromium, Arsenic, and Nickel), Rita from UMZ (for DDTs), and Mottled eel from UMZ (for Copper, and Lead).

E. Ecological Risk

- 1 In UZ, high ecological risk exists due to 7-11 pesticides. In middle zone of Uttar Pradesh, the ecological risk exists due to presence of 11 pesticides. LZ emerged as the zone with highest ecological risk due to contamination at all the sample sites from 6-14 pesticides (Figure 5.7).
- 2 Among pesticides, Drins, Heptachlors, p, p' DDT, p, p' DDE, Methyl Parathion, Malathion, and Chlorpyrifos, and among heavy metals Copper, Iron, Chromium and Lead were identified as contaminants posing higher risks to aquatic biodiversity. Considerable potential ecological risk was observed due to PCB.
- 3 Heavy metals posed low ecological risk in all the zones, except cadmium. Considerable risk was recorded due to cadmium in UZ and LMZ, while moderate risks were recorded in UMZ (Figure 5.8).



Figure 5.7
Site-wise
ecological risk
assessment of
individual OCPs in
water of the
Ganga River



S1- Harshil, S2- Uttarkashi, S3- Dharasu, S4- Rishikesh, S5- Bijnor, S6- Tigri Ghat, S7- Brijghat, S8- Narora, S9- Anoopshahr, S10- Kachla, S11- Samshabad, S12- Kannauj, S13- Kanpur, S14- Jajmau, S15- Fatehpur, S16- Rasoolabad, Prayagraj, S17- Sangam, Prayagraj, S18- Bhadoi, S19- Mirzapur, S20- Raona, Varanasi, S21- Assi Ghat, Varanasi, S22- Ghazipur, S23- Ballia, S24- Sitabdiara, S25- Patna, S26- Simariya Ghat, S27- Tilakpur, S28- Kahalgaon, S29- Munger, S30- Mokama U/S, S31- Mokama D/S, S32- Sahibganj, S33- Farrakka, S34- Jiaganj, S35- Sujapur, S36- Nawadwip, S37- Sukhsagar, S38- Tribeni, S39- Serampore, S40- Garden Reach, S41- Batanagar, S42- Falta, S43- Diamond Harbour

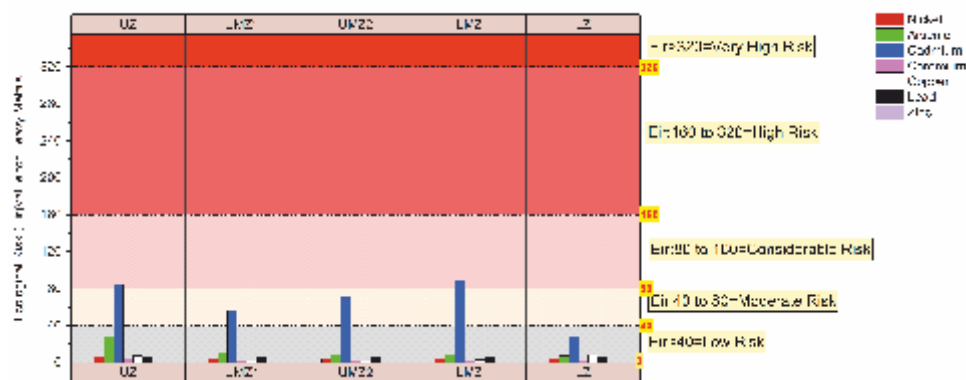


Figure 5.8
Zone-wise
ecological risk
posed by heavy
metals in
sediments of the
Ganga River

5.2 Outcomes

1. Spatial-temporal assessment highlights that the Ganga River is subjected to high contamination by pesticides (banned and restricted), heavy metals, PCBs, and microplastics.
2. 23 pesticides investigated in this study mostly belonged to banned and restricted category in India. High concentration of these pesticides in all components of the Ganga viz., water, sediment and fishes, point towards serious gap in understanding the toxic effects of these pesticides at the local level, and follow up of ban at regional and national level.
3. Lower zone i.e. the sampling stretch in West Bengal, emerged as the most contaminated zone with pesticides and heavy metals, which manifested in this zone being at high ecological risk. PCBs posed considerable ecological risk in UMZ2.
4. Fresh inputs of HCH in all the zones and continued use of DDT and HCH in upper pristine region of Uttarakhand is a matter of concern.
5. High levels of Chromium in UMZ, presence of Mercury in fish from Uttar Pradesh, and presence of highly toxic Cadmium in UZ, UMZ and LMZ may lead to biomagnification along the food chain resulting in potential health risk to humans..
6. Accumulation of pesticides and heavy metals in fishes from all the zones was an indicator of extensive and continuous use of banned toxic pesticides and discharge of untreated industrial waste. These pollutants can pose health hazards to humans.
7. High quantities of microplastics in UMZ, need attention before it starts leaching in other zones and affects the aquatic wildlife.
8. Accumulation of toxic compounds in commercially exploited fish species, such as snow trout, singhara, hilsa, bata, rita and mottled eel, is a potential health hazard for humans.
9. It is evident from the risk map that pesticides such as Drins, Heptachlors, p, p' DDT, p, p' DDE, Methyl Parathion, Malathion and Chlorpyrifos, and heavy metals such as Cadmium, Arsenic, Copper, Lead, Chromium and Mercury, should be prioritized for risk management.
10. The risk map will act as decision support for prioritizing risk zones and site-specific action plans for management of the environmental toxicants.
11. The risk map will also aid in focused enforcement of the National Implementation Plan of the Stockholm Convention on Persistent Organic Pollutants (POPs) in high ecological risk zones such as LZ.





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CAPACITY BUILDING OF STAKEHOLDERS FOR GANGA REJUVENATION

06

6.1 Introduction

Success of the efforts to restore the biodiversity of the Ganga River depends on building capacities of multiple stakeholders including forest departments, veterinarians, entrepreneur, industrialist, local communities, NGOs, scientists, professors, teachers, university and college students, school children, and volunteers from concerned areas through an integrated and holistic approach. The involvement of stakeholders who are aware and trained in field methodologies for undertaking habitat assessment, ecological monitoring, rescue and rehabilitation, monitoring of environmental pollution, community participation, and conservation education is crucial to the conservation process. The efforts intended to build the capacity of stakeholders, so they can effectively contribute to the restoration of ecological integrity of the Ganga River. The stakeholders would act as a self-sufficient human resource capable of carrying forward the conservation activities. The aim of fourth component of the project was to develop capacity of forest department and other stakeholders of the Ganga River in conservation related activities, such as species identification, ecological monitoring, community participation and conservation education.



6.2 Objectives

1. To develop training materials for the different capacity building programmes on Ganga biodiversity conservation.
2. Identification and establishment of spearhead teams in the five Ganga states, consisting of selected forest staff and local youth, and train them in different aspects of biodiversity conservation and methodologies for survey of the indicator species.
3. Development of capacity of forest officials of Ganga States and other stakeholders for monitoring of Ganga aqualife, wetlands and river conservation, community involvement and conservation education.

6.3 Methodology

To achieve the training objectives and goals, a comprehensive capacity building framework was designed. The training programmes were implemented for multiple stakeholders in five Ganga states viz., Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal. The trainings were organized in four main modules - Wetland and River Ecology, Biodiversity Monitoring, Community Involvement and Conservation Education. The training techniques were operated in an andragogy mode and competency based methods to ensure development of adequate competence among the participants. 16 training need assessment workshops were conducted at the onset of the capacity building programmes with different target groups such as Forest Departments (FD), State Programme Management Group (SPMG), local communities, Ganga Praharis, Veterinarians (Vets), professors/teachers, college and school students, religious groups, line agencies, NGOs, entrepreneurs and media personnel, to finalize the designing of training materials and programmes.

6.4 Key findings

Training and development activities were evaluated before, during and after the training programmes, with the help of a self-administered questionnaire. Pre and post training comparison was done to evaluate the impact of the training programmes. In addition, monitoring and evaluation was done based on the Kirkpatrick's model (Kirkpatrick and Kirkpatrick, 2009) using a random follow up e-questionnaire survey to examine the 'after' training efficacy and effectiveness amongst the participants from 2017 to 2019. KnightLab software (<https://knightlab.northwestern.edu>) was used to trace and map the success stories of stakeholders with an aim to propagate such activities either individually or at the institutional level.

- 1 16 training need assessment workshops with different target groups were conducted to design the training materials and programmes (Table 6.1) (Annexure 6.1).
- 2 The training curriculum and materials were developed (Table 6.2) (Annexure 6.1) after intensive literature review, consultation with experts and implementation of diverse training programmes organized in the five Ganga States.

Table 6.1
Training Need Assessment workshops with different target groups for designing of training materials and programmes

S. No.	Target Groups	Number of Training programmes	Number of Participants
1.	WII-NMCG project team	1	25
2.	Graduates, Postgraduates and Professors	6	286
3.	Frontline forest officials	4	213
4.	Veterinarians and Line agencies	1	56
5.	Local People	1	50
6.	School Students and Teachers	3	485
Total		16	1115

Table 6.2
List of training materials developed for capacity building programmes

S. No.	Training Knowledge product	Category	Significance
1.	Training approach & curriculum	Manual (English)	This curriculum provides information about the syllabus and key approaches for developing and implementation of training programmes for multiple stakeholders in biodiversity conservation of the Ganga River.
2.	Monitoring Field Guide	Manual (English)	The monitoring field guide was developed to train the frontline officials and youth in the techniques of biodiversity monitoring and data collection methods.
3.	Water conservation approaches for Bal Ganga Praharis	Booklet (Hindi and English)	This booklet focuses on water conservation approaches for school children, and ways to empower younger generation to save and conserve water.
4.	Hamari Janhvi	Booklet (Hindi)	A collection of poems informs children about the biodiversity and key species of the Ganga.
5.	Training plan for stakeholder	Brochure (English)	The brochure provides information on the formulation and implementation of training programmes.
6.	Training database for capacity building programmes	Brochure (English)	This brochure provides information on the training database developed as a single point source to disseminate training information in different aspects of biodiversity conservation aimed for a wider audience.

S. No.	Training Knowledge product	Category	Significance
7.	Ganga Biodiversity Calendar	Brochure (Hindi and English)	The calender is designed to inculcate awareness in school children about the biodiversity of Ganga River and its conservation through celebration of specials events and days annually. This calender is targeted for Bal Ganga Praharis.
8.	Biodiversity of Ganga River	Poster (English)	The poster depicts the distribution of biodiversity in the Ganga River.
9.	Mobilization of youth for biodiversity conservation	Poster (English)	The poster highlights the awareness activities and mobilization of youth for sustainable conservation of biodiversity of the Ganga River.
10.	Building the Foundation: Bal Ganga Praharis	Poster (English)	The poster highlights the Bal Ganga Prahari programme and involvement of school children in the initiatives taken up for biodiversity conservation of the Ganga River.
11.	Kya Tum Jante ho...	Poster (Hindi)	A poem on Ganga River and its cultural values.
12.	Ganga ke geet...	Poster (Hindi)	A song on Ganga's biodiversity.
13.	Bacchon ka akhbar	Hindi newspaper (Editions I, to X; May 2018 to December 2019)	Newspaper on Ganga's biodiversity printed bimonthly, aimed for school children.
14.	Say No to Single use plastic (I & II)	Pamphlets	The pamphlet gives the information regarding the hazardous effects of single use plastic and its impact on biodiversity.



3

Established forest department's Spearhead teams for five Ganga River states. The spearhead team members comprises of 73 personnel from the state forest departments of five Ganga River states. Two National level training programmes on biodiversity conservation were organised for spearhead teams (Figure 6.1).

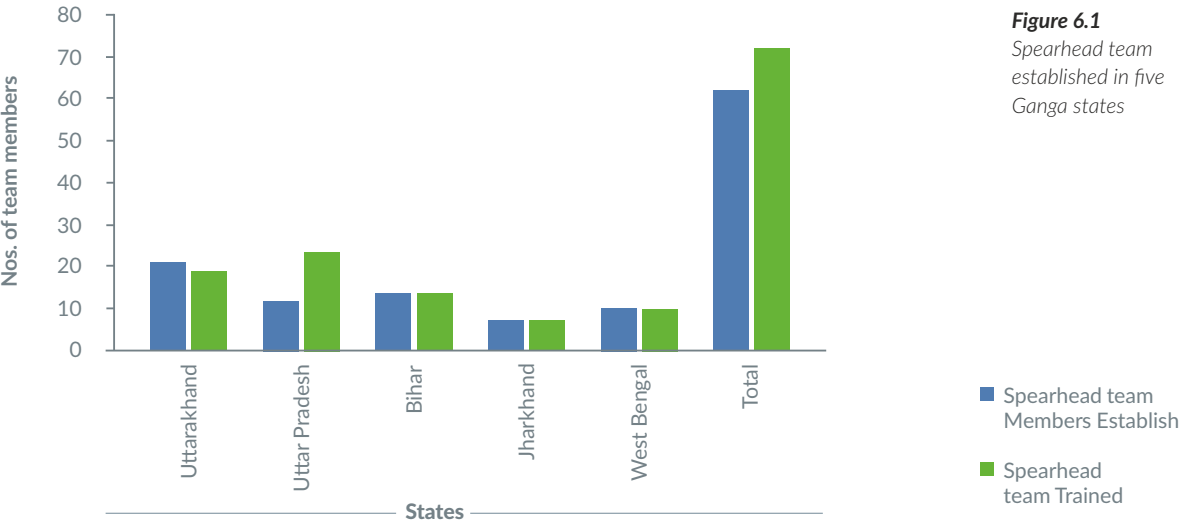


Figure 6.1
Spearhead team established in five Ganga states

4 The spearhead teams trained a pool of 307 youth, including Ganga Praharis, on ecological survey methods for river, wetlands and species of conservation concern (Figure 6.2). The trained individuals have been deployed at field stations and are assisting WII survey teams, carrying out river rafting expeditions organized by NMCG, and conservation activities organised by forest departments.

5 Trained youths are carrying out ecological monitoring as part of international expeditions such as "Sea to Source: Ganges" river expedition organised by the National Geographic Society.

Figure 6.2
Total number of youth trained by spearhead teams in their respective states

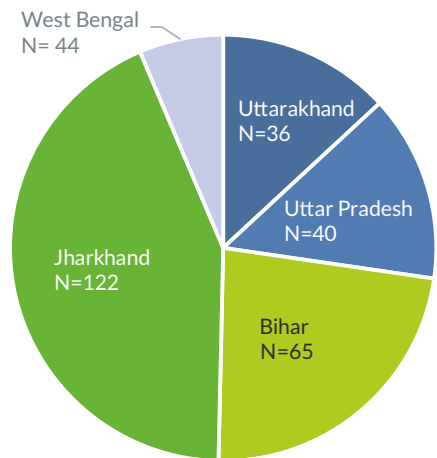
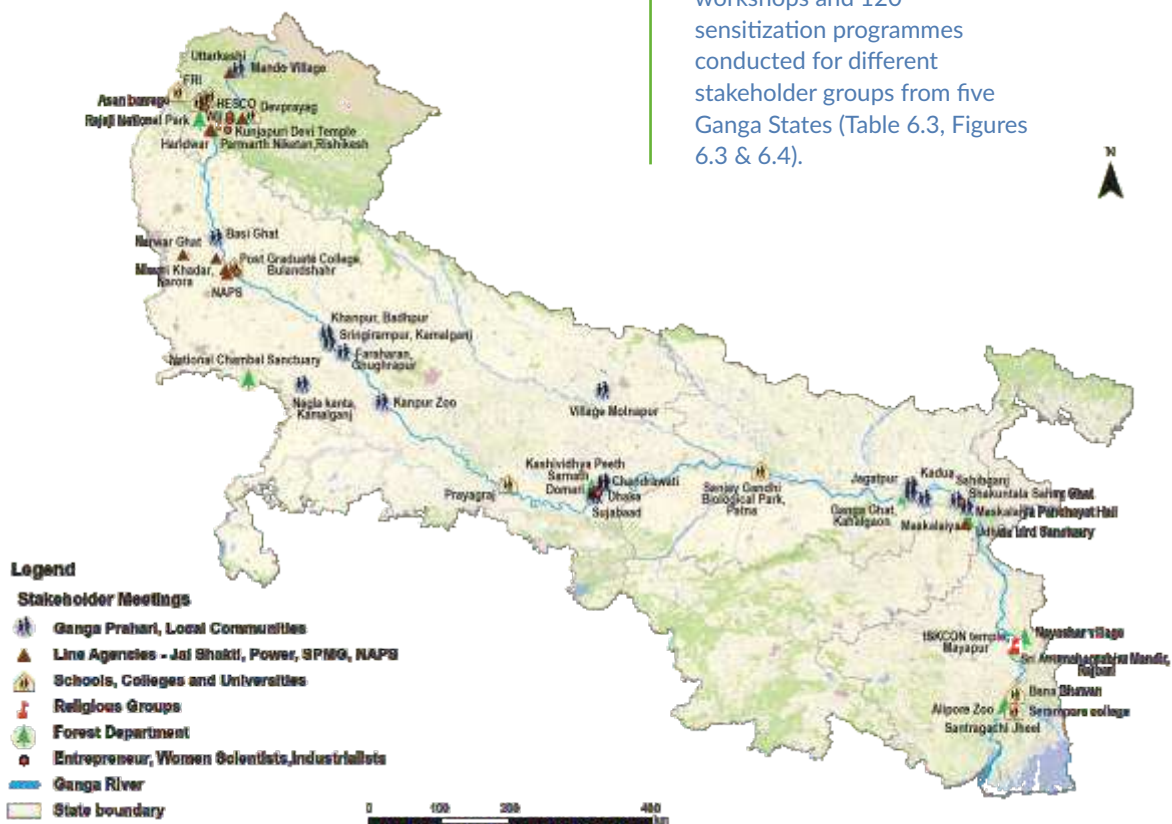


Figure 6.3
Spatial coverage of training workshops and sensitization programmes along the Ganga River

6 736 persons were trained and more than 12,000 were sensitized through 19 training workshops and 120 sensitization programmes conducted for different stakeholder groups from five Ganga States (Table 6.3, Figures 6.3 & 6.4).



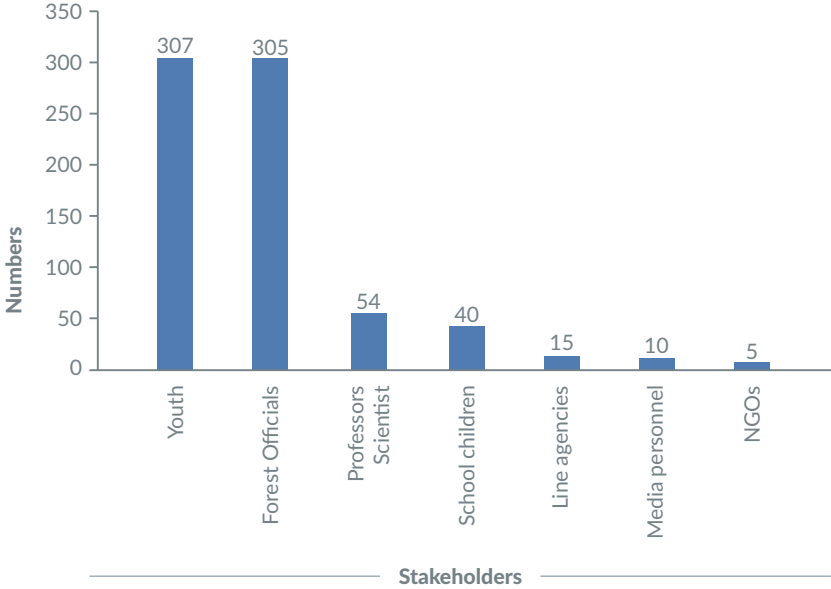


Figure 6.4
Total number of trained individuals from different stakeholders groups

Table 6.3 Number of stakeholder groups sensitised in the five Ganga States

States	Forest official	Veterinarian	SPMG official	Professor/Teacher	College Student	Local Communities	Religious group	Ganga Praharis	Media personnel	School children	NGOs	Line agencies	Entrepreneur
Uttarakhand	79	0	13	154	288	96	5	53	6	5053	16	140	29
Uttar Pradesh	117	40	1	149	74	1053	56	174	14	1954	3	8	0
Bihar	3	0	1	70	31	86	0	81	1	1201	0	1	0
Jharkhand	5	0	1	2	0	188	0	4	0	528	0	0	0
West Bengal	13	0	2	22	140	29	0	40	1	172	22	0	0
Total	217	40	18	397	533	1452	61	352	22	8908	41	149	29



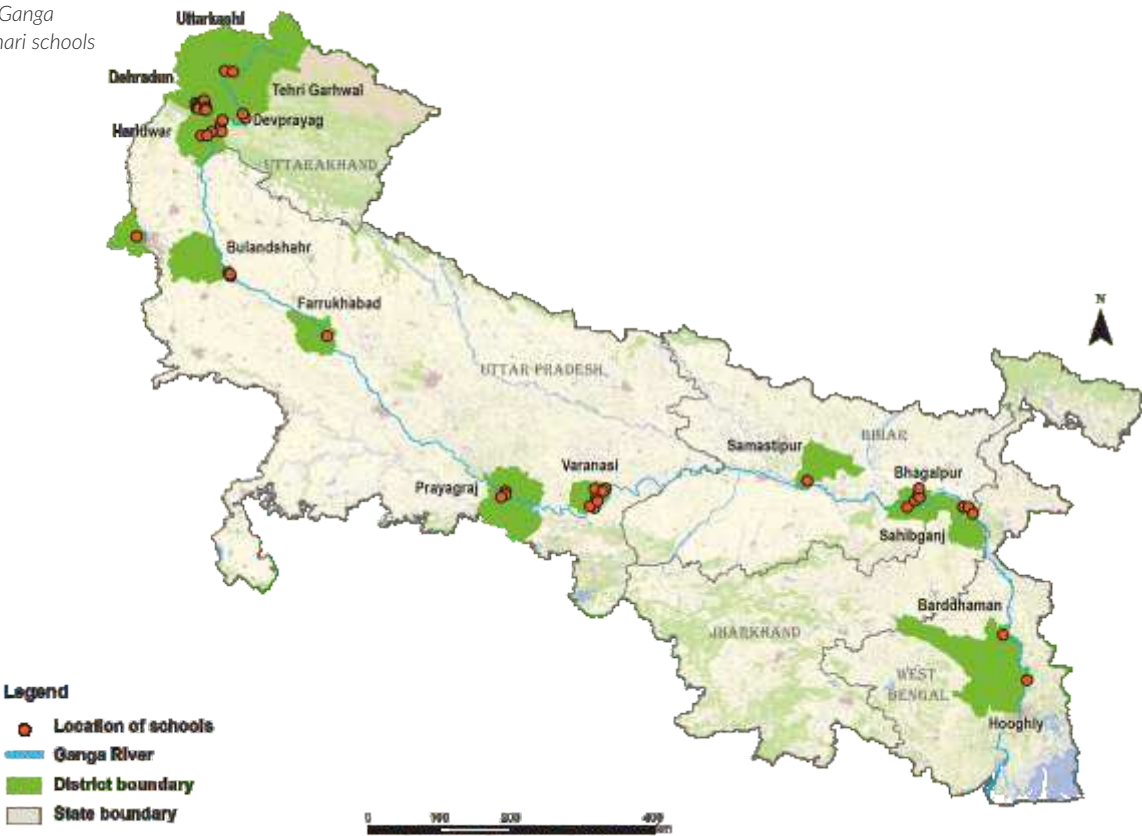
7 Under the Bal Ganga Prahari programme, 64 schools have been identified along the banks of the Ganga River (Figure 6.5) and more than 8,000 school children have been sensitized (Table 6.4) through 74 awareness programmes. Outreach activities ranging from awareness rallies, cultural events, *nukkad natak*, slogan and poster competitions, and hand and face painting competitions were conducted (Annexure 6.3, 6.4).



Table 4.3
School children sensitized under the Bal Ganga Prahari Programme

S. No.	State	School Students
1	Uttarakhand	5053
2	Uttar Pradesh	1954
3	Bihar	1201
4	Jharkhand	528
5	West Bengal	172
Total		8908

Figure 6.5
Spatial distribution of Bal Ganga Prahari schools



8 For easy access to the training information by the different agencies/institutions, a training database was established on a digital domain (Figure 6.6). This digital database contains information on the trained persons and the skills imparted to them. Any agency or institution in need of the trained human

resource for tasks related to biodiversity conservation, ecological monitoring, conservation education can search the database as per their need and approach the trained person.

- ▶ **Endangered Species Recovery Programme**
- ▼ **Biodiversity Conservation and Ganga Rejuvenation**
 - Background - Ganga & NMCG
 - Components
 - Priority Species
 - Protected Area Along Ganga
 - Relevant Literature
 - News and Events
 - Knowledge and Events
 - Knowledge Products
 - ▶ **Training Database**
 - 2019
 - 2018
 - 2016-2017
 - Training Team Profile
 - Training in Media News

Figure 6.6

Training database of multiple stakeholders developed at WII-NMCG Webpage

Website: <http://www.wii.gov.in/nmcg/Trainingdatabase>, http://www.wii.gov.in/nmcg/news_events

Facebook Page: <http://facebook.com/glimpsesofganga>
Instagram: <http://instagram.com/glimpsesofganga>



9 On the basis of the training effectiveness evaluation, positive differences in attitudes and opinions were observed towards Ganga River and biodiversity conservation. Before training, few stakeholders knew about presence of otters, gharial, snakes and amphibians in the river. After training, the awareness levels significantly improved among the key stakeholder groups (Figures 6.7 & 6.8).

