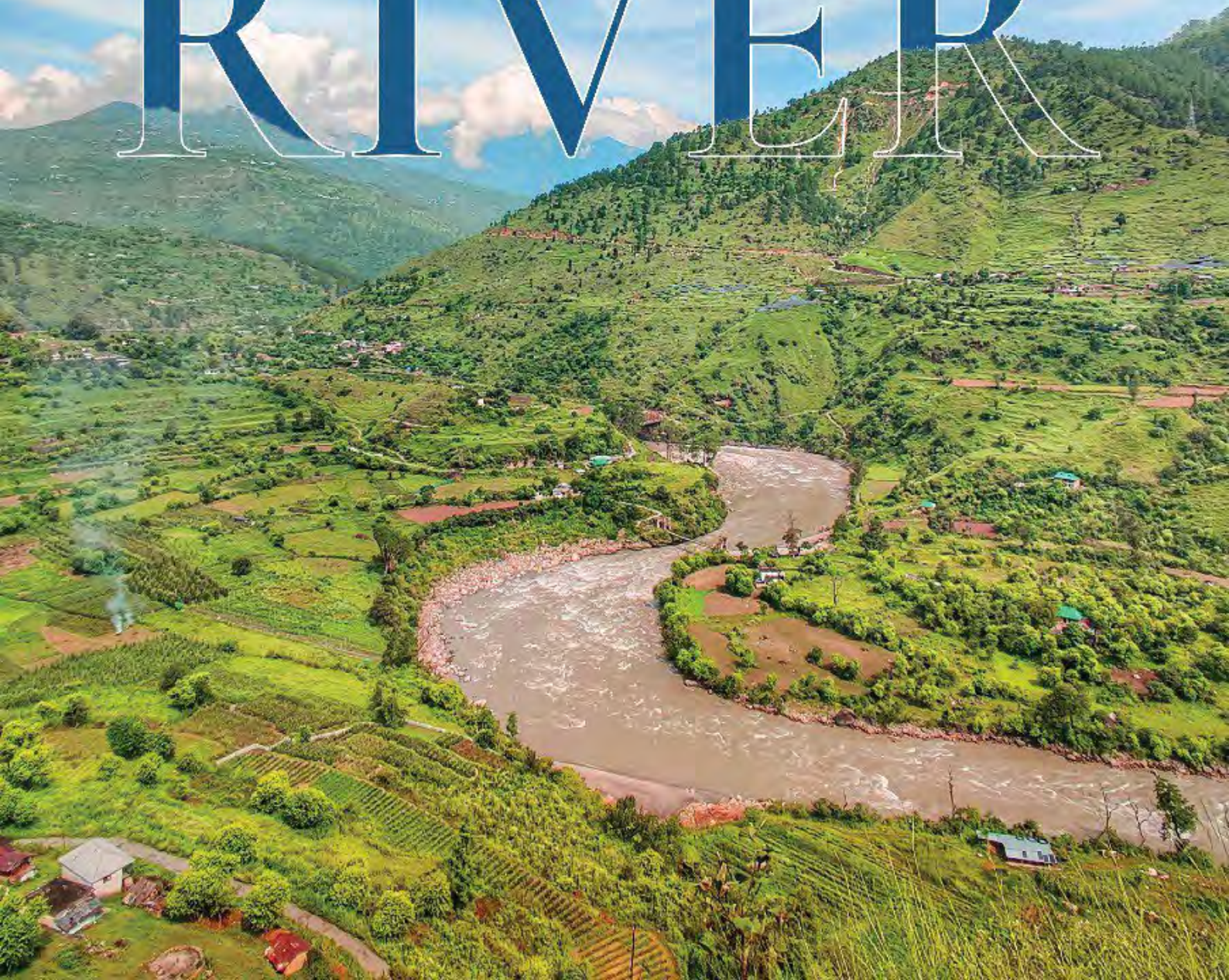


SOCIO-ECOLOGICAL PROFILE OF

TONS RIVER



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TONS RIVER

Project Investigators

Ruchi Badola, Syed Ainul Hussain

Coordinating Lead Authors

Syed Ainul Hussain, Ruchi Badola, Shivani Barthwal

Lead Authors

Umama Khan, Khadija, Neelamadhab Sahu

Contributing Authors

Revan Yogesh Chaudhari, Ashish Mani, Shatakshi Sharma,
Swati Nawani, Vishnu CS, Srija Das

Maps

Ashish Mani, Shatakshi Sharma

Cover Photo

Tons River as seen from Mendrath, Uttarakhand. © Anand Sankar

Photo credit

Ashish Mani, Revan Yogesh Chaudhary, Shivani Barthwal, Swati Nawani

Layout Assistant

Vishal Pal

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Wildlife Institute of India,
Chandrabani
Dehra Dun - 248001
Uttarakhand, India

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Ministry of Jal Shakti

C. R. Patil, *Union Minister*

Raj Bhushan Choudhary, *Minister of State*

V. Somanna, *Minister of State*

V. L. Kantha Rao, *Secretary*

National Mission for Clean Ganga (NMCG)

Rajeev Kumar Mital, *Director General*

Nalin Kumar Srivastava, *Deputy Director General*

S. P. Vashishth, *Executive Director (Admin)*

Bhaskar Dasgupta, *Executive Director (Finance)*

Brijendra Swaroop, *Executive Director (Projects)*

Anup Kumar Srivastava, *Executive Director (Technical)*

Sandeep Behera, *Biodiversity Consultant*

Sunil Kumar, *Assistant Engineer*

Ministry of Environment, Forest and Climate Change

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Anjan Kumar Mohanty, *Additional Director General of Forest (Forest Conservation)*

Ramesh Pandey, *Additional Director General, Wildlife*

R. Raghu Prasad, *Inspector General, Wildlife*

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G. Asok Kumar, *Former Special Secretary and Director General, NMCG*

Wildlife Institute of India

Gobind Sagar Bhardwaj, *Director*

Ruchi Badola, *Dean*



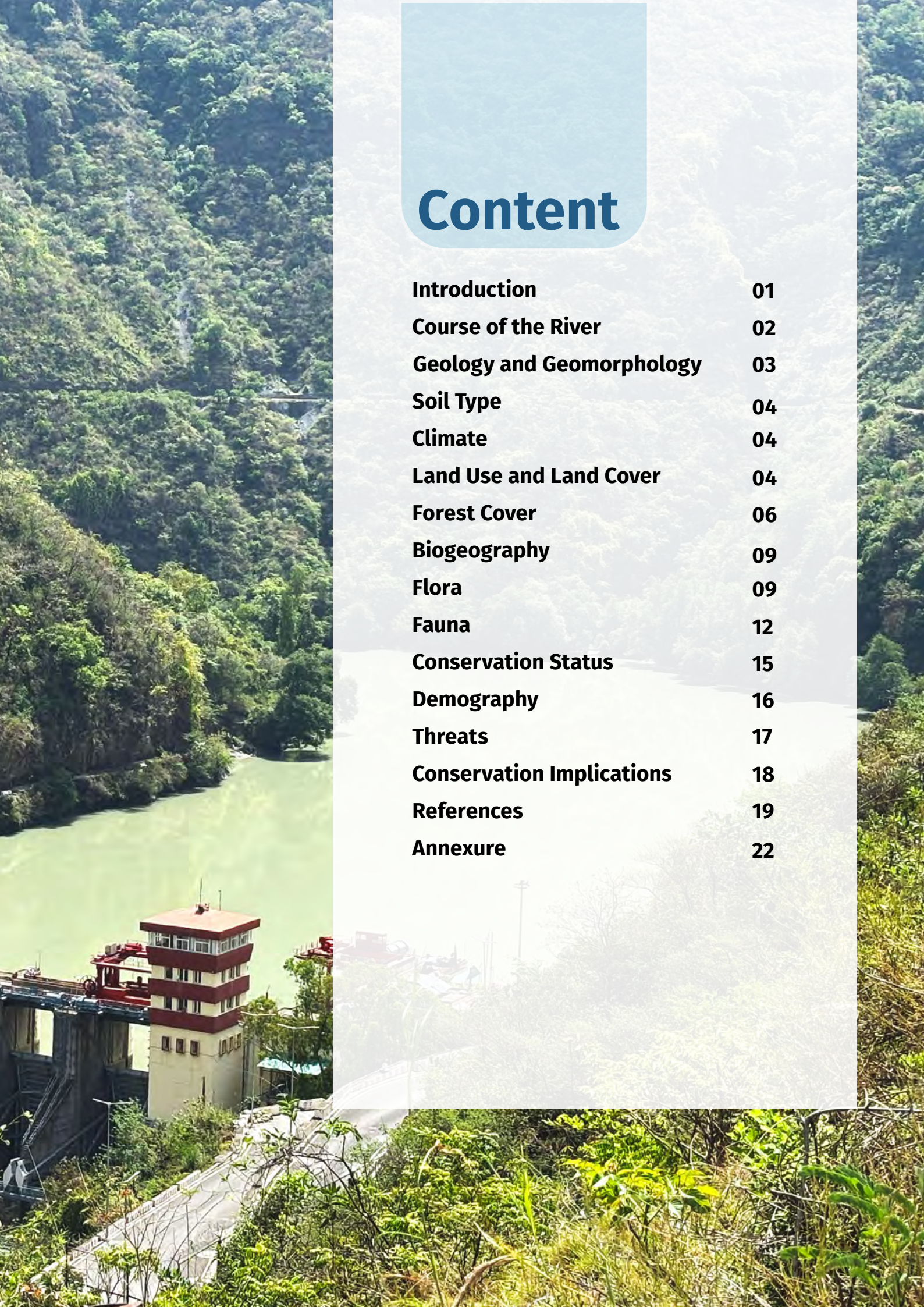
Preface

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 for millennia. 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. However, such tributaries also bring with them numerous pollutants and toxic waste, increasing the pollution load on the Ganga River.

The Wildlife Institute of India, through the Biodiversity Conservation and Ganga Rejuvenation Project funded by the National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, has been working towards the conservation of the Ganga River, to strengthen concerted efforts for restoring 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 the 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 a study of major tributaries of the Ganga River. During the study, it was realized that the smaller tributaries in the Ganga River basin maintain the connectivity and provide habitat for aquatic species, and hence, a few smaller tributaries were selected for study.

Tons River, the largest tributary of the Yamuna River in the Himalayas, originates in the high-altitude glaciated regions of the Garhwal Himalaya. The Tons River forms after the confluence of two tributaries: the Har ki Dun Gad and the Ruinsara Gad. This perennial river flows approximately for about 150 kilometers through rugged mountainous terrain of Himachal Pradesh and Uttarakhand before joining with the Yamuna River at Haripur, Kalsi in the Dehradun district. Govind National Park, Govind Pashu Vihar Wildlife Sanctuary, and Talar Wildlife Sanctuary are the protected areas within the Tons River basin and are known for their rich biodiversity. Based on the secondary literature review and preliminary survey of selected taxa groups, the report attempts to compile the socio-ecological profile of the Tons River. A total of 39 mammalian species, 128 bird species, six reptilian species, four amphibian species, and 30 fish species have been reported by previous studies from the Tons River basin. A preliminary survey of herpetofauna recorded a total of 14 reptile and eight amphibian species, while the riparian vegetation survey recorded a total of 321 angiosperm taxa, representing 212 genera and 73 families along the Tons River. This report aims to highlight the need for more focused scientific studies of the Tons River and conservation efforts to develop a knowledge base for the species of the Tons River, facilitate biological restoration, and assist policymakers and managers to judiciously use water from the river, given the needs of the species therein.





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Introduction

Tons River, the largest tributary of the Yamuna River in the Himalayas, originates in the high-altitude glaciated regions of the Garhwal Himalaya. Its primary water source is the Bandarpunch glacier, located at an elevation of approximately 6,315 meters above sea level (Negi, 1991). Flowing through the states of Himachal Pradesh and Uttarakhand, the River is perennial, sustained by glacial melt, snowmelt, along with the seasonal precipitation from the Indian summer monsoon. As it moves southwest, the River flows through rugged mountainous terrain before joining with the Yamuna River below Kalsi at approximately 30°32'N latitude and 77°51'E longitude in the Dehradun district of Uttarakhand (Khanna et al., 2010; Mehta et al., 2013).

