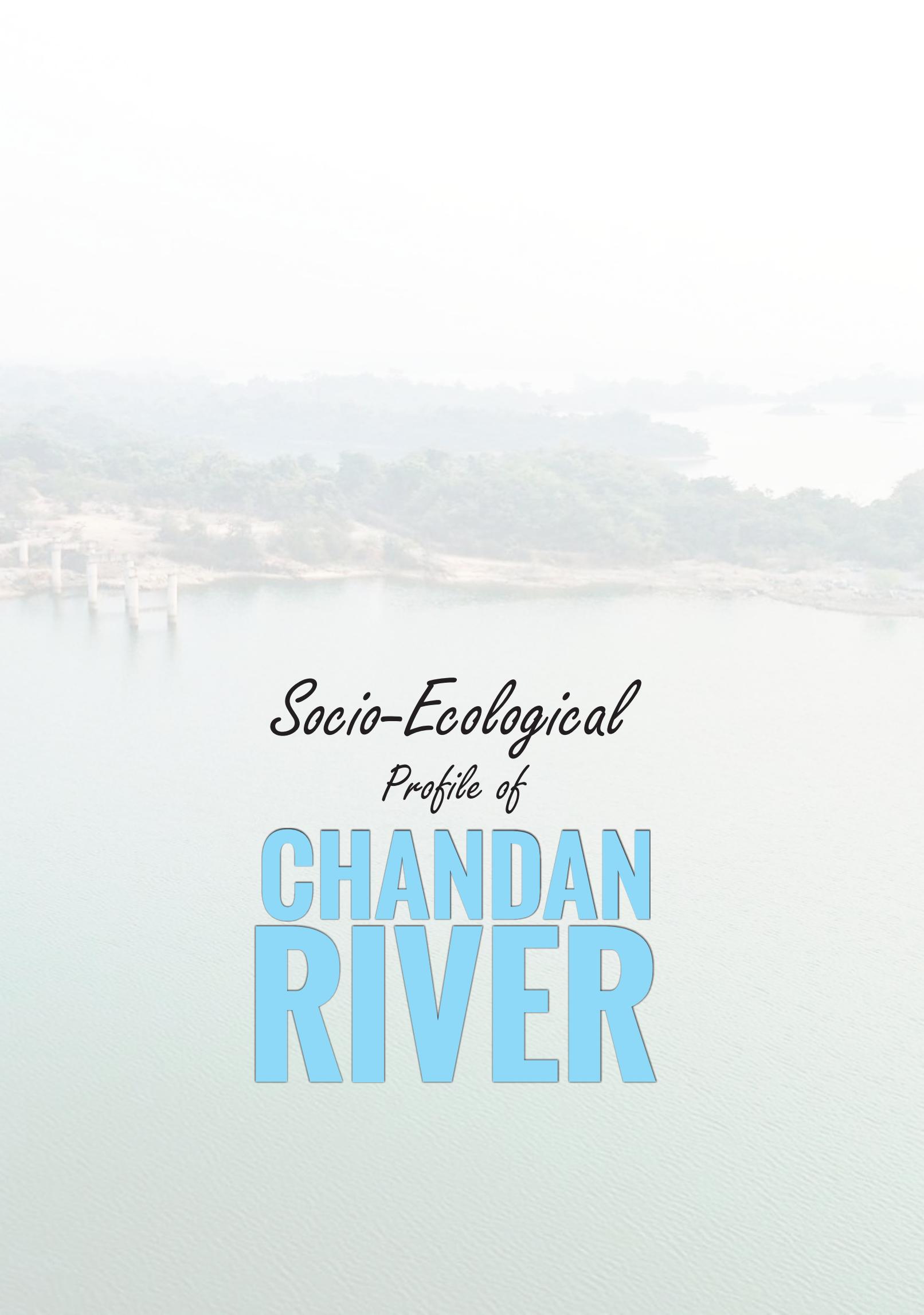
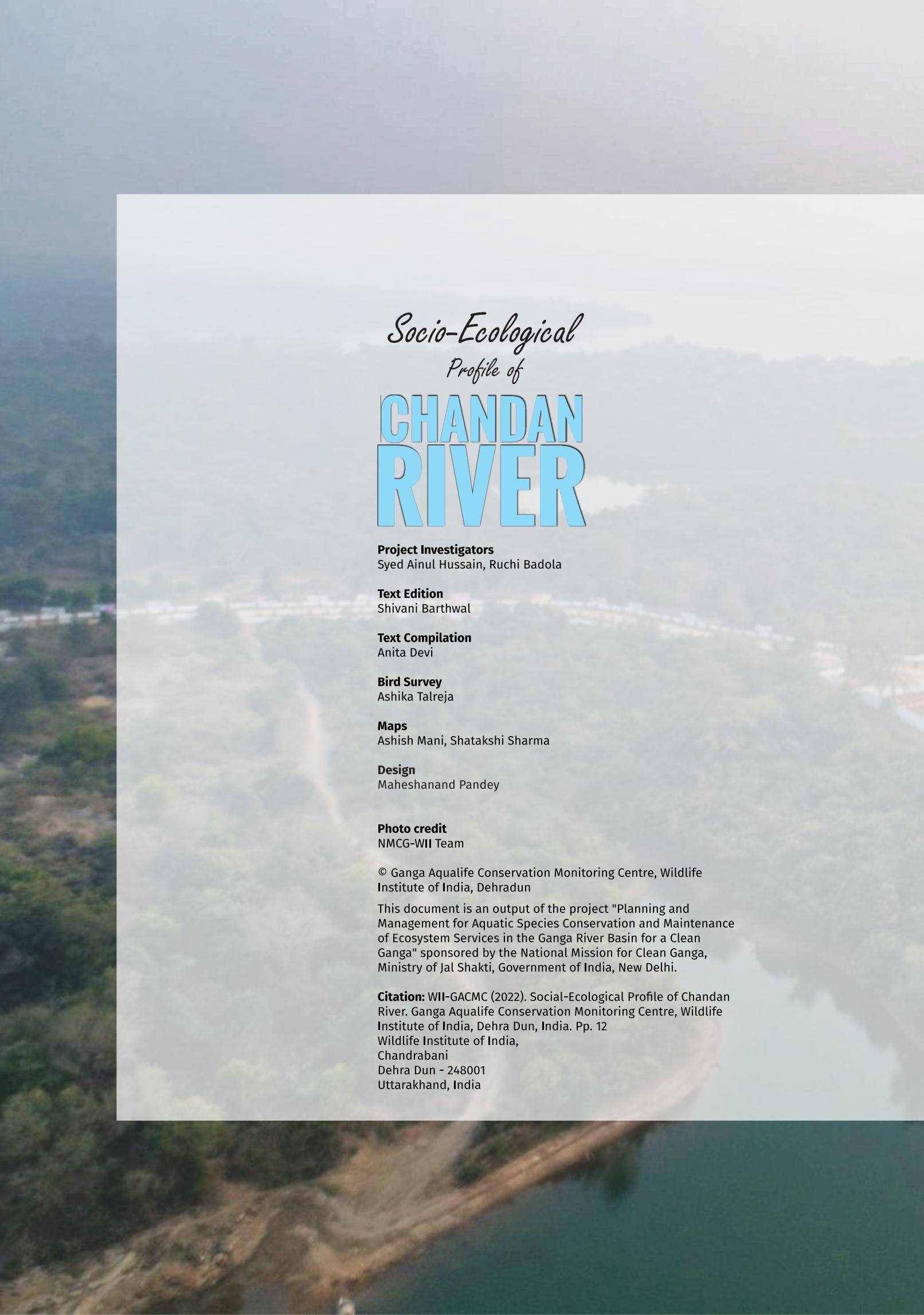