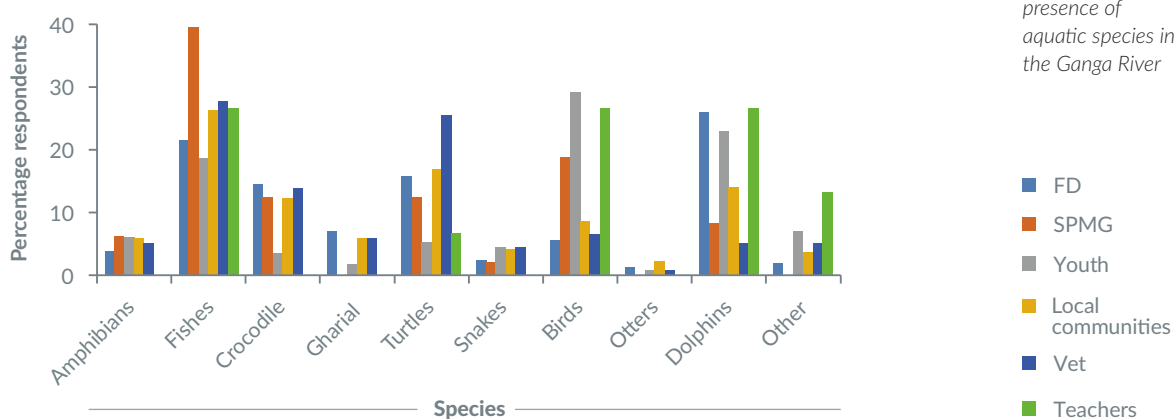
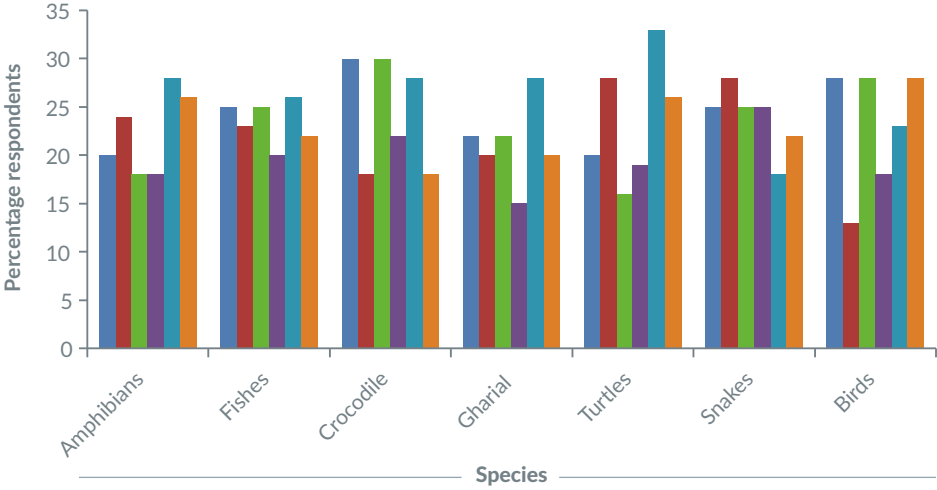


Figure 6.7

Pre-training awareness on presence of aquatic species in the Ganga River

Figure 6.8
Post-training awareness on presence of aquatic species in the Ganga River

FD
SPMG
Youth
Local communities
Vet
Teachers



10 Prior to training, the trainees, perceived that the populations of different aquatic taxa were increasing, especially fishes, amphibians and birds; and most of them were unaware about any change in population or diversity of these

taxa (Figure 6.9). After the training and sensitization programmes, all the stakeholders unanimously agreed that populations of all taxa are declining, especially, turtles, Gangetic dolphin, otters and crocodiles (Figure 6.10).

Figure 6.9
Perception of increase in biodiversity among stakeholders groups during pre-training assessment

FD
SPMG
Youth
Local communities
Vet
Teachers

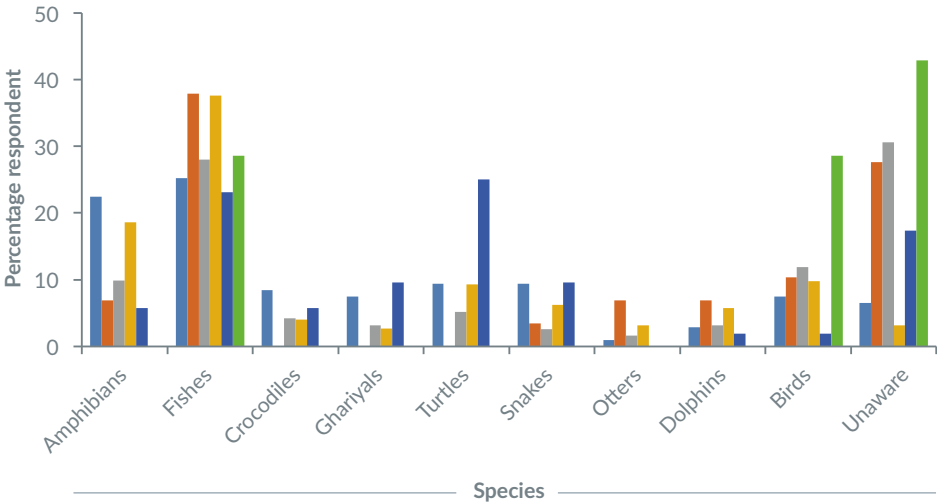
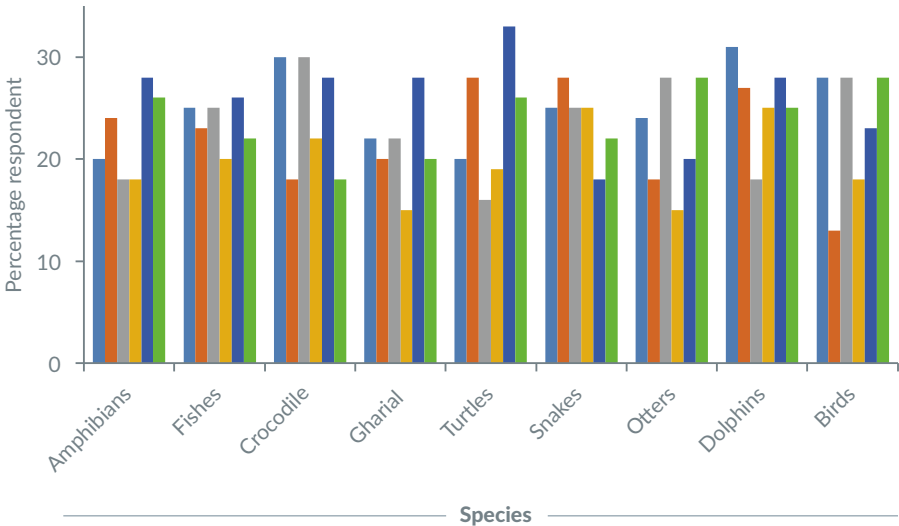


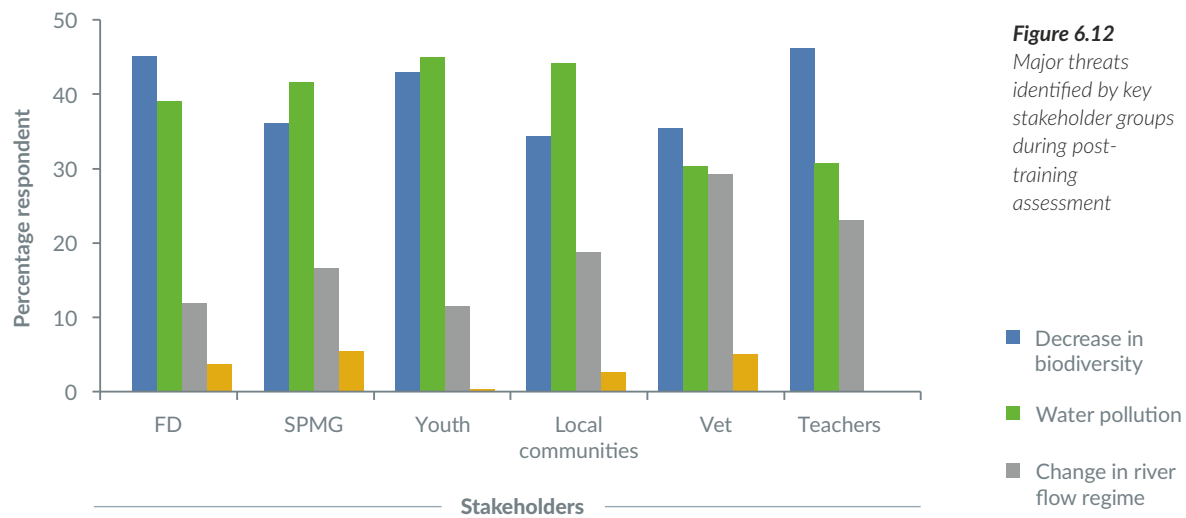
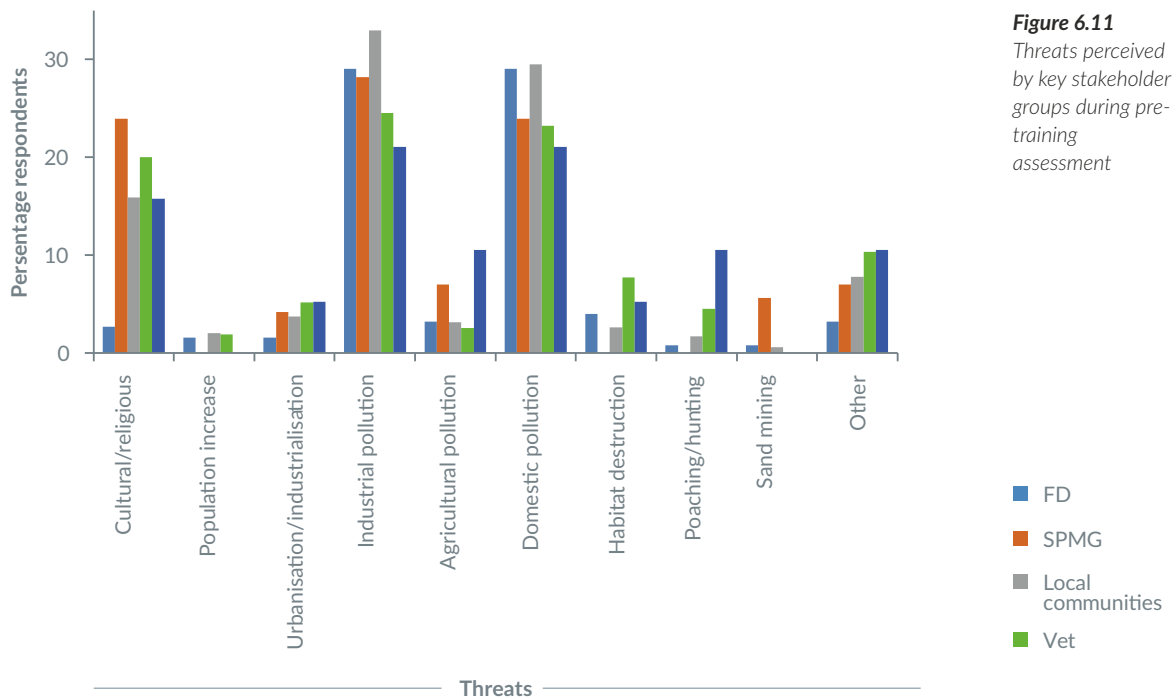
Figure 6.10
Perception of decrease in biodiversity among stakeholders groups during post-training assessment

FD
SPMG
Youth
Local communities
Vet
Teachers



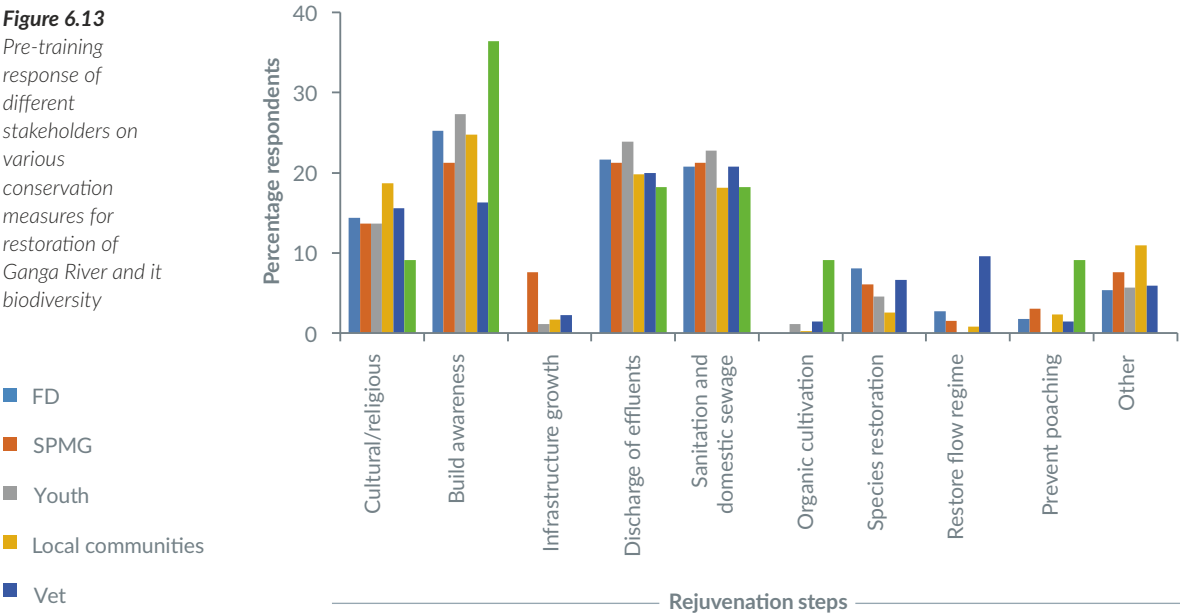
11 Before training, the trainees identified pollution (industrial and domestic wastewater discharge, and religious offerings) as a major threat to the river ecosystem (Figure 6.11).

After sensitization and training workshops, they opined that apart from pollution, decrease in biodiversity and change in river flow regime are also major threats to the Ganga River (Figure 6.12).



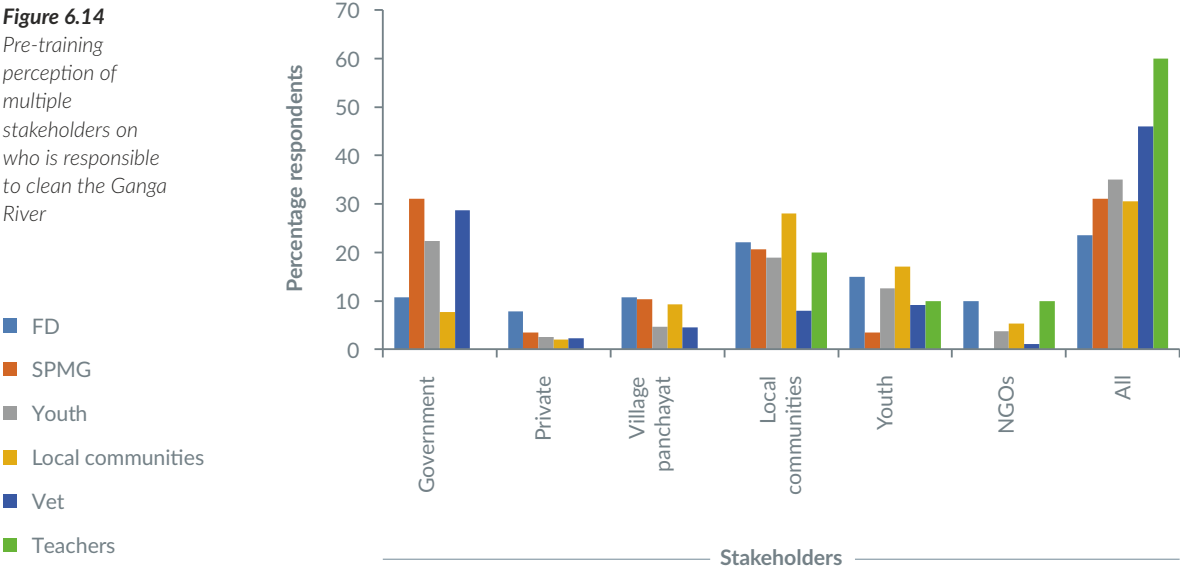
12 During the pre-evaluation process, key stakeholders focused on pollution control and generating awareness as steps toward restoring and rejuvenating the Ganga River (Figure 6.13).

Figure 6.13
Pre-training
response of
different
stakeholders on
various
conservation
measures for
restoration of
Ganga River and it
biodiversity



13 Prior to the sensitization and training programmes, the key stakeholders had conflicting opinions about the responsibilities for cleaning the Ganga River. Most of the stakeholders held the government and local communities residing along the Ganga River responsible for cleaning the river. However, many of them were also aware that it is a collective responsibility (Figure 6.14). The trained stakeholder groups, on the other hand, unanimously agreed that cleaning of the Ganga River is a collective responsibility (Figure 6.15).

Figure 6.14
Pre-training
perception of
multiple
stakeholders on
who is responsible
to clean the Ganga
River



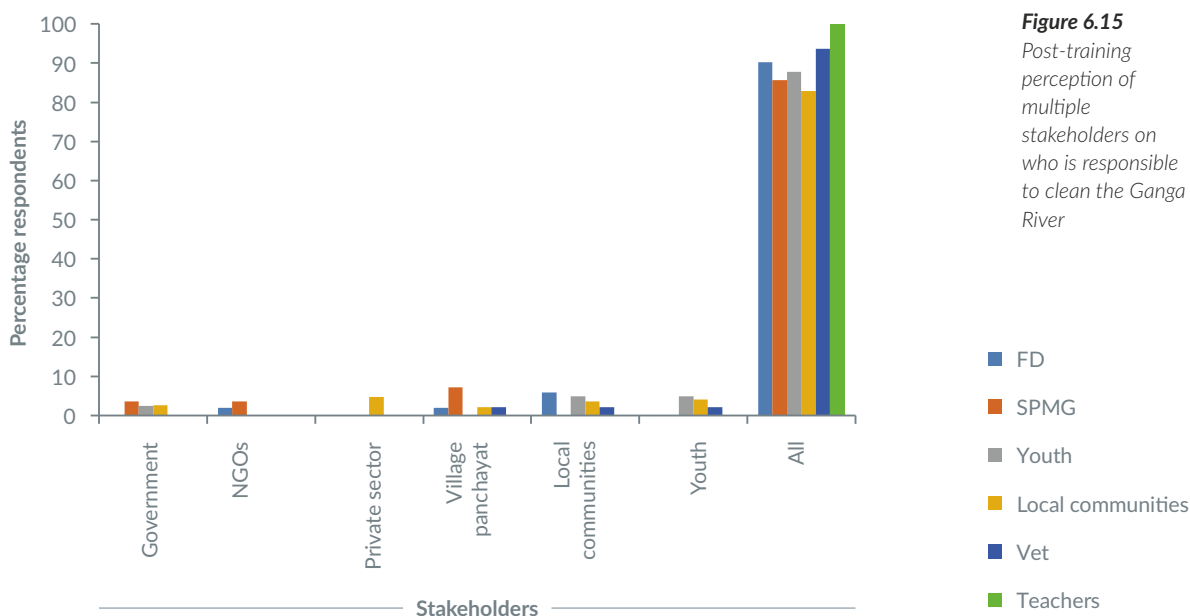


Figure 6.15
Post-training perception of multiple stakeholders on who is responsible to clean the Ganga River

14 To evaluate the effectiveness of the training programmes, 158 trained personnel were sent a semi-structured e-questionnaire. It was found that more than 85% of the trained personnel have benefited from the training programmes. 60% of the trained personnel carried forward the key activities such as awareness programmes in their respective states. (Figure 6.16).

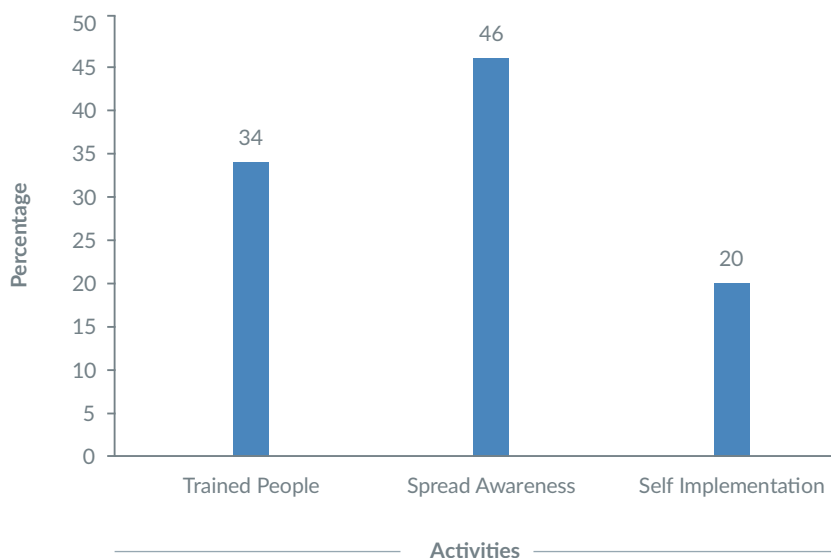


Figure 6.16
Activities carried forward by the trained participants

15 KnightLab software was used to trace and map the success stories of the capacity building programmes of the stakeholders. This shows the footprints of each and every successful training programme conducted with different target groups in the five Ganga states.

(<https://uploads.knightlab.com/storymapjs/5d436162eb13431fd8578104e89ebf31/timeline-of-major-workshop-conducted-2017-19/index.html>)

6.7 Outcomes

1. The trained spearhead teams have conducted seven training and 30 sensitization programmes through which more than 5000 participants were mobilised and 422 participants were trained. These comprised of frontline staff, different line agencies, local youth, Ganga Praharis, teachers, students, religious groups, local communities, veterinarians, and representatives of NGOs. These trained human resources have carried forward the conservation activities.
2. The trained spearhead teams has been carrying out training and ecological survey activities on their own, which included population count of Gangetic dolphin in Bihar, monitoring of turtle at Varanasi and migratory bird survey at Sahibganj, Jharkhand, and training on ecological monitoring of rivers and wetlands in West Bengal. Besides these, the Serampore College in West Bengal and ISKCON temple Committee, at Mayapur, West Bengal has initiated Ganga conservation activities and cleanliness drives.
3. The trained spearhead team has been executing important activities with the involvement of local youth like training other frontline staffs, creating awareness, conducting sensitization programmes and executing field duties like plantation and cleanliness drives.
4. The trained Ganga Praharis are actively coordinating sensitization, cleanliness and **escort** services for pilgrims at religious and cultural places with local administration and NMCG. The effort has been highly successful in highlighting the role that stakeholders play at the grassroots levels and provide them a pathway to engage meaningfully in river restoration programmes.
5. A pool of trained Ganga Praharis is available, who are involved in conservation actions by different line agencies. This pool of trained individuals are a part of the citizen scientist network and are helping in ecological surveys and monitoring of species of conservation concern.
6. Trained youth deployed at field stations are assisting various survey teams and forest departments, and are attached to research and training institutes as per their qualification, and are also used for piloting different training programmes.







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DEALING WITH ANIMAL IN DISTRESS: ESTABLISHMENT OF RESCUE AND REHABILITATION CENTRES

07

7.1

Introduction

The multifaceted dependency on the resources of the Ganga River affects the quality and extent of habitat available to the diverse life forms that draw sustenance from the riverine system. In addition, intentional or unintentional human activities impact aquatic species and endanger their survival. Impacts of human activities may include loss of individuals as a result of getting trapped, injury by crafts, destruction/conversion of habitat, competition for resources, and pollution. The resultant small, isolated and fragmented populations of conservation dependent species necessitate conservation interventions towards ensuring presence of multiple self-sustaining populations in suitable habitats within their natural range of occurrence. This however is a challenging task and an alternate viable option, increasingly being adopted is the translocation-supplementation- reintroduction of healthy animals from rescue and rehabilitation facilities to natural habitats within the species range while attempting to mitigate factors that are causing population declines. Rehabilitation also ensures that every individual



animal of these species gets an opportunity to contribute to the growth of the population and thereby towards long-term species survival. Rescue and rehabilitation additionally contributes indirectly to conservation by increasing awareness through outreach programs and providing opportunities for understanding the biology and behaviour of the species. These programmes can target the effect of illegal wildlife trade on public health, pet trade as a causal factor for population declines and the legal consequences of being caught with a conservation dependent animal.

Conventional conservation effort is focused on establishing a network of protected areas with a top down policy approach; however, conserving the biodiversity of the Ganga River requires a different paradigm as the river system has limited protected area coverage and much of the biodiversity needing conservation effort lies outside this network. This would require involving multiple stakeholders that include officials of the forest department for providing the necessary legal framework for rescuing animals and their ultimate release, veterinary professionals of the state animal husbandry

departments for providing the requisite veterinary health management required for restoring the sick and injured animals back to fitness to enable their ultimate release and, last but not the least, members of communities residing along the river's banks.

The local communities have a traditional dependence on the river's resources for their livelihoods, social needs and beliefs. Additionally, these communities have first-hand information of ongoing resource extraction and can serve as first responders by providing relevant information for enforcement and other government agencies engaged in conserving the river and its biodiversity. Thus an integrated approach that actively involves local communities in rescue and rehabilitation of higher vertebrate fauna of Ganga River will have a higher chance of success. Hence, one of the components of the project is aimed at rescue and rehabilitation of conservation dependent higher aquatic vertebrate fauna of the Ganga River.

Objectives

1. Establishment and upgradation of rescue and rehabilitation centres at Narora and Sarnath.
2. Capacity enhancement of local communities.
3. Capacity enhancement of personnel of the forest department and field veterinarians in managing emergent situations.

Methodology

An assessment of the existing infrastructure and husbandry practices at Narora and Sarnath was carried out to examine the areas requiring improvement. Required permissions and approvals were obtained for repair and animal handling. After a preliminary inventory of the infrastructure and animal stock, the facilities were scientifically upgraded to accommodate, quarantine, rehabilitation, hatchery and veterinary care facilities for aquatic wildlife. Summer and winter care infrastructure was established to provide effective husbandry for rescued animals. Water quality and hygiene were ensured through continuous supply of freshwater, replenishment and use of disinfectants. Basic animal treatment facility cum office was established to monitor and coordinate activities. Scientific animal healthcare was ensured through specific feeding charts, based on the species, age and season. Naturalistic enclosures were created by means of environmental enrichment for effective basking, thermoregulation and behavioural augmentation.

Protocols were developed for handling and veterinary care for the species of conservation concern in distress. The capacity of the frontline forest staffs, Veterinary officers and Ganga Praharis were developed through extensive trainings in scientific handling, veterinary and latest husbandry tools and techniques as first responders. A network of Ganga Praharis and frontline forest staffs were established as first responder and rapid response team to tackle emergent situations. The handholding with the centres is being continued by WII to refine rescue and rehabilitation operations and provide expert advice.

In addition to the rescue and rehabilitation centres at Narora and Sarnath, technical assistance was provided to establish a rescue facility at Bhagalpur, in collaboration with Bihar Forest Department. The Ganga Aqualife Rescue Rehabilitation and Transit Facility is also being established at Barrackpore, West Bengal.

Key findings

1. Ganga Aqualife Rescue and Rehabilitation Centre in Narora, Ganga Aqualife Rescue and Rehabilitation Centre in Sarnath and Ganga Aqualife Rescue, Rehabilitation and Transit Facility in Kolkata were established (Annexure 7.1).
2. Turtles were the most confiscated and rescued species along the Ganga River. Among them, juveniles and sub-adults were frequently encountered. Therefore, the facilities were established in consonance with the animals being received.
3. The rescue and rehabilitation centres at Narora and Sarnath are fully functional and regularly receive rescued animals that are scientifically handled and managed to restore fitness for their release. The facility at Narora is pivotal for wild to wild rescue and rehabilitation of aquatic wildlife as there are fewer confiscations. The facility has husbandry and healthcare capacity for almost 50 turtle individuals (juvenile and sub-adults). The trained network of rescue personnel is exemplary in the biodiversity conservation process.
4. The facility at Sarnath is one of the most strategic in terms of confiscation, rescue and release of the aquatic wildlife in distress. The state-of-the-art facility is turning out to be a model rescue and rehabilitation centre, especially for turtles, with husbandry and healthcare capacity for almost 2,500-3,000 turtle individuals (juvenile and sub-adults).
5. Both the centres have rescue ponds for turtles that are provided with features for thermoregulation through basking and performing other natural behavioural patterns, quarantine facility, veterinary laboratory and animal care room that enable them to handle emergent situations.
6. Biofiltration units were established at both the centres, based on hydroponium and sand-bed filtration mechanism. Water is recycled to maintain the water quality in the rescue ponds.