Course of the river

The Tons River is primarily fed by two tributaries: the Har ki Dun Gad, originating from the Jaundhar glacier, and the Ruinsara Gad, which arises from the Bandarpunch glacier (Mehta et al., 2013). After the confluence of these two mountain rivers, the combined flow is known as the Tons River (Chopra and Singh, 2016; Chandra and Uniyal, 2021) (Figure 1a). As the River flows downstream, it passes through towns such as Mori and Hanol, and is joined by several tributaries, including the Pabar, Sainj, and Nira. Most of these smaller tributaries originate from glaciers such as Bandarpunch, Jaundhar Bamak, Jhajju Bamak, and Tilku, with the Pabar being the only major tributary not glacially fed (Pankaj et al., 2012). The River traverses ecologically important protected areas such as Govind National Park, Govind Wildlife Sanctuary, and Talar Wildlife Sanctuary, all known for their rich biodiversity (Aziem et al., 2020). In the Jaunsar region, it forms the border between Uttarakhand and Himachal Pradesh (Bartwal et al., 2011), and it completes its course by joining the Yamuna River at Haripur in Kalsi, after travelling approximately 150 kilometers with a catchment area of 5,146 sq. km (Khanna et al., 2010; Mehta et al., 2013; Sati and Banerjee, 2025). The Tons River Basin has a dendritic drainage pattern (Figure 1b).



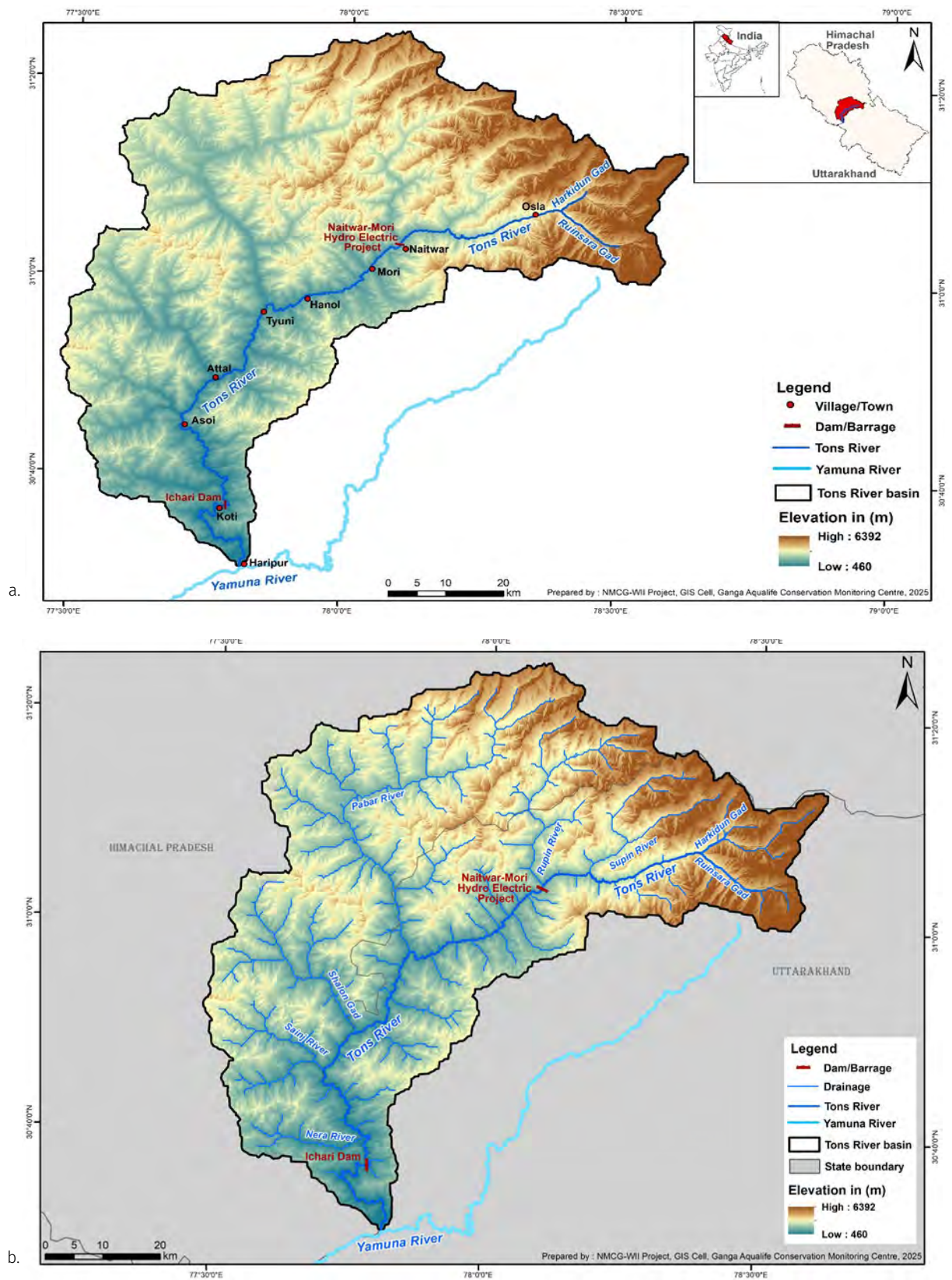


Figure 1. Maps showing (a) Tons River basin and (b) drainage network of the Tons River.

Geology and Geomorphology

The Tons River basin is located in the Himalayas, a region shaped by powerful geological forces. Two major tectonic faults, the Main Central Thrust and the Vaikrita Thrust, run through this region and make the landscape unstable and prone to natural hazards such as landslides and earthquakes (Pankaj et al., 2012; Day, 2016). The basin is made up of both metamorphic and sedimentary rocks that have been heavily folded and broken over time. The region consists of three primary rock formations. The Munsyari Jutog Formation, composed of granite and augen gneiss, is predominantly found in the higher eastern areas. The Chail Formation, characterized by quartzite, schist, and phyllite, exhibits mixed soil types. The Jaunsar Formation, primarily composed of quartzite and schist, extends across the western part of the basin (Day, 2016). These rock types affect the slope, soil quality, and erosion patterns throughout the basin. In the upper parts of the basin, many glaciers are covered by thick layers of debris known as supraglacial moraine. Glaciers, often fed by avalanches, add large amounts of sediment to the river as they melt. This sediment shapes the riverbanks and the landscape downstream. The meltwater predominantly follows a north-northeast to south-southwest trajectory, significantly influencing the river's morphology and hydrodynamics (Pankaj et al., 2012).



Tons River flowing through Tyuni

Soil Type

The Tons River basin is characterised by Cambisols and Lithosols, covering approximately 61.57% and 38.43% of the basin, respectively. Cambisol soil is found in the basin's southern regions, whereas Lithosols soil is found in the basin's northern region (FAO-UNESCO, 1977).

Climate

Climate of the Tons River basin changes with elevation, ranging from warm subtropical weather in the lower areas to cold alpine conditions in the higher mountains. The basin can be divided into three main climate zones: subtropical (1,200–1,700 m), temperate (1,700–3,500 m), and alpine (above 3,500 m). In the lower parts, summer temperatures can reach up to 39°C, while winters are generally mild. In higher areas, summers are cooler, with temperatures ranging between 4°C and 15°C, and winter temperatures often fall below freezing, reaching as low as -2.3°C (Mehta et al., 2013).

Annual rainfall in the basin ranges from 300 mm to 2,100 mm, with about 85% occurring during the monsoon season (June to September) (Yadav et al., 1985; Pankaj et al., 2012). Snowfall is common in the upper regions, especially between November and March. The average yearly humidity is around 60%, increasing during the monsoon. These climate conditions, combined with the varied elevation, support a wide range of plant and animal life, making the Tons basin one of the most ecologically rich areas in the region (Yadav et al., 1985).

Land Use and Land Cover

Based on NRSC, ISRO data for the years 2008–09 and 2018–19, two Land Use and Land Cover (LULC) maps were prepared for the Tons River Basin. The LULC in the basin was classified into 12 categories: Built-up, Kharif crop, Double/Triple crop, Fallow land, Plantation, Evergreen Forest, Deciduous Forest, Degraded/ Scrub Forest, Grassland, Wasteland, Waterbodies, and Snow cover.

In 2008–09, about 45.12% of the Tons River basin was covered by evergreen forest, followed by wasteland (24.57%), grassland (6.28%), deciduous forest (5.10%), plantation (4.90%), and fallow land (4.22%). Other land cover classes included double/triple crop (1.82%), kharif crop (1.49%), snow cover (3.12%), degraded/scrub forest (2.00%), water bodies (0.95%), and built-up area (0.43%) in 2008–09 (Figure 2a).

In 2018–19, the LULC pattern showed some notable changes. Percentage coverage of the evergreen forest slightly increased to 45.24%, while wasteland decreased significantly to 22.17%. Kharif crop rose markedly to 5.48%, reflecting agricultural expansion. The built-up area also grew to 0.49%, indicating urban expansion. Grassland expanded to 6.61%, while fallow land declined to 1.48%. Other changes included increases in double/triple crop (1.97%), snow cover (3.62%), and water bodies (0.97%), while deciduous forest (5.06%), plantation (4.89%), and degraded/scrub forest (2.02%) remained relatively stable (Figure 2b).

Over these ten years, the basin experienced increases of 3.99% in kharif crop, 0.06% in built-up area, 0.50% in snow cover, 0.15% in double/triple crop, 0.33% in grassland, and 0.02% in water bodies. On the other hand, there was a significant reduction in fallow land (-2.74%) and wasteland (-2.40%), which were possibly converted to agricultural or forested areas. Minor decreases were also observed in deciduous forest (-0.04%), plantation (-0.01%) (Figures 3a and 3b, and Table 1).

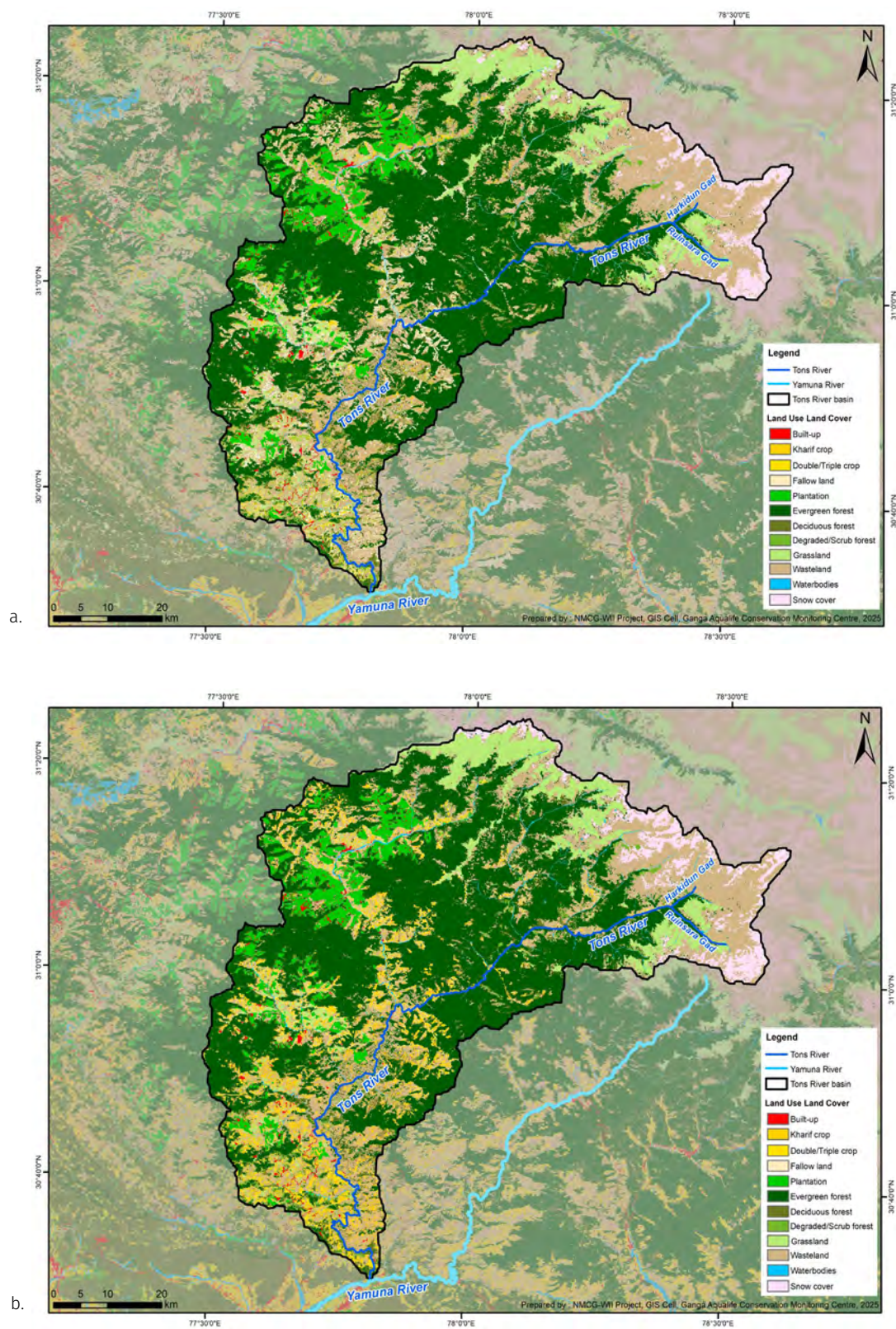


Figure 2. LULC map of Tons River basin for the years 2008-09 (a) and 2018-19 (b).