*Socio-Ecological
Profile of*
**CHANDAN
RIVER**



*Socio-Ecological
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Socio-Ecological Profile of **CHANDAN** **RIVER**

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preface

India, as a megadiverse country, is home to a diverse range of landscapes and ecosystems, including freshwater ecosystems that comprise rivers and associated wetlands. Among them, the Ganga River basin is an important life-support system that has sustained human civilizations. The Ganga River, which flows across the five states is a vital source of life for more than 40 per cent of India's billion-plus population. The Ganga River is fed by several tributaries, which contribute to the river's resourcefulness by providing adequate nutrients, drift, and favourable ecological conditions for the species it houses. On the contrary, such tributaries also bring with them numerous pollutants and toxic waste resulting in the increase of the pollution load on the Ganga River.

The Wildlife Institute of India through the *Biodiversity Conservation and Ganga Rejuvenation Project* funded by the Ministry of Jal Shakti "National Mission for Clean Ganga" under its flagship programme 'Namami Gange' has been working towards the conservation of the Ganga River, to strengthen concerted efforts for restoration of its biodiversity value. During the project's first phase, which focused on the detailed biodiversity profiling of the Ganga River, the importance of conservation of its tributaries in supporting the biodiversity of Ganga River was realized. As a result, phase II of the project "*Planning and Management for Aquatic Species Conservation and Maintenance of Ecosystem Services in the Ganga River Basin for a Clean Ganga*" was designed to develop a comprehensive restoration and long-term plan for the Ganga River's tributaries.

In view of this the project undertook study of major tributaries of Ganga River and studied smaller tributaries in the Ganga basin. Chandan River originates near the northern part of Deoghar hills in Jharkhand. It meets Ganga river through the Jamunia river in Bihar. Based on the secondary literature review, the report attempts to compile the socio-ecological profile of the Chandan River and will enable the reader to better understand the variety of the flora and fauna of the Chandan River, change in forest cover and land use land cover patterns, and the threats faced by the River. This report aims to highlight the need for more focused scientific studies of the Chandan River, conservation efforts, to develop a knowledge base for the species of Chandan River, aid in biological restoration, and assist policy planners and managers to judiciously use water from the Chandan River, given the needs of the species therein.

Ruchi Badola
Syed Ainul Hussain

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INTRODUCTION

Flowing through the two Indian states, Jharkhand and Bihar, the Chandan River covers a length of about 145 km, of which 138 km flows through Bihar and 7 km through Jharkhand (Figure 1). In Bihar, the chandan river also known as CHANAN RIVER locally. It is a small tributary of the Ganga River and the largest hill stream in south Bhagalpur. With its well-defined channels and high banks, Chandan River becomes rapid torrents during monsoon and is almost dry in the summer season (FSI, 1985). The Chandan River Basin covers an area of 4771.76 km², of which 54.5% falls in Bihar and 45.5% in Jharkhand. Chandan River with Chir and Bilasi rivers forms a Bilasi-Chandan-Chir River basin, which is situated between latitudes 24°30' N and 22° 51' N and longitudes 84° 36' E and 87° 27' E (WRD, 2019). In the Chandan River, floods are a common occurrence. The right bank of the river is more susceptible to flooding than the left bank (Rana et al., 2022). Chandan River is one of the major sources of irrigation for agriculture, an important livelihood in the area (Pandey and Kumar, 2014).