7 A protocol on the rescue and rehabilitation for aquatic wildlife, especially for turtles, was developed. It includes standardized methods of handling rescued animals, their transportation to the rescue facility and release sites, veterinary care, husbandry practice and code of conduct (Annexure 7.2).

8 Species specific feeding practices were standardised on the basis of age and physical health of the aquatic wildlife, especially turtles. Treatment protocols were standardised for turtles, and in pioneering efforts, penile prolapse, carapace fracture and fish hook injury were treated successfully. The standardised methodology used can be replicated for similar cases in the future (Annexure 7.1).

9 Capacity enhancement workshops were carried out for officials of forest department and field veterinarians from five Ganga states in managing emergent situations including rescue, rehabilitation and release of aquatic wildlife. Trainings in Uttarakhand, Uttar Pradesh and Bihar have been carried out to enhance capacities of local communities, such as local fishermen, to assist in addressing emergent situations pertaining to aquatic higher vertebrate fauna. 69 Veterinary officers, 214 local community members and 232 forest officials were trained and sensitised, and are carrying forward the rescue and rehabilitation operations (Annexure 7.1)



- 10** | The trained community members have been contributing as first responders for rescue emergencies across the Ganga states. The trained forest officials have been scientifically handling and transporting most of the rescued animals while working in coordination with line agencies (Annexure 7.1).
- 11** | The trained veterinary officers are successfully addressing veterinary emergencies and conflict situations of species of conservation concern, especially turtles and crocodiles in collaboration with forest staffs, Ganga Praharis and WII project personnel (Annexure 7.1).
- 12** | In three years, 4,196 turtles were rescued and successfully rehabilitated. As a part of species restoration process, 4,776 turtles were released into their natural habitat.



7.5 Outcomes

1. A network and system is in place to facilitate rescue and rehabilitation of distressed aquatic wildlife of conservation concern along the Ganga states.
2. First of its kind technical guidelines are published focussing on identification, handling and husbandry of aquatic wildlife. These documents are paving the way towards scientific rescue and successful rehabilitation.



3. For the first time, capacity of forest departments and other stakeholders are enhanced to carry out rescue and rehabilitation operations for the key aquatic wildlife. The training and sensitization programmes have ensured timely, coordinated and efficient rescue and release operations.
4. Biofiltration process for recycling water used in the ponds of the rescue centres is a novel approach that has been introduced in this project. The mechanism is cost-effective, minimizes water consumption and is replicable in similar facilities.
5. A network of Ganga Praharis, representatives of riverside communities, are sensitized and motivated to report and assist in addressing emergent situations pertaining to aquatic higher vertebrate fauna of Ganga River. Along with trained forest staff and veterinarians, the Ganga Praharis are acting as informers as well as rescuers to ensure rapid response, first aid, survival of the animals and rehabilitation.
6. The timely and quick response of the rescue team is avoiding conflicts arising due to human-species interaction. The Ganga Praharis are also helping in spreading message of biodiversity conservation and are able to defend against community retaliation and killing of animals such as mugger and Gangetic dolphins.
7. Sensitized local communities, especially fishermen, are now spontaneously releasing accidentally captured turtles and river dolphins, and informing the Forest Department about any such incidents.
8. The trained veterinary and forest officers ensure rehabilitation of the rescued animals till their release to the designated stretches of the river with suitable habitat.
9. The release of confiscated animals back into the Ganga River is contributing directly towards the species restoration process.



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COMMUNITY BASED CONSERVATION PROGRAMME

08

8.1 Introduction

Community-based conservation is commonly seen as having two central objectives: to enhance conservation of wildlife, biodiversity, and/or the environment; and to provide economic, social, cultural, and political benefits to local people (Campbell, 2007). Community conservation “starts from the ground up but deals with cross-scale relations”, and that a more nuanced understanding is needed of “people, communities, institutions, and their interrelations at various levels” (Berkes, 2004). This perspective of community-based conservation leads into the realm of governance networks. Recent years have seen the emergence of “integrated conservation and development programmes” (ICDPs) and “community-based conservation” projects in many different parts of the world — approaches that seek to link environmental conservation with development. Such projects have prompted much discussion about the implications of the integration of human populations to the objectives of biodiversity preservation to maintain the ecological processes and ensure sustained ecosystem services.



The Ganga River is the lifeline for millions of people across the Himalayas and the Gangetic plains. People are dependent on its regulating, provisioning, supporting and cultural services. In the Ganga basin, there are areas that are predominantly low-level subsistence systems and thus are vulnerable to shocks such as climate variability and degradation of ecological quality. Therefore, a key challenge for the region is to negotiate the reasonable and equitable utilization of the river and its resources among various stakeholders. To initiate this process, participation of local communities along with other stakeholders and line agencies is crucial for sharing the benefits and addressing the impacts and the risks.

The outcomes of community-based conservation are often governed by the level of participation from target groups and stakeholders as well as their willingness to participate. Three overlapping and interacting mechanisms by which participation is expected to enhance river basin management are: (1) providing space for deliberation and consensus building for better quality decisions, (2) mobilizing and developing human and social capital for better quality decisions and their implementation, and (3) raising

the legitimacy of decisions to facilitate their implementation. The major obstacles for conserving the Ganga basin for continued provision of the services, include dense human population, rapid unplanned development for growing economy, pollution from domestic and industrial sources, multiple stakeholders with different priorities, high dependence and little or no effective regulation mechanisms. These issues are aggravated by poverty, lack of economic opportunities, and casteism leading to inadequate rights and distribution of resources for the majority population. To address this, involvement of stakeholders with different capacities is crucial in both the preparation and implementation of integrated water resource management. The following five objectives were formulated to strategize the long-term participation of stakeholders, especially local communities.

Objectives

1. Involve local communities in the conservation of the Ganga through the Panchayati Raj System.
2. Elicit the participation of stakeholders at different levels to achieve the biodiversity conservation goal of NMCG.
3. Assess the monetary contribution of ecosystem services provided by the Ganga to different stakeholders.
4. Develop site-specific strategies for aligning local people's livelihoods with conservation priorities.
5. Suggest institutional mechanisms for the sustainability of project initiatives in the demonstration sites.

conservation. To facilitate women participation in conservation and to align local economy to conservation goals, site-specific sustainable livelihood strategies were developed as per the interest of Ganga Praharis and availability of raw material and market. Linkages were established with agencies working on livelihood development to increase the effectiveness of the livelihood trainings. Ganga Praharis were further linked with existing market to make them economically independent and to ensure sustainability of the livelihood development programme. In absence of market, innovative livelihood centres i.e. Jalaj, were developed to create the market for Ganga Prahari products. To understand the contribution of Ganga and its biodiversity in local and national economy, ecosystem services of the river were assessed and a framework was designed for the valuation. Village-level microplanning approach was used to institutionalize the above-mentioned conservation efforts and to internalize biodiversity conservation in the village level development.

Methodology

Stakeholder analysis was done to understand the position and interest of various stakeholders' with respect to Ganga biodiversity and cleanliness. Specific strategies were developed to sensitize each identified stakeholder group. Besides continuous dialogue through meetings and workshops, mass awareness tools such as *pad yatra*, rallies, *chaupals*, hoardings, slogan and wall paintings, inter and intra-school competitions, dance, poems and story sessions were conducted throughout the length of the Ganga River. To ensure the sustainability of the efforts on the ground, a cadre of motivated volunteers i.e. Ganga Praharis, was established. Ganga Praharis were identified through a series of site level consultative meetings and workshops. The primary criterion for identification in a candidate was their passion and zeal to work for the Ganga River

Table 8.1

State wise number of stakeholders involved in conservation

Stakeholders							
State	Participants from Educational Institutions	Ganga Praharis	Media Officials	Participants from State Government	Visitors/ Tourists/ Pilgrims	Local Businessmen	Bal Ganga Praharis
Bihar	847	788	5			9	
Jharkhand	5034	1545	21	2		3	
Uttar Pradesh	3825	6940			3305		
Uttarakhand	1194	678		4		19	62
West Bengal	52	305			320		
Grand Total	10952	10256	26	6	3625	31	62

Key findings

1. 55,178 people of different stakeholder categories participated in the biodiversity conservation activities (1,895 activities; 45% male participants; 55% female participants). Local people constituted 48% of the participants in the activities, followed by students (20%), Ganga Praharis (18.5%) and others (13.5%) (Figure 8.1; Table 8.1, 8.2) (Annexure 8.1).

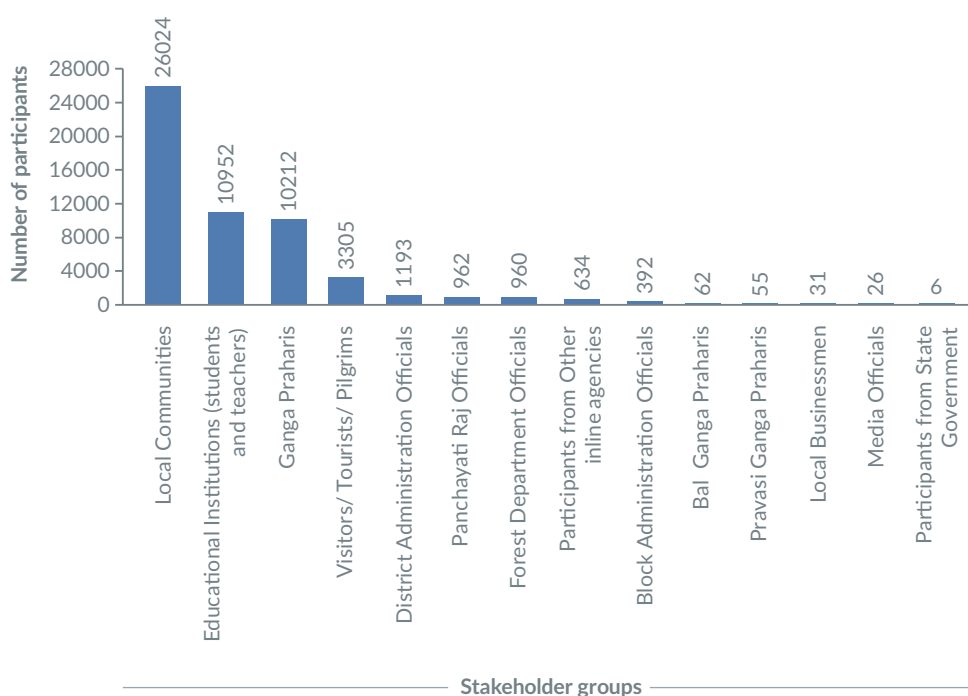


Figure 8.1
Stakeholder participation in project activities

Participants from other line agencies	Pravasi Ganga Praharis	District Administration Officials	Block Administration Officials	Local Communities	Forest Department Officials	Panchayati Raj Officials
2		125	1	1092	8	7
127		107	23	1778	197	93
384	17	920	358	20977	491	717
121	38	138	10	2076	250	143
		3		101	14	2
634	55	1193	392	26024	960	962

Table 8.2 Year wise number of stakeholders involved in various activities

Type of Activities	Awareness Programme		Cleanliness Drive		Consultative Meetings		Cultural Activities		Ecological Survey		Livelihood Activities		Mobilization workshop		Orientation		
Year	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	
2016															3	32	
2017	11	504	3	100	199	1158	1	40			1	59	9	446	15	265	
2018	113	4053	64	1682	316	2977	1	101	14	74	45	1760	26	658	14	228	
2019	147	6630	25	592	251	2591	6	5832	6	31	33	1666	27	656	15	526	
Grand Total	271	11187	92	2374	766	6726	8	5873	20	105	79	3485	62	1760	47	1051	

2 | The stakeholder participation increased with the enhanced interactions by WII team and Ganga Praharis with local communities, and site-specific livelihood and conservation interventions in the targeted sites. Collaboration with local institutions, and creating a platform for deliberations and addressing issues of the local communities aided in achieving attitudinal success (Figure 8.2; Annexure 8.1).

Figure 8.2
Participation of stakeholders increased over the project duration

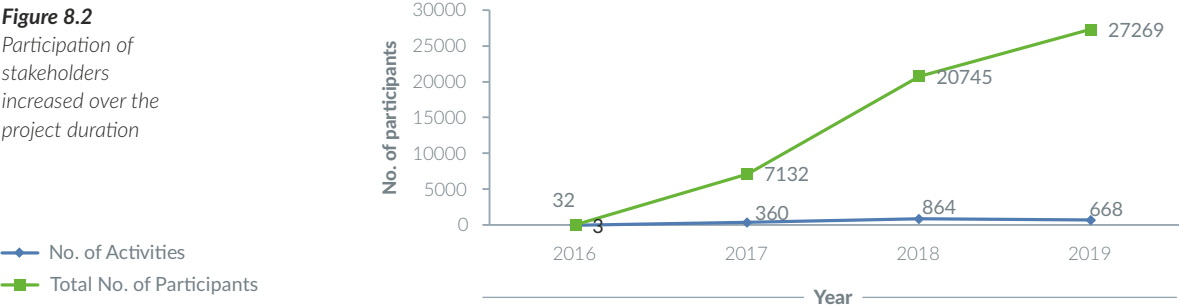
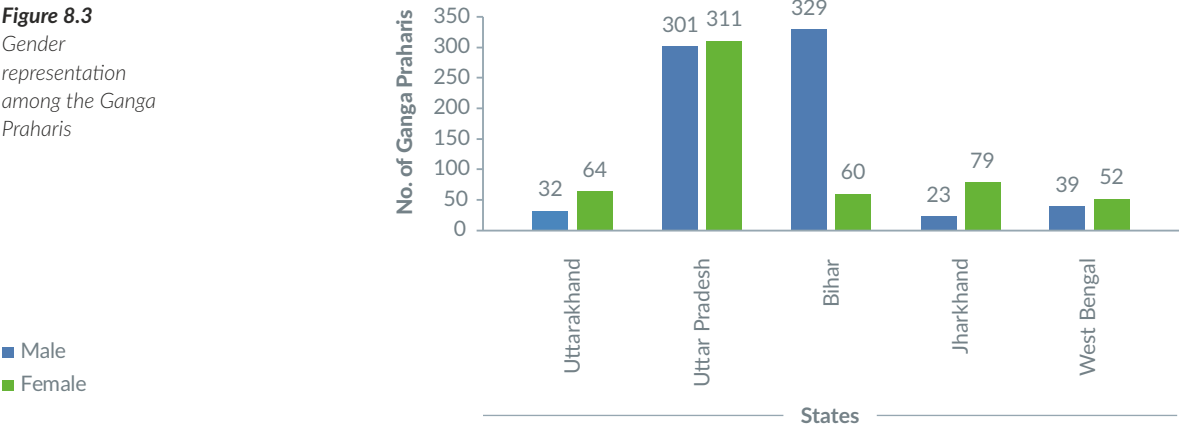


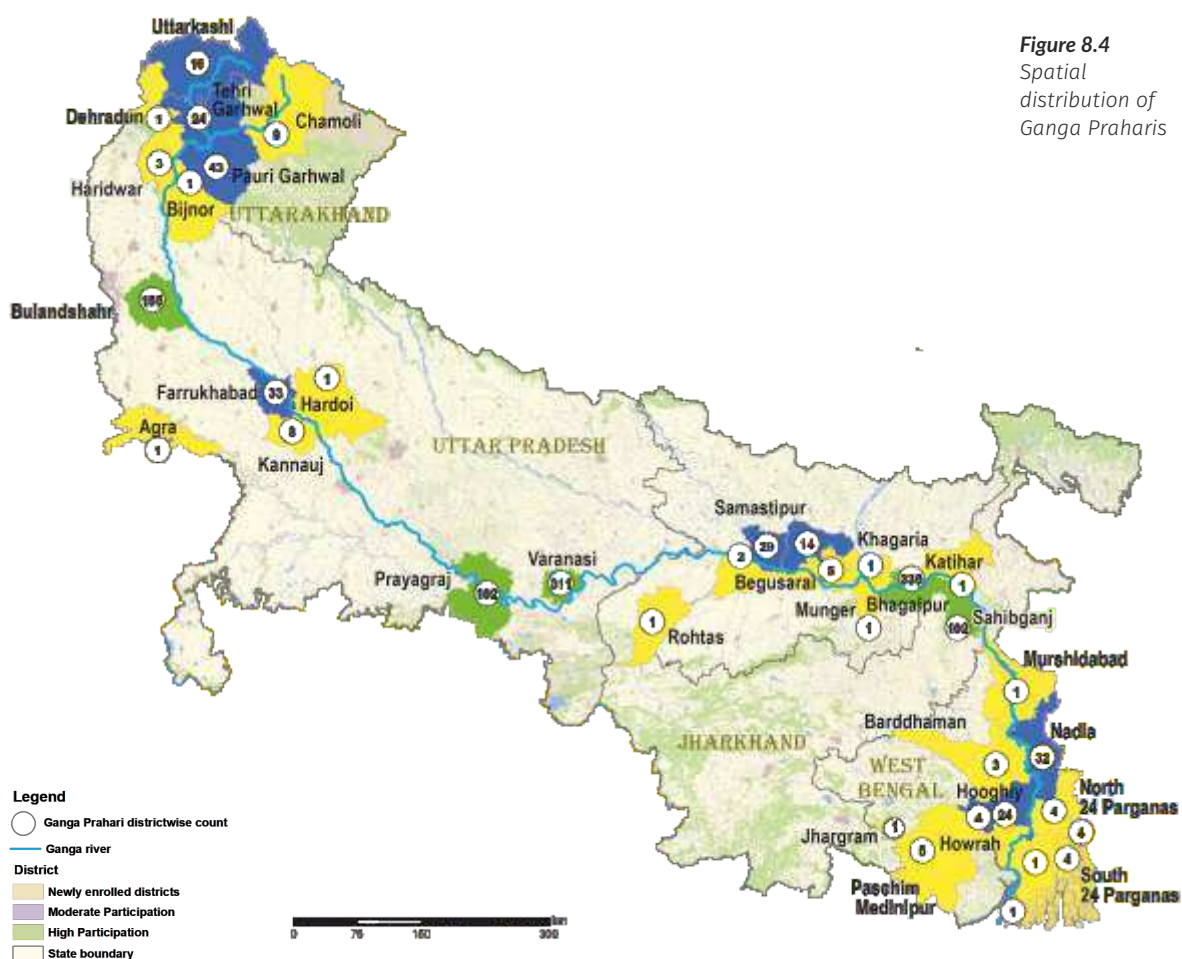
Figure 8.3
Gender representation among the Ganga Praharis



3 | The project received significant representation from female participants. The skill development interventions paved the way for more female representation and resulted in effective implementation of conservation actions (Figure 8.3).

Others		Plantation Drive		Population Monitoring		Rescue and Rehabilitation		Sensitization Workshop		Socio-economic Survey		Training Workshop		Total	
No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants
														3	32
		14	597			2	20	98	3681	1	31	6	231	360	7132
7	314	89	2393	2	55	22	230	119	4856	1	69	31	1295	864	20745
53	2556	22	447			13	15	46	4679	8	127	16	921	668	27269
60	2870	125	3437	2	55	37	265	263	13216	10	227	53	2447	1895	55178

- 4 A functional cadre of self-motivated Ganga Praharis was established across the five Ganga River states to aid in and carry forward conservation activities (Figure 8.4; Annexure 8.1). 1290 (female: 566, male: 724) Ganga Praharis have been identified across the five Ganga River states (Figure 8.3).



5 The Ganga Praharis were trained in various activities pertaining to village level microplanning, ecological survey, community mobilization activities, plantation and cleanliness drives, linking people and current government schemes, skill development in alternate livelihood activities, reporting of animal in distress and liaising with State Forest Departments through various capacity building programmes, workshops and training centres (Table 8.4).

6 The Ganga Praharis conducted 316 conservation and cleanliness activities at their respective individual sites (Table 8.4).

Table 8.4
Input by WII-
NMCG and
output by
Ganga Praharis

Sl. No.	Activities	Input by WII-NMCG team	Output by Ganga Praharis
1.	Awareness Programmes	118	133
2.	Consultative Meetings	108	19
3.	Sensitization Workshops	57	7
4.	Livelihood Activities	35	-
5.	Trainings (project objectives & rescue and rehabilitation activities)	20	35
6.	Cleanliness Drives	27	56
7.	Ecological Surveys	13	-
8.	Orientation Programmes	12	-
9.	Plantation Drives	19	63
10.	Mobilization Workshops	8	1
11.	Questionnaire Surveys	3	1
12.	Others (Cultural, Ganga Amantran Expedition, Wetland and Water Programme, National Geographic Society surveys)	13	1
Total		433	316

7 The motivated stakeholders, including Ganga Praharis, developed contacts with external institutions and WII for logistic and technical advice, and organized awareness activities, cleanliness drives and plantation drives, and have sensitized 5,683 people in their communities (Table 8.5).

Table 8.5 Output activities conducted by stakeholders for Ganga biodiversity conservation after association with project

Type of Activities	Awareness Programme		Cleanliness Drive		Consultative Meeting		Cultural Activity		Ecological Survey		Livelihood Activity		
State	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	
Uttarakhand	12	173	2	28	4	33	0	0	3	5	2	51	
Uttar Pradesh	53	1058	33	567	13	168	4	214	5	7	1	40	
Bihar	21	242	5	77	1	5	0	0	1	1	0	0	
Jharkhand	27	629	2	53	30	113	0	0	0	0	0	0	
West Bengal	8	238	2	14	0	0	0	0	4	10	0	0	
Grand Total	121	2340	44	739	48	319	4	214	13	23	3	91	



Mobilization Workshop		Plantation Drive		Rescue & Rehabilitation		Sensitization Workshop		Training Workshop		Others		Total Count of Type of Meeting	
No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants	No. of activities	Total no. of participants
0	0	6	132	0	0	0	0	0	0	0	0	29	422
0	0	13	117	13	16	5	390	4	110	0	0	144	2687
1	31	34	454	10	17	4	453	1	21	0	0	78	1301
1	14	1	57	2	60	0	0	0	0	0	0	63	926
0	0	3	70	0	0	0	0	0	0	2	15	14	186
2	45	57	830	25	93	9	843	5	131	2	15	333	5683

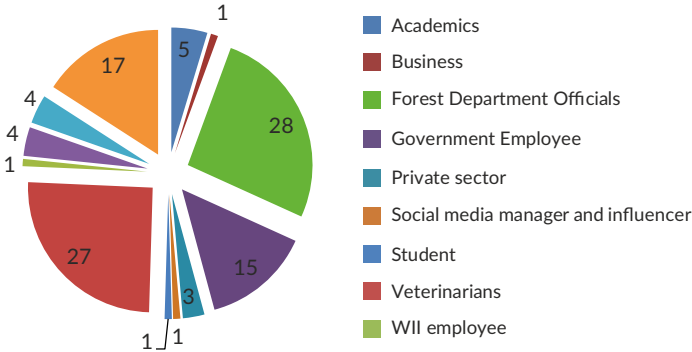
8 54 Citizens from 17 different countries have joined the cadre as Pravasi Ganga Prahari, created for NRIs, foreign nationals, Overseas Citizen of India (OCIs) and Persons of Indian Origin (PIOs) (Figure 8.5).

Figure 8.5
Global reach of
Pravasi Ganga
Praharis



Figure 8.6
Composition of
Ganga Prahari
Mentor group

9 107 persons have been registered as Ganga Prahari mentor, which is a platform to encourage the citizens of India to support the grassroots level movement of the Ganga Praharis (Figure 8.6).



- 10** The Ganga Praharis have not only benefitted in terms of capacity development and livelihood enhancement but are globally recognized for their efforts. The reward for untiring efforts reached a new horizon when Sh. Darshan Nishad, Ganga Prahari from Varanasi, got a chance to interact with the Hon'ble Prime Minister of India, Shri Narendra Damodardas Modi, and briefed him on the Ganga Prahari programme, during a mega plantation drive held during April 2019.



- 11** Ganga Praharis were engaged with State Forest Departments, District Administration, Block Development Offices (BDOs) and other government agencies for 1,514 man days as trained human resource in activities on Ganga conservation, plantation, cleanliness and awareness.

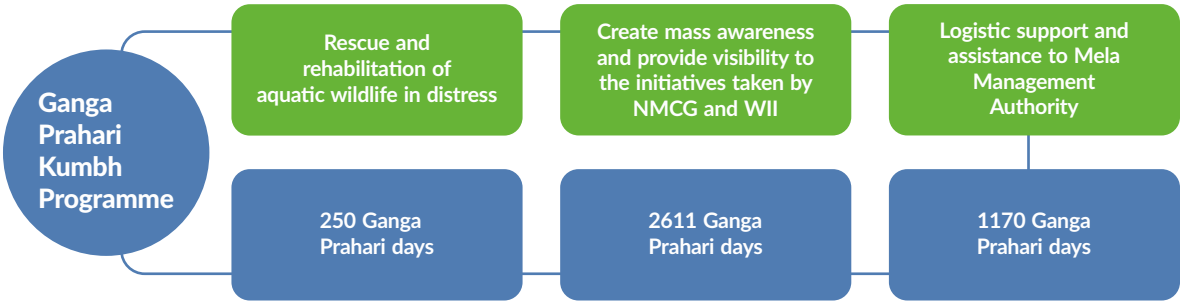
- 12** 89 Ganga Praharis were engaged by National Geographic Society in the India Chapter of 'Sea to Source' expedition on plastic waste. They were involved as local partners during both pre- and post-monsoon expeditions.

- 13** 149 Ganga Praharis actively participated in the management of Kumbh Mela at Prayagraj and carried out cleanliness drives, awareness campaigns, rescue of distressed aquatic animals, guided visitors to shelter and health camps and managed the Namami Gange Pavilion of NMCG (Annexure 8.1). As an appreciation of their sincere effort, those Ganga Praharis were felicitated by the Hon'ble Minister of Jal Shakti, Shri Gajendra Singh Shekhawat in New Delhi on the occasion of World Environment Day 2019.

Ganga Praharis involved in Kumbh Mela Prayagraj were felicitated by Hon'ble Minister of Jal Shakti, Shri Gajendra Singh Shekhawat



Figure 8.7 Investment of Ganga Prahari days towards the three objectives of the Kumbh Ganga Prahari programme



14 686 female and 27 male members of the Ganga Praharis were trained through 35 livelihood trainings in various sustainable livelihood activities such as sewing and stitching, value addition of local produce, health and wellness, nursery development, biodiversity-based tourist guide, fruit preservation, baking and handicraft making (Figure 8.8; Annexure 8.1). Two advance trainings were also conducted for the Ganga Praharis trained in sewing and stitching in collaboration with USHA Limited. To structure the livelihood trainings, six training manuals have been developed.