Table 1. LULC statistics of the Tons River basin for 2008-09, 2018-19 and 2008 to 2019.

LULC Classes	(2008-09) Area in Sq. km	(2008-09) Area in %	(2018-19) Area in Sq. km	(2018-19) Area in %	Area Change in Sq. km	Area Change in %
Built-up	22.29	0.43	25.13	0.49	2.84	0.06
Kharif crop	76.46	1.49	282.13	5.48	205.67	3.99
Double/Triple crop	93.6	1.82	101.62	1.97	8.02	0.15
Fallow land	217.3	4.22	75.95	1.48	-141.35	-2.74
Plantation	252.1	4.9	251.61	4.89	-0.49	-0.01
Evergreen forest	2321.79	45.12	2327.74	45.24	5.95	0.12
Deciduous forest	262.51	5.1	260.52	5.06	-1.99	-0.04
Degraded/ Scrub forest	102.71	2	104.02	2.02	1.31	0.02
Grassland	323.09	6.28	339.87	6.61	16.78	0.33
Wasteland	1264.07	24.57	1140.61	22.17	-123.46	-2.4
Waterbodies	49.07	0.95	49.71	0.97	0.64	0.02
Snow cover	160.42	3.12	186.5	3.62	26.08	0.5
Total	5145.41	100	5145.41	100		

Source: NRSC (2009 and 2019)

Forest Cover

The Tons River basin has approximately 44.35% of its total area under forest cover, according to the Forest Survey of India (FSI, 2019). Based on FSI data from 2015 and 2019, the catchment area is primarily dominated by moderately dense forest, followed by open forest, very dense forest, non-forest areas, and scrubland (Figures 3a and 3b). Between 2015 and 2019, there was a notable increase of 0.98% in the area under very dense forest, indicating a positive trend in forest regeneration or afforestation. Additionally, scrubland expanded by 0.67%, possibly reflecting transitional vegetation or forest degradation. On the other hand, the basin witnessed a decline of 0.46% in moderately dense forest and 0.20% in open forest, suggesting a shift in canopy density. The non-forest area also decreased slightly by 0.99%, potentially due to reforestation or land-use changes.



Table 2. Summary statistics of the forest cover of the Tons River basin from 2015 to 2019.

Forest Cover Classes	(2015) Area in Sq. km	(2015) Area in %	(2019) Area in Sq. km	(2019) Area in %	Area Change in Sq. km	Area Change in %
Scrubland	19.2	0.37	53.64	1.04	34.44	0.67
Open Forest	599.28	11.65	589.08	11.45	-10.2	-0.2
Moderately Dense Forest	1139.6	22.15	1116.06	21.69	-23.54	-0.46
Very Dense Forest	523.65	10.18	574.18	11.16	50.53	0.98
Non-forest	2863.68	55.65	2812.45	54.66	-51.23	-0.99
Total	5145.41	100	5145.41	100		

Source: FSI (2015 & 2019)



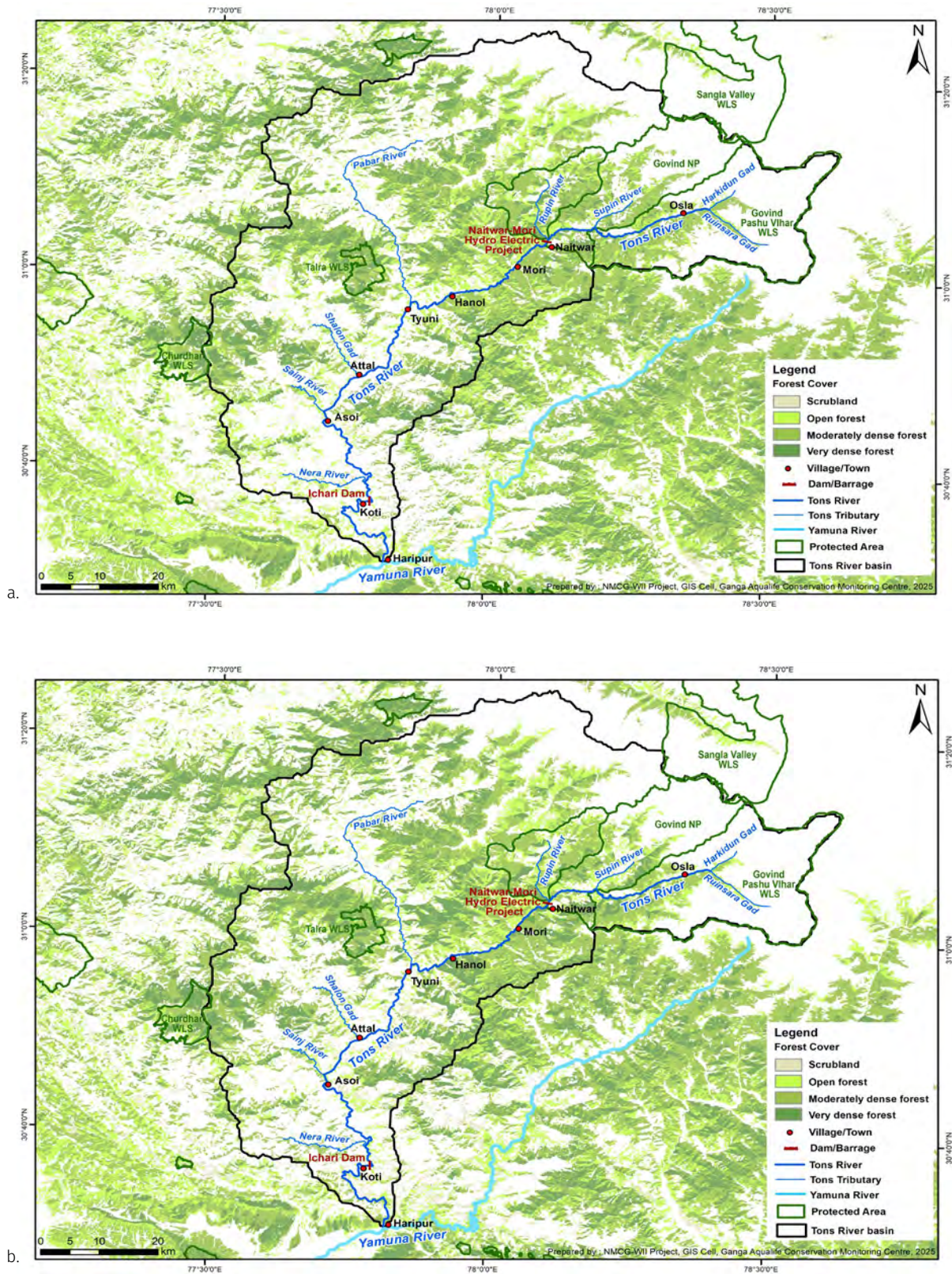


Figure 3. Forest Cover Classes of Tons River basin in 2015 (a) and 2019 (b).

Biogeography

According to the biogeographic classification system by Rodgers and Panwar (1988), the Tons River basin mostly lies within the Himalaya (2) biogeographic zone, specifically the West Himalaya (2B) biotic province. This region includes the mountains and forested areas of the basin. In the lower reaches of its course, near its confluence with the Yamuna River, the basin enters into the Upper Gangetic Plain (7A) biotic province. This area is flatter and more suitable for agriculture, with a different climate and vegetation compared to the Himalayan region. According to Champion and Seth (1968), Tons River falls under Type 9/C1: Himalayan Subtropical Pine Forests, Type 11/C1: East Himalayan Wet Temperate Forests, Type 12/C1: Lower Western Himalayan Temperate Forests, and Type 15/C1: Moist Alpine Scrub types.

Flora

During a reconnaissance survey along the Tons River (Figure 4), 321 taxa (Angiosperms) were recorded, representing 212 genera, and 73 Families (Figure 5a, Annexure VI). Poaceae was found to be the most dominant family with 38 species, followed by Fabaceae (28 spp.), Cyperaceae (24 spp.), Asteraceae (18 spp.), and Amaranthaceae (13 spp.) (Figure 5b). The life form (habit) of recorded plant species along the Tons River was dominated by herbaceous flora (167 spp.), followed by Grasses (66 spp.), Shrubs (44 spp.), Trees (38 spp.) and Climbers (6 spp.) (Figure 6a). Habitat preference of species found in the survey was as follows: Aquatic (16 spp.), Semi-aquatic (270 spp.), Terrestrial (35 spp.) (Figure 6b). Among the species recorded, 69 plants were Exotic while 252 plant species were found to be native to the region (Figure 7). Dominant families with the highest number of exotic plants were found to be Asteraceae (13 spp.) and Fabaceae (9 spp.). Habit-wise dominant plant species along the Tons River recorded are given in Table 3.



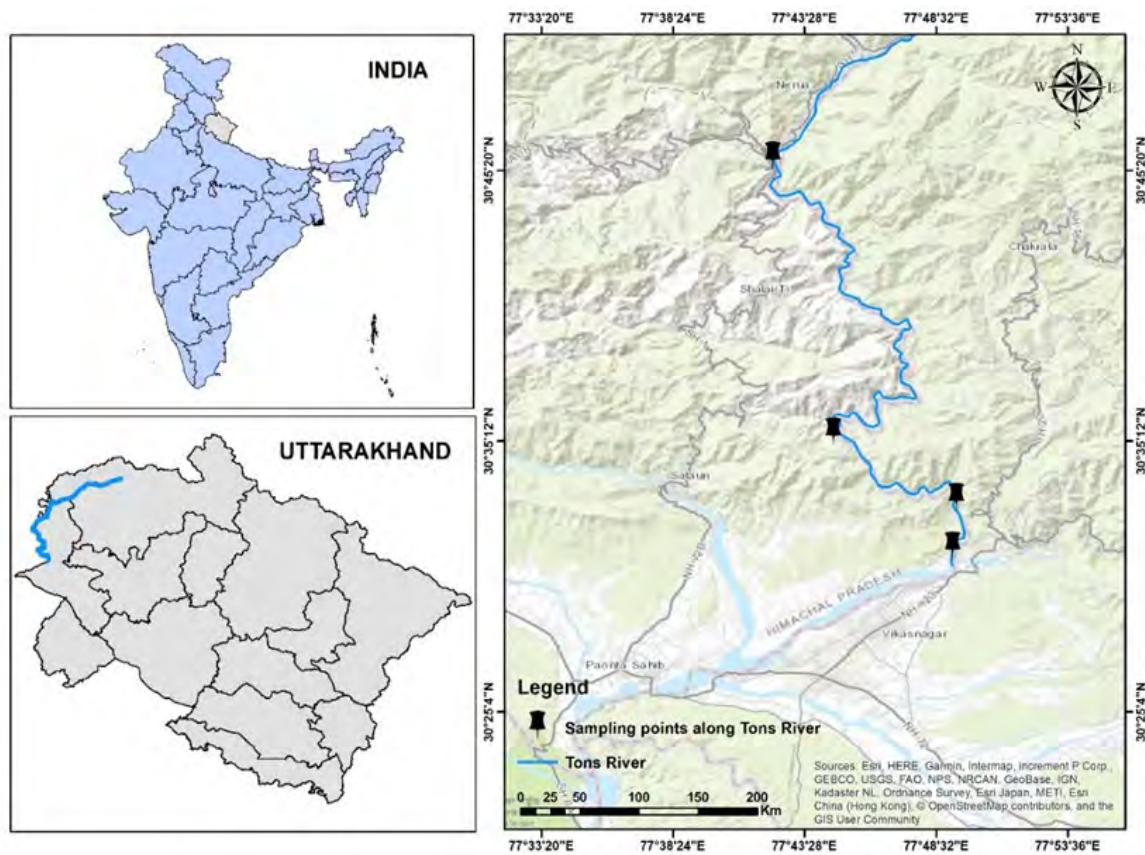


Figure 4. The map shows the sampling points for the riparian vegetation survey along the Tons River.