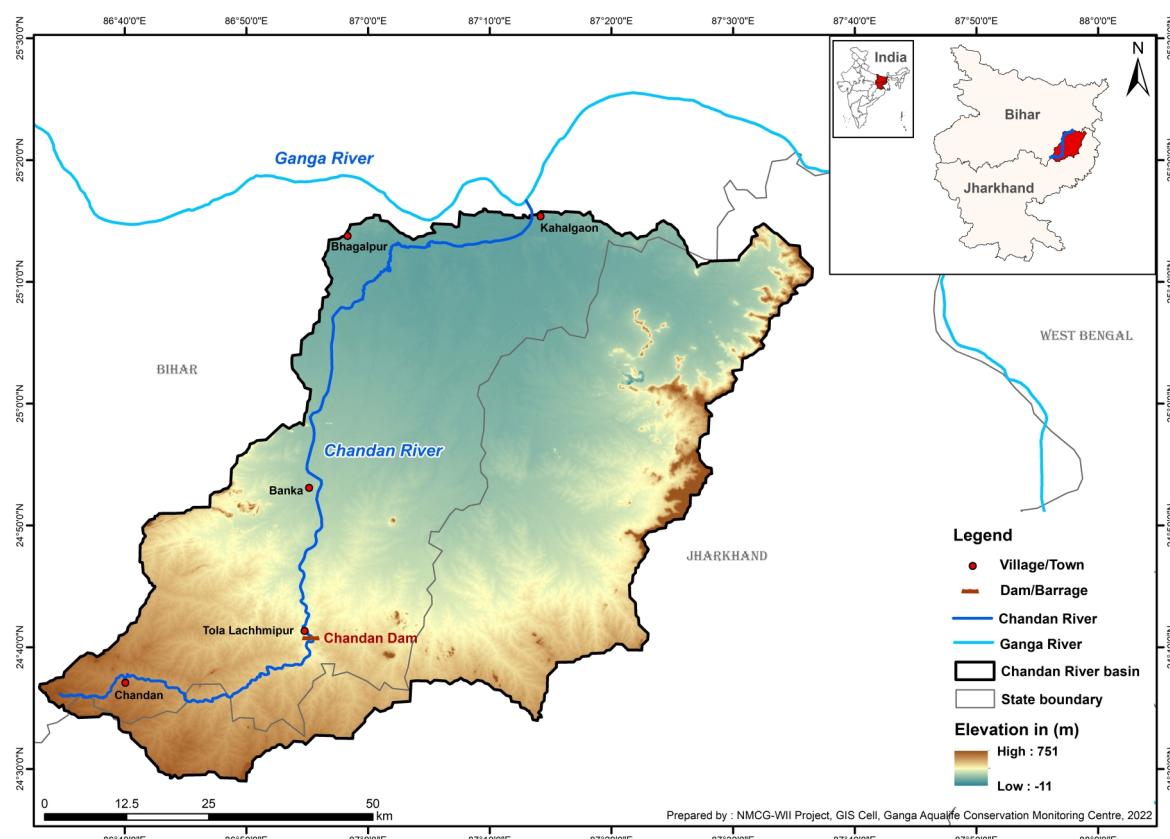


Figure 1. Map of Chandan River

COURSE OF THE RIVER

Chandan river originates near the northern part of Deoghar hills in Jharkhand state at an elevation of 274 m (WRD, 2019). During its course, the river flows through major areas of Tola Lachmipur, and enters the Banka district from the southwest, and flows northwards through Bhagalpur and Kahalgaon. During its journey, the river bifurcates into a number of small streams with characteristics of the deltaic river. It meets the Ganga River through the Jamunia river channel nearby Vikramshila Bridge at Barari in Bihar (Pandey and Kumar, 2014). The important tributaries of Chandan are Orhni, Kuldar and Chatri (WRD, 2019) (Figure 2).

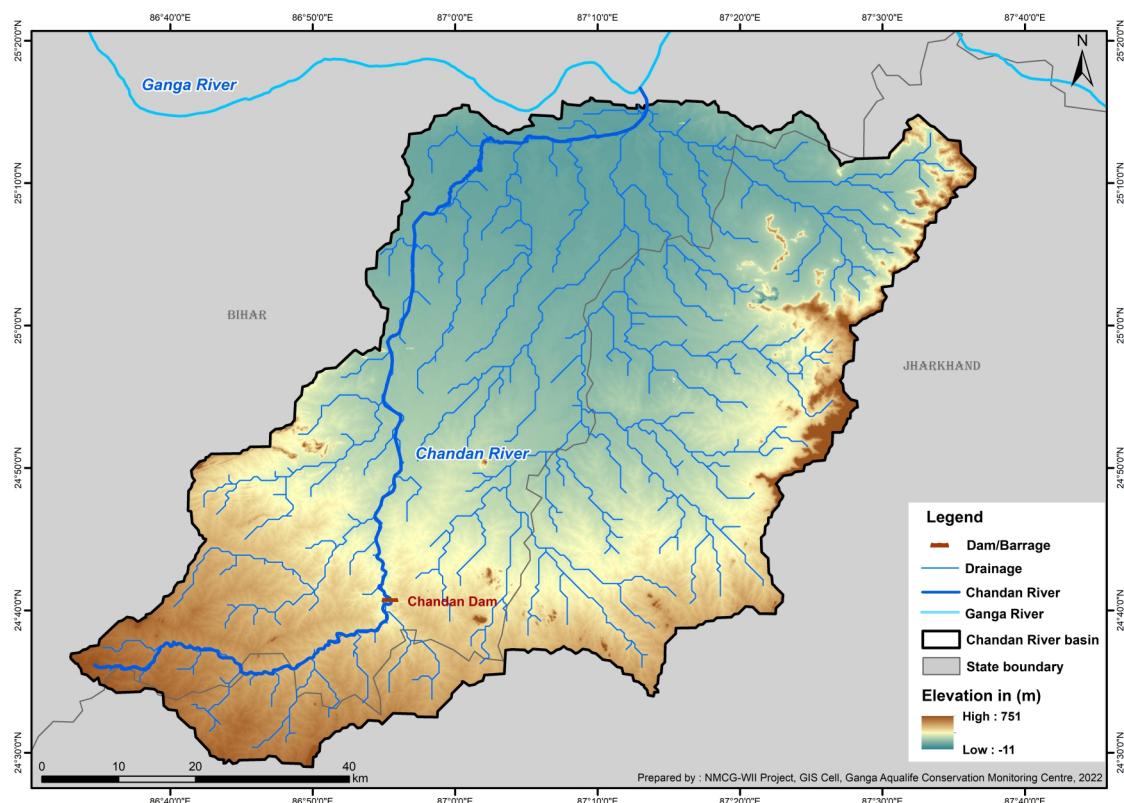


Figure 2. Drainage map of Chandan River

GEOLOGY AND GEOMORPHOLOGY

Physiographically the area is represented by an alluvial plain in the north and a hilly tract in the south. The area is characterised by ancient crystalline rocks (archean genesis) and older sedimentary rocks. The hilly tracks are moderate in height, denuded, and irregularly scattered. Geomorphologically, the area is divided into five units: the Diara surface, Belhar surface, Sautadih surface, Pediplain surface, and Hilly/ Rocky upland (FSI, 1985; CGWB, 2013).