Figure 8.8 Location of livelihood centres along the Ganga River



15 To create market for the products created by the Ganga Praharis, a mobile country boat was developed as a livelihood centre called "Jalaj" at Varanasi. Jalaj comprises of a small shopping complex and sells the products produced in different villages situated along the Ganga River. A business model in collaboration with IBM USA was developed for the Jalaj (Figure 8.9).



Jalaj at Rajghat, Varanasi



Jalaj at Sahibganj, Jharkhand



Ganga Praharis welcoming the Hon'ble Minister of Jal Shakti Shri Gajendra Singh Shekhawat on Jalaj, who was also accompanied by Director General, NMCG Shri Rajiv Ranjan Mishra

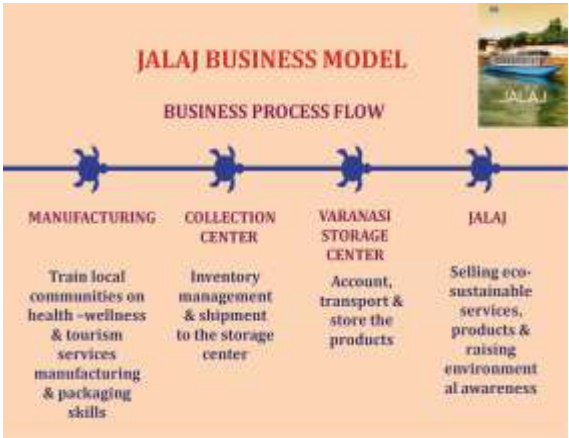
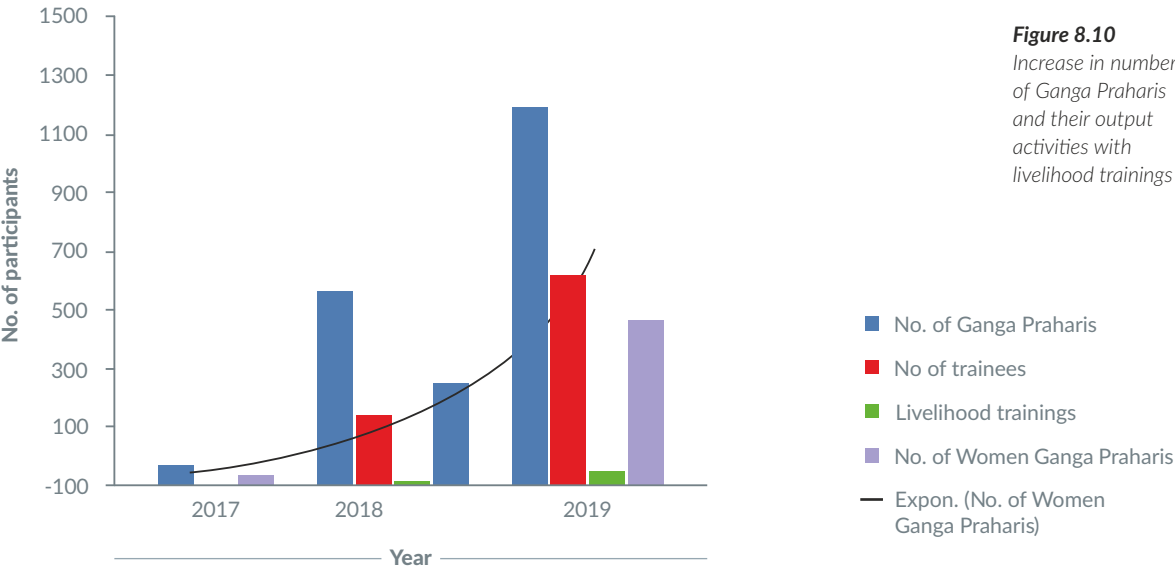


Figure 8.9 Business model developed for Jalaj in collaboration with IBM, US

16 The livelihood trainings developed capacities of local people to opt for sustainable alternative livelihoods and encouraged them to participate in the conservation activities, and established them as “Green Entrepreneurs”. As a result of a successful livelihood programme, the participation and output activities increased as more people joined the project as Ganga Praharis (Figure 8.10).

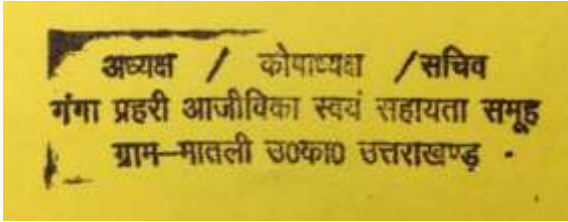


17 Questionnaire-based interviews with 213 Ganga Praharis trained during livelihood trainings in Narora, and Varanasi, Uttar Pradesh, and Sahibganj, Jharkhand, revealed that the average income of Ganga Praharis trained at livelihood centres has increased by ₹ 200-4,500 per month (Table 8.6).

Table 8.6
Increase in
monthly income
of trained Ganga
Praharis

S. No.	Training	No. of trainings	No. of Ganga Praharis	Increase in income (INR/month)	
				From	To
1	Sewing and stitching	17	368	200	4500
2	Prasad and incense stick making	5	92	500	2500
3	Jute bag making	1	20	100	500
4	Bakery	3	30	500	1500
5	Health and Wellness	3	80	2000	4500
6	Tourist guide	1	20	1000	3500
7	Nursery development	1	15	1000	3000
8	Handicraft	1	52	500	2500
9	Fruit processing and value addition	3	36	200	1500
Total		35	713	-	-

18 Women of Malti village in Dunda block of Uttarkashi district, Uttarakhand, are making rugs and mats using old plastic bags. The group has been formalised with a bank linkage with help from the WII, into a self-help group (SHG) — “Ganga Prahari Ajeevika Evam Sahayata Samuh”, which has been registered with the Integrated Livelihood Support Project in Uttarkashi District.

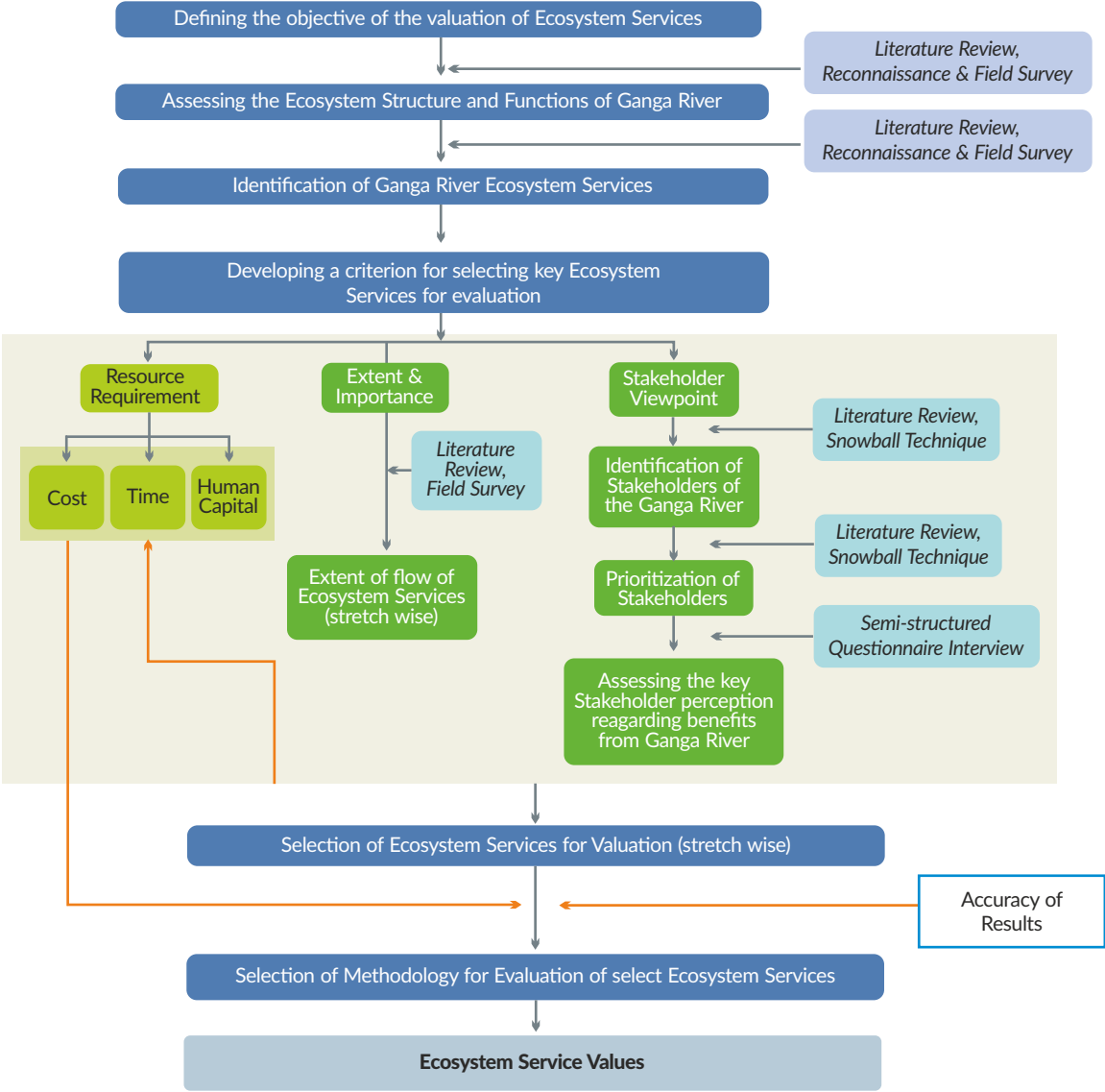


Official stamp of the self-help group “Ganga Prahari Ajeevika Evam Sahayata Samuh”



19 | A framework for evaluating select ecosystem services of the Ganga River at designated stretches was designed on the basis of the resource requirements (time, finance and human) (Figure 8.11; Annexure 8.1).

Figure 8.11
Framework for the evaluation of select ecosystem services of the Ganga River



Of the 22 key ecosystem services identified for the entire stretch, eight ecosystem services, namely, water for drinking and domestic use and power generation, benefits to agriculture (water for irrigation and soil fertility), riverbed material, provision of fish, water for transportation, recreational and religious/spiritual services, were selected for valuation, at select sites, based upon three factors, (a) the perception of various stakeholders regarding their contribution to human wellbeing and livelihood, (b) the extent and importance of services provided, and (c) the cost, time and man power requirement of conducting an evaluation (Table 8.7).

Table 8.7:
Ecosystem
Services provided
by Ganga River
and their extent

Ecosystem Services	Upper Ganga	Middle Ganga	Lower Ganga
Provisioning Services			
Consumptive use of water			
Drinking	•	●	●
Domestic use	•	●	●
Agriculture (irrigation)	•	●	●
Livestock (drinking, bathing etc.)	•	●	●
Industry	•	●	●
Non-consumptive use of water			
Power generation (hydro, nuclear and thermal)	●	•	•
Transportation	○	●	●
Resource Material			
Fish and other aquatic fauna for food	•	●	●
Fuelwood	•	•	●
Riverine vegetation for multiple uses	•	•	•
Riverbed material	•	●	●
Regulating & Supporting Services			
Maintaining population & habitat	●	●	●
Regulation of micro climate	●	●	●
Soil fertility	•	●	●
Soil formation (sediment deposition)	○	●	●
Water purification and waste management	●	•	•
Water cycle	•	•	•
Storm protection (through mangroves)	○	○	●
Cultural Services			
Tourism	●	●	●
Religious/Spiritual	●	●	●
Aesthetic	●	●	●
Heritage sites	●	●	●

Ecosystem Services: ○ → none; • → little/sometimes; ● → medium; ● → large

21 503 stakeholders belonging to different stakeholder groups were surveyed along the Ganga River. In Upper Ganga (Gaumukh to Haridwar; 175 respondents), water for drinking was the most cited ecosystem

service. Water for irrigation was the most cited ecosystem service in both Middle Ganga (Haridwar to Varanasi; 131 respondents) and Lower Ganga (Varanasi to Ganga Sagar; 197 respondents) (Figure 8.12 & 8.13, Annexure 8.1).

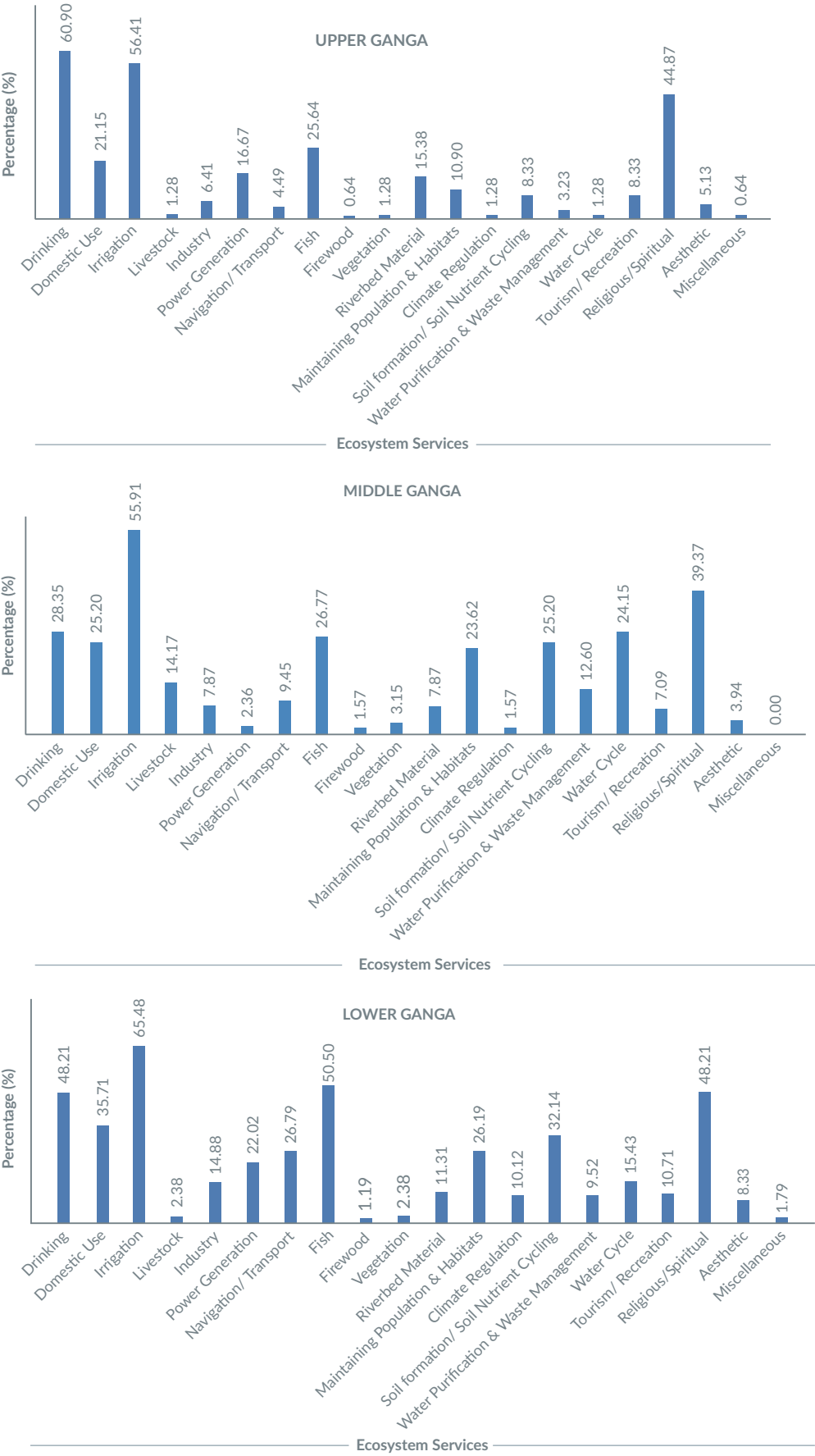


Figure 8.12
Ecosystem services cited by stakeholders from Upper, Middle and Lower Ganga stretches

Figure 8.13
Extent of the ecosystem services
provided by the Ganga River as
perceived by stakeholders from Upper,
Middle and Lower Ganga stretches



22 The water supply system of ten urban centres along the Ganga River i.e. Srinagar, Uttarkashi, Haridwar, Meerut, Kanpur, Mirzapur, Varanasi, Patna Urban Area, Bhagalpur and Kolkata Municipal Corporation, including Joka in southwest Kolkata, and Anandapur and Patuli areas in Eastern Kolkata, was examined. It was noted 1,574.29 MLD surface water and 1,008.68 MLD ground water is being withdrawn daily, valued at ₹51.79 million and ₹33.19 million, assuming constant utility per unit of consumption.

23 The Ganga states have a total cropped area of 45,955,000 ha (averaged over 2012-13, 2013-14, 2014-15), which comprises of 82.5% of the total geographical area of these states. There are an estimated 34,799,700 agricultural households (June 2012-July 2013) in the five Ganga states, which is 60.28% of the estimated 57,731,200 rural households. There are 12,847,402 cultivators and 18,645,163 agricultural labourers in the districts along the Ganga (Census, 2011).

24 In Upper Ganga and Alaknanda mainstem, there are currently nine commissioned hydro power plants (HEP) (>1 MW) with an estimated potential of 2,777.30 MW and annual generation of 10,441.54 million units. The Narora Atomic Power Station (NAPS) with an estimated potential of 440 MW, generates 3,402.50 (± 194.80) million units, annually between 2015-16 and 2018-19. Considering coal burning thermal power plants as the alternative, the nine HEPs and NAPS prevent the emission of an estimated 9.93 million tCO₂ and 3.22 (± 0.18) million tCO₂, respectively, annually (Figure 8.14).

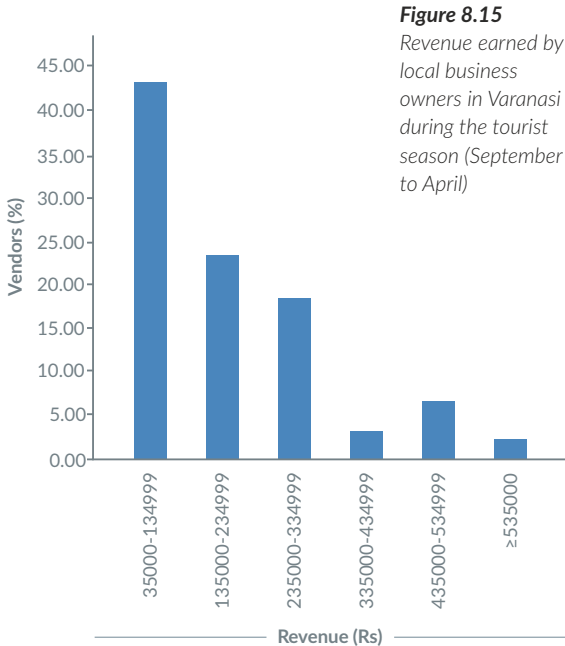
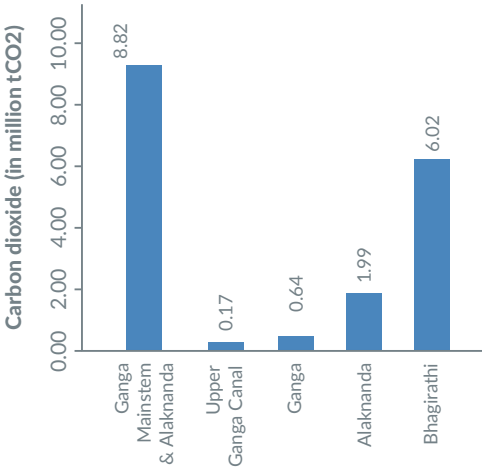
25 Inland waterways have the lowest comparative inter-modal cost of transporting freight at ₹1.06/TKm as opposed to ₹1.43/TKm for railways and ₹2.63/TKm for roadways. However, considering the inter-modal cost of transporting freight the entire length of the NW1 from Haldia to Prayagraj, railways is the most cost effective at ₹1,365.17/T followed by inland waterways at ₹1,717.20/T and roadways at ₹2,323.12/T.

26 In the Uttar Pradesh Ganga districts, 1,716,849 m³ quantity of sand was dispatched by lease holders on which they earned revenue of ₹547,263,143.80 (as on 27th January, 2020). The fertile alluvial Indo-Gangetic plains produce over 65% of the bricks manufactured in India (Centre for Science and Environment).

27 The annual contribution of fish catch from Varanasi and Narora to economy of local fishermen/vendors is ₹168,226.42 (± 316,996.52) and ₹355,200 (± 280,623.02), respectively.

28 Local business owners (110 respondents) were surveyed in Varanasi in order to assess the importance of tourism for their livelihood. 44.71% of the vendors that responded (85 respondents) earned between ₹35,000 and ₹134,999 during the tourist season (Figure 8.15). Vendors (136 respondents) at the Ardh Kumbh Mela 2019 in Prayagraj reported a 210.07% (± 238) increase in daily income during Kumbh, with an average daily income of ₹6,231.56 (± 26,852.17) during Kumbh as opposed to ₹2,251.79 (± 7,717.24) during business as usual scenario.

Figure 8.14
Emission of Carbon dioxide (in million tCO₂) prevented by the commissioned hydropower plants along Ganga mainstem and Alaknanda



29 A detailed Microplanning Guideline eliciting the significance and detailed procedure to prepare village microplans has been developed (Annexure 8.1). The document takes into consideration the Ganga conservation and village development challenges and has been prepared after consultations with multiple stakeholders and implementers.

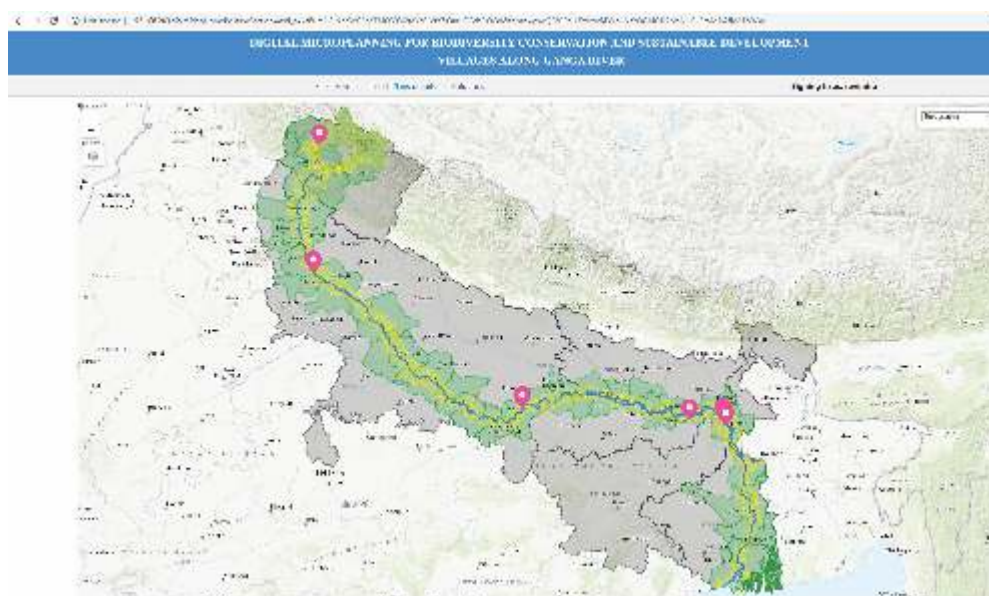
30 Based on the focus group discussions, questionnaire surveys, village meetings and the microplanning guideline, 12 village microplans were developed. These villages include Sirour in Uttarakhand; Rajghat, Udaigarhi, Domari, Tatepur, Rampur and Dhaka in Uttar Pradesh; Shahzadpur and Teentanga Diara in Bihar; and Maskaliyan, Ghat Jamini and Mokhipur in Jharkhand (Figure 8.16).

Figure 8.16
Spatial distribution of 12 villages for which microplans were developed



31 A digital framework of village microplans has been developed using various computer applications and softwares (Figure 8.17 and 8.18). This digital village microplan framework is active on the intranet services of the WII (<http://192.168.203.42/>).

Figure 8.17
Snapshot of webpage developed for digital village microplan and the villages where village microplans were developed are highlighted



PERSONAL INFORMATION

Personal Information

Name: Date of Birth: Sex: Marital Status: Religion:

Education

Level of Education: Field of Study: Degree:

Employment

Current Employer: Position: Date of Hire:

Housing

Current Address: Rental Status: Monthly Rent:

Health

Current Health Status: Date of Last Medical Checkup: Current Medication:

Social

Current Social Security Number: Date of Birth: Sex:

Other

Current Other Information: Date of Birth: Sex:

Figure 8.18
Snapshot of the
digital village
microplan data
collecting form

[illegible]

Figure 8.19
Prototype of
indicator form for
Biodiversity
Conservation
Strategic Plan

Source: Data collected from the field visits and interviews with the village leaders and community members.

Intervention	SDI Score (1-100)
Drinking water supply	60
Drinking water supply	30
Sanitation and WASH Management	40
Agriculture and Livelihoods	20
Sustainable Energy	60
Sustainable Livelihoods	30
WFP Culture	60
Women's Leadership	40
Forests	80

Figure 8.20
Snapshot of
Solution Page for
Community
Awareness
showcasing the
recommended
solutions under
High, Medium and
Low categories

Part 1 Community Awareness	
1. Awareness on conservation and use of biodiversity	
Rank: 1	Solution:
Meetings with local communities, Panchayat members, women and youth groups etc.	
Awareness on various government schemes and concerned departments.	
Liaison with concerned departments, block and district administration.	
Sensitization on various government schemes and concerned departments.	
Dissemination of films and documentaries and broadcast radio shows.	
2. Awareness on solid and liquid waste management	
Rank: 2	Solution:
Meetings on importance of solid and liquid waste management.	
Campaigns, street plays and wall paintings.	
Awareness on various government schemes and concerned departments.	
Liaison with concerned departments, block and district administration.	
Awareness programs and workshops in schools.	
Dissemination of films and documentaries and broadcast of radio shows.	
3. Awareness on renewable energy schemes, department and line agencies.	

29 An activity tracker has been developed online for the digital village microplan as a repository tool that will track the record of activities done by the local communities, Gram Panchayat, local institutions and other stakeholders with date and details of department (Figure 8.21).

Figure 8.21
Snapshot of
Activity Tracker of
Digital Village
Microplan

35 Key social and ecological issues/challenges identified in the 12 village microplans were lack of awareness among stakeholders on Ganga biodiversity conservation issues, dependence on resources of Ganga due to lack of livelihood alternatives, over exploitation of biological resources, non-functional or lack of local institutions, ineffective waste management, disposal of religious waste into the river, agricultural runoff, and lack of convergence between departments and sectors for implementation. Strategies were developed to address identified issues/challenges. Letters of consent have been signed by the Gram Pradhans of the 12 villages to ensure their support during implementation of the microplans.