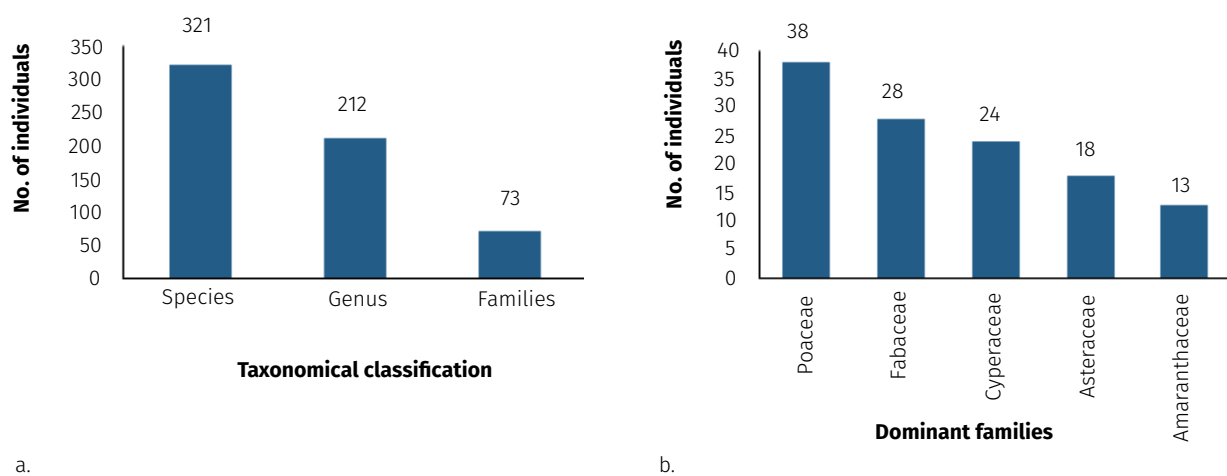


Figure 5. Taxonomical classification (a) and dominant families (b) of plants recorded during the survey along the Tons River.

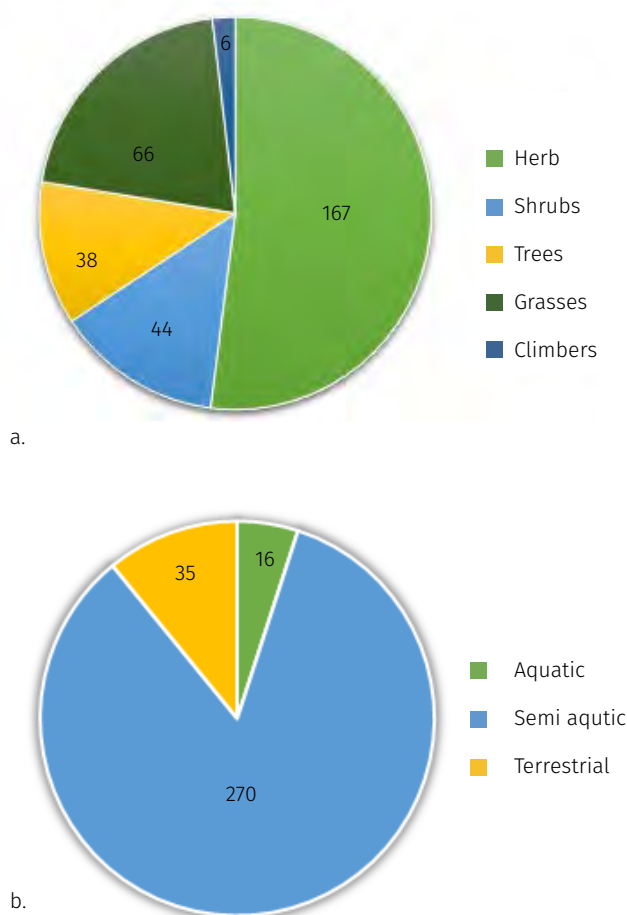


Figure 6. Habit- (a) and habitat (b)-wise classification of plant species recorded along the Tons River.

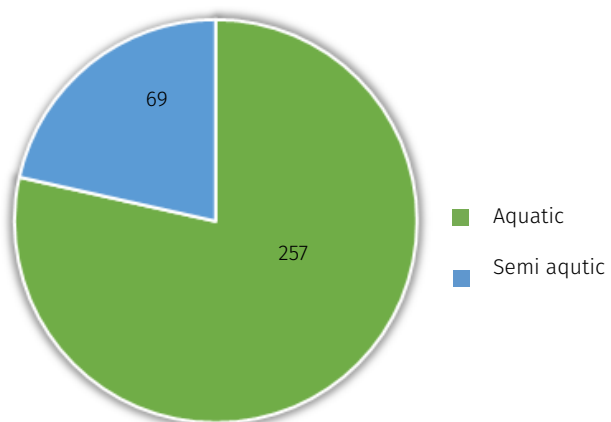


Figure 7. Nativity of plant species recorded along the Tons River.



Table 3. Habit-wise dominant plant species along the Tons River.

Habit type of plants	Dominant species
Tree	<i>Acacia catechu</i> , <i>A. nilotica</i> , <i>Dalbergia sissoo</i> , <i>Morus alba</i> , <i>Holoptelea integrifolia</i> , <i>Melia azadirachta</i> , <i>Bombax ceiba</i> , <i>Ficus religiosa</i> , <i>Syzygium cumini</i> , <i>Shorea robusta</i> , <i>Pinus roxburghii</i> , <i>Pinus wallichiana</i>
Shrub	<i>Clerodendrum viscosum</i> , <i>Lantana camara</i> , <i>Colebrookia oppositifolia</i> , <i>Ricinus communis</i> , <i>Rubus niveus</i> , <i>Berberis asiatica</i> , <i>Mimosa himalayana</i> , <i>Murraya keonigii</i>
Herb	<i>Colocassia esculenta</i> , <i>Acemella ciliata</i> , <i>Ageratum conyzoides</i> , <i>Alternanthera philoxeroides</i> , <i>Croton bonplandianus</i> , <i>Tridax procumbens</i> , <i>Parthenium hysterophorus</i> , <i>Portulaca Pilosa</i> , <i>Oxalis corniculata</i>
Grass	<i>Thysanolaena latifolia</i> , <i>Saccharum spontaneum</i> , <i>Imperata cylindrica</i> , <i>Cyperus rotundus</i> , <i>Cynodon dactylon</i> etc.
Climber	<i>Coccinea grandis</i> , <i>Dregea volubilis</i> , <i>Tinospora cordifolia</i> , <i>Dregea volubilis</i>
Exotic plant	<i>Alternanthera ficoidea</i> , <i>Alternanthera philoxeroides</i> , <i>Amaranthus spinosus</i> , <i>Sonchus asper</i> , <i>Croton bonplandianus</i> , <i>Eclipta prostrata</i> , <i>Ipomoea carnea</i> , <i>Lantana camara</i>

Fauna

Mammalian diversity in the context of the Tons River basin has been highlighted by Sati and Sinha (2004), who reported 32 species belonging to 29 genera, 16 families, and seven orders from the Gobind Pashu Vihar Wildlife Sanctuary (Annexure I). More recently, Singh et al. (2025) documented 27 species from 13 families and five orders, including threatened species such as Kashmir musk deer (*Moschus cupreus*) and Himalayan musk deer (*Moschus leucogaster*), and Vulnerable species like the Asiatic black bear (*Ursus thibetanus*), sambar (*Rusa unicolor*), Himalayan serow (*Capricornis thar*), snow leopard (*Panthera uncia*), and Tibetan wolf (*Canis lupus chanco*) (Annexure I). Mahabal (2000) reported 61 bird species belonging to 19 families from the Talra Wildlife Sanctuary, highlighting the site's avian richness. Later, Tak et al. (2004) documented 115 avifaunal species representing 31 families from Govind Pashu Vihar National Park and surrounding areas. The region also harbours several threatened species of conservation concern, including the Critically Endangered white-rumped vulture (*Gyps bengalensis*), the Vulnerable cheer pheasant (*Catreus wallichii*), and the Vulnerable western tragopan (*Tragopan melanocephalus*) (Annexure II).



The Tons River has been relatively understudied regarding herpetofauna diversity. Earlier, Husain (2004) recorded four species of amphibians and six species of reptiles from the region. To address this knowledge gap, a survey was conducted along the Tons River during summer 2022 (Figure 8). Time constrained visual encounter survey (VES, 2 person/h) (Crump and Scott 1994) and opportunistic survey were used for documenting amphibians and reptiles. A 2 km buffer of the mainstem Tons River was surveyed. All findings of dead amphibians and reptiles were photographed and georeferenced. The surveys were executed for one hour at dusk between 1900 h and 2200 h. Forest trails, hill streams, temporary water pools, marshy lands were actively surveyed and georeferenced to record the presence of individuals. Microhabitat such as leaf litter, dead bark of the trees and fallen logs were also examined. Species were identified using the keys of Smith (1935, 1943), Das (1995), Dutta (1997), Schleich and Kastle (2002). VES data was used to estimate abundance and encounter rates of herpetofaunal species. Shannon's diversity index, Simpson's diversity index and rarefaction curve for all the sites were also calculated. A total of 22 species of herpetofauna, including eight amphibians (anurans) belonging to four genera and three families, and 14 reptiles, consisting of eight snakes and six lizards, belonging to 13 genera across five families, were recorded (Annexure III, IV). *Duttaphrynus melanostictus* has the highest relative abundance value (0.26) during the study period among amphibians, while *Amolops formosus* has the lowest relative abundance (0.02) (Figure 9). Whereas in reptiles, *Laudakia tuberculata* has the higher relative abundance (0.13) (Figure 10).

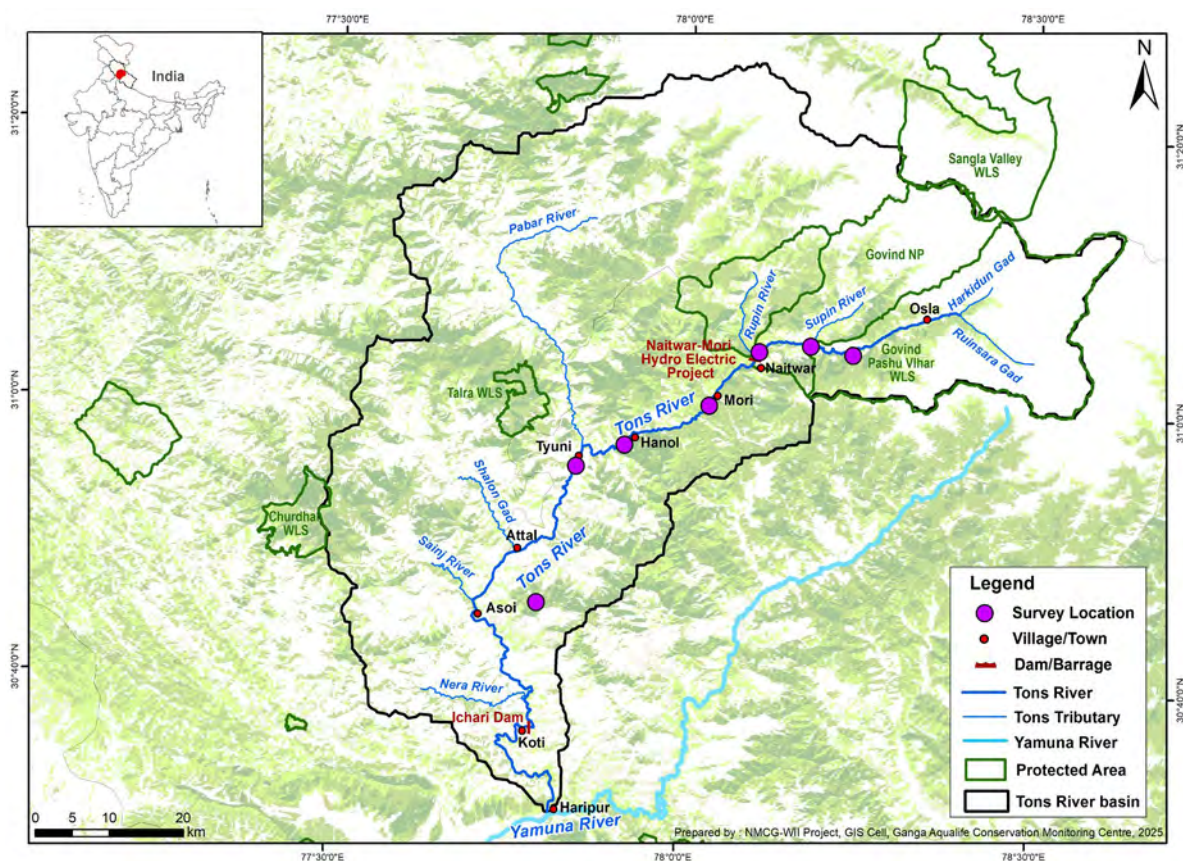


Figure 8. Map showing the sampling points for the reptilian and amphibian survey along the Tons River.