SOIL TYPE

Chandan River is dynamic in nature, and gradual modification in the river system resulted in a vibrant soil system that can be broadly grouped into two categories, alluvial soil and hilly soil (CGWB, 2013). Both older alluvium and newer floodplain deposits formed the alluvial soil which is characterised by light to dark grey colour and fine texture. Derived from the weathered rocks, the hilly soil is coarse-grained, ferruginous, poor in

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nitrogen content, medium to high potash and acidic in nature (CGWB, 2013). According to FAO-UNESCO (1997), the catchment of the Chandan River is represented by 50.03% of Luvisols soil, followed by 32.96% of Nitosols soil, 14.48% of Cambisols soil and 2.53% of Fluvisols soil. Luvisols soil occurs in northern and central parts of the catchment, Nitosols in southern parts, Cambisols in the western and eastern parts, and Fluvisols in northern parts. Chandan river system has a topographical variability that has contributed to a greater extent to soil formation with respect to soil depth, texture, fertility, water retaining capacity and physico-chemical characteristics (Pandey and Kumar, 2014). Therefore, making the Chandan River floodplain very useful for agriculture.

CLIMATE

The climate of the area is sub-tropical and subhumid, which is characterised by hot summers, monsoons and winters. Summers from March to May are hot, while November to February is cold. The minimum and maximum temperatures range between 10.2°C and 36.5°C, with the mean annual temperature between 28.8 to 36.5 °C (Pandey and Kumar, 2014). During monsoon, about 75 to 80% of the annual rainfall occurs from June to September, with the precipitation varying from 1135 mm to 1200 mm (Chatterjee and Ghosh, 1998; Pandey and Kumar, 2014).

BIOGEOGRAPHY, FLORA AND FAUNA

The Chandan flows through two biogeographic zones, the Deccan Peninsula and the Gangetic Plains and two biotic provinces, Chhota Nagpur (6B) and Lower Gangetic Plains (7B). According to Champion and Seth (1968), there are three forest types in the Chandan River basin, dry peninsular sal forest (5B/C1c), northern mixed deciduous forest type (5B/C2) and dry deciduous scrub forest (5/DS1). The vegetation is represented by *Shorea-Anogeissus-Woodfordia* communities, *Cochlospermum-Euphorbia* communities, *Anogeissus-Mitragyna-Dendrocalamus- Daedalacanthus* communities, *Acacia catechu*, *Randia dumetorum*, *Ziziphus* spp., *Carissa* spp and *Butea monosperma*.

White-rumped vulture (*Gyps bengalensis*), Indian skimmer (*Rynchops albicollis*), black-bellied tern (*Sterna acuticauda*), Greater adjutant (*Leptoptilos dubius*), and river tern (*Sterna aurantia*) are some of the important bird species found in the Chandan River basin (Dey et al., 2014). However, ecologically, the lack of scientific studies focusing on biodiversity in terms of flora and fauna of the Chandan River makes it one of the least studied rivers in the Ganga River basin.

STATUS OF WATERBIRDS DIVERSITY IN THE CHANDAN RIVER

A total of 35 species of waterbirds and water associated birds, belonging to 17 families, were recorded during the ecological survey of the Chandan River, carried out in post-monsoon 2022. Of these, eight species were winter migrant.

Over, Ardeidae was the most abundant family, followed by Scolopacidae. River lapwing, a near-threatened species was present all along the survey sites. Least number of species was recorded near the origin, while most of the sightings were recorded near the confluence with the Ganga River. The confluence also had the highest number of migratory species.

CONSERVATION STATUS

Vikramshila Wildlife Sanctuary in Bihar is the only protected area that falls in the Chandan River basin. Around a 4 km stretch of Chandan River flows through the Vikramshila Wildlife Sanctuary which has been protected since 1991 by the Government of Bihar, India. Vikramshila is crucial in conserving Gangetic river dolphins (*Platanista gangetica*), as it is the only protected area in India dedicated to dolphin conservation. Besides this, it also supports the population of smooth-coated otter (*Lutrogale perspicillata*), gharial (*Gavialis gangeticus*), several freshwater turtles and 76 fish species (Choudhary et al., 2006). The Sanctuary supports 135 bird species and is identified as an Important Bird Area by BNHS (Choudhary et al., 2006).

FOREST COVER

According to the Forest Survey of India (2015 & 2019), the catchment of the Chandan River is dominated by non-forest cover, followed by moderately dense forest, open forest, scrubland, and very dense forest. From 2015 to 2019, an increase of 0.72%, 0.32% and 0.14% was recorded for the open forest, scrubland and moderately dense forest, respectively. However, a decrease of 1.21% was recorded for non-forest cover (Figures 3a & 3b and Table 1).