8.5 Outcomes

1. Stakeholders and their roles were identified in the five Ganga River states. The sensitized and motivated stakeholders are conducting activities for biodiversity conservation including awareness programmes, plantation and cleanliness drives, rescue and monitoring of species of conservation concern.
2. The Memorandum of Agreements signed with village Pradhans are ensuring long-term association of local communities and local institutions with Ganga cleanliness and biodiversity conservation.
3. Synergistic alliances developed with government and non-government agencies are playing an important role in developing skills of the local communities, and ensuring sustainable livelihood development and their participation in conservation.
4. Trained Ganga Praharis along the mainstem Ganga River have become role models for their community members and are successfully mobilizing other community members. At places they have taken up leadership as group representatives of their communities and other institutions such as Gram Pradhan, District Coordinator of Nehru Yuva Kendra Sangathan and member of NMCG-WII team at WII. They are conducting conservation, cleanliness and awareness activities independently in their respective communities and villages.
5. The Ganga Praharis have become synonymous with the Namami Gange Programme and are actively participating in various state and national level programmes organized by WII, NMCG, State Forest Departments, National Geographic Society and other state, national and international organizations. They have been recognized and felicitated at various national and state platforms. Their activities have been regularly captured by both print and electronic media.
6. Cadre of Ganga Prahari mentors, Pravasi Ganga Prahari and Bal Ganga Praharis are ensuring sustained conservation activities for aquatic ecosystems from the grassroots to the global level.
7. Ganga Prahari programme has provided women of the rural households a unique opportunity to be in the forefront of conservation through various skill development workshops and economic development, which not only improved their mobility but also built their confidence to voice their concern for the Ganga River.
8. Site-specific livelihood interventions and self-sustaining model livelihood centre are strengthening youth and women self-help groups, building trust and creating a larger constituency for Ganga cleanliness and conservation.
9. The nine strategic areas in the microplans will contribute and support in strengthening the policies and regulations by filling in the identified knowledge gaps and developing research based conservation sensitive village development plans.
10. The village level development microplans will systematically address the issues and challenges of biodiversity and Ganga conservation, and internalize it with the mandate of various departments and schemes of Government of India.





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NATURE INTERPRETATION AND CONSERVATION EDUCATION

09

9.1 Introduction

Nature interpretation and education is integral to biodiversity conservation of the Ganga River. As an institution for dissemination of knowledge of natural or cultural heritage through provocation and revelation of the relationships and meanings of the natural environment (Orams, 1997), interpretation centres stimulates, facilities and extends people's understanding so that empathy and concern towards river and biodiversity conservation can be developed, prompting more responsible behaviour (Bramwell and Lane, 1993; Stewart et al., 1998). Local people can benefit from an interpretation programme, for instance, it increases their understanding of how they can contribute to the protection of an area's natural resources upon which they depend for subsistence or some form of income.



9.2 Objectives

1. Communicating to the community about the value of aquatic biodiversity and natural processes through the establishment of interpretation centres at three sites.
2. Educate and involve the public in the Ganga basin's natural systems by creating a network of community-based environmental education programmes.
3. Foster public awareness of the river ecosystem, its conditions and resources.

9.3 Methodology

Sites for the interpretation centres were selected based on the status of the river, significant biodiversity, the number of tourists or visitors, and availability of an existing building to house the interpretation centre. A building inside the Turtle Rescue and Rehabilitation Centre at Sarnath and the Allen building inside Kanpur Zoological Park was found suitable for establishment of interpretation centres. To create awareness on site, a mobile interpretation centre was also created. In this regard, a *bajra* (large country boat) on the ghats of Varanasi was identified and established as a floating mobile exhibition centre.

A need assessment survey was conducted to assess the visible interest of different stakeholders in floating exhibition, interpretation centre and conservation education programmes. Set of questionnaires were developed for different stakeholders like visitors, hoteliers, and schools to understand their information level about Ganga and its prevailing challenges. For conducting effective education programmes, the rural and urban government schools within 1 km to 8 km of the Ganga River and its tributaries in both Uttar Pradesh and Uttarakhand states were selected. Government schools were targeted initially for education programmes.

The training workshops for teachers were conducted with the aid of visual presentation and hands-on activities to impart clear understanding of river ecosystem, environmental concerns and develop skills to address environmental challenges. To assess the training effectiveness, feedback from teachers were also taken.

9.4 Key findings

- 1

Conservation education workshops were held at villages, towns and cities targeting students, teachers and representatives from other stakeholder groups to create awareness. Twenty one schools in both Uttarakhand and Uttar Pradesh were covered out of which 11 were from rural and seven from urban areas. 1,928 students were sensitized (Annexure 9.1).
- 2

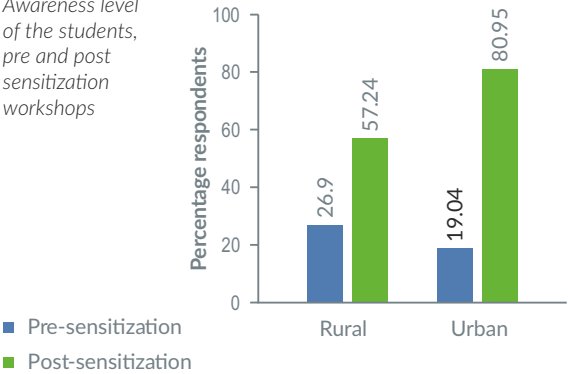
The ecological awareness increased among the stakeholders and students after the sensitization programmes (Figure 9.1 & 9.2).
- 3

Sensitization and orientation of 84 teachers on activities pertaining to Ganga conservation and cleanliness were conducted (Annexure 9.2).
- 4

An interpretation centre, 'Ganga Darpan' was established at Sarnath, it was inaugurated on 27th February 2019. The interpretation centre showcases Ganga as an integral part of our lives since ancient times. The centre aims to improve the image of the Ganga River from a highly polluted river to one that is appreciated for its aesthetic values and natural beauty (Annexure 9.3).

Figure 9.1

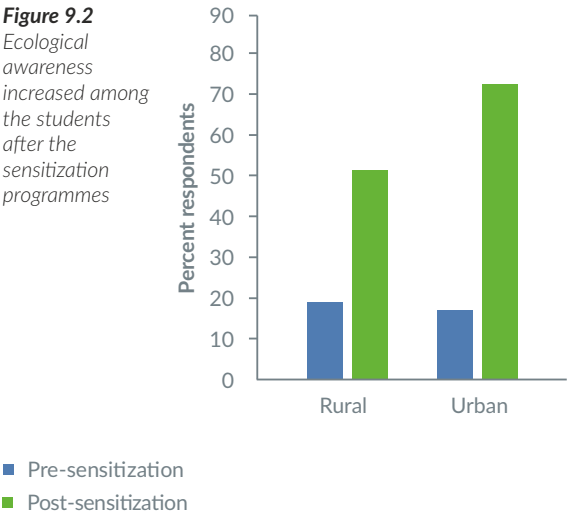
Awareness level of the students, pre and post sensitization workshops



Ganga Darpan, an interpretation centre at Sarnath

Figure 9.2

Ecological awareness increased among the students after the sensitization programmes



Information panel at Ganga Darpan reflecting ecological and cultural heritage of the Ganga River



Anubhuti Interpretation Centre



Panels and diorama creating mass awareness on the Ganga River and its biodiversity

5 | An interpretation centre, 'Anubhuti', was established at Kanpur Zoological Park, Kanpur and inaugurated on 24th January 2020 (Annexure 9.4).

6 | Mobile interpretation centre, 'Ganga Tarini', was established at Varanasi. This centre has created mass awareness among local community and visitors from India and other countries about Ganga River, its ecological and cultural heritage and people's role in cleaning and conservation of the river (Annexure 9.5).



Ganga Tarini at Varanasi creating awareness among the masses



- 7 To reach a wider audience, popular outreach activities such as wall paintings, puppet shows, *nukkad natak*, along with posters in e-rickshaws and temporary exhibitions along the ghats were regularly carried out.



Informative paintings in local boats at Varanasi



Awareness programmes with school children



Wall paintings



Puppet shows

8.5 Outcomes

- '1. Ganga Darpan received a total footfall of around 1,800 people till November 2019, creating a larger constituency for Ganga River cleanliness and biodiversity conservation.
- '2. Ganga Tarini received total footfall of 3,000 people till November 2019. This unique mobile interpretation centre is playing a key role in Ganga River cleanliness and biodiversity conservation by reaching out to people at the grassroots level.
3. The strategic location of 'Anubhuti' has a national reach and is creating awareness among the visitors. It has received a footfall of around 2,000 people till February 2020.
4. A system of continued education is in place for school children, which will mainstream nature education in schools.

भारत का सबसे ऊँचा पक्षी India's Tallest Flying Bird

भारत का सबसे ऊँचा पक्षी जो है, वह है गंगाईया। यह पक्षी भारत के पश्चिमी हिस्से में पाया जाता है। यह पक्षी बहुत बड़ा होता है और इसकी लंबाई लगभग 2.5 मीटर तक हो सकती है। यह पक्षी अपने लंबे गर्दन और पैरों के कारण बहुत ऊँचा उड़ सकता है।

गंगाईया आमतौर पर घास के मैदानों में पाया जाता है। यह पक्षी अपने लंबे गर्दन और पैरों के कारण बहुत ऊँचा उड़ सकता है। यह पक्षी अपने लंबे गर्दन और पैरों के कारण बहुत ऊँचा उड़ सकता है।

गंगाईया भारत का सबसे ऊँचा पक्षी है। यह पक्षी अपने लंबे गर्दन और पैरों के कारण बहुत ऊँचा उड़ सकता है। यह पक्षी अपने लंबे गर्दन और पैरों के कारण बहुत ऊँचा उड़ सकता है।

Ganges is the largest Indian crane that finds a reference in the Sanskrit literature as "Gangadhar". It is found in the Northern, Central and Eastern India, including West Bengal, Bihar and Punjab. In the Gangetic plains, it is now distributed in the middle stretch of the Ganga river and has been locally wiped out from West Bengal. Sarus lives in the agricultural lands, paddy fields, floodplains and dry grasslands and feeds on insects and seeds.

Loss of habitat such as natural wetlands has pushed these birds close to human dominated agricultural landscapes. Eggs and chicks are threatened because of dogs which feeds on the breeding success. Insects, harmful pesticides and electrocution which impacts the bird population.

Uttar Pradesh supports the largest population as compared to other States. Large congregation of breeding population have been located in the north-eastern region of the State.



The Ganga and its associated waterbodies attract large number of species of birds. Seasonally flooded wetlands, lakes and marshes around the river add to the diversity of habitats. Both resident and migratory species are spotted here. Lesser Adjutant, Sarus Crane, Puffin's Puff, Greater Spotted Eagle, Indian Skimmer and Black-bellied Tern are some of the globally threatened bird species that are seen in and around the Ganga river. Some of the common birds seen here include Blue Laysan, Painted Stork, Little Pheasant and several species of ducks, storks, herons, gulls, terns, kingfishers and waders.



पक्षी मित्र Feathered Friends

भारत में जीवों की बहुत ही प्रचुरता पायी जाती है। इनमें से बहुत से पक्षी हैं जो हमारे जीवन में बहुत ही महत्वपूर्ण भूमिका निभाते हैं। वे हमारे स्वास्थ्य और पर्यावरण को स्वस्थ रखने में मदद करते हैं।

Several hundred species of which a large number use the Indian Territory in winter season. Water birds are other organisms, considered indicators of ecological health of the water bodies and the land.





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KEY FINDINGS OF THE PROJECT AND LINKAGES WITH SDGS

10

10.1 Key findings of the project

The project “Biodiversity Conservation and Ganga Rejuvenation” under the aegis of NMCG, Ministry of Jal Shakti, successfully demonstrated science-based aquatic species conservation through the participation of stakeholders. The project adopted a systematic conservation planning approach. The project stressed on the fact that Ganga conservation is a societal responsibility and ensured sustained community participation in the biodiversity restoration process. The scientific findings of the project will play a key role in achieving the goal of *Aviral* and *Nirmal* Ganga of the *Namami Gange* Programme.

1. The project carried out comprehensive aquatic ecological surveys in the mainstem Ganga River from Devprayag in Uttarakhand to Nurpur in West Bengal. These surveys were first of its kind in that these were inclusive of the entirety of the mainstem Ganga and these established 32 intensive monitoring sites along it. These surveys



generated information on the status and distribution of several species of conservation concern along the mainstem Ganga and established that 49% of it still retains high biodiversity value.

2. From the results of these surveys, it was inferred that Protected Areas are the repositories of key aquatic species. Six high biodiversity areas and 13 conservation priority zones were identified along the mainstem Ganga. The priority zones can be conserved by strengthening legal protection and through support of the local communities. The thirteen conservation priority zones will be taken up for conservation planning in the Phase II of the project (Table 10.2).
3. The aquatic species assemblage and distribution along the Ganga River follows a natural pattern, and is determined by habitat heterogeneity. Headwaters of the Bhagirathi and Alaknanda rivers are ideal habitats for cold water fish species such as snow trout (*Schizothorax richardsonii*). The species prefers snow-fed torrential streams, however construction of dams and channelization of water for irrigation and

drinking, have created stagnant deep pools, which have affected snow trout populations.

4. Range reduction of Gangetic dolphin (*Platanista gangetica gangetica*), golden mahseer (*Tor putitora*) and hilsa (*Tenulosa ilisha*) in the Ganga is attributed to dams and barrages. Water abstraction from the Upper Ganga Canal at Bhimgoda in Haridwar, Middle Ganga Canal at Bijnor, and Lower Ganga Canal and Parallel Lower Ganga Canal at Narora has reduced the flow of the Ganga River to 10% of its natural flow regime, resulting in disruption of the horizontal and longitudinal connectivity between habitats for the priority species.
5. Bank feature alteration due to agriculture, construction and sand mining has disrupted the lateral connectivity of the river. Extensive bank and sandbar cultivation has rendered the habitat unsuitable for use as nesting sites by turtles and island-nesting birds.
6. The Tehri and Srinagar dams act as migration barriers, resulting in disconnected gene pools of the golden mahseer in the Bhagirathi, Alaknanda

and Ganga rivers. However, the monsoonal high flow and successive opening of barrage gates enable movements of fish, turtles and Gangetic dolphins and maintain genetic diversity in the Middle and Lower Ganga.

7. Water quality in the Middle and Lower Ganga is altered due to spillovers from domestic and industrial sources and non-point sources. The high concentration of pesticides, heavy metals, polychlorinated biphenyls and microplastics in sediment and fish samples is an evidence of continued usage of banned pesticides and fertilizers in agriculture and horticulture. Presence of microplastics such as polypropylene, polyethylene and polyvinyl aldehyde, predominantly in the Middle Ganga, is an indication that toxic micro-pollutants have already established their niche into the Ganga River ecosystem. Bio-magnification of these toxic compounds pose a health hazard to humans.
8. Most of the key aquatic fauna of the Ganga River are conservation dependent. Local extirpation is unavoidable without science-based conservation interventions. The project demonstrated that rescue and subsequent rehabilitation of confiscated and entrapped key aquatic species, if executed in scientific way, can be helpful in species restoration and assisted recolonization. The rescue centres established at Narora and Sarnath, are a part of the network to facilitate rescue and rehabilitation of distressed individuals of species of conservation concern. Capacities of forest department officials and field veterinarians from the five Ganga River states, in managing emergent situations of aquatic macro-fauna were strengthened through training and workshops. Additionally, a network of trained local community members are providing effective assistance in rescue and rehabilitation efforts. The role of the first responders, trained in rescue, handling, husbandry, veterinary care and rehabilitation techniques, is proving to be pivotal in aquatic species conservation.
9. To sustain on-ground conservation activities and ecological monitoring for evaluation of the success of conservation and restoration plans, building institutional, professional and vocational capacities of the primary stakeholders is critical. Spearhead teams were created for the forest departments of the five Ganga River states, and were trained at two national level training programmes. Spearhead teams are aiding in internalizing capacities for aquatic species conservation, monitoring and handling emergent situations. Enhancing the vocational and professional capacities of the forest departments has sustained on-ground conservation activities.
10. Local communities are supportive towards the Government's commitment for a clean Ganga and are actively participating in activities associated with Ganga conservation. Grassroots participation were enhanced through addressing the women and youth members of the local communities. A functional cadre of self-motivated Ganga Prahari has been established across the five Ganga River states. They are actively participating in local, regional and national events related to Ganga conservation. The Ganga Prahari programme has provided rural women a unique opportunity for economic upliftment and to be in the forefront of conservation via skill development training courses for livelihood intervention. The local community members were trained in livelihood activities, through integration of various schemes of the government and NGOs. Jalaj — a mobile livelihood centre at Varanasi, is a successful model of such intervention.
11. The Ganga River and its biodiversity can be protected through enhanced cooperation and locally relevant measures. Such measures include developing a platform for interaction, deliberation and consensus building for decision-making and their implementation. The Ganga Prahari cadre and the livelihood centres provide such platform to the local community members.
12. Transparency, coherence and ecosystem based incentives can minimize environmental, economic and social conflicts. Microplans were developed to bring transparency in the implementation of government schemes for village development in coherence to Ganga conservation. These microplans are digitized and are solution oriented, with a focus on Ganga conservation through mechanism for ecosystem based incentives.
13. Educating the masses about the importance of the Ganga River's biodiversity and the ways stakeholders can contribute to its conservation is indispensable to changing attitude. In view of this, nature interpretation centres '*Ganga Darpan*' at Sarnath, '*Ganga Tarini*' at Varanasi and '*Anubhuti*' at Kanpur were established. School teachers and students were sensitized on the topic 'Ganga and its aquatic biodiversity' through workshops, training programmes, mass media, interpretation centres and performing arts. These activities have resulted in behavioral changes and attitudinal shift towards the conservation of the Ganga and its biodiversity.
14. GACMC has been instrumental in spearheading Ganga conservation efforts, and gathering and disseminating information on the ecological and biological aspects of the river. GACMC as a centralized facility has also engendered stakeholder's co-operation by providing knowledge support to NMCG and is striving to provide scientifically relevant information for decision-making.

10.2 Project outcomes vis-a-vis Sustainable Development Goals (SDGs)

In 2015, the member states of the United Nations adopted Sustainable Development agenda to be achieved till 2030. The agenda is based on 17 Sustainable Development Goals (SDGs), and recognize that ending poverty must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – while tackling climate change and working to preserve the oceans and forests (UN, 2015).

The conservation of the Ganga River has the potential for addressing most of these SDGs through channeled priorities and management actions.

1. The river provides livelihood opportunities for people living on its basin (SDG1).
2. The Ganga basin is one of the most fertile river basins with more than 51% of the total basin area supporting agriculture to feed half of India's population (SDG 2).
3. The Ganga River and its floodplains support clean water, food and aesthetics, improving various aspects of quality of life and thereby, promoting overall good health, along with spiritual and cultural well-being (SDG 3).
4. The Ganga and its floodplain wetlands provide ample research opportunities for in-depth studies (SDG 4).
5. Improved water services will reduce gender inequality in water collection and management, a major issue in the Ganga River basin (SDG 5).
6. The river supports over one-third of the human population of the country, providing clean water among other resources (SDG 6).
7. Dams along the river provide affordable energy to millions of downstream users, extending to the basin. Efficient and wildlife friendly dam management with technological interventions will cut costs and ensure more resilient systems in the face of climate change (SDG 7).
8. The Ganga River offers diverse livelihood opportunities, which is being channeled to harness 3% of the Gross Domestic Product (GDP) through sustainable and viable economic development framework 'Arth Ganga' for the Ganga Basin (SDG 8).
9. New innovations using science and technology for water-based solutions can lead to advances in efficient use and economic development (SDG 9).
10. Rectifying access to water-use and imbalances in services and sanitation among the rich and poor can be neutralized through policy reforms (SDG 10).
11. Sustainable management of the land and water resources by the bank side communities (villages, towns and cities) will enhance productivity, and create sustainable cities and communities (SDG 11).
12. Water allocation for ecological flows will ensure sustainable consumption and production of water and water-associated resources (SDG 12).
13. Strong local institutions at the grassroots level will strengthen resilience and adaptive capacity through implementation of local disaster risk reduction strategies, thereby, ensuring climate actions across scales (SDG 13).
14. Improving the water quality of the Ganga River will have a positive impact on reducing ocean pollution. It will also sustain many important fisheries whose life cycles are dependent on both freshwater and marine ecosystems, such as the hilsa (SDG 14).
15. Adoption of water conservation techniques in the Ganga basin will improve the riparian habitats, thereby, directly impacting the terrestrial biodiversity of the basin (SDG 15).
16. Effective and sustainable management of the river and surrounding landscapes will strengthen existing local institutions and promote peace and justice (SDG 16).
17. A well-managed Ganga basin through multilateral collaborations at the global, regional, national and grassroots levels will enhance partnership at multiple scales and lead to sustainability and environmental justice (SDG 17).

■ The project has been instrumental in addressing 14 of the 17 SDGs through eight thematic areas for the Ganga River. The different components of the project have contributed to addressing at least a few targets within each SDG, which were validated through the indicators provided by the United Nations (UN, 2015). The details of the SDG linkages and the project components are given in Table 10.1.

Table 10.1
SDG mapping for the
NMCG-WII Biodiversity
Conservation and Ganga
Rejuvenation project

Thematic areas	SDGs covered	Project activities (SDGs- Sustainable Development Goals; PC- Project Component)
Ensure conservation of freshwater and/or riverine ecosystems by strengthening aquatic species conservation, through protection of the species, genetic and ecosystems diversity	  	1. Reviewed and consolidated literature on freshwater and/or riverine ecosystems, to strengthen the information on aquatic species of the Ganga River (SDG Targets 6.6, 15.1; PC- I).
		2. Conducted biodiversity assessments throughout the river to strengthen knowledge base on aquatic species and their habitats along the Ganga River (SDG Targets 6.6, 15.1, 15.5; PC – I, II).
		3. Conducted genetic study to assess genetic variability of species subjected to connectivity barrier (SDG Targets 6.6, PC- II).
		4. Conducted eco-toxicology studies to evaluate the level of bioaccumulation and magnification of toxic compounds in the river and their source (SDG Targets 6.3, 6.4, 6.6; PC- II).
		5. Evaluated the e-flow of the river to ensure sustainable water use (SDG Targets 6.4, 6.5, 6.6; PC- I).
		6. Prepared science-based river conservation plan for the Ganga River after critical examination of the global river conservation scenario and in consultation with relevant stakeholders (SDG Targets 6.4, 6.5, 6.6; PC- I).
		7. Prepared guideline documents for sustainable resource use, ecosystem services, stakeholder engagement, capacity building, and aquatic species restoration to aid in decision-making (SDG Targets 6.4, 6.5, 6.6; PC- I, III, V).
		8. Carried out afforestation activities with the support of state forest departments, local communities, village panchayats and Ganga Praharis to restore the riparian areas along the river (SDG Targets 6.6, 6b, 15.2; PC- V).
		9. Conducted wetland restoration activities along the river basin with local communities' participation (SDG Targets 6.6, 6b, 15.1; PC- I, V).
		10. Mainstreaming river and biodiversity conservation efforts through various publications and social platforms (SDG Targets 6.6, 6b; PC- I).
		11. Assessed the extent of plastic use along the river in collaboration with the National Geographic Society's "Sea to Source" expedition (SDG Targets 6.3; PC- II, V).
		12. Evaluated the trend of temperature and precipitation anomalies for three decades for the entire Ganga basin to identify areas vulnerable to climate extremes such as floods and droughts, and prepare guidelines to enhance local community's resilience to the same (SDG Targets 13.1, 13.3, 13b; PC-I).
		13. Enhanced the adaptive capacities of local communities, especially women, in the face of climate externalities through skill development trainings and creation of market chains for livelihood enhancement (SDG Targets 13.1, 13.3, 13b PC- V).
		14. Evaluated the status of Protected Areas (PAs) along the river for aquatic species restoration (SDG Targets 15.1; PC- I).
		15. Established rescue and rehabilitation centres for distressed aquatic animals and protocols for the same put in place to reduce poaching and trafficking of threatened species, and halt the loss of aquatic and associated species (SDG Targets 15.5, 15.7; PC- IV).
		16. Identified and assessed the ecosystem services provided by the Ganga River and developed strategies for inclusion in national and state level development planning (SDG Targets 15.9; PC- I, V).

Thematic areas	SDGs covered	Project activities (SDGs- Sustainable Development Goals; PC- Project Component)
Strengthen science-based capacity building of multiple stakeholders for freshwater and/or riverine ecosystem conservation.	  	1. Organized conservation education and awareness programmes targeting multiple stakeholders including local communities, schools and colleges, rural and urban governance bodies through use of multi-media (brochures, information booklets, TV and radio show, street plays, workshops, wall paintings, interpretation centres) (SDG Targets 6.6, 6b; PC- I, III, V, VI).
		2. Established a cadre of motivated and trained cadre of Ganga Praharis from the local communities in the five Ganga states. 1290 Ganga Praharis have been registered and trained in socio-economic and ecological surveys, community mobilization, rescue and rehabilitation, village microplanning activities (SDG Targets 6.6; PC- V).
		3. Developed a comprehensive Village Microplanning Guideline, and using this, prepared 12 village microplans in consultation with the local communities, institutions and local governments addressing issues of hygiene and sanitation, water-efficient agricultural systems and sustainable water use, biodiversity conservation, community awareness, livelihood and skill development. Additionally, developed digital microplans for ease of access (SDG Targets 6.6, 6b, 15.9, 15c; PC- V).
		4. Developed linkages with various government departments, training institutes, NGOs and other line agencies such as the state forest departments, district administration, PNB RSETI, USHA, HESCO, DST-SEED, Nehru Yuva Kendra Sangathan (NYKS), to reduce community's direct dependence on the resources of the river and to ensure mainstreaming biodiversity conservation in the mandate of these institutions (SDG Target 15c; PC- V).
		5. Curricula developed for capacity building of frontline staff and primary responders, including Ganga Praharis and other local people, for reporting species in distress and initiating their rescue, state forest department (SDG Target 15.7; PC- III).
		6. Identified Bal Ganga Prahari schools and conducted trainings for school children to create awareness about biodiversity conservation of the Ganga River (SDG Targets 4.7, 6.6; PC- III; V).
		7. Developed newspaper content for school children, as a medium to make them aware and disseminate knowledge on Ganga biodiversity conservation and river cleanliness (SDG Target 15.8; PC-III, V).
		8. Developed Teacher's Training Manuals to train school teachers in conservation education (SDG Target 4.7; PC- III; VI).
Promote sustainable utilization of goods and services provided by the freshwater and/ or riverine ecosystem aiming at management of ecosystem services.	   	1. Evaluated current scenario of human's use of the river's resources and mapped threats along the river to plan for sustainable resource use (SDG Targets 6.5, 6.6; PC- I)
		2. Prepared guidelines for the restriction on certain human activities and limitations on others to aid in decision-making (SDG Targets 6.4, 6.5, 6.6; PC- I).
		3. Conducted awareness programmes on sustainable consumption and production especially with regard to agriculture and water abstraction from the Ganga River (SDG Target 8.4; PC- V).
		4. Disseminated information on promoting environment friendly and resource conservation technologies in agriculture (both on-farm and off-farm) with the support from concerned government departments (SDG Target 12.2, 12.3, 12.8;12b PC- I, III, V, VI).
		5. Developed skills of the local communities dependent on the river's resources for alternative livelihood generation to reduce the pressure on the river and its resources (SDG Target 2.3, 12.2; PC- V).
		6. Conducted workshops on 'Value from Waste' with school children of villages located along the Ganga River (SDG Target 12.2; PC-V).