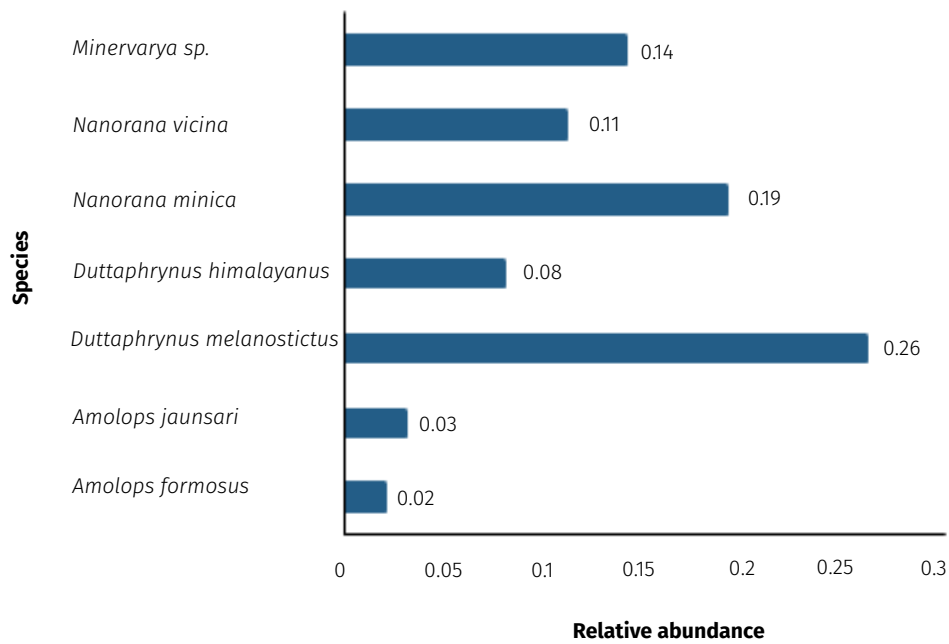


Figure 9. Relative abundance of amphibian species recorded from the Tons River.

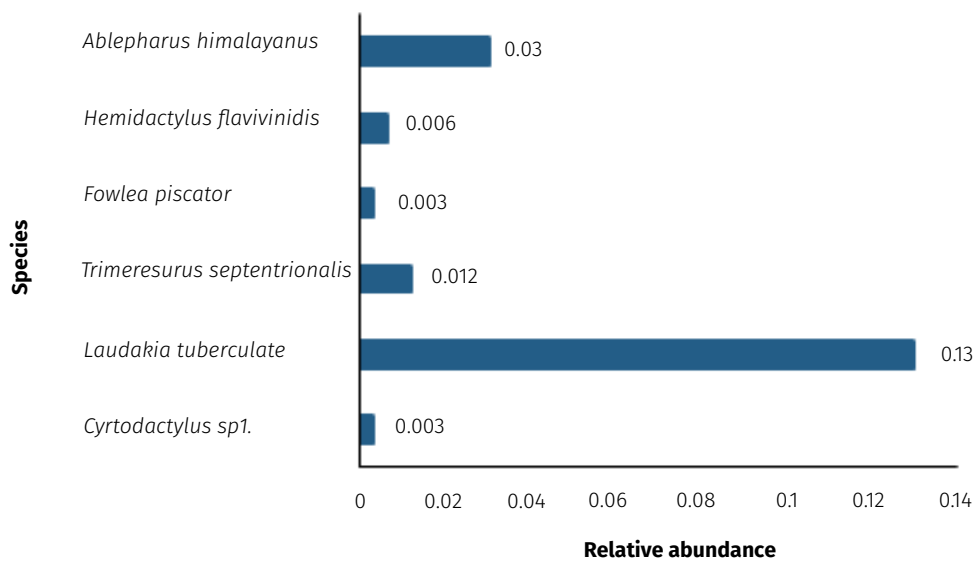


Figure 10. Relative abundance of reptile species recorded from the Tons River.

In the Tons River, Uniyal (2009) recorded 25 fish species belonging to 19 genera and seven families, distributed across four orders, indicating high ichthyofaunal diversity. In contrast, Rayal et al. (2021) reported 10 fish species from the Mal Gad stream, belonging to five genera and three families. Furthermore, Panda et al. (2023) documented the first distribution record of *Schisturas caturigina*, adding to the regional checklist and extending its known range (Annexure V).



Conservation Status

Tons River basin spans several important forest divisions and protected areas across Uttarakhand and Himachal Pradesh, reflecting both its ecological and administrative significance. The upper catchment falls in the Govind National Park and Govind Wildlife Sanctuary, located in the Uttarkashi Forest Division and serves as a habitat for species like Asiatic brown bear, snow leopards, ungulates like Himalayan serow, musk deer and birds like tragopan and monal pheasants (Sati and Sinha, 2004; Sharief et al., 2022; Singh et al., 2025).

Within the Tons River basin, Talra Wildlife Sanctuary is located in Jubbal and Chopal tehsils of Shimla district, Himachal Pradesh, in the Lesser Himalayas. Situated in the Pabbar Valley, this sanctuary is known for its scenic beauty and historical significance (Kumar et al., 2025). The sanctuary supports diverse faunal species, including Himalayan monal, koklass pheasants, common leopard, Asiatic black bear, Indian porcupine, and yellow-throated marten (Mahabal, 2000; Kumar et al., 2025).

As the river progresses downstream, it enters the Tons Forest Division, covering an estimated 40 to 50 km stretch through the forested regions around Mori and Hanol. This area holds both ecological and cultural significance, with Hanol being home to the Mahasu Devta Temple (Sati and Banerjee, 2025). Further downstream, the Tons flows through the Chakrata Forest Division in the Dehradun district. The River basin here falls within the Jaunsar-Bawar region, a tribal belt known for its biodiversity, traditional forest management practices, and ethnobotanical knowledge (Kala, 2015).

Throughout its course, the Tons River plays a key geo-political role, forming part of the inter-state boundary between Uttarakhand and Himachal Pradesh (Pankaj et al., 2012; Chopra and Singh, 2016). Spanning approximately 150 km, the river traverses protected areas and diverse forest landscapes, making it crucial for both regional hydrology and biodiversity conservation (Yadav, 1985; Sati and Banerjee, 2025).

Demography

The Tons River basin spans the Indian states of Uttarakhand and Himachal Pradesh, covering a total population of approximately 6.43 lakh as per the Census of 2011 (Figure 11, Table 4). The basin includes nine administrative blocks across four districts: Uttarkashi and Dehradun in Uttarakhand, and Shimla and Sirmaur in Himachal Pradesh.

Table 4. Block-wise human population statistics of the Tons River basin for 2011.

District	Block	Population (2011)	Population 2011 (%)
Uttarkashi	Puraula	31863	4.96
Uttarkashi	Mori	39691	6.18
Dehradun	Chakrata	67258	10.47
Dehradun	Kalsi	58228	9.06
Shimla	Rohru	56421	8.78
Shimla	Jubbai-Kothkai	74012	11.52
Shimla	Chaupal	85244	13.26
Sirmaur	Shillai	60229	9.37
Sirmaur	Paonta Sahib	169682	26.4
Total		642628	100

Source: Government of India, 2011

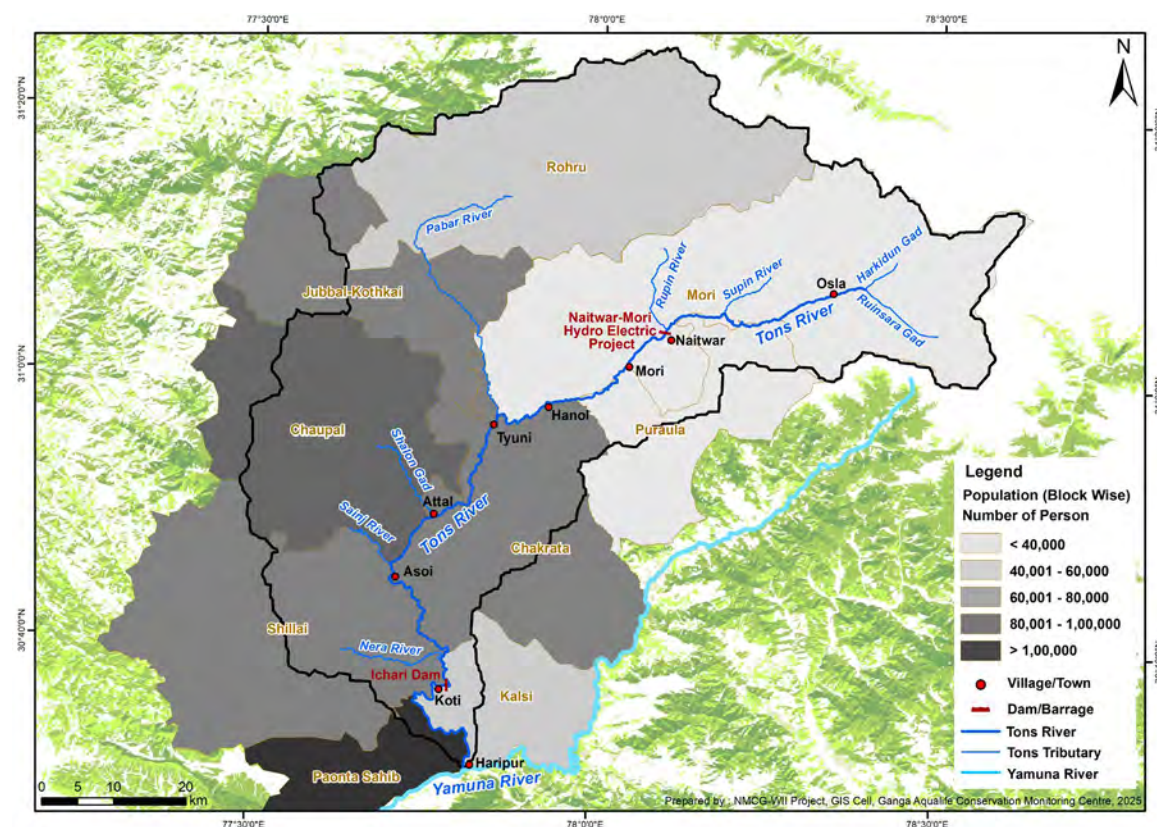


Figure 11. Block-wise human population status in the Tons River basin based on 2011 census

Threats

In the upper Tons River basin, climate change poses a significant risk, particularly through its impact on the region's glaciers. These glaciers are highly sensitive to even minor temperature fluctuations, and their meltwater is crucial for sustaining perennial river flow, which supports drinking water, agriculture, and hydropower needs for millions of people downstream (Singh and Kumar, 2007; Immerzeel et al., 2010). As glacier mass continues to decline, concerns over long-term water availability are mounting (Bolch et al., 2012).

Studies estimating spatial changes in the Jaundhar, Jhajju, and Tilku glaciers between 1962 and 2010 reveal an overall glacial area loss of approximately 3.6 km² (5.4% of total area). Meteorological records from the region indicate a trend of rising summer temperatures and reduced winter precipitation over recent decades, contributing to rapid glacial melt and highlighting the growing vulnerability of the Tons River's glacial sources under ongoing climate change (Mehta et al., 2013).

Another major threat includes the rapid expansion of hydropower projects. Besides the existing Chibbro, Khodri dam, Ichari dam, and Naitwar-Mori hydroelectric project, 35 new hydropower projects were proposed across the Tons River and its tributaries, including 11 large ones (11 MW to 600 MW) on the Tons, Rupin, and Supin rivers (Chopra and Singh, 2016). These mostly use run-of-the-river (R-o-R) designs with tunnels that divert water, leaving long stretches of riverbed dry (Chopra et al., 2016). These proposed hydropower projects may severely affect aquatic life and interrupt natural processes like sediment movement and self-cleaning of the river.

Additionally, small-scale hydropower projects inside Govind National Park, such as Har-ki-Dun Gad and Ruinsara Gad, pose even more risk to the ecosystem of this region. Infrastructure development, including roads, tunnels, and temporary labor camps, has already caused habitat fragmentation and human disturbance in this protected area (Chopra and Singh, 2016). Moreover, the dense network of hydropower projects makes the basin more vulnerable to earthquakes, as it lies along the Tons thrust, which makes a tectonic boundary between allochthonous rocks of the Krol nappe and the autochthonous Simla groups (Srivastava et al., 2015). Furthermore, the upper catchment of the basin is prone to frequent landslides, posing serious threats to both people and the environment (Raman and Puniya, 2012; Kainthola et al., 2021). These landslides can significantly alter river courses, triggering cascading ecological and socio-economic impacts (Schuster and Highland, 2001; Geertsema et al., 2009; Othman and Gloaguen, 2013).