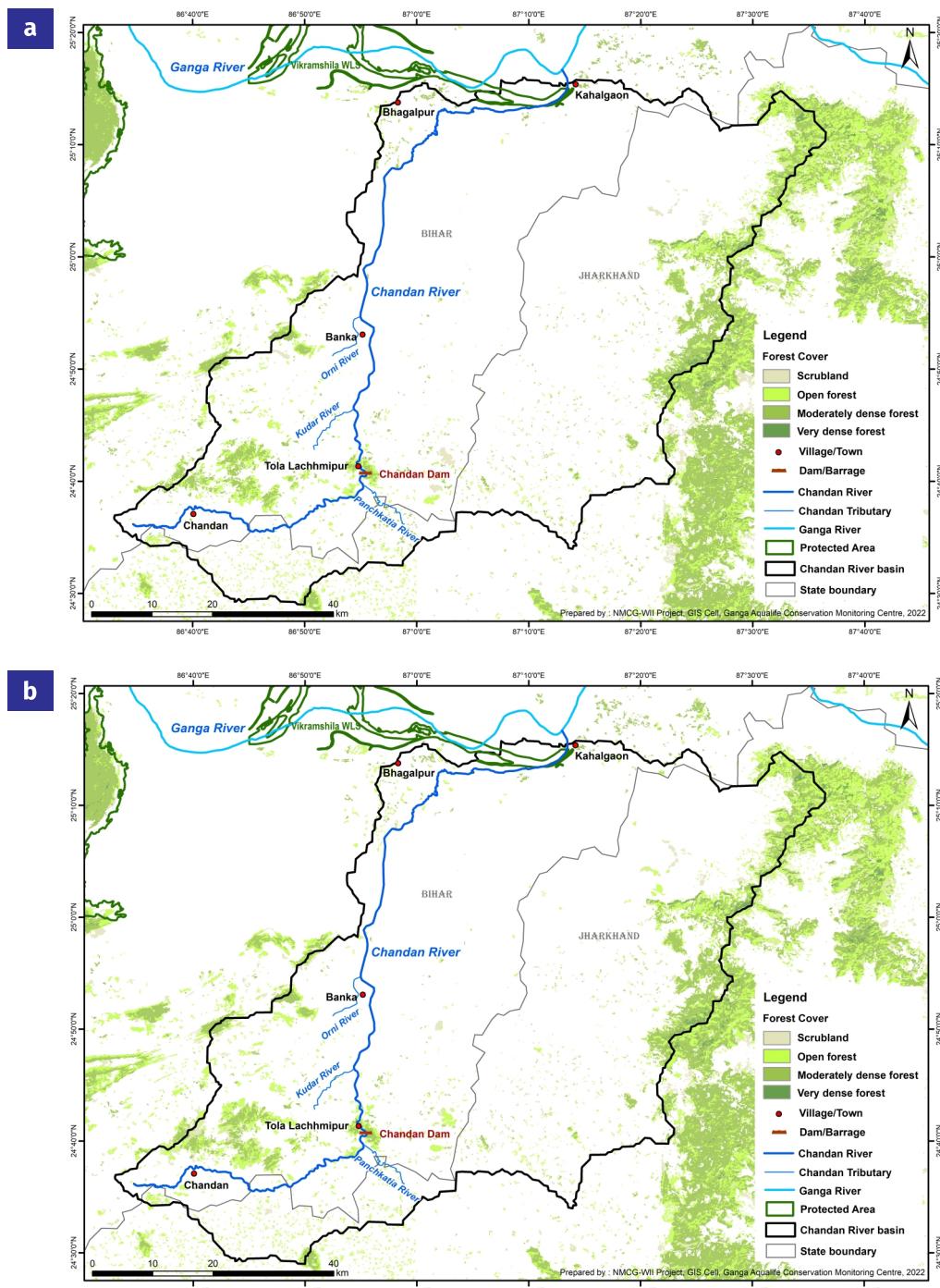


Figure 3. Forest Cover of Chandan River basin in a) 2015 and b) 2019

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Table 1. Summary statistics of the forest cover of the Chandan River basin from 2015 to 2019.

S.No.	Forest Cover Classes	2015		2019		Change (2015 to 2019)	
		Area (km ²)	Area (%)	Area (km ²)	Area (%)	Area (km ²)	Area (%)
1	Scrubland	18.95	0.4	34.38	0.72	15.43	0.32
2	Open Forest	186.24	3.9	220.2	4.62	33.96	0.72
3	Moderately Dense Forest	192.81	4.04	199.4	4.18	6.59	0.14
4	Very Dense Forest	10.72	0.22	12.06	0.25	1.34	0.03
5	Non-forest	4363.04	91.44	4305.72	90.23	-57.32	-1.21
Total Area		4771.76	100	4771.76	100	-	-

Source: FSI (2015 & 2019)

DEMOGRAPHY

Chandan River basin supports a human population of 25.93 lakh, of which 22.74 lakh are in Bihar and 3.19 lakh are in Jharkhand (GOI, 2011). There are four districts in the Chandan River basin, of which Bhagalpur, Jamui and Banka fall in Bihar and Deoghar in Jharkhand. The Banka district is the most populated of these, with an 11.08 lakh human population (Figure 4 and Table 2).