Thematic areas	SDGs covered	Project activities (SDGs- Sustainable Development Goals; PC- Project Component)
Promote gender equality by ensuring equitable learning opportunities.	    	- Strengthened women Self-help groups (SHGs) along the Ganga River (SDG Targets 5.5, 8.3, 10.2; PC- V). - Organized skill enhancement, livelihood trainings and capacity building programmes for youth and women, including Ganga Praharis, through various government skill development programmes and schemes such as Green Skill Development Programme (GSDP), Pradhan Mantri Kaushal Vikas Yojna (PMKY), DST- SEED, Rural Self Employment Training Institute (RSETI) including trainings in micro-financing by linking with banks (SDG Targets 4.4, 8.3; PC- III, V). - More than 50% of women Ganga Praharis were trained in sewing and stitching, health and wellness making of value added food products in livelihood centres established in the villages along the Ganga River. Trained women and local youth in micro-financing by linking with banks (SDG Targets 2.3, 4.4, 4.7, 8.3; PC- V).
Achieve economic growth by promoting sustainable livelihood opportunities and strengthening local economy.	   	- Strengthened existing SHGs and institutionalized the prospective ones to enhance the local economy and reduce dependence on the river and linked them with potential collaborators and donors such as HESCO, USHA, ENVIS MoEF&CC, PNB RSETI (SDG Targets 1.4; 1.5; PC- V). - Established Jalaj- a floating market, as a platform for enhancing market linkages through value addition of local produce by the women SHGs, which is contributing to income diversification and economic growth (SDG Targets 1.4; 9.3; PC- V). - Encouraged the local communities to open bank accounts, established bank linkages for the existing SHGs and established new institutions under the National Rural Livelihood Mission (NRLM) for micro-financing and loans (SDG Target 8.1; PC- V). - Developed linkages with government and non-government organizations and programmes such as Green Skill Development Programme (GSDP), Rural Self Employment Training Institute (RSETI) for skill enhancement trainings and green entrepreneurial skills (SDG Targets 8.3, 8.4; PC- V). - Installed solar panels in Jalaj (Varanasi) provided by the Uttar Pradesh New and Renewable Energy Development Agency (UPNREDA), to promote clean, efficient and sustainable energy resource (SDG Target 9.4; PC- V). - Liaison with the Nagar Palikas, Municipal corporation for domestic waste management. With active participation from local communities and Ganga Praharis, organized awareness programmes, rallies and drives on cleanliness and waste management (SDG Target 11.6; PC- V).
Internalize freshwater and/or riverine ecosystem conservation across government and society by developing strong and effective institutions.	 	- Established a cadre of motivated and trained volunteers from among the local communities known as Ganga Prahari, to be at the forefront of conservation efforts. (SDG Target 16.6, 16.7; PC- V). - Created platforms such as Ganga Prahari Mentor (for Indian citizens) and Pravasi Ganga Prahari (for foreign nationals and NRIs) for mass awareness and participation in Ganga River conservation (SDG Targets 16.6; 17.16, 17.17; PC-V).

Thematic areas	SDGs covered	Project activities (SDGs- Sustainable Development Goals; PC- Project Component)
Promote local, regional, national and international cooperation and partnerships in conservation of freshwater and/or riverine ecosystems through participatory planning and decision-making processes at multiple levels.	  	1. Mobilized and increased financial resources through various governmental and non-governmental organizations and institutions to conserve and sustainably use biodiversity and ecosystems (SDG Target 15a; PC- V). 2. Analyzed Indian policies to identify their mechanisms at the regional and state levels to achieve global conservation goals and targets in order to achieve coherence (SDG Target 17.14; PC- I). 3. Signed Memorandum of Agreement (MoA) with Gram Pradhans of Gram Panchayats located on the banks of the Ganga River for their support in conducting Ganga conservation activities (SDG Targets 16.6, 17.17; PC-V). 4. Signed Memorandum of Understanding (MoU) with USHA Ltd. for collaboration in organizing and conducting livelihood activities such as sewing and stitching for local communities residing along the Ganga River (SDG Targets 6.b, 17.17; PC-V). 5. Organized capacity building trainings for Ganga Praharis with the support from Ganga Task Force (GTF), District Administration of Prayagraj, Kumbh Mela Pradhikaran, Parmarth Niketan Ashram (SDG Target 17.17; PC-V). 6. Collaborated with Corporate Services Corps IBM team in developing a business plan for the Ganga Praharis and enhance the replicability and scalability of the established Jalaj. (SDG Target 17.16; PC-V). 7. Collaborated with Panorama: Solutions for a Healthy Planet, a web platform of IUCN to develop case studies regarding social and ecological aspects of Ganga River conservation (SDG Target 17.6; PC-I). 8. Using ESRI Map Story platform a story map of Ganga Parahris was developed for awareness and information dissemination regarding Ganga conservation efforts to the masses (SDG Target 17.6, PC-V).
Underpin integrated river basin management in development planning, decision and policy-making processes.	 	1. Incorporated Integrated River Basin Management in river conservation planning for sustained management of the resources of the Ganga River (SDG Targets 6.4, 6.5, 6.6; PC- I). 2. Assessed current river policy scenario to address information gaps and aided in horizontal and vertical policy integration, and sectoral coherence (SDG Target 17.14; PC- I).

Table 10.2 Conservation Priority Zones along the Ganga River

Conservation priority zones	Location		Length (km)	Prescription
	From	To		
1	Abusaidpur, Bijnor, Uttar Pradesh (50 km from Haridwar)	Bangarpur, Amroha, Uttar Pradesh (155 km from Haridwar)	110	- This stretch is a part of the Hastinapur Wildlife Sanctuary. - It can be designated as a potential rehabilitation site for conservation dependent species such as gharial and turtles. - Agriculture along the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - This stretch can be also be developed for eco-tourism under the purview of Arth Ganga.
2	Sisaiganj, Aligarh, Uttar Pradesh (245 km from Haridwar)	Rikera, Kasganj, Uttar Pradesh (305 km from Haridwar)	65	- This stretch has good congregations of waterbirds and turtles, and thus may be designated as a Conservation Reserve. - This site offers good habitat conditions for conservation dependent species, hence may be taken up as a potential reintroduction site. - Community based in-situ conservation of turtles and communal nesting islands of turtles as well as resident waterbirds may be carried out. - Agriculture along the river bank is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed.
3	Kaimganj, Farukhabad, Uttar Pradesh (350 km from Haridwar)	Kannauj, Uttar Pradesh (450 km from Haridwar)	105	- This stretch may be designated as eco-sensitive area (ESA) as it includes the confluence with Ramganga River, providing connectivity (corridor for movement of aquatic species) and contributing about 29% to the flow of the mainstem Ganga. - The stretch also supports a good population of waterbirds and turtles, hence may be protected as Conservation Reserve. - Flow augmentation in the Ramganga River through the restoration and revival of wetlands, and afforestation to augment riparian cover would contribute to the flow of the Ganga River. - TC increased in this stretch downstream of Ramganga confluence, hence there is an urgent need to check on wastewater inflow from point sources (drains) along the Ramganga River. - Agriculture along the river bank and in the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods.
4	Saharia Salempur Gairis, Unnao, Uttar Pradesh (485 km from Haridwar)	Ghahpur, Kanpur, Uttar Pradesh (510 km from Haridwar)	30	- This stretch has good habitat conditions except for high TC, hence there is an urgent need to check on wastewater inflow from point and non-point sources before this stretch as well as along this stretch. - The stretch is a potential rehabilitation site for key aquatic species. - Agriculture along the river bank and in the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods.

Conservation priority zones	Location		Length (km)	Prescription
	From	To		
5	Haripur, Rae Bareli, Uttar Pradesh (585 km from Haridwar)	Tanda, Fatehpur, Uttar Pradesh (610 km from Haridwar)	30	- The stretch has high habitat heterogeneity with a good combination of deep and medium pools, and hence Gangetic dolphins are frequently sighted. In view of this, the stretch may be designated as eco-sensitive area (ESA) and eco-tourism under the purview of Arth Ganga may be promoted. - TC is high in this stretch due to sewage inflow from Kanpur city, hence the wastewater inflow from point sources (drains) needs to be checked. - Agriculture along the river bank and in the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods.
6	Gospur Kachhar, Kaushambi, Uttar Pradesh (725 km from Haridwar)	Mand, Prayagraj, Uttar Pradesh (785 km from Haridwar)	65	- Yamuna and Tamas confluences provide connectivity (corridor for movement of aquatic species) and substantial flow to the mainstem Ganga in this stretch. Communal nesting islands of turtles as well as resident waterbirds along this stretch need protection. - This stretch may be declared as eco-sensitive area (ESA) and construction of any permanent structure may be prohibited and/or regulated. - TC is high in this stretch due to sewage inflow from Prayagraj city, hence the wastewater inflow from point sources (drains) needs to be checked. - Eco-tourism may be promoted under the purview of the Arth Ganga programme. - Agriculture along the river bank and in the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - This stretch falls under National Waterway 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels.
7	Revelganj, Saran, Bihar (1195 km from Haridwar)	Patna, Bihar (1255 km from Haridwar)	65	- The river confluences (Ghaghara, Son and Gandak) in this stretch provide vital ecological connectivity and is prone to monsoonal floods. In view of this, these confluences may be designated as Eco-sensitive area (ESA). - TC is high in this stretch due to high influx from Patna city, hence the wastewater inflow from point and non-point sources need to be checked. - Resource extraction in this stretch needs to be regulated through provisions of the Bihar Fisheries Policy, 2008 and Environment (Protection) Act, 1986. - Agriculture along the river bank is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - This stretch falls under National Waterway 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels.

Conservation priority zones	Location		Length (km)	Prescription
	From	To		
8	Raghopur, Vaishali, Bihar (1275 km from Haridwar)	Barauni, Begusarai, Bihar (1335 km from Haridwar)	65	- Resource extraction in this stretch needs to be regulated through provisions of the Bihar Fisheries Policy, 2008 and Environment (Protection) Act, 1986. - Agriculture along the river bank is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - This stretch falls under National Waterway 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels.
9	Shahbegpur, Begusarai, Bihar (1380 km from Haridwar)	Bhagalpur, Bihar (1470 km from Haridwar)	95	- This stretch is located upstream of VGDS and may be designated as Eco-sensitive area (ESA) to provide a buffer to the Sanctuary from the high anthropogenic impacts along the stretch. - Agriculture along the river bank is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Resource extraction in this stretch needs to be regulated through provisions of the Bihar Fisheries Policy, 2008 and Environment (Protection) Act, 1986. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - To link livelihood of local communities with river and biodiversity conservation, eco-tourism may be promoted under the purview of Arth Ganga. - This stretch falls under National Waterway 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels.
10	Jot Talih, Katihar, Bihar (1540 km from Haridwar)	Rostampur, Maldah, West Bengal (1600 km from Haridwar)	65	- The Farraka barrage has resulted in stagnancy and sediment deposition upstream of the barrage. - Agriculture along the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Resource extraction in this stretch needs to be regulated through provisions of the Bihar Fisheries Policy, 2008, The West Bengal Inland Fisheries Act, 1984 and Environment (Protection) Act, 1986. - To link livelihood of local communities with river and biodiversity conservation, eco-tourism may be promoted under the purview of Arth Ganga. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - This stretch falls under National Waterway 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels.

Conservation priority zones	Location		Length (km)	Prescription
	From	To		
11	Amuha, Murshidabad, West Bengal (1650 km from Haridwar)	Maliapara, Murshidabad, West Bengal (1710 km from Haridwar)	65	- Agriculture along the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - High fishing intensity may pose threat to dolphin and turtle population and thus may be regulated through the provisions of the West Bengal Inland Fisheries Act, 1984. - This stretch falls under National Waterways 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels. - The stretch is part of the up-stream migratory route of the Hilsa, therefore regulation of the catch of the migrating population shall be enforced under the purview of the West Bengal Inland Fisheries Act, 1984.
12	Char Brajanathpur, Bardhaman, West Bengal (1815 km from Haridwar)	Jaluidanga, Nadia, West Bengal (1885 km from Haridwar)	75	- The stretch is downstream of confluence with Ajay river. - Agriculture along the riverbed is high that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - To link livelihood of local communities with river and biodiversity conservation, eco-tourism may be promoted under the purview of Arth Ganga. - High fishing intensity may pose threat to dolphin and turtle population and thus may be regulated through the provisions of West Bengal Inland Fisheries Act, 1984. - This stretch falls under National Waterways 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels. - The stretch is up-stream migratory route of the Hilsa, therefore regulation of the catch of the migrating population shall be enforced under the purview of the West Bengal Inland Fisheries Act, 1984.
13	Maheshtala, South 24 Pargana, West Bengal (2020 km from Haridwar)	Burul, South 24 Pargana, West Bengal (2045 from Haridwar)	30	- Agriculture along the riverbed is moderate that has the potential of conversion into an organic system, provided that linkages with agencies that build capacity for organic farming and certification of organic products are developed. - TC is high in this stretch due to sewage inflow from Kolkata city, hence the wastewater inflow from point sources (drain) needs to be checked. - Fishermen may be sensitized and involved in conservation activities and their capacities may be developed in alternate or secondary livelihoods. - High fishing intensity may pose threat to dolphin and turtle population and thus may be regulated through the provisions of West Bengal Inland Fisheries Act, 1984. - This stretch falls under National Waterways 1 and hence preventive and corrective actions may be adopted to avoid accidental mortality of key aquatic species, water pollution, wave and wake, underwater noise and sediment resuspension from the movement of large vessels. - The stretch is up-stream migratory route of the Hilsa, therefore regulation of the catch of the migrating population shall be enforced under the purview of the West Bengal Inland Fisheries Act, 1984.

Table 10.3 Log-frame depicting the component wise achievements and outputs for Phase I, NMCG WII Project

1st COMPONENT

ESTABLISHMENT OF GANGA AQUALIFE CONSERVATION MONITORING CENTRE

Objective: 1 Build up scientific knowledge base on aquatic wildlife of Ganga River Basin in accordance with the objectives of the proposed Ganga Knowledge Centres.

Proposed	Achieved	Outcomes
- Literature review and baseline survey for assessing the biodiversity and its conservation status in Ganga River Basin. Proposed output: Consolidated study report on the biodiversity conservation status of Ganga River.	- Information on status of biodiversity and issues of Ganga River consolidated through extensive literature review and a resource repository established at GACMC. - Studies focusing Ganga River (n=3500) were reviewed for extracting information on mammals (n=90), birds (n= 46), reptiles (n=76), amphibians (n=30), fishes (n= 145) and threats (78). - Five comprehensive ecological surveys from Devprayag to Nurgpur covering 2200 Km conducted to determine occurrence and distribution of species of conservation concern and their habitat condition.	Study reports- - Macrofauna of the Ganga River: Status and Conservation of Select Species. - Ganga River State of Biodiversity at a Glance Books- - Glimpses of Ganga Series (I and II). - Wings of Ganga Series (I, II and III). - Binding Roots. - Information on status of aquatic fauna. - Identified and mapped threats to biodiversity along the Ganga River. - Conservation priority zones identified. - These resources are extensively referred by NMCG, Forest Departments, Line agencies and Universities for scientific studies and general information.

Remarks- 100% Achieved

Objective: 2 Disseminate the knowledge on Ganga to the general public and scientific community through printed and electronic medium.

Proposed	Achieved	Outcomes
Publications in the form of popular and research articles and documentaries on the resources of Ganga. - Established an online portal for dissemination of information to public on Ganga. Proposed output: A website 'biodiversity information system' for dissemination of information to general public on Ganga.	- Print media viz. press release (17 newspapers), brochures (n= 25), standees (n=50), species message canvas (n=12), wall paintings (n=800) used in five Ganga River states. - Scientific information published as research articles, abstracts and solution based case studies on Ganga River (n= 96). - National (n=5) and International (n=3) workshops attended to present the studies related to Ganga River. - Electronic media viz. Radio Talk show (AIR FM), TV Interviews (2 channels) and TV series (2 channel). - Webpages viz. NMCG-WII, Ganga Prahari and Pravasi Ganga Prahari https://wii.gov.in/nmcg/national-mission-for-clean-ganga https://nmcg.nic.in/wii/prgbgsp.aspx https://nmcg.nic.in/pravasigangaprahari.html	Print Media - Press releases- 225 in Hindi, English and Bangla - Brochures on mammals, birds, crocodile, turtle, amphibian, fish and migratory waterbirds were published in Hindi, English and Bangla language - About 60,000 brochures distributed - Bilingual standees displayed at key airport, workshops and events across Ganga River states. Scientific Publications Articles- - Hussain et al. (2020). <i>Landscape Research</i>. - Irengbam et al. (2019). <i>Down To Earth</i>. - Sangha et al. (2019). <i>Ecosystem Services</i>. National Workshops 80 abstracts presented during Ganga Research Seminar conducted at WII from 2018-2019, which included 21 presentations, 36 e-posters and 23 standees. - Three abstracts presented in Annual Research Seminar at WII between 2017 and 2019.

	chieved	Outcomes
	- Social media, viz. Facebook, Instagram, and YouTube https://www.facebook.com/glimpsesofganga/ https://www.facebook.com/PravasiGangaPrahari/ https://www.instagram.com/glimpsesofganga/ https://www.youtube.com/channel/UC_YXsLpYQu4FNWVIE0CdEaA	International conference - SSC Leaders' Meeting 2019 at Abu Dhabi, UAE, October 2019. - Water future conference at Bengaluru, India, September 2019. - Our Biodiversity, Our Food, Our Health held in New Delhi, India, May 2019. - Seven solution case studies were submitted through online platform PANORAMA Solutions for a Healthy Planet. Electronic Media - Radio talk shows- 11. - TV interviews- 13. - TV series- Two episodes in Rag Rag Mein Ganga, One episode in NDTV- Usha Kushalta Ke Kadam and one in NDTV-Behatar India. - Webpages- 55910 views. - Developed data collector android app. Social Media - Facebook- 1,195 followers. - Instagram- 272 followers. - YouTube- 11,958 channel views, 89 subscribers and 8 documentaries with 11,539 views.

Remarks- 100% Achieved

Objective: 3 Promote sustainable utilization of goods and services provided by the riverine ecosystem by developing stake of local communities in conservation efforts in consonants with the Indian cultural and socio-economic milieus.

Proposed	Achieved	Outcomes
- A 'guideline document' to integrate ecosystem service values of riverine ecosystem into management planning. Proposed output: Preparation of a 'guideline document' to integrate ecosystem service values of riverine ecosystem into the conservation planning.	- Literature review carried out to consolidate the information for stakeholder framework (n= 500), river ecological status (n= 221), river conservation approaches (n = 1000). - Five comprehensive ecological surveys from Devprayag to Nurgpur covering 2200 Km conducted to assess ecological integrity of Ganga River. - Prepared framework document through identification of stakeholders of the Ganga River. - Prepared guideline document, providing recommendations to involve stakeholders and integrate their interests in the conservation management of aquatic wildlife of Ganga River. - Reviewed policies of various sectors and Key Messages for the Policy Makers prepared.	Framework- Stakeholder for Ganga Aqualife conservation: Achieving Coherence in Diversity. Guideline document- Ecological integrity assessment and recommendations. - Policy pathways and strategies developed to involve stakeholders and integrate their interests in the conservation management of aquatic wildlife of Ganga River.

Remarks- 100% Achieved

Objective: 4 Develop national guidelines for considering the needs of aquatic fauna in planning and execution of water development and promote these guidelines.

Proposed	Achieved	Outcomes
- Preparation of a 'guideline document' for development planners to integrate the requirement of the aquatic fauna of Ganga River. - Coordination meetings with the managers and policy maker to sensitize them on the needs of aquatic fauna and integration of conservation priorities into the development planning process. Proposed output: - A guideline document for considering the needs of aquatic fauna in planning and execution of water development and promote these guidelines by sensitizing the policy makers.	- Occurrence and distribution of species of conservation concern, habitat condition and anthropogenic influence mapped on GIS domain. - Coordination meetings with managers and policy makers conducted. - Launch Workshops- National and state level to sensitize line agencies, policy makers, scientists, universities and general public.	Published Guideline documents- - Prepared conservation action plan for Gangetic dolphin for 2020-2030, "Conserving Gangetic Dolphin Smart strategy implementation and Adaptive Management for the Ganga River. - Issues and need of aquatic fauna were addressed at different platforms to promote species conservation and influence policy decision. - Proposed 140 km turtle sanctuary in mainstem Ganga River downstream of Newada in Allahabad district to Adalpur in Mirzapur district, on basis of ecological requirement of aquatic species, particularly turtles.

 **Remarks- 100% Achieved**

Objective: 5 Develop a Centre of International Importance on Aquatic Wildlife and Natural Resource Conservation.

Proposed	Achieved	Outcomes
- Establish a fully functional Ganga Aqualife Conservation Monitoring Centre. Proposed output: - A fully operational Ganga Aqualife Conservation Monitoring Centre.	- A fully operational 'Ganga Aqualife Conservation Monitoring Centre' established at Wildlife Institute of India, Dehradun as a centralized knowledge repository and nodal agency for policy support on biodiversity and Ganga River conservation. - Awareness programs on important days like Dolphin day, World environment day and Biodiversity day were coordinated with NMCG. - Progress of project was continuously monitored and recommendations were incorporated as correction. - Three monitoring committee meetings held at WII, since 2017. - WII collaboration with NGS for "Sea to Source Ganga Expedition".	- Team of 65 trained and experienced project personnel conducting ecological assessment, ensuring community participation and supporting NMCG and Ministry of Jal Shakti in Parliamentary queries, RTI questions, and other legal queries about biodiversity of the Ganga River. - Provided institutional support to the line agencies and other stakeholders, viz. NMCG, SPMG, NPCIL, NGOs, forest department, Ganga organization, Ganga vichar manch and universities. - Launch of project river dolphin was discussed as an important agenda in the 1st National Ganga Council meeting (14 December, 2019). Published Reports- - Biodiversity conservation and Ganga Rejuvenation (Phase I&II)/annual report. - Biodiversity conservation and Ganga Rejuvenation Bihar (INTERIM REPORT). - Mission Gange River Rafting Expedition A Report. Published Brochures- - NMCG and WII initiative- Biodiversity conservation and Ganga Rejuvenation. - Wetland and water programme. - Narora Atomic Power Station. - Wall Calendar- 2020

	Outcome
	Second phase of the Project “Planning and Management for Aquatic Species Conservation and Maintenance of Ecosystem Services in the Ganga River Basin for Clean Ganga” was initiated.

Remarks- 100% Achieved

2nd COMPONENT

PLANNING AQUATIC SPECIES RESTORATION FOR GANGA RIVER

Objective 1: Derive empirical relationships between river conditions and ecological status of the major species so as to determine the desired future state

Proposed	Achieved	Outcome
- Document abundance of conservation significance species including River dolphins and their habitat for select stretches of the Ganga River. - Assessment status of various environmental factors such as water depth, water quality and anthropogenic activities for select stretches of the Ganga River.	- Relative abundance of conservation significant species such as Gangetic dolphin, turtles and gharial was documented for entire Ganga River. - Abundance of lower taxa such as amphibians, fishes and Odonate (dragonfly) and their associated habitat variables were documented. 32 intensive monitoring sites were established along the mainstem Ganga River. At each site biodiversity profile, habitat features and status of water quality were documented.	- A book entitled “Biodiversity profile of Rive Ganga” was published. This book contains 11 chapters describing status of conservation significant species, status of environmental & water quality variables at different sections of the Ganga River. - A report on wildlife value of the Ganga River from Bijnor to Ballia including Turtle Wildlife Sanctuary “Assessment of wildlife values of Ganga River from Bijnor to Ballia” was published.

Remarks- 100% Achieved

Objective 2: Derive the current trend in genetic variability and gene flow of the critically endangered and endangered species which might have been disrupted due to fragmentation of the longitudinal connectivity of the river

Proposed	Achieved	Outcome
- Assessment of DNA sequence of species of conservation significance and genetic variability within the species. - Document extent of genetic variability and gene flow of the critically endangered and endangered species.	- Genetic status and genetic diversity of conservation significant species, golden mahseer, snow trout, goonch, soft shell turtles and roofed turtle were documented. - The extent of gene flow between different populations of golden mahseer was established.	- A chapter containing information on genetic status, diversity and gene flow of endangered fish was included in 'Biodiversity profile of Rive Ganga'. - A separate report on “Genetic status and gene flow of selected aquatic species” was produced. - Published scientific paper “Yadav et al (2020). PLOS ONE”.

Remarks- 100% Achieved

Objective 3: Assess the concentration of key pollutants in species of conservation significance that may affect their long term survival.

Proposed	Achieved	Outcome
- Assessment of physico-chemical parameters and organochlorine pesticides in water and sediments of the river Ganga. - Document level of pollutants such as heavy metals pesticides and polychlorinated biphenyls on abiotic and biotic Components.	- Status of physico-chemical, heavy metal and organochloride pesticides in 32 intensive monitoring sties was generated. - Major pollutants such as pesticides, heavy metals, polychlorinated biphenyls and micro-plastics load in abiotic (water and sediment) and biotic (fish) samples in river Ganga were documented. - Based on Risk Quotient analysis the lower zone of Ganga (West Bengal) sector was identified as high risk zone in terms of heavy metal, pesticide pollution. - High amount of pesticides classes such as chlordanes, OPPs, DDE, Drins were detected in different fish species.	- A chapter containing information physico-chemical, heavy metal and orgaochloride pesticides in 32 intensive monitoring sties was included in Book titled 'Biodiversity profile of Rive Ganga'. - A comprehensive report titled "Eco-Toxicological Survey Report: An assessment of seasonal variations in surface water quality of river Ganges" was publshied. - Published scientific paper "Sah et al (2020). <i>Environmental Pollution</i>".

 **Remarks- 100% Achieved**

Objective 4: Map the areas of high species diversity in GIS domain where natural significance that may affect their long-term augmented.

Propose	Achieve	Outcome
- Prepare spatial database on aquatic wildlife, habitat condition and areas with potential to augment the growth of wildlife population created and spatial risk maps created. - Prioritize conservation areas within the select stretches.	- Spatial database on aquatic wildlife, habitat condition and areas was prepared. - Maps of areas with high conservation significant area were generated.	- Spatial database on aquatic wildlife and associated habitat is readily available with Ganga Aqualife Centre. - Based on the biodiversity rich area and conservation significant area, spatial risk maps were produced.