Beyond hydropower development, the overexploitation of natural resources, including excessive extraction of medicinal plants, intensive grazing, and widespread firewood collection, has placed considerable pressure on the biodiversity of the Tons River basin. Excessive extraction of flora has led to a decline in several endemic and economically valuable plant species (Kala, 2015). In addition, illegal sand mining and unregulated water extraction further threaten the ecological integrity of the basin.



Conservation Implications

The Tons River, a major tributary of the Yamuna River, holds significant conservation value within the Ganga basin ecosystem. Tributaries play an important ecological, hydrological, and geomorphologic role in supporting the integrity of the main river systems (Benda et al., 2004). Despite carrying more water than the Yamuna and being home to endangered and vulnerable species such as the snow leopard, Tibetan wolf, Himalayan serow, and western tragopan, the Tons River has received limited attention in both scientific research and conservation management.

The reptiles recorded from the Tons River basin, viz., *Boiga multifasciata*, *Ablepharus himalayanus*, *Laudakia tuberculata*, *Gloydius himalayanus*, *Herpetoreas platyceps*, *Lycodon bicolor*, *Elaphe hodgsoni*, *Sibynophis collaris*, are endemic to the Himalayas, and their presence in the Tons River shows the relative undisturbed habitat for now. But with proposed hydropower projects, the existence of these species is in danger. The highlight of the present study is the record of a rare Himalayan wolf snake known *L. mackinnoni*. However, the snake was killed by the local people. Hence, there is an urgent need to educate people about the conservation values of the species.

There is an urgent need for comprehensive scientific investigations into the biodiversity, ecotoxicology, and physicochemical properties of the river to develop a nuanced understanding of the Tons River ecosystem for effective conservation and management planning. Currently, ecological information is largely limited to the upstream Govind Pashu Vihar National Park, underscoring the need for focused studies in downstream forested regions such as Chakrata and Tons Forest Divisions.

The basin faces multiple threats, including a dense network of hydropower projects (both existing and proposed), natural hazards such as earthquakes and landslides, and the overarching impacts of climate change. These challenges call for a holistic and integrated management approach. Additionally, the region holds high ethnobotanical value, and documenting traditional knowledge of medicinal and culturally significant plants can contribute to the protection of rare flora. Community-led conservation initiatives can enhance biodiversity protection while promoting sustainable livelihoods through well-managed ecotourism.

Focused ecological assessments are also needed for the smaller tributaries of the Tons River, which play a vital role in maintaining the basin's health. Given the ecological sensitivity and fragility of Himalayan ecosystems, adaptive and participatory management strategies are essential to address their growing vulnerability and to ensure long-term resilience and sustainability.



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Annexure I

Mammal species recorded from the Protected Areas and Uttarkashi district of the Tons River basin.

Family	Common Name	Scientific Name	IUCN status	IWPA Status	Previous Studies
Bovidae	Himalayan Tahr	<i>Hemitragus jemlahicus</i>	NT	Schedule I	a
	Himalayan Goral	<i>Naemorhaedus goral</i>	NT	Schedule I	a, b
	Blue Sheep	<i>Pseudois nayaur</i>	LC	Schedule I	a, b
	Himalayan Serow	<i>Capricornis tahr</i>	VU	Schedule I	a, b
Canidae	Golden Jackal	<i>Canis aureus</i>	LC	Schedule I	a, b
	Tibetan Wolf	<i>Canis lupus chanco</i>	VU	Schedule I	a
	Himalayan Red Fox	<i>Vulpes vulpes</i>	LC	Schedule I	a
Cercopithecidae	Rhesus Macaques	<i>Macaca mulata</i>	LC	Not Applicable	a, b
	Himalayan Langur	<i>Semnopithecus entellus</i>	CR	Schedule I	a, b
Cervidae	Barking Deer	<i>Muntiacus muntjak</i>	LC	Schedule I	a, b
	Sambar	<i>Rusa unicolor</i>	VU	Schedule I	a, b
Felidae	Jungle Cat	<i>Felis chaus</i>	LC	Schedule I	a, b
	Common Leopard	<i>Panthera pardus</i>	NT	Schedule I	a, b
	Snow Leopard	<i>Panthera uncia</i>	VU	Schedule I	a, b
	Leopard Cat	<i>Prionailurus bengalensis</i>	LC	Schedule I	a, b
Hystriidae	Himalayan Crestless Porcupine	<i>Hystrix brachyura</i>	LC	Schedule I	a, b
	Indian Crested Porcupine	<i>Hystrix indica</i>	LC	Schedule I	b
Leporidae	Black-naped Hare	<i>Lepus nigricollis</i>	LC	Schedule II	b
Moschidae	Kashmir Musk deer	<i>Moschus cupreus</i>	EN	Schedule I	a
	Himalayan Musk Deer	<i>Moschus leucogaster</i>	EN	Schedule I	b
Muridae	Blyth's Vole	<i>Microtus leucurus</i>	LC	Not Applicable	b
	Metad	<i>Millardia melitana</i>	LC	Not Applicable	b
	House Mouse	<i>Mus musculus</i>	LC	Not Applicable	b
	Rat	<i>Rattus spp.</i>	NA	Not Applicable	a, b
Mustelidae	Yellow thorated Marten	<i>Martes flavigula</i>	LC	Schedule I	a, b
	Mountain Weasel	<i>Mustela altaica</i>	NT	Schedule I	a, b
Ochotonidae	Pika	<i>Ochotona ladacensis</i>	LC	Schedule I	a

Family	Common Name	Scientific Name	IUCN status	IWPA Status	Previous Studies
Ochotonidae	Large-eared Pika	<i>Ochotona macrotis</i>	LC	Not Applicable	b
Pteropodidae	Short-nosed Fruit Bat	<i>Cynopterus sphinx</i>	LC	Not Applicable	b
Sciuridae	Five Striped Palm Squirrel	<i>Funambulu pennantii</i>	LC	Not Applicable	a
	Flying Squirrel	<i>Glaucomys sabrinus</i>	CR	Schedule I	a, b
Soricidae	Pygmy Whitetoothed Shrew	<i>Suncus etruscus</i>	LC	Not Applicable	b
	House Shrew	<i>Suncus murinus</i>	LC	Not Applicable	b
Suidae	Wild Boar	<i>Sus scrofa</i>	LC	Schedule II	a, b
Ursidae	Himalayan Brown Bear	<i>Ursus arctos isabellinus</i>	CR	Schedule I	a, b
	Asiatic Black Bear	<i>Ursus thibetanus</i>	VU	Schedule I	a, b
Verpertilioi-dae	Indian Pipistrelle Bat	<i>Pipistrellus coromandra</i>	LC	Not Applicable	b
Viverridae	Palm Civet	<i>Paguma larvata</i>	LC	Schedule I	a

Abbreviation: **CR**- Critically Endangered ; **EN**- Endangered ; **VU**- Vulnerable ; **NT**- Near Threatened ; **NA**- Not Applicable

^a Singh, H., Sharief, A., Mehar, B., Joshi, B.D., Bharadwaj, N., Thakur, M. & Sharma, L.K. (2025). Patterns of mammalian diversity, activity, and habitat associations in Uttarkashi, Western Himalayas. SSRN Electronic Journal.

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Annexure II

Avifauna recorded from the Protected Areas and Uttarkashi district of the Tons River basin.

Family	Common Name	Scientific Name	IUCN status	IWPA Status	Previous Studies
Accipitridae	Eurasian Sparrowhawk	<i>Accipiter nisus</i>	LC	Schedule-I	a
	Golden Eagle	<i>Aquila chrysaetos</i>	LC	Schedule-I	b
	Bearded Vulture	<i>Gypaetus barbatus</i>	NT	Schedule-I	b
	White-rumped Vulture	<i>Gyps bengalensis</i>	CR	Schedule-I	b
	Griffon Vulture	<i>Gyps fulvus</i>	LC	Schedule-I	a
	Himalayan Vulture	<i>Gyps himalayensis</i>	NT	Schedule-I	b
	Crested Goshawk	<i>Lophospiza trivirgata</i>	LC	Schedule-I	b
	Crested Serpent-Eagle	<i>Spilornis cheela</i>	LC	Schedule-I	b
	Shikra	<i>Tachyspiza badia</i>	LC	Schedule-I	b
	Black-throated Tit	<i>Aegithalos concinnus</i>	LC	Schedule-II	b
Campephagidae	Long-tailed Minivet	<i>Pericrocotus etholgus</i>	LC	Schedule-II	a, b
Certhiidae	Bar-tailed Treecreeper	<i>Certhia himalayana</i>	LC	Schedule-II	b
Cinclidae	Brown Dipper	<i>Cinclus pallasii</i>	LC	Schedule-II	b
Cisticolidae	Common Tailorbird	<i>Orthotomus sutorius</i>	LC	Schedule-II	b
	Hill Prinia	<i>Prinia supercilialis</i>	LC	Schedule-II	a
Columbidae	Speckled Wood-Pigeon	<i>Columba hodgsonii</i>	LC	Schedule-II	b
	Rock Pigeon	<i>Columba livia</i>	LC	Not scheduled	b
	Spotted Dove	<i>Spilopelia chinensis</i>	LC	Schedule-II	a, b
	Eurasian Colared-Dove	<i>Streptopelia decocto</i>	LC	Schedule-II	b
	Oriental Turtle-Dove	<i>Streptopelia orietalis</i>	LC	Schedule-II	a, b
	Yellow-footed Green-Pigeon	<i>Treron phoenicoterus</i>	LC	Schedule-II	b
Coraciidae	Indian Roller	<i>Coracias benghaensis</i>	LC	Schedule-II	a
Corvidae	Large-billed Crow	<i>Corvus macrorhychos</i>	LC	Schedule-II	b
	Grey Treepie	<i>Dendrocitta formosae</i>	LC	Schedule-II	a, b
	Eurasian Jay	<i>Garrulus glandarius</i>	LC	Schedule-II	a, b
	Kashmir Nutcracker	<i>Nucifraga multipuntata</i>	LC	Schedule-II	a, b
	Yellow-billed Chough	<i>Pyrrhocorax graculus</i>	LC	Schedule-II	b
	Red-billed Chough	<i>Pyrrhocorax pyrrhocorax</i>	LC	Schedule-II	b

Family	Common Name	Scientific Name	IUCN status	IWPA Status	Previous Studies
Corvidae	Red-billed Blue-Magpie	<i>Urocissa erythroryncha</i>	LC	Schedule-II	b
	Yellow-billed Blue-Magpie	<i>Urocissa flavirostris</i>	LC	Schedule-II	b
Cuculidae	Pied Cuckoo	<i>Clamator jacobinus</i>	LC	Schedule-II	a
Dicaeidae	Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>	LC	Schedule-II	b
Dicruridae	Ashy Drongo	<i>Dicrurus leucophaeus</i>	LC	Schedule-II	b
	Black Drongo	<i>Dicrurus macrocercus</i>	LC	Schedule-II	a, b
Emberizidae	Rock Bunting	<i>Emberiza cia</i>	LC	Schedule-II	b
Estrildidae	Scaly-breasted Munia	<i>Lonchura punctulata</i>	LC	Schedule-II	b
Falconidae	Eurasian Hobby	<i>Falco subbuteo</i>	LC	Schedule-II	b
	Common Kestrel	<i>Falco tinnunculus</i>	LC	Schedule-II	b
Fringillidae	Yellow-breasted Greenfinch	<i>Chloris spinoides</i>	LC	Schedule-II	b
	Collared Grosbeak	<i>Mycerobas affinis</i>	LC	Schedule-II	b
	Dark-breasted Rosefinch	<i>Procarduelis nipalensis</i>	LC	Schedule-II	b
Hirundinidae	Northern House-Martin	<i>Delichon urbicum</i>	LC	Schedule-II	b
	Eurasian Crag-Martin	<i>Ptyonoprogne rupestris</i>	LC	Schedule-II	b
Hypsipetidae	White-throated Laughingthrush	<i>Pterorhinus albobularis</i>	LC	Schedule-II	a, b
Leiothrichidae	Chestnut-tailed Minla	<i>Actinodura strigula</i>	LC	Schedule-II	b
	Rufous Sibia	<i>Heterophasia capistrata</i>	LC	Schedule-II	a, b
	Streaked Laughingthrush	<i>Trochalopteron lineatum</i>	LC	Schedule-II	a, b
Megalaimidae	Great Barbet	<i>Psilopogon virens</i>	LC	Schedule-II	a
Motacillidae	Upland Pipit	<i>Anthus sylvanus</i>	LC	Schedule-II	a
	White Wagtail	<i>Motacilla alba</i>	LC	Schedule-II	a
	Grey Wagtail	<i>Motacilla cinerea</i>	LC	Schedule-II	a, b
	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	LC	Schedule-II	b