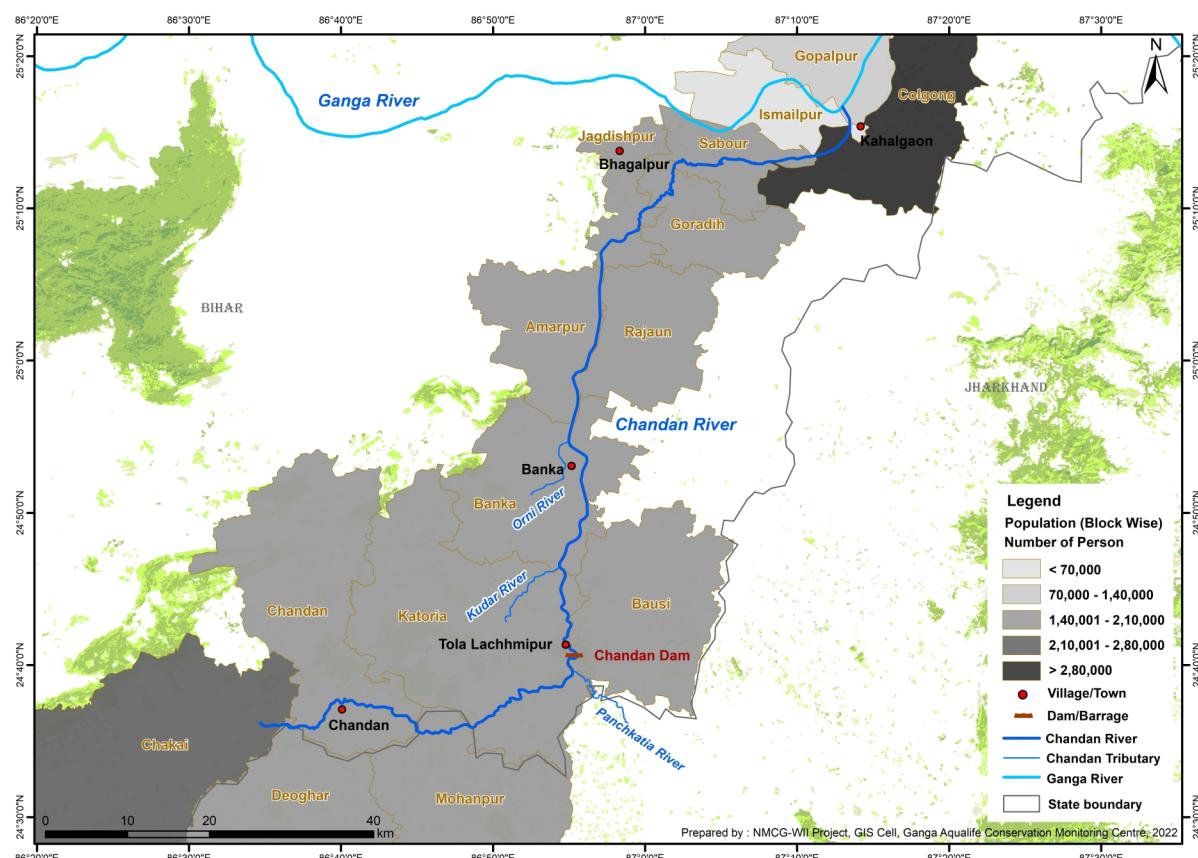


Figure 4. Human population status of Chandan River basin (2011)

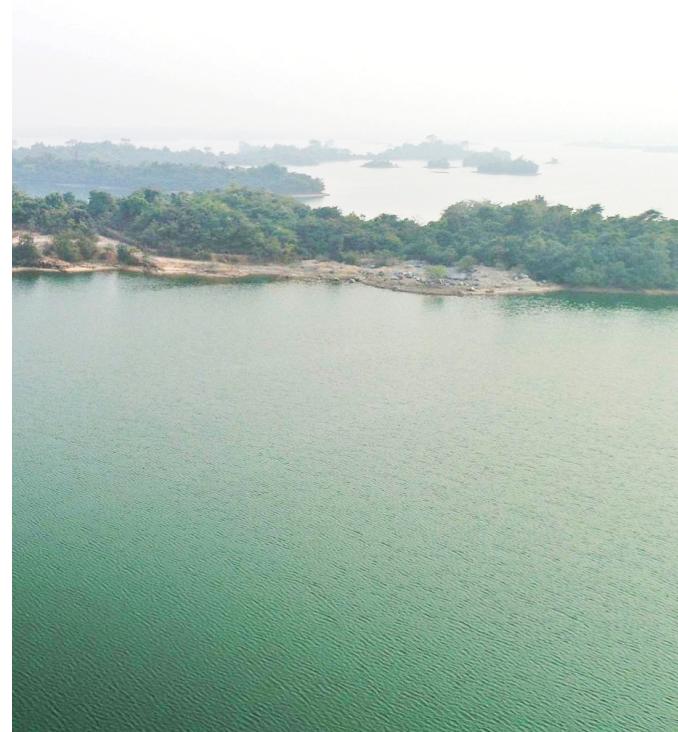
Table 2. Block-wise human population statistics of the Chandan River basin for 2011

State	District	Block	Population	Population (%)
Bihar	Bhagalpur	Gopalpur	94952	3.66
		Colgong	331585	12.79
		Ismailpur	43440	1.68
		Sabour	142805	5.51
		Goradiah	146210	5.64
		Jagdishpur	172107	6.64
	Jamui	Chakai	235188	9.07
	Banka	Amarpur	201351	7.77
		Rajaun	197601	7.62
		Banka	171324	6.61
		Chanan	165634	6.39
		Katoria	186646	7.20
		Bausi	185000	7.14
Jharkhand	Deoghar	Deoghar	142966	5.51
		Mohanpur	175845	6.78
		Total	2592654	100

Source: Government of India, 2011

LAND USE AND LAND COVER OF THE AREA

Based on NRSC data (2008-09 and 2018-19), two Land Use and Land Cover (LULC) maps of the Chandan River basin were prepared. The Land Use and Land Cover of the Chandan River basin can be categorised into 11 categories: built-up, Kharif crop, rabi crop, zaid crop, double/triple crop, fallow land, plantation, deciduous forest, degraded/ scrub forest, wasteland, and waterbodies. From 2008-09, the Chandan River basin was dominated by 34.96% of Kharif crop, followed by 15.53% of double/triple crop, 15.01% of fallow land, 10.85% of wasteland, 6.5% of degraded/scrub forest, 5.58% of built-up area, 4.39% of deciduous forest, 3.01% of rabi crop, 3.01% of waterbodies, 0.98% of plantation and 0.18% of zaid crop. From 2018-19, the Kharif crop, with 51.73% of the area, represents the maximum cover, followed by 11.94% of double/triple crop, 9.01% of wasteland, 6.42% of degraded/ scrub forest, 5.75% of built-up, 4.95% of fallow land, 4.33% of deciduous forest, 2.88% of waterbodies, 2% of rabi crop and 0.99% of plantation. LULC maps revealed that over a period of ten years, there was an increase of 16.77% in the Kharif crop area and a decrease of 10.06%, 3.59%, 1.84% and 1.01% in the fallow land, double/triple crop, wasteland and rabi crop area, respectively (Figure 5a & 5b and Table 3).