 **Remarks- 100% Achieved**

Objective 5: Identify indicator species/ communities that could be used for monitoring the ecological health of the Ganga River.

Propose	Achieve	Outcome
- Identify indicator species for monitoring the ecological health - Prepare protocol for monitoring indicator species	- Based on the species sensitivity towards habitat quality and disturbance indicator insect (Odonate) and fish species were identified. - Monitoring protocol was developed.	Information on indicator species and monitoring protocol were included in the species restoration plan.

 **Remarks- 100% Achieved**

Objective 6: Develop an aquatic species restoration plan and demonstrate species restoration in selected stretch of Ganga.

Propose	Achieve	Outcome
Plan for ecological restoration of aquatic species and restocking.	Ecology and restoration plan for conservation significance species are in place.	Report on ecology of conservation significance species of fish, turtle, amphibians and birds was published.

Remarks- 100% Achieved

3rd COMPONENT

CAPACITY BUILDING OF FOREST DEPARTMENT AND OTHER STAKEHOLDERS

Objective 1: To develop training materials for different capacity building programmes on the Ganga biodiversity conservation for future use.

Proposed	Achieved	Outcome
- Develop prototypes of training programmes and materials for further replication Proposed output - Training material to be used by spearhead teams designed	16 training need assessment workshops with different target groups organised to design the training materials. - Training curriculum developed. - Training materials such as field guide manual, booklet developed. - Awareness materials such as brochures, posters, pamphlets developed.	Published Manuals - Training approach and curriculum - Monitoring Field Guide Published Booklets - Water conservation approaches for <i>Bal Ganga Praharis</i> (English & Hindi) <i>Hamari Janhvi</i>-A book of poems inform children regarding the biodiversity and key species of Ganga. Published Brochures - Training Plan for stakeholders - Training Database for capacity building programmes - Ganga Biodiversity Calendar (English & Hindi) Published Posters <i>Kya Tum Jante ho...</i> - Ganga ke geet... - Biodiversity of Ganga River - Mobilization of youth for Biodiversity conservation - Building the Foundation: <i>Bal Ganga Praharis</i> Published Pamphlets - Say No to Single use plastic-I - Say No to Single use plastic-II Newspaper <i>Bacchon ka akhbar</i>: Editions I to X; May 2018 to Dec. 2019. Training Database - Training database developed as a single point source to disseminate training information to a wider audience.

Remarks- 100% Achieved

Objective 2: Identification and establishment of spearhead teams in the five Ganga states, consisting of selected forest staff and local youth, and to train them in different aspects of biodiversity conservation and methodologies for survey of the indicator species.

Propose	Achieve	Outcome
Establishment of spearhead teams comprising of forest department personnel in five Ganga states.	- Spearhead teams comprising of forest officials established in five Ganga states. - Total 73 members of spearhead teams trained at	The WII-NMCG training team collaboration with spearhead team conducted 7 trainings and 30 sensitization programmes through which >5,000 participants were mobilized and 422 participants were trained comprising of frontline staff, line agencies, local youth, <i>Ganga Praharis</i>, teachers, students, religious groups, local communities, veterinarians, representatives

Propose	Achieve	Outcome
• Training of spearhead teams in different aspects of biodiversity conservation. • Training of local youth in methodologies for survey of indicator species. Proposed Output • Spearhead teams for three representative sites established and trained. • A pool of 100 youth trained for methodology of baseline survey of indicator species through spearhead teams spread over a period of three years.	• two National level training programmes. • 307 youth trained in Biodiversity monitoring, Wetland and river conservation, Community involvement and Conservation education.	• of NGOs etc. and carry forward the conservation efforts. • Trained youth deployed at field stations are assisting various survey teams and forest departments in ecological surveys, biodiversity monitoring, and community engagement and awareness. • Trained individuals are being attached to research and training institutes as per their qualifications and choice. • Pool of trained individuals is carrying out citizen engagement activities.

 Remarks- 100% Target Achieved

In some cases, targets were over achieved due to multiplier effect of training programmes, on demand from NMCG and State Forest Departments and other stakeholders such as universities and colleges. In some places part of the logistic support was provided.

Objective 3: To develop capacity of forest officials and other stakeholders for monitoring of Ganga Aqualife, management planning of wetlands, community involvement and conservation education.

Proposed	Achieved	Outcome
• Capacity building of Forest officials and other stakeholders in four modules viz: • Monitoring of Ganga aqualife. • Wetland and river conservation. • Participatory management. • Conservation education. • Sensitization programmes for school children. Proposed Output: • 300 officers from Forest departments will be trained for management planning of wetlands and aquatic habitats.	• *227 Forest officials; 54 scientists/professors; 5 representatives from NGOs; 10 Media personnel trained in biodiversity monitoring. • *219 Forest officials; 39 scientists/professors; 5 representatives from NGOs; 10 Media personnel; 15 line agencies trained in wetland conservation. • *212 Forest officials; 39 scientists/professors; 5 representatives from NGOs; 10 media personnel trained in community involvement. • *207 Forest officials; 39 scientists/professors; 5 representatives from NGOs; 10 Media personnel trained in conservation education. • 64 schools enrolled under the <i>Bal Ganga Praharis</i> programme. • Training impact assessment conducted for >5000 trainees/participants.	• 305 forest officials from State Forest department of five Ganga states trained in four modules. • 736 participants trained and >12000 stakeholders sensitized. • 10 National level training programmes, 9 State level training workshops and 120 sensitization programmes conducted. • Training impact assessment conducted for >5000 trainees/participants. • ≈80% of trained participant carried forward conservation activities on Ganga aqualife conservation. Out of these, >40% helped in creating awareness through workshops and various forms of interactive events. While ≈34% trained more people on biodiversity monitoring. • Training impact assessments suggest that such programmes result in change in attitudes of stakeholders and also provide them a pathway to engage meaningfully in the efforts to restore the Ganga river ecosystem.

 Remarks- 100% target achieved

*These are overlapping in terms of trained numbers, since most people were trained on all the four modules.

ESTABLISHMENT OF RESCUE AND REHABILITATION CENTRES

Objective 1: Establishment and up-gradation of rescue and rehabilitation centres at Narora and Sarnath.

Proposed	Achieved	Outcome
- Assessment and planning of infrastructure at Turtle Breeding Centre, Sarnath and Narora - Functional centres at Narora and Sarnath established for rescue and rehabilitation of aquatic higher vertebrate fauna - Two functional centres established for demonstration and capacity enhancement	- Assessment of existing infrastructure at Narora and Sarnath, was carried out and plans developed for retrofitting of enclosures to meet species requirements in captivity. - Rescue and subsequent rehabilitation of turtles with the active support of forest department and local communities is carried out. - Based on a request from the Forest Department, Government of Bihar, technical inputs were provided in development of a rescue and rehabilitation facility at Bhagalpur, Bihar.	- Functional centres at Narora (Ganga Aqualife Rescue and Rehabilitation Centre) and Sarnath (Kachua Punarvas Kendra), established for rescue and rehabilitation of aquatic higher vertebrate fauna. - A total of 4775 turtles of 12 species and one marsh crocodile were successfully rehabilitated by the Sarnath and Narora facilities. - Besides rescuing turtles the centres are used to conduct capacity building programs of local communities and forest officials. - An additional functional centre has been established in collaboration with the Bihar Forest Department in Bhagalpur.

Remarks- 100% Target Achieved

Objective 2: Capacity enhancement of local communities.

Proposed	Achieved	Outcome
- Capacity building of local communities. Five for each Ganga state (25 nos.) - A network from representatives of riverside communities from all the five states that is sensitive and motivated to report and assist in addressing emergent situations pertaining to higher aquatic vertebrate fauna of River Ganga.	- Capacities of 214 participants from local communities to provide effective assistance in rescue and rehabilitation efforts were developed from 5 Ganga River states i.e. Uttarakhand (15), Uttar Pradesh (95), Bihar (35), Jharkhand (33) and West Bengal (36). - A network from representatives of riverside communities that is sensitive and motivated to report and work synergistically with line agencies in addressing emergent situations pertaining to aquatic higher vertebrate fauna of Ganga River was initiated.	- A curriculum for enhancement of skills of local communities for rescue and rehabilitation of aquatic macro-fauna was developed. 2018 – 2019 - Three sensitization workshops were conducted with capacity enhancement of 95 participants. 2019 – 2020 - Four sensitization workshops were conducted with capacity enhancement of 109 participants. - These trained individuals are carrying forward aquatic species conservation.

Objective 3: Capacity enhancement of personnel of forest department and field veterinarians in managing the emergent situations.

Proposed	Achieved	Outcome
- Capacity development through training in skills needed for handling emergent situations pertaining to higher aquatic vertebrate fauna of River Ganga - Forest department personnel (25 each) (2 trainings) - Field veterinarians (25 each) (2 trainings)	- Capacities of 232 forest officials in effective rescue and rehabilitation of aquatic macro-fauna from the five Ganga River States were enhanced.. - The major skills imparted were field identification of different species, ethical, safe and humane handling and legalities. - Capacities of sixty-nine field veterinarians in effective rescue and rehabilitation of aquatic macro-fauna from the five Ganga River States were developed. - Capacities of five field veterinarians from Ganga River states were enhanced through international field course on "Intervention in Wild Animal Health, 2019" for effective management of aquatic macro-fauna during distress.	- The efforts led to the creation of a networked team of forest officials and field veterinarians capable of addressing emergent situations of aquatic macro-fauna. - The role of the first responders, trained in rescue, handling, husbandry, veterinary care and rehabilitation techniques, is proving to be pivotal in aquatic species conservation.

 **Remarks- 100% Target Achieved**

5th COMPONENT

COMMUNITY BASED CONSERVATION PROGRAMMES FOR SPECIES RESTORATION IN GANGA RIVER

Objective: 1 Involve local communities in conservation of Ganga through the Panchayati Raj System.

Proposed	Achieved	Outcomes
- Purposive sampling and surveys for conducting stakeholder analysis. - Facilitating establishment of local level institutions. - To put in place a system of regular meetings of council members for ensuring effective working Proposed output: Establishment of village level institutions with representations of all concerned stakeholders.	- Conducted reconnaissance survey along the river in five Ganga states. - Conducted 1010 Household surveys 962 meetings undertaken with members of Panchayati Raj system - A total of 1,895 activities conducted in villages and towns along Ganga River which included consultative meetings, awareness programmes, cleanliness drives, plantation drives, rescue & rehabilitation and livelihood development activities.	50 stakeholder groups and their roles identified - Aware and sensitized stakeholders conducted 333 activities for biodiversity conservation including awareness programmes, plantations, cleanliness drives, rescue and monitoring of aqualife. 173 MoAs signed with village Pradhans wherein the villagers have pledged to support NMCG and WII for cleanliness and biodiversity conservation of Ganga River. - Village level institution Ganga Prahari established along the entire river stretch.

 **Remarks- 100% Target Achieved**

Objective: 2. Elicit the participation of stakeholders at different levels to achieve the biodiversity conservation goal of National Mission for Clean Ganga (NMCG).

Proposed	Achieved	Outcomes
- Capacity building programme for identified stakeholders, cadre of "Ganga Prahari" and staff of government bodies. - Coordination meetings among members of institutions and management team of concerned departments to promote partnerships among them. Proposed output: - Local communities and other stakeholders sensitized and trained to participate in conservation of Ganga. - A synergistic alliance of institutions in place to facilitate participation of different stakeholders and ensure sectoral coordination. - A trained and motivated cadre of "Ganga Prahari" to support the local institutions and monitor the quality of the natural resources of Ganga. - Strengthening of skills and capacities of existing staff of concerned government agencies.	Ganga Praharis State Forest Department, district administration, educational institutes, media officials, tourists and pilgrims, local businessmen, Bal Ganga Prahari, Pravasi Ganga Praharis sensitized towards biodiversity conservation - Interactions conducted with: - State Forest Departments (SFDs)-144 - State Project Management Groups - 5 - District Administration- 204 - Block development officials (BDOs)- 72 - State government officials- 6 - Other line agencies- 154 - A total of 1290 (female- 566, male- 724) Ganga Praharis have been registered 164 Ganga Praharis trained during National Training Workshop. 328 trainings imparted to Ganga Praharis in socio-economic and ecological surveys, community mobilization, plantation and cleanliness drives, alternate livelihood activities, rescue and rehabilitation of animals in distress and village microplanning. - Liaison with government and non-government organizations established and institutionalized in village microplans.	- SFDs, PNB-RSETI, USHA, HESCO, ILSP, DST SEED developed for skill development activities. 431 activities conducted so far independently by Ganga Praharis. - Participation in state and national level programmes and recognition from dignitaries. Sh. Darshan Nishad, <i>Ganga Prahari</i> from Varanasi interacted with Hon. PM and briefed him on Ganga Prahari program, in April 2019 <i>Ganga Prahari</i> recognized for their efforts 149 <i>Ganga Praharis</i> conducted cleanliness drives, awareness campaigns, rescued distressed animals, guided visitors to shelter and health camps during Kumbh 2019, Prayagraj, UP. 89 Ganga Praharis assisted National Geographic Society teams during pre and post monsoon Sea to Source Expedition on plastic waste - Motivated and trained Ganga Praharis are holding key positions in their communities, and other institutions such as Gram Pradhan, District Coordinator of NYKS and member of NMCG-WII team at WII. 487 Ganga Praharis engaged by SFDs, 611 by District Administration, 231 by BDOs, 185 by state governments for plantation, cleanliness and Ganga conservation activities.

 **Remarks- 100% Target Achieved**

Objective: 3 Assess the monetary contribution of ecosystem services provided by River Ganga to different stakeholders

Proposed	Achieved	Outcomes
- Identification and evaluation of key ecosystem services provided by Ganga River system. Proposed output: Facilitate the integration of ecosystem service values in the decision making process for conservation development planning along the Ganga	- Extensive literature review and visits to various national, state and district level departments conducted for identification of ecosystem services. 503 questionnaire surveys conducted with various stakeholders. - Designed a framework for evaluation of ecosystem services provided by Ganga River. 22 key ecosystem services identified of which 8 have been evaluated in detail.	Reports on: - site and stretch wise assessment of ecosystem services - dependence pattern and resource use - Assessed monetary value of 8 evaluated ecosystem services: Water - Urban surface water supply- INR 50.1 million. - Urban ground water supply- INR 31.21 million Agriculture - Revenue from water intensive crops i.e paddy, wheat and sugarcane- INR107,614.34 million ($\pm 14,766.95$ million), INR82,736.06 million ($\pm 19,120.29$ million) and INR29,241.54 million ($\pm 5,018.29$ million), respectively. Power Generation: - Annual reduced emissions of nine HEPs and one nuclear power plant is an estimated 8.82 million tCO₂ and 9,979.2 tCO₂, respectively. Water for transportation - Comparative intermodal cost advantage of transporting freight on National Waterway 1 is ₹605.93/tonne versus roads and (-) ₹352.03/tonne versus railways. Riverbed material - Lease holders in UP Ganga districts earned revenue of ₹503,419,068.8/- by dispatching 1,618,534 m³ quantity of sand. Provision of fish - Fish vendors in Varanasi (n= 53) and Narora (n=3) reported an estimated average annual income of ₹172,471.7/- ($\pm 317,230.5$) and ₹355,200 ($\pm 162,017.78$), respectively. Cultural services - In Varanasi, 44.71% of local businessmen (n=110) reported an average income between ₹35,000/- and ₹134,999/- during tourist season. Vendors (n=136) at Ardh Kumbh Mela 2019 in Prayagraj reported a 210.07% (± 238) increase in daily income during Kumbh. - A policy document based on PES model developed that would facilitate integration of ecosystem values in decision making process for conservation planning.

 **Remarks- 100% Target Achieved**

Objective: 4 Develop site specific strategies for aligning local people's livelihoods with conservation priorities

Proposed	Achieved	Outcomes
- Skill development workshops for local community. - Regular surveys and assessment of village institutions and Ganga Prahari' cadre by concerned government institutions. - A system of incentives in terms of financial transfers, technology transfer	- Need and resource availability assessed - Market demands and availability assessed. - Site-based livelihood trainings and marketing strategies developed. 35 livelihood trainings conducted in collaboration with USHA, PNB RSETI, HESCO, ENVIS- MoEF&CC 713 Ganga Praharis trained in livelihood activities	- Site based livelihood framework developed 6 livelihood modules developed 19 mobile and 2 permanent livelihood centers established 16 youth groups and 18 Self Help Group (SHGs) strengthened - Trained Ganga Praharis linked to the market and other institutions for livelihood enhancement. - Household income of trained Ganga Praharis increased by ₹200-4,500 per month.

Proposed	Achieved	
and capacity building of local people, village level councils and Ganga Prahari' cadre on a merit basis. Proposed output: • Sustainable Livelihood strategies for the people dependent on the Ganga River system. • Incentive-based conservation tool developed to reward efficient village level institutions and 'Ganga Prahari' cadre.	• Linkage developed with existing market and created a market for products made by Ganga Prahari in form of a floating livelihood centre "Jalaj" established at Varanasi	

Remarks- 100% Target Achieved

Objective: 5 Suggest institutional mechanisms for the sustainability of project initiatives in the demonstration sites.

Proposed	Achieved	Outcomes
• Developing a performance matrix having a set of decision criteria to assess the performance, progress and demonstrate achievement of objectives and overall goals. Proposed output: • A performance evaluation "guide" to evaluate effectiveness of community conservation program. • Self-sustaining institutions to manage the equitable and sustainable distribution of benefits from the Ganga River system.	• Performance matrix developed • Microplanning guidelines prepared • Focus Group Discussions (FGD) and Participatory Rural Appraisals (PRAs) conducted with local communities and other stakeholders and 12 village level conservation sensitive microplans developed on digital platform	• 12 Letter of consent signed by Gram Pradhans of Gram Panchayats for implementation of the microplans • 54 citizens from 17 different countries have registered as Pravasi Ganga Prahari • A business model in collaboration with <i>Pravasi Ganga Prahari</i> (IBM-USA) was developed for <i>Jalaj</i> • <i>Ganga Prahari</i> Mentor Platform created and 107 members registered • 64 Bal <i>Ganga Prahari</i> schools identified.

Remarks- 100% Target Achieved

NATURE INTERPRETATION AND EDUCATION FOR BIODIVERSITY CONSERVATION OF GANGA RIVER

Objective 1: Communicating to the community about the value of aquatic biodiversity and natural processes through the establishment of Interpretation Centre at three sites.

Proposed	Achieved	Outcomes
Site Selection for the Interpretation Centres Interpretation centres at 3 sites to be established	- Established three interpretation centres in Sarnath, Varanasi and Kanpur. - These centres were established after obtaining necessary permissions Forest department, renovation and modification of identified sites. - Concept of Gange specific interpretation center developed, panels, exhibits and other display material developed for the interpretation centers. - A house boat hired, modified and renovated and a floating exhibition on Ganga and its biodiversity "Ganga Tarini" launched at Varanasi. - Interpretation centre established within the premises of the Turtle Rescue and Rehabilitation Centre at Sarnath has 3 theme based exhibition halls with QR based panels defining the importance of Ganga River, its biodiversity, threats and how we can help. It also has a children's activity room for conducting workshops with school children.	Ganga Darpan - Ganga Darpan was inaugurated on February 27, 2019. - It had a total footfall of 2200 visitors till January 2020. Ganga Tarini - The first of its kind in the country, a floating interpretation center was setup at Varanasi and was opened to public on 27th February 2019. - It had a total footfall of 3300 visitors till December 2019. Anubhuti - Allen Forest building in Kanpur Zoological Park was renovated as the interpretation centre. - It had a total footfall of 3300 visitors till December 2019.

Remarks- 100% Target Achieved

Objective 2: Educate and involve the public in the Ganga basin's natural systems by creating a network of community-based environmental education programs.

Proposed	Achieved	Outcomes
2 eco clubs *3 sites Teacher's Training 2 training per site*3 sites*20 participants Curriculum based resource pack: Resource for education programs prepared	7 eco clubs "Gangaridai" established at 4 sites, Uttarkashi (42 members), Varanasi (45 members), Dehradun – Haridwar (19 members), Kanpur (39 members) - Published 'Discovering Ganga': Teacher's manual for environmental education in the classroom and equipped teachers to use it. - Puppet shows created - Fact sheets 'Companions in and around Ganga' created about Ganga and its priority species in Hindi and English. - A total number of 1928 students sensitized about 'Ganga and its aquatic biodiversity' - Bookmarks, Name slips, Awareness posters, Sarpdash (Snake bite) booklet prepared. - Conducted 8 teacher training programs in four sites: Uttarkashi (24 participants), Varanasi (70 participants), Dehradun – Haridwar (47 participants), Kanpur- (50 participants) - Water testing kit prepared for assessing parameters (Dissolved oxygen, pH, Temperature).	- Eco club members are actively participating in the slogan writing activities, rallies, plantation and cleanliness drives, nukkad natak, special days celebration, quiz competitions, wall paintings. - Training manuals distributed to more than 600 teachers as resource material. - Teachers trained to use puppet shows and other resource material. - Distributed 608 copies of facts sheets to students during various awareness campaigns. - A total number of 19,200 Bookmarks, 68,00 name slips 11,600 awareness posters and 500 copies of 'Sarpdash' booklet have been distributed as resource material during exhibitions, campaigns, awareness programs and 'Ganga Chaupal'. - Conducted several water quality tests with more than 1,500 students and trained more than 100 teachers to use and handle water testing kit in classrooms.

Remarks- 100% Target Achieved

Objective 3: Foster public awareness of the river ecosystem, its conditions and resources.		
Proposed	Achieved	Outcomes
Identification of target audience Program with different stakeholders Interactive website	A need assessment survey was conducted to assess interest of stakeholders in floating exhibition, Interpretation centre and conservation education programs. Interviewed Visitors (101), hotels (71) and schools (70). Conducted sensitization workshops for 61 Gram Pradhans, Dibai and 82 for BDO and Block Pramukh in Anoopshaher. Conducted informal meetings in 2 villages of Cholapur block, Varanasi, and 2 villages in Uttarkashi. Sensitization of 23 Boatmen done Tin boxes provided to each boatman to keep them in their boats as dustbins 50 Fishermen sensitized. A total of 31 guides from Varanasi and 30 guides from Sarnath were sensitized. Interpretation activities designed for different target groups Visitors • Paintings on walls in Varansi ghats and Narora Railway station. • Dustbins and signage placed on ghats of Narora and Varanasi. • Boats in Varansi ghats painted with messages and depiction of priority species. • Signage on E-rickshaw • Ganga Janmotsav a temporary exhibition installed at Narora Hotels • Flyers of Ganga Darpan and dustbins distributed to hotels, public places and heritage sites.	• Schools agreed to participate in conservation education workshops, for trips to interpretation centers. • Pradhans pledged to sensitize villagers and contribute or cleanliness activities. • Boatmen, fishermen and tourists guides now sensitizing visitors and pilgrims and convince them to place their floral offerings in tin boxes. • A bilingual and user interactive website hosted and linked with the QR codes placed on panels of the Interpretation Centres and Bajra. • Link: www.gangadarpan.in • The website makes it easy for the visitors to go through the panels anytime and is also an initiative towards digital India.

COMPONENT 1: ESTABLISHMENT OF GANGA AQUALIFE CONSERVATION MONITORING CENTRE

OBJECTIVES

Build up scientific knowledge base on aquatic wildlife of Ganga River Basin in accordance with the objectives of proposed Ganga Knowledge Centre.

Disseminate knowledge on Ganga to the general public and scientific community through printed and electronic medium.

Promote sustainable utilization of goods and services provided by the riverine ecosystem by developing stake of local communities in conservation efforts in consonance with Indian cultural and socio-economic milieu.

OUTPUTS

Published

- "Macrofauna of the Ganga River: Status and Conservation of Select Species"
- "Ganga River State of Biodiversity at a Glance".
- Eight booklets under Vibrant Ganga series depicting aquatic fauna of Ganga River.

- 225 press releases and about 60000 brochures (Hindi, English and Bangla) distributed. Bilingual standees displayed at key airports, workshops and events across Ganga River states.
- Published four scientific publications, 83 abstracts in national and 3 in international workshops from 2017 to 2019
- 11 radio talk shows, 13 TV interviews, 4 episodes in three TV series, 55910 views on webpages, 1411 Facebook followers, 284 Instagram followers and 126 YouTube subscribers with 13944 views

- Published "Stakeholder for Ganga Aqualife conservation: Achieving Coherence in Diversity".
- Identified conservation priority areas and provided recommendations for sustainable utilization of resources, in 'Ecological health assessment and Key messages for Policy makers'.

ACTIVITIES

- Ecological information generated through review of 3500 documents: 500 were specifically on key aquatic species of the Ganga River.
- Five ecological surveys conducted from Devprayag to Nurgpur (2200 Km), between 2017 and 2019.

- Press release (17 newspapers), brochures (n= 25), standees (n=50), species message canvas (n=12), wall paintings (n=800).
- Published scientific information as research articles, abstracts and solution based case studies on Ganga River (n= 96).
- Participation in National (n=5) and International (n=3) workshops to present findings.
- Activities regularly updated through Radio Talks, TV Interviews and TV series, Webpages (n=3) and social media (Facebook, Instagram, and YouTube)

- Literature review for stakeholder framework (n= 500), river ecological status (n= 221), river conservation approaches (n = 1000 and five ecological surveys from Devprayag to Nurgpur (2200 Km) to assess ecological integrity of Ganga River.
- Reviewed policies of different sectors and summarized in Key Messages for Policy Makers. Assessment of ecosystem service value of the riverine ecosystem

Develop national guidelines for considering the needs of aquatic fauna in planning and execution of water development and promote these guidelines

Develop a Centre of International Importance on Aquatic Wildlife and Natural Resource Conservation.

- Published guideline documents "Assessment of the wildlife values of Ganga River from Bijnor to Ballia including Turtle Wildlife Sanctuary, UP" and "Conservation action plan for Gangetic dolphin for 2020-2030".
- Proposed 140 km turtle sanctuary from downstream Newada, Allahabad to Adalpur, Mirzapur.
- Addressed issues and need of aquatic fauna to promote species conservation and influence policy decisions.

- 65 trained and experienced project personnel conducting ecological assessment, ensuring community participation and supporting NMCG and Ministry of Jal Shakti in Parliamentary queries, RTIs, legal queries about biodiversity of Ganga River. Provide institutional support to line agencies and other stakeholders.
- Launch of project river dolphin, an important agenda in 1st National Ganga Council meeting.
- Published reports on Biodiversity conservation and Ganga Rejuvenation, Mission Gange River Rafting Expedition, State reports, and brochures (n=3).
- Second phase of the Project initiated in the Ganga basin.

- Conducted national and state launch workshops to sensitize and interact with line agencies, policy makers, and SPMGs.
- Occurrence and distribution of species of conservation concern, habitat condition and anthropogenic influence mapped on GIS domain.