Family	Common Name	Scientific Name	IUCN status	IWPA Status	Previous Studies
Muscicapidae	Chinese Rubythroat	<i>Calliope tschebaiewi</i>	LC	Schedule-I	b
	Pale Blue Flycatcher	<i>Cyornis unicolor</i>	LC	Schedule-II	b
	Spotted Forktail	<i>Enicurus maculatus</i>	LC	Schedule-II	b
	Little Forktail	<i>Enicurus scouleri</i>	LC	Schedule-II	b
	Verditer Flycatcher	<i>Eumyias thalassinus</i>	LC	Schedule-II	a, b
	Rufous-gorgeted Flycatcher	<i>Ficedula strophciata</i>	LC	Schedule-II	a, b
	Ultramarine Flycatcher	<i>Ficedula superciliaris</i>	LC	Schedule-II	b
	Little Pied Flycatcher	<i>Ficedula westermanni</i>	LC	Schedule-II	b
	Blue-capped Rock-Thrush	<i>Monticola cinclorhyncha</i>	LC	Schedule-II	b
	Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	LC	Schedule-II	a
	Blue Whistling-Thrush	<i>Myophonus caeruleus</i>	LC	Schedule-II	a, b
	Rufous-bellied Niltava	<i>Niltava sundara</i>	LC	Schedule-II	b
	White-winged Redstart	<i>Phoenicurus erythrogastrus</i>	LC	Schedule-II	b
	Plumbeous Redstart	<i>Phoenicurus fuliginosus</i>	LC	Schedule-II	a, b
	White-capped Redstart	<i>Phoenicurus leucocephalus</i>	LC	Schedule-II	b
	Pied Bushchat	<i>Saxicola caprata</i>	LC	Schedule-II	b
	Grey Bushchat	<i>Saxicola ferreus</i>	LC	Schedule-II	a
	Siberian Stonechat	<i>Saxicola maurus</i>	NR	Schedule-II	a
Oriolidae	Maroon Oriole	<i>Oriolus traillii</i>	LC	Schedule-II	b
Paridae	Grey-crested Tit	<i>Lophophanes dichrous</i>	LC	Schedule-II	b
	Cinereous Tit	<i>Parus cinereus</i>	NR	Schedule-II	a
	Green-backed Tit	<i>Parus monticolus</i>	LC	Schedule-II	a, b
	Coal Tit	<i>Periparus ater melanolophus</i>	LC	Schedule-II	a
	Rufous-vented Tit	<i>Periparus rubidiventris</i>	LC	Schedule-II	a
	Yellow-browed Tit	<i>Sylviparus modestus</i>	LC	Schedule-II	a
Passeridae	Russet Sparrow	<i>Passer cinnamomeus</i>	LC	Schedule-II	b
	House Sparrow	<i>Passer domesticus</i>	LC	Schedule-II	b
	Eurasian Tree Sparrow	<i>Passer montanus</i>	LC	Schedule-II	b

Family	Common Name	Scientific Name	IUCN status	IWPA Status	Previous Studies
Phasianidae	Hill Partridge	<i>Arborophila torqueola</i>	LC	Schedule-II	b
	Cheer Pheasant	<i>Catreus wallichii</i>	VU	Schedule-I	a, b
	Black Francolin	<i>Francolinus francolinus</i>	LC	Schedule-II	b
	Snow Partridge	<i>Lerwa lerwa</i>	LC	Schedule-II	b
	Himalayan Monal	<i>Lophophorus impejanus</i>	LC	Schedule-I	a, b, c
	Kalij Pheasant	<i>Lophura leucomelanos</i>	LC	Schedule-I	a, b
	Koklass Pheasant	<i>Pucrasia macrolopha</i>	LC	Schedule-II	a, b
	Himalayan Snowcock	<i>Tetraogallus himalayensis</i>	LC	Schedule-II	b
	Western Tragopan	<i>Tragopan melanocephalus</i>	VU	Schedule-I	b
	Satyr Tragopan	<i>Tragopan satyra</i>	LC	Schedule-I	b
Phylloscopidae	Tickell's Leaf Warbler	<i>Phylloscopus affinis</i>	LC	Schedule-II	b
	Green-crowned Warbler	<i>Phylloscopus burkii</i>	LC	Schedule-II	a
	Lemon-rumped Warbler	<i>Phylloscopus chloronotus</i>	LC	Schedule-II	a
	Hume's Warbler	<i>Phylloscopus humei</i>	LC	Schedule-II	b
	Yellow-browed Warbler	<i>Phylloscopus inornatus</i>	LC	Schedule-II	a
	Western Crowned Warbler	<i>Phylloscopus occipitalis</i>	LC	Schedule-II	b
	Greenish Warbler	<i>Phylloscopus trochiloides</i>	LC	Schedule-II	a
	Grey-hooded Warbler	<i>Phylloscopus xanthoschistos</i>	LC	Schedule-II	a
Picidae	Stripe-breasted Woodpecker	<i>Dendrocopos atratus</i>	LC	Schedule-II	b
	Himalayan Woodpecker	<i>Dendrocopos himalayensis</i>	LC	Schedule-II	a
	Rufous-bellied Woodpecker	<i>Dendrocopos hyperythrus</i>	LC	Schedule-II	b
	Brown-fronted Woodpecker	<i>Dendrocoptes auriceps</i>	LC	Schedule-II	b
	Grey-headed Woodpecker	<i>Picus canus</i>	LC	Schedule-II	a

Family	Common Name	Scientific Name	IUCN status	IWPA Status	Previous Studies
Picidae	Scaly-bellied Woodpecker	<i>Picus squamatus</i>	LC	Schedule-II	a
Psittaculidae	Slaty-headed Parakeet	<i>Psittacula himalayana</i>	LC	Schedule-II	a, b
	Blossom-headed Parakeet	<i>Psittacula roseata</i>	NT	Schedule-II	b
	Black Bulbul	<i>Hypsipetes leucocephalus</i>	LC	Schedule-II	a, b
	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC	Schedule-II	b
	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	LC	Schedule-II	b
	Eurasian Woodcock	<i>Scolopax rusticola</i>	LC	Schedule-II	b
Sittidae	Chestnut-bellied Nut-hatch	<i>Sitta cinnamoventris</i>	LC	Schedule-II	b
	White-cheeked Nuthatch	<i>Sitta leucopsis</i>	LC	Schedule-II	b
Stenostiridae	Yellow-bellied Fairy-Fantail	<i>Chelidorhynch hypoxanthus</i>	LC	Schedule-II	b
	Grey-headed Canary-Flycatcher	<i>Culicicapa ceylonensis</i>	LC	Schedule-II	b
Strigidae	Eurasian Eagle-Owl	<i>Bubo bubo</i>	LC	Schedule-I	a
	Himalayan Owl	<i>Strix niviculum</i>	LC	Schedule-II	b
Sturnidae	Common Myna	<i>Acridotheres tristis</i>	LC	Schedule-II	a, b
Tichodromidae	Wallcreeper	<i>Tichodroma muraria</i>	LC	Schedule-II	b
Timaliidae	Rusty-cheeked Scimitar-Babbler	<i>Erythrogonys erythrogonys</i>	LC	Schedule-II	a
	Indian Scimitar-Babbler	<i>Pomatorhinus horsfieldii</i>	LC	Schedule-II	a
	Chestnut-capped Babbler	<i>Timalia pileata</i>	LC	Schedule-II	a
Turdidae	Pied Thrush	<i>Geokichla wardii</i>	LC	Schedule-II	b
	Grey-winged Blackbird	<i>Turdus boulboul</i>	LC	Schedule-II	a
	Indian Blackbird	<i>Turdus simillimus</i>	LC	Schedule-II	a
	Tickell's Thrush	<i>Turdus unicolor</i>	LC	Schedule-II	a
	Himalayan Thrush	<i>Zoothera salimalii</i>	LC	Schedule-II	b
Vangidae	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	LC	Schedule-II	b
Zosteropidae	Indian White-eye	<i>Zosterops palpebrosus</i>	LC	Schedule-II	b

Abbreviation: **CR**- Critically Endangered; **VU**- Vulnerable; **NT**- Near Threatened; **LC**- Least concern; **NR**- Not Recognised

^a Mahabal, A. (2000). Birds of Talra Wildlife Sanctuary in lower western Himalaya, HP, with notes on their status and altitudinal movements. ZOOS'PRINT JOURNAL, 15(10), pp.334-338.

^b Tak, P.C., Sati, J.P. & Kumar P. (2004). Aves. In: Kumar, A., Gupta, S.K. and Padmanaban, P., eds. Some selected fauna of Gobind Pashu Vihar. Conservation Area Series No. 18. Kolkata: Zoological Survey of India, pp.41-54.

^c Sharief, A., Singh, H., Joshi, B.D., Singh, I., Mukherjee, T., Chandra, K., Thakur, M. & Sharma, L.K. (2022). Understanding distribution and occupancy of Himalayan monal in Uttarkashi district, Uttarakhand for conservation and management planning. Wildlife Biology, 2022(2), p.e01013.

Annexure III

Reptilian species recorded along the Tons River and Gobind Pashu Bihar WLS/NP in the Tons River basin.

Family	Common Name	Scientific Name	IUCN status	Studies
Agamidae	Oriental garden Lizard	<i>Calotes versicolor</i>	LC	a
	Common Rock Lizard	<i>Laudakia tuberculata</i>	LC	a, b
Colubridae	Many-banded Tree Snake	<i>Boiga multifasciata</i>	LC	a, b
	Common Cat Snake	<i>Boiga trigonata</i>	LC	b
	Himalyan Trinket Snake	<i>Elaphe hodgsoni</i>	LC	a
	Checkered Keelback	<i>Fowlea piscator</i>	LC	a
	Himalayan Keelbackj	<i>Herpetoreas platyceps</i>	LC	a, b
	Mackinnoni Wolf Snake	<i>Lycodon mackinnoni</i>	NT	a
	Common Many-toothed Snake	<i>Sibynophis collaris</i>	LC	a
Gekkonidae	-	<i>Cyrtodactylus spp.</i>		a
	Northern House Gecko	<i>Hemidactylus flaviviridis</i>	LC	a
Scincidae	Himalayan Ground Skink	<i>Ablepharus himalayanus</i>	LC	a, b
	Yellow-bellied Mole Skink	<i>Eurylepis taeniolata</i>	LC	b

Abbreviation: **NT**- Near Threatened ; **LC**- Least Concern

^a Present study

^b Husain, A. (2004). Reptilia. In: Kumar, A., Gupta, S.K. and Padmanaban, P, eds. Some selected fauna of Gobind Pashu Vihar. Conservation Area Series No. 18. Kolkata: Zoological Survey of India, pp.37-39.

Annexure IV

Amphibian species recorded along the Tons River and Gobind Pashu Bihar WLS/NP in the Tons River basin.

Family	Common Name	Scientific Name	IUCN status	Studies
Bufonidae	Common Toad	<i>Duttaphrynus melanostictus</i>	LC	a, b
	Mountain Toad	<i>Duttaphrynus himalayanus</i>	LC	a, b
Dicroglossidae	-	<i>Minervarya</i> spp.		a
	Rice Field Frog	<i>Fejervarya limnocharis</i>	LC	a, b
	Sikkim Paa Frog	<i>Nanorana liebigii</i>	LC	a, b
	Tiny Frog	<i>Nanorana minica</i>	LC	a
	Himalaya Paa Frog	<i>Nanorana vicina</i>	LC	a
Ranidae	Assam Sucker Frog	<i>Amolops formosus</i>	LC	a
	Jaunsar Stream Frog	<i>Amolops jaunsari</i>	DD	a

Abbreviation: **LC**- Least Concern ; **DD**- Data Deficient

^a Present study

^b Husain, A. (2004). Amphibia. In: Kumar, A., Gupta, S.K. and Padmanaban, P., eds. Some selected fauna of Gobind Pashu Vihar. Conservation Area Series No. 18. Kolkata: Zoological Survey of India, pp.35–36.

Annexure V

Fish species recorded from the Tons River basin.