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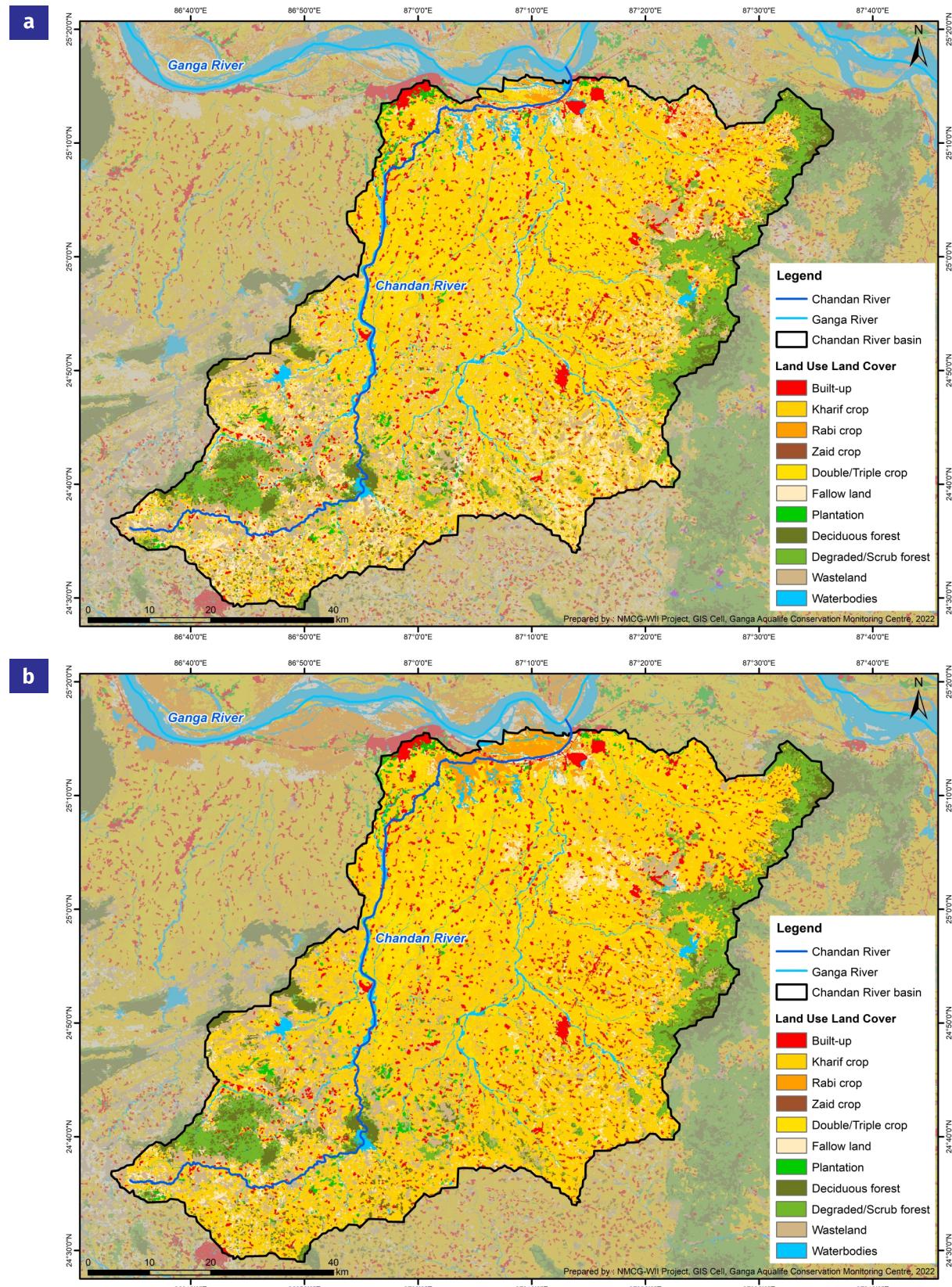


Figure 5. LULC map of Chandan River basin a) 2008-09 and b) 2018-19

Table 3. LULC statistics of the Asan River basin for 2008-09, 2018-19 and 2008 to 2019.

S. No.	LULC Classes	2008-09		2018-19		Change (2008-19)	
		Area (km ²)	Area (%)	Area (km ²)	Area (%)	Area (km ²)	Area (%)
1	Built-up	266.42	5.58	274.44	5.75	8.02	0.17
2	Kharif crop	1668.29	34.96	2468.21	51.73	799.92	16.77
3	Rabi crop	143.55	3.01	95.3	2	-48.25	-1.01
4	Zaid crop	8.75	0.18	0.1	0	-8.65	-0.18
5	Double/Triple crop	741.05	15.53	569.96	11.94	-171.09	-3.59
6	Fallow land	716.1	15.01	236.24	4.95	-479.86	-10.06
7	Plantation	46.68	0.98	47.03	0.99	0.35	0.01
8	Deciduous forest	209.3	4.39	206.66	4.33	-2.64	-0.06
9	Degraded/Scrub forest	310.4	6.5	306.31	6.42	-4.09	-0.08
10	Wasteland	517.7	10.85	430.16	9.01	-87.54	-1.84
11	Waterbodies	143.52	3.01	137.35	2.88	-6.17	-0.13
Total Area		4771.76	100	4771.76	100		

Source: NRSC (2009 and 2019)

DAMS AND BARRAGES

A dam and two weirs were constructed on the Chandan River for irrigation purposes. Chandan Dam has been constructed in the year 1967 (WRD, BIHAR) on the Chandan River in the Banka District, Bihar. The dam, with a length of 1554 m (WRD, BIHAR) has a gross storage capacity of 157.23 million cubic meters (India-WRIS, 2014). Ghogha weir, with a length of 312.4 m and 4528 cumecs design flood discharge, was built on Chandan River in Banka District, Bihar. Ikoria Weir constructed on Chandan River in Banka district, has a length of 244 m and a flood discharge capacity of 2830 cumecs (India-WRIS, 2014).



Chandan Dam on Chandan River

THREATS

Over time, change in Land Use patterns has impacted the Chandan River basin. Encroachment due to agriculture is majorly affecting the river habitat. Excessive fishing through trap nets, brick kilns and water extraction for agriculture and industrial purposes have altering the hydrology of the river. Increasing the network of roads/bridges over or on the river leads to the loss of water connectivity and the future disappearance of the river. Agricultural runoff is one of the major sources of pollution in Chandan as it brings a load of toxic pesticides, fertilisers and insecticides into the River. Discharge of domestic waste and garbage dumps into the river also threatens the physico-chemical characteristics of river water. Uncontrolled riverbed mining in Chandan also alters the natural riverine habitat. The study conducted by Jha and Sinha (2015) reported heavy sand mining in the Jagdishpur block of Bhagalpur District, affecting the riverine habitat of the Chandan River. Various human activities such as bathing, washing clothes, and dumping dead bodies into the Chandan River also deteriorate the water quality.