- Fully operational 'Ganga Aqualife Conservation Monitoring Centre', as a centralized knowledge repository and nodal agency for policy support on river and biodiversity conservation.
- Awareness programs on important days celebrated with NMCG.
- Three monitoring committee meetings held at WII.
- Collaborated with NGS for "Sea to Source Ganga Expedition"

COMPONENT 2: PLANNING AQUATIC SPECIES RESTORATION FOR GANGA RIVER

OBJECTIVES

Derive empirical relationships between river conditions and ecological status of the major species so as to determine the desired future state.

Derive the current trend in genetic variability and gene flow of the critically endangered and endangered species

Asses the concentration of key pollutants in species of conservation significance

OUTPUTS

Biodiversity profile of River Ganga describing status of conservation significant species & water quality variables at different sections was published.
A separate report on wildlife value of the Ganga river from Bijunor to Ballia was

- Genetic status, diversity and gene flow of endangered fish was included in the Biodiversity profile report
- A separate report on 'Genetic status and gene flow of selected aquatic species' was produced.

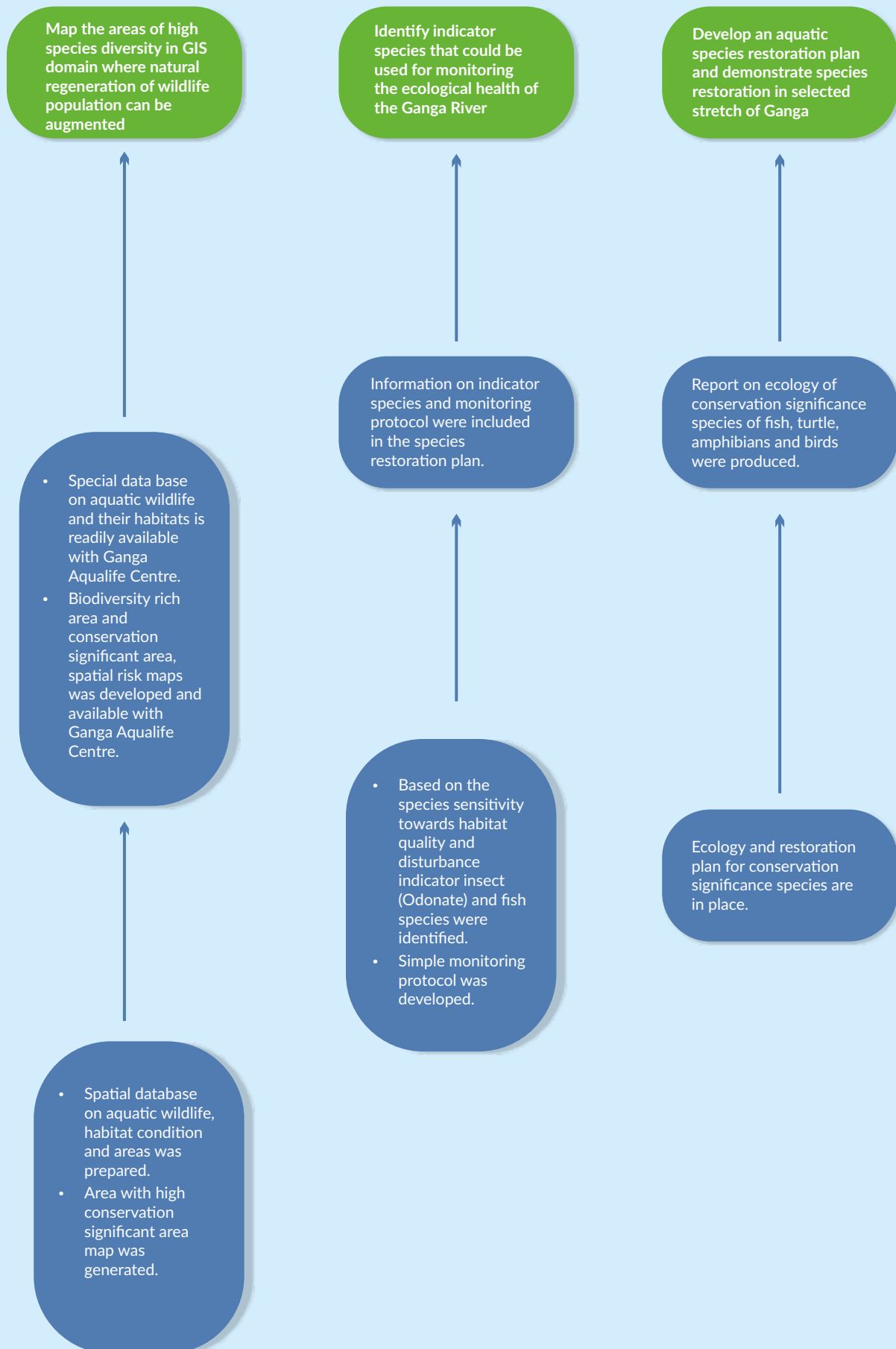
- The physico-chemical, heavy metal and organochloride pesticides in 32 monitoring sties were included in Biodiversity profile book.
- Eco-Toxicological Survey Report on seasonal variations in surface water quality of river Ganges was produced.

ACTIVITIES

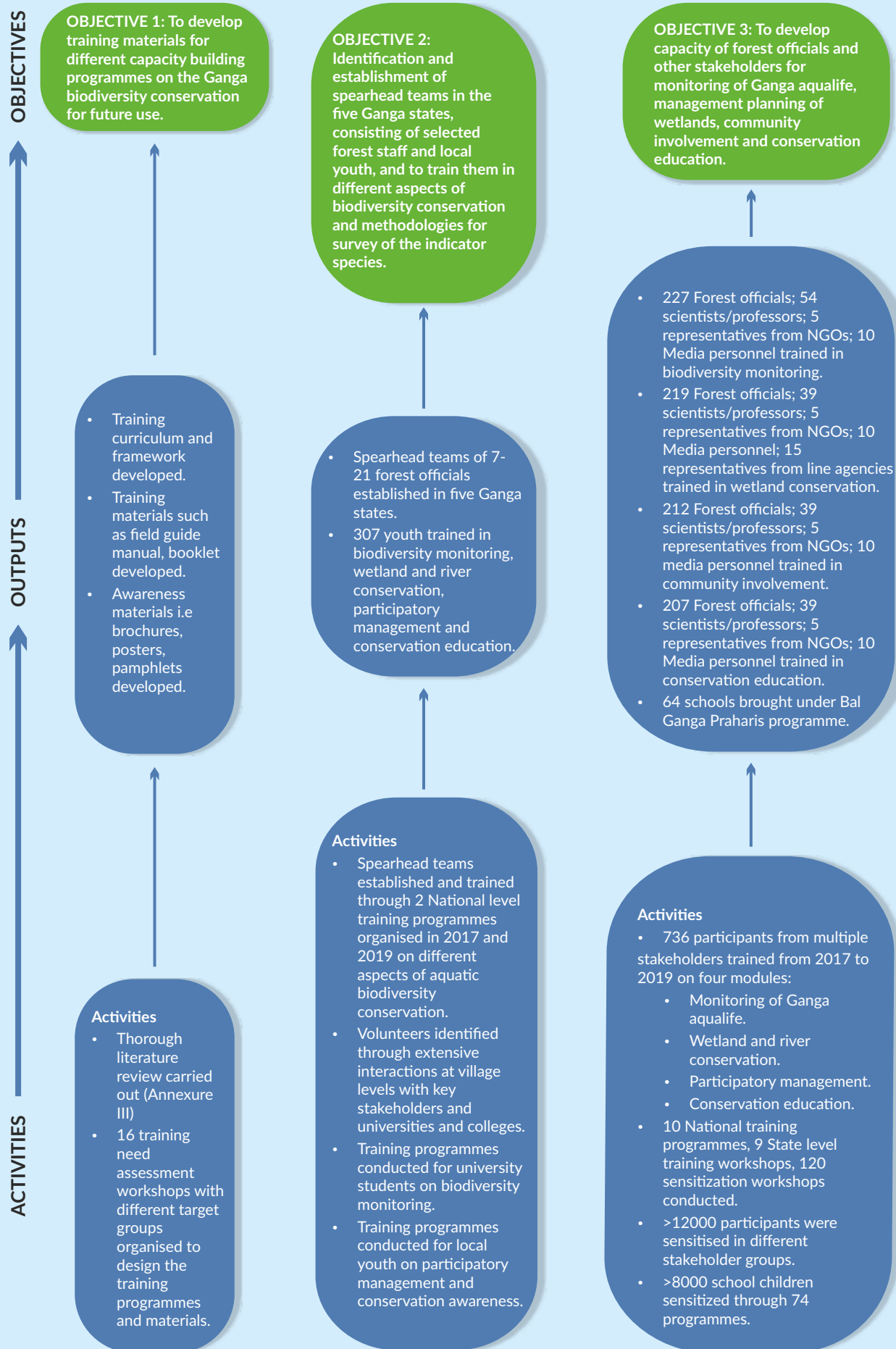
- Abundance of conservation significant species such as Gangetic Dolphin, Turtles and Gharial, amphibians, fishes and Odonate (dragonfly) were documented.
- 32 intensive monitoring sites were

- Genetic diversity of conservation significant species (fish and turtles) was documented.
- The extent of gene flow between different populations of golden mahseer was established.

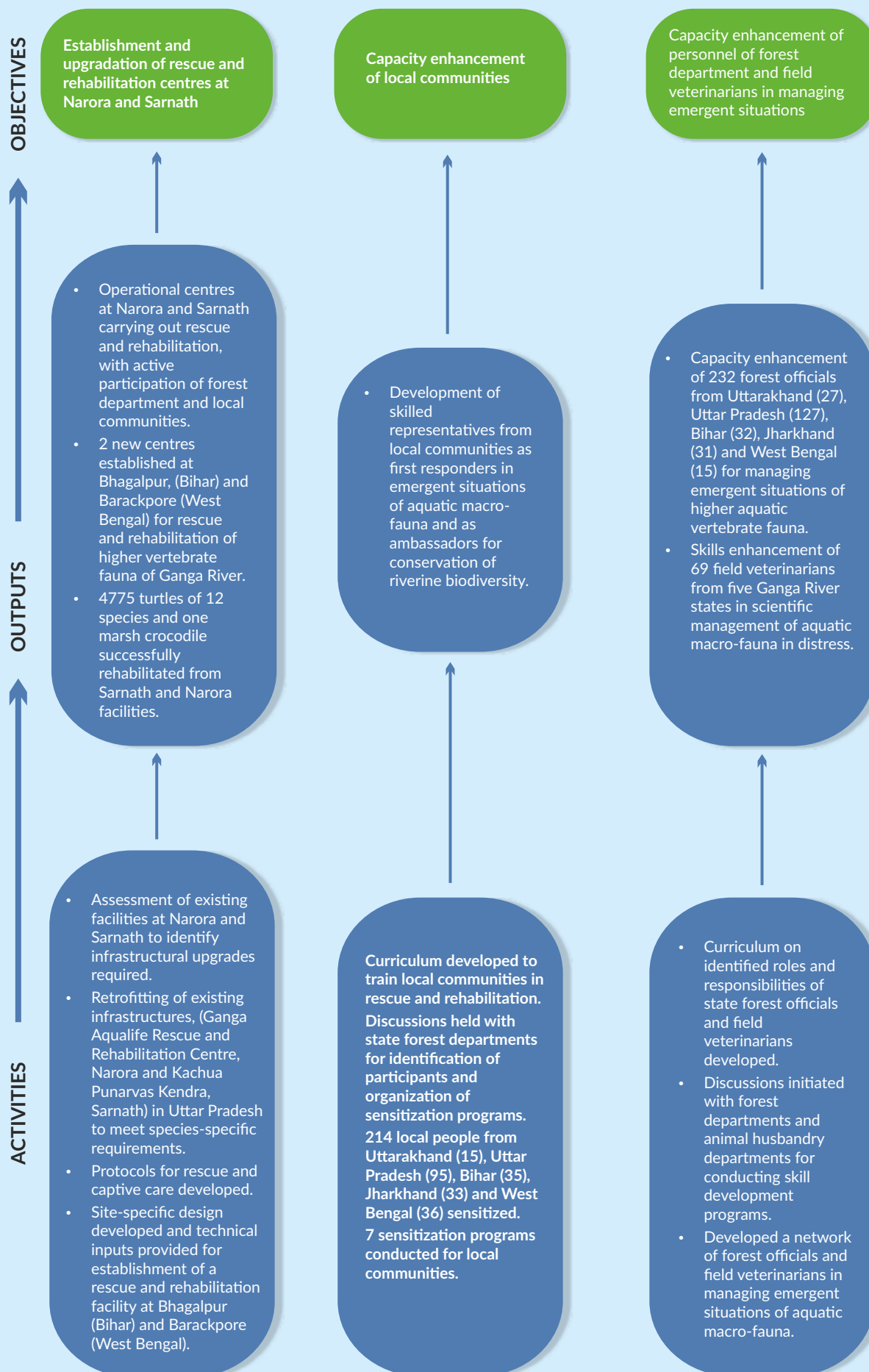
- Status of physico-chemical, heavy metal and organochloride pesticides in 32 monitoring sties were generated.
- West Bengal sector was identified as high risk zone in terms of toxicity level.



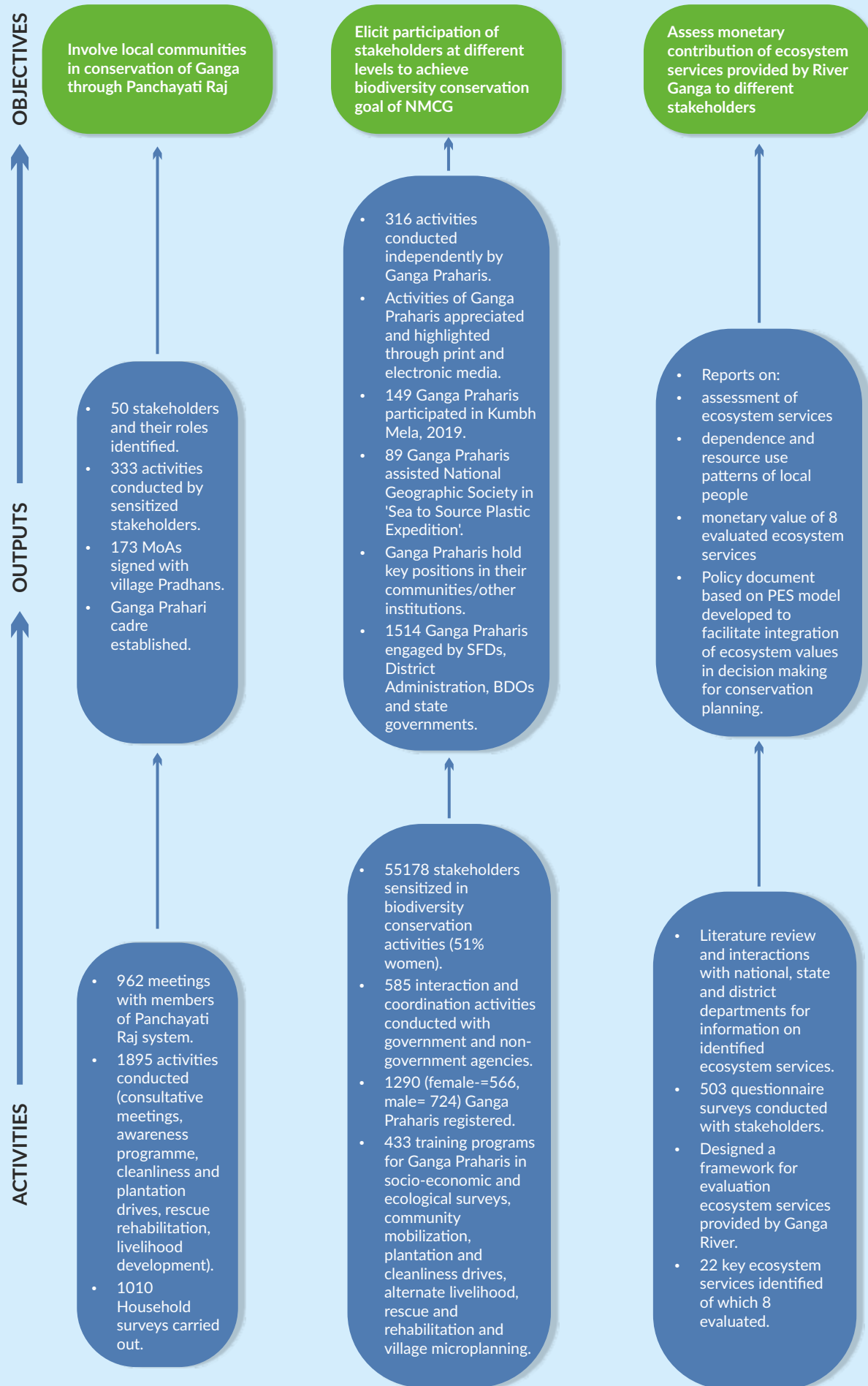
COMPONENT 3: CAPACITY OF FOREST DEPARTMENT AND OTHER STAKEHOLDERS DEVELOPED



COMPONENT 4: ESTABLISHMENT OF RESCUE AND REHABILITATION



COMPONENT 5: COMMUNITY BASED CONSERVATION PROGRAMMES FOR SPECIES RESTORATION IN GANGA RIVER



Develop site specific strategies for aligning local people's livelihoods with conservation priorities

- Site based livelihood framework developed.
- 7 livelihood modules developed.
- 30 males and 683 females trained in sustainable livelihood activities.
- 16 youth and 18 Self Help Groups strengthened.
- Household income of trained Ganga Praharis increased by INR 200-4500/month.
- 21 Livelihood centres established.
- Market linkages established.

- 6 livelihood training modules developed.
- 35 livelihood trainings done in collaboration with USHA, PNB RSETI, HESCO, ENVIS MoEF&CC.
- 713 Ganga Praharis trained.
- "Jalaj" a floating market developed for Ganga Prahari products at Varanasi
- A business model developed in collaboration with Pravasi Ganga Praharis.
- Market linkages established with various government and non-government schemes.

Suggest institutional mechanisms for sustainability of project initiatives in demonstration sites

- Microplanning guidelines prepared and a digital platform created.
- 12 village level microplans developed on digital platform and letter of consent signed by Gram Pradhans for implementation.
- 54 citizens from 17 countries registered as Pravasi Ganga Prahari.
- 107 members registered as Ganga Prahari Mentor.
- 64 Bal Ganga Prahari schools connected.

- Performance evaluation matrix developed.
- Focus Group Discussions and Participatory Rural Appraisals conducted with local communities and other stakeholders.
- Role of government and non-government organizations institutionalized in microplans.
- Pravasi, Mentor and Bal Ganga Prahari programmes launched.

COMPONENT 6: NATURE INTERPRETATION AND CONSERVATION EDUCATION

OBJECTIVES

Communicating to the community about the value of aquatic biodiversity and natural processes through the establishment of Interpretation Centre at 3 sites.

Educate and involve the public in the Ganga basin's natural systems by creating a network of community-based environmental education programs

OUTPUTS

Three Interpretation centres were established on three sites.

Sites
Visitors

Ganga Darpan (27/2/2019 - 01/01/2020)	2200
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Ganga Tarini (27/2/2019 - 1/1/2019)	3300
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Anubhuti inaugurated on 24/1/ 2020

7 Gangaridai ecoclubs in 4 sites with 150 active ecoclub members.

8 teacher training in 4 sites with a total number of 191 teachers.

Conservation education programs in 5 sites with 1928 students.

Curriculum based resource pack was developed.

Material	Published
Teaching manual	1000
Facts sheets	1000
Water testing kit	
Resource for education program	
Bookmarks	20000
Nameslips	10000
Awareness posters	15000
Sarpdandsh	500

ACTIVITIES

Site Selection

Sites were shortlisted on the basis of following key points:

- Availability of buildings.
- Renovation and fabrication

Ganga Darpan

Three theme based exhibition halls with QR based thematic panels, Children's activity room for conducting workshops with school children, one room accommodation for Education Officer and Office room was developed.

Ganga Tarini

The house boat was hired, modified and renovated followed by fabrication. The upper deck housed with QR code enabled thematic panels. The lower deck housed a TV which screened films on Ganga to the visitors and can even be used as an activity area.

Anubhuti

Allen Forest building in Kanpur Zoological Park is a double story heritage building which was renovated to have the interpretation centre. The ground floor has four rooms and a central hall which have thematic panel. The first floor has library and a Conference Hall where workshops can take place.

Activities undertaken by ecoclub

Slogan writing activity, Ganga Sanrakshan' rallies, Plantation drives, Cleanliness drives, Nukkad Natak

Special days celebration, Quiz competitions, Paintings on walls, Visit to nearby river ecosystem, Visit to interpretation centre

Teacher's training

Visual Presentation, equipped teachers to use Teacher's manual. Teachers were trained to use puppet shows. Training manuals and fact sheets were distributed to teachers. Teachers were trained to use water testing kit.

Conservation education programs conducted with the help of teacher's manual, water testing kit and resource material.

Curriculum based resource pack was developed

"Discovering Ganga"

A teacher's training manual for environmental education in the classroom in both Hindi and English language was developed.

'Companions in and around Ganga'

Fact sheets about the aquatic ecosystem and its priority species in both hindi and English languages were developed.

Foster public awareness of the river ecosystem, its conditions and resources.

Identification of target audience

Need assessment survey was conducted with -

Target audience	No.
Visitors	101
Hotels	71
Rural and urban schools	70
Programs with different stakeholders	No.
Gram Pradhans workshop	143
Ganga Chaupal	106
Sensitization boatmen	23
Sensitization fishermen	15
Tourist guide training	61

Digital media developed

Links: www.gangadarpan.in

<https://www.instagram.com/ganga.darpan/>

<https://www.facebook.com/ganga.darpan.39>

<https://www.youtube.com/channel/UCMH8cFQOk1E6FDIQOA08nWQ?>

Identification of target audience

Need assessment survey was conducted to see the visible interest of different stakeholders in Floating exhibition, Interpretation centre and conservation education programs.

Different programs with stakeholders

-Sensitization workshop Gram Pradhan of Dibai and in Anoopshaher with BDO and Block Pramukh was conducted.

- 'Ganga Chaupal' an informal meeting with the villagers to sensitize them about the conservation of the river Ganga.

-Sensitization of Boatmen and fishermen with the help of presentations, discussions and resource material.

-Tourist Guide Training to encourage public to visit interpretation centre and Bajra.

Interactive website

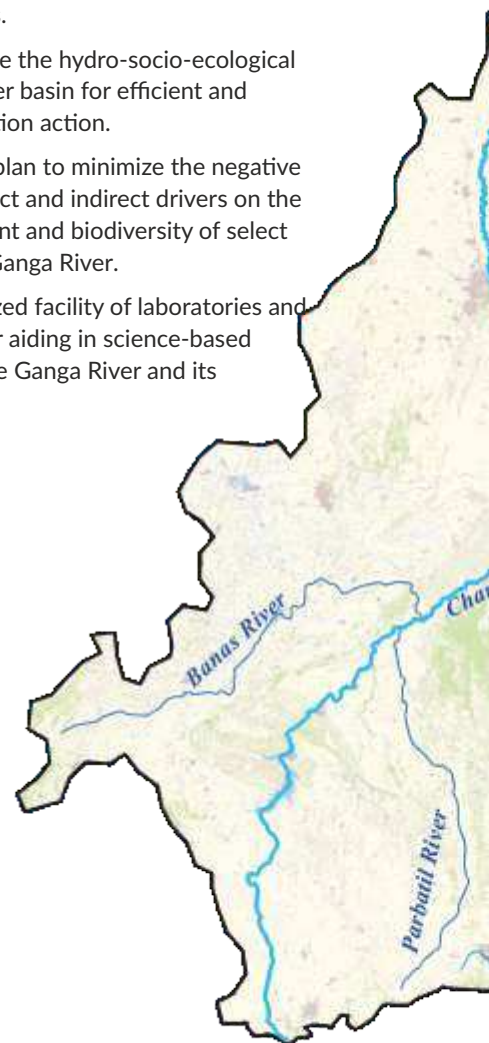
A bilingual website was hosted and linked with the QR codes placed on the panels of the Interpretation Centres and Bajra which can be visited once the QR code is scanned.

Initiation of Phase II at Ganga River basin

The Ganga River is intricately connected with a network of tributaries and floodplain wetlands. Together, these serve as breeding grounds and refuge for aquatic species. However, these tributaries also drain pollutants into the river, severely affecting aquatic fauna and their habitat. The efforts made in the Phase I of the 'Biodiversity Conservation and Ganga Rejuvenation' project emphasized urgent need to account for natural and anthropogenic processes and upscaling present efforts to the basin level to ensure sustainable and effective Ganga conservation. Further, it was realized that a centralized repository of basin-scale information and laboratory infrastructures are needed to ensure effective implementation of the project and to provide timely decision-support to NMCG.

In view of this, the Phase II of the project titled 'Planning and Management for Aquatic Species Conservation and Maintenance of Ecosystem Services in the Ganga River Basin for a Clean Ganga' has been initiated and will be carried out over a period of 5 years. The conservation activities are being set off in Ramganga, Gomti, Ghaghara, Gandak, Kosi, Yamuna, Son and Chambal rivers. Phase II aims to intensify the conservation efforts in identified sites along the mainstem Ganga River and up-scale the conservation efforts to the basin level for aquatic biodiversity conservation and maintenance of ecosystem services, that will be achieved through the following objectives:-

1. Strengthen the aquatic biodiversity conservation measures at six identified biodiversity hotspots along the Ganga River and monitor status of other areas.
2. Explore the natural and assisted colonization of species of conservation significance to other stretches of mainstem Ganga River.
3. Determine the current state of aquatic environment and biodiversity of the major tributaries and wetlands in Ganga basin.
4. Identify direct and indirect drivers affecting the integrity of the aquatic environment and biodiversity in the Ganga basin.
5. Pinpoint problematic areas and identify conservation priority zones.
6. Strengthen/establish rescue and rehabilitation centres at strategic locations for aquatic species in distress.
7. Involve communities and other stakeholders in the conservation process through capacity building, innovation and strengthening existing institutions.
8. Garner support for aquatic biodiversity and Ganga conservation through education and outreach programs.
9. Identify and analyse the hydro-socio-ecological relations in the river basin for efficient and targeted conservation action.
10. Prepare an action plan to minimize the negative impacts of the direct and indirect drivers on the aquatic environment and biodiversity of select tributaries of the Ganga River.
11. Develop a centralized facility of laboratories and resource centre for aiding in science-based management of the Ganga River and its tributaries.





These objectives will be covered under three components viz.,

1. Science-based aquatic species conservation and maintenance of ecosystem services in the Ganga River basin.
2. Capacity building of the Forest Department and other stakeholders in managing aquatic and wetland resources.
3. Develop community-based aquatic species conservation and outreach programmes for Ganga River basin.

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