Family	Common Name	Scientific Name	IUCN Status	Previous Studies
Amblycepsidae	Indian torrent catfish	<i>Amblyceps mangois</i> (Hamilton 1822)	LC	a
Channidae	Red seam snakehead	<i>Channa gachua</i> (Hamilton 1822)	LC	a
Cobitidae	Guntea loach	<i>Lepidocephalichthys guntea</i> (Hamilton 1822)	LC	a
Cyprinidae	Kalabans	<i>Bangana dero</i> (Hamilton 1822)	LC	a
	Chaguni	<i>Chagunius chagunio</i> (Hamilton 1822)	LC	a
	Sucker head	<i>Garra gotyla</i> (Gray 1830)	LC	a
	Lamta garra	<i>Garra lamta</i> (Hamilton 1822)	LC	a
	Catla	<i>Labeo catla</i> (Hamilton 1822)	LC	a, c
	Dark mahseer	<i>Naziritor chelynooides</i> (McClelland 1839)	VU	b
	Ticto barb	<i>Pethia ticto</i> (Hamilton 1822)	LC	a
	Swamp barb	<i>Puntius chola</i> (Hamilton 1822)	LC	a
	Dinnawah Snowtrout	<i>Schizothorax progastus</i> (McClelland 1839)	LC	a
	Hill trout	<i>Schizothorax plagiostomus</i> Heckel 1838	VU	b
	Snow Trout	<i>Schizothorax richardsonii</i> (Gray 1832)	VU	a, b
	Gangetic latia	<i>Tariqilabeo latius</i> (Hamilton 1822)	LC	a
	Putitor Mahseer	<i>Tor putitora</i> (Hamilton 1822)	EN	a
	Tor barb	<i>Tor tor</i> (Hamilton 1822)	DD	a
Danionidae	Vagra baril	<i>Barilius vagra</i> (Hamilton 1822)	LC	a, b
	Barna baril	<i>Opsarius barna</i> (Hamilton 1822)	LC	a, b
	-	<i>Opsarius bendelisis</i> (Hamilton 1807)	LC	a
	Trout barb	<i>Raiamas bola</i> (Hamilton 1822)	LC	a
Mastacembelidae	Zig-Zag eel	<i>Mastacembelus armatus</i> (Lacepède 1800)	LC	b
Nemacheilidae	Mottled loach	<i>Paracanthocobitis botia</i> (Hamilton 1822)	LC	a
	-	<i>Paraschistura montana</i> (McClelland 1838)	NE	b
	-	<i>Schistura denisoni</i> (Day 1867)	LC	b
	-	<i>Schistura rupecula</i> McClelland 1838	LC	a, b
	-	<i>Schistura scaturigina</i> McClelland 1839	LC	d
Salmonidae	Sea trout	<i>Salmo trutta</i> Linnaeus 1758	Exotic	a, c

Sisoridae	River cat	<i>Glyptothorax pectinopterus</i> (McClelland 1842)	LC	a
	Sucker throat catfish	<i>Pseudecheneis sulcata</i> (McClelland 1842)	LC	a

Abbreviation: **EN**- Endangered ; **VU**- Vulnerable ; **NT**- Near Threatened ; **LC**- Least Concern ; **DD**- Data Deficient

^a Uniyal, D.P. (2009). Diversity and conservation of fish resources of Tons Valley, Uttarakhand, Western Himalayas, India. In: Dobhal, R. & Kotila, B.S., eds. Science and Technology in Uttarakhand. New Delhi: Macmillan India Ltd., pp.139–150.

^b Rayal, R., Bhatt, A., Bahuguna, P. & Joshi, H.K. (2021). Fish diversity of Mal Gad stream Near Purola town from district Uttarakashi, Uttarakhand, India. Uttar Pradesh Journal of Zoology, 42(14), pp.54-59.

^c Husain, A. (2004). Pisces. In: Kumar, A., Gupta, S.K. and Padmanaban, P., eds. Some selected fauna of Gobind Pashu Vihar. Conservation Area Series No. 18. Kolkata: Zoological Survey of India, pp.33–34.

^d Panda, S.P., Nandy, S., Kumari, M., Kunui, A., Sahoo, A.K., Meena, D.K., Bhakta, D., Paul, S.K. & Das, B.K. (2023). First distribution record of *Schistura scaturigina* McClelland, 1839 in river Tons, a tributary of river Yamuna in Uttarakhand, in morphological and molecular approach.

Annexure VI

Plant species recorded along the Tons River.

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Acanthaceae	<i>Dicliptera paniculata</i> (Forssk.)	Native	H	SA
	<i>Justicia adhatoda</i> L.	Native	S	SA
	<i>Justicia simplex</i> Lindau	Native	H	SA
	<i>Lepidagathis cuspidata</i> Nees	Native	H	SA
	<i>Lepidagathis incurva</i> Buch. -Ham. ex D.Don	Native	H	SA
	<i>Strobilanthes hirta</i> (Vahl) Blume	Native	H	SA
Acoraceae	<i>Acorus calamus</i> L.	Native	H	SA
Alismataceae	<i>Sagittaria guayanensis</i> ssp. <i>lappula</i> (D.Don) Bogin	Native	H	A
Amaranthaceae	<i>Achyranthes aspera</i> L.	Native	H	SA
	<i>Aerva lanata</i> (L.) Juss. ex-Schult.	Native	H	SA
	<i>Alternanthera ficoidea</i> (L.) Sm.	Exotic	H	SA
	<i>Alternanthera paronychioides</i> A.t. Hil.	Exotic	H	SA
	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Exotic	H	SA
	<i>Alternanthera pungens</i> Kunth	Exotic	H	SA
	<i>Alternanthera sessilis</i> (L.) R.Br. ex-DC.	Native	H	SA
	<i>Amaranthus spinosus</i> L.	Exotic	H	SA
	<i>Amaranthus viridis</i> L.	Exotic	H	SA
	<i>Chenopodium album</i> L.	Native	H	SA
	<i>Digrea muricata</i> (L.) Mart	Native	H	SA
	<i>Gomphrena serrata</i> L.	Exotic	H	SA
	<i>Pupalia lappacea</i> (L.) Juss.	Native	H	SA
Apocynaceae	<i>Alstonia scholaris</i> (L.) R.Br.	Native	T	SA
	<i>Asclepias curassavica</i> L.	Exotic	H	SA
	<i>Calotropis gigantea</i> (L.) Dryand.	Native	S	SA
	<i>Calotropis procera</i> (Aiton) W.T.Aiton	Native	S	T
	<i>Cryptolepis buchanani</i> Roem. & Schult.	Native	C	SA
	<i>Dregea volubilis</i> (L.f.) Benth. Ex Hook.f.	Native	C	SA
	<i>Oxystelma esculentum</i> (L.f.) Sm.	Native	C	SA
	<i>Pergularia daemia</i> (Forssk.) Chiov.	Native	C	SA
Araceae	<i>Colocassia esculenta</i> (L.) Schott.	Native	H	SA
	<i>Lemna minor</i> L.	Native	H	A
	<i>Lemna perpusilla</i> Torr.	Native	H	A

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Araceae	<i>Pistia stratiotes</i> L.	Native	H	A
	<i>Spirodela polyrhiza</i> (L.) Schleid.	Native	H	A
	<i>Phoenix sylvestris</i> (L.) Roxb.	Native	T	SA
Asteraceae	<i>Acmella ciliata</i> (Kunth) Cass.	Exotic	H	SA
	<i>Ageratum conyzoides</i> L.	Exotic	H	SA
	<i>Ageratum houstonianum</i> Mill.	Exotic	H	SA
	<i>Bidens pilosa</i> L.	Exotic	H	SA
	<i>Blumea axillaris</i> (Lam.) DC.	Native	H	SA
	<i>Calypocarpus vialis</i> Less.	Exotic	H	SA
	<i>Chromolaena odorata</i> (L.) R.M.	Exotic	H	SA
	<i>Cichorium intybus</i> L.	Exotic	H	SA
	<i>Cirsium arvense</i> (L.) Scop.	Native	H	SA
	<i>Eupatorium adenophorum</i> Spreng.	Exotic	H	SA
	<i>Grangea maderaspatana</i> (L.) Poir.	Native	H	SA
	<i>Grangea minima</i> (L.) Dum.Cours.	Native	H	SA
	<i>Launaea procumbens</i> (Roxb.) Ramayya & Rajagopal	Native	H	SA
	<i>Parthenium hysterophorus</i> L.	Exotic	H	SA
	<i>Soliva anthemifolia</i> (Juss.) Sweet	Exotic	H	SA
	<i>Sonchus asper</i> (L.) Hill	Exotic	H	SA
	<i>Sonchus oleraceus</i> L.	Exotic	H	SA
	<i>Tridax procumbens</i> L.	Exotic	H	SA
Berberidaceae	<i>Berberis asiatica</i> Roxb. ex DC.	Native	S	T
	<i>Cordia dicotoma</i> G. Forst.	Native	T	SA
	<i>Ehretia acuminata</i> (DC.) R. Br.	Native	T	SA
	<i>Heliotropium strigosum</i> Willd.	Native	H	T
	<i>Cardamine hirsuta</i> L.	Native	H	SA
	<i>Lepidium didymium</i> L.	Exotic	H	SA
	<i>Lepidium sativum</i> L.	Exotic	H	SA
	<i>Nasturtium officinal</i> W.T.Aiton	Exotic	H	SA
	<i>Rorippa dubia</i> (Pers.) H.Hara	Native	H	SA
	<i>Rorippa indica</i> (L.) Hiern	Native	H	SA
	<i>Rorippa palustris</i> (L.) Besser	Native	H	SA
Cactaceae	<i>Opuntia cochenillifera</i> (L.) Mill.	Exotic	S	SA

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Cannabaceae	<i>Cannabis sativa</i> L.	Exotic	H	SA
	<i>Capparis zeylanica</i> L.	Native	S	SA
Caryophyllaceae	<i>Stellaria media</i> (L.) Vill	Native	H	SA
Celastraceae	<i>Celastrus paniculatus</i> Willd.	Native	S	SA
Ceratophyllaceae	<i>Ceratophyllum demersum</i> L.	Native	H	SA
Cleomaceae	<i>Cleome viscosa</i> L.	Native	H	SA
Commelinaceae	<i>Commelina benghalensis</i> L.	Native	H	SA
	<i>Cyanotis axillaris</i> (L.) D.Don ex Sweet	Native	H	SA
	<i>Cyanotis cristata</i> (L.) D.Don	Native	H	SA
	<i>Murdannia nudiflora</i> (L.) Brenan	Native	H	SA
Convolvulaceae	<i>Evolvulus nummularius</i> (L.) L.	Exotic	H	SA
	<i>Ipomoea aquatica</i> Forssk	Native	H	SA
	<i>Ipomoea carnea</i> Jacq.	Exotic	S	SA
	<i>Ipomoea nil</i> (L.) Roth	Exotic	H	SA
	<i>Operculina turpethum</i> (L.) Silva Manso	Native	H	SA
Cucurbitaceae	<i>Coccinea grandis</i> (L.) Voigt	Native	C	SA
Cupressaceae	<i>Cupressus torulosa</i> D.Don ex Lamb.	Native	T	T
Cyperaceae	<i>Bolboschoenus glaucus</i> (Lam.) S.G.Sm.	Native	G	SA
	<i>Bolboschoenus maritimus</i> (L.) Palla	Native	G	SA
	<i>Bulbostylis barbata</i> (Rottb.) C.B.Clarke	Native	G	SA
	<i>Carex fedia</i> Nees	Native	G	SA
	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Native	G	SA
	<i>Cyperus compressus</i> L.	Native	G	SA
	<i>Cyperus cyperoides</i> (L.) Kuntze	Native	G	SA
	<i>Cyperus difformis</i> L.	Native	G	SA
	<i>Cyperus distans</i> L.f.	Native	G	SA
	<i>Cyperus flavidus</i> Retz.	Native	G	SA
	<i>Cyperus iria</i> L.	Native	G	SA
	<i>Cyperus mindorensis</i> (Steud.) Huygh, syn. <i>Kyllinga nemoralis</i> (J.R.Forst. & G.Forst.) Dandy ex Hutch. & Dalziel	Native	G	SA
	<i>Cyperus pilosus</i> Vahl	Native	G	SA
	<i>Cyperus rotundus</i> L.	Native	G	SA
	<i>Cyperus squarrosus</i> L.	Native	G	SA
	<i>Cyperus tenuifolius</i> (Steud.) Dandy	Native	G	SA
	<i>Eleocharis dulcis</i> (Burm.f.) Trin. ex Hensch.	Native	G	SA
	<i>Eleocharis palustris</i> (L.) Roem. & Schult.	Native	G	SA

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Cyperaceae	<i>Fimbristylis dichotoma</i> (L.) Vahl	Native	G	SA
	<i>Fimbristylis ovata</i> (Burm.f.) J.Kern	Native	G	SA
	<i>Fimbristylis