CONSERVATION IMPLICATIONS

The tributaries are known to increase in channel and habitat complexities, depth, and change in substrate composition, which increases the mainstem diversity downstream of the tributaries (Benda et al., 2004; Fernandez et al., 2004). Apart from contributing to the flow and aquatic diversity of the mainstem the tributaries also contribute to the pollution load to the mainstem. Any conservation actions for the mainstem, thus should also be directed at the tributaries. Thus the smaller tributaries of the Ganga River were taken up for study. Chandan River, despite being a small tributary of the Ganga River hasn't received the attention of the research institutions. The secondary literature review of the Chandan River highlights the lack of scientific documentation and information on the Chandan River basin. Therefore to understand the ecological status of the Chandan River, more scientific studies on the river's biodiversity, ecotoxicology and physicochemical parameters, and identification of threats are needed. Chandan River is very dynamic in nature. Therefore, the Chandan River encroachment must be prevented as it increases inundation risk (Rana et al., 2022). This will further help in reducing the loss of lives and properties during high floods (Rana et al., 2022). Administrative and legal steps should be taken to check uncontrolled sand mining. Participation of local communities in the conservation of this tributary will certainly help in the rejuvenation of the River.



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**Annexure:
Avifauna of Chandan River**

Order	Family	Species
Anseriformes	Anatidae	Ruddy Shelduck
Anseriformes	Anatidae	Lesser Whistling-Duck
Podicipediformes	Podicipedidae	Little Grebe
Coraciiformes	Alcedinidae	Common Kingfisher
Coraciiformes	Alcedinidae	White-throated Kingfisher
Coraciiformes	Alcedinidae	Pied Kingfisher
Suliformes	Phalacrocoracidae	Little Cormorant
Suliformes	Phalacrocoracidae	Great Cormorant
Pelacaniformes	Ardeidae	Grey Heron
Pelacaniformes	Ardeidae	Indian Pond Heron
Pelacaniformes	Ardeidae	Great Egret
Pelacaniformes	Ardeidae	Intermediate Egret
Pelacaniformes	Ardeidae	Little Egret
Pelacaniformes	Ardeidae	Cattle Egret
Pelacaniformes	Threskiornithidae	Red-naped Ibis
Ciconiiformes	Ciconiidae	Asian Openbill
Charadriiformes	Charadriidae	River Lapwing
Charadriiformes	Charadriidae	Red-wattled Lapwing
Charadriiformes	Charadriidae	Little Ringed Plover
Charadriiformes	Jacanidae	Pheasant-tailed Jacana
Charadriiformes	Jacanidae	Bronze-winged Jacana
Charadriiformes	Scolopacidae	Common Sandpiper
Charadriiformes	Scolopacidae	Green Sandpiper
Charadriiformes	Scolopacidae	Common Greenshank
Charadriiformes	Scolopacidae	Common Redshank
Passeriformes	Motacillidae	Citrine Wagtail
Passeriformes	Motacillidae	White-browed Wagtail
Passeriformes	Motacillidae	White Wagtail
Gruiformes	Rallidae	White-breasted Waterhen
Passeriformes	Hirundinidae	Grey-throated Martin
Passeriformes	Hirundinidae	Barn Swallow
Charadriiformes	Laridae	River Tern
Accipitriformes	Accipitridae	Bonelli's Eagle
Passeriformes	Dicruridae	Black Drongo
Passeriformes	Sturnidae	Indian Pied Starling

Abbreviation

NT- Near Threatened, V-Vulnerable, LC- Least Concern

R- Resident, R/LM- Resident with Local Migrant, R/WM- Resident with winter influx, WM- Winter Migrant

C- Carnivore, H- Herbivore, O- Omnivore, P-Piscivore, P/I- Piscivore/Insectivore, I/H- Insectivore/Herbivore,

P/C- Piscivore/Carnivore

Scientific Name	IUCN Status	IWPA Status	Residential Status	Feeding Guild
<i>Tadorna ferruginea</i>	LC	II	WM	O
<i>Dendrocygna javanica</i>	LC	II	R	O
<i>Tachybaptus ruficollis</i>	LC	II	R	O
<i>Alcedo atthis</i>	LC	II	R	P/C
<i>Halcyon smyrnensis</i>	LC	II	R	P/C
<i>Ceryle rudis</i>	LC	II	R	P/C
<i>Microcarbo niger</i>	LC	II	R	P/C
<i>Phalacrocorax carbo</i>	LC	II	R	P/C
<i>Ardea cinerea</i>	LC	II	R	P/I
<i>Ardeola grayii</i>	LC	II	R/LM	P/I
<i>Ardea alba</i>	LC	II	R/LM	P/I
<i>Ardea intermedia</i>	LC	II	R/LM	P/I
<i>Egretta garzetta</i>	LC	II	R/LM	P/I
<i>Bubulcus ibis</i>	LC	II	R	C/I
<i>Pseudibis papillosa</i>	LC	II	R	C
<i>Anastomus oscitans</i>	LC	II	R	O
<i>Vanellus duvaucelii</i>	NT	II	R	C
<i>Vanellus indicus</i>	LC	II	R	I
<i>Charadrius dubius</i>	LC	II	R	I
<i>Hydrophasianus chirurgus</i>	LC	II	R/LM	I/O
<i>Metopidius indicus</i>	LC	II	R	I/O
<i>Actitis hypoleucos</i>	LC	II	R/WM	I
<i>Tringa ochropus</i>	LC	II	WM	I/P
<i>Tringa nebularia</i>	LC	I	WM	I/P
<i>Tringa totanus</i>	LC	II	WM	I/C
<i>Motacilla citreola</i>	LC	II	WM	I
<i>Motacilla maderaspatensis</i>	LC	II	R	I
<i>Motacilla alba</i>	LC	II	WM	I
<i>Amaurornis phoenicurus</i>	LC	II	R	O
<i>Riparia chinensis</i>	LC	II	R	I
<i>Hirundo rustica</i>	LC	II	WM	I
<i>Sterna aurantia</i>	V	I	R	P/I
<i>Aquila fasciata</i>	LC	I	R	C
<i>Dicrurus macrocercus</i>	LC	II	R	I/C
<i>Gracupica contra</i>	LC	II	R	I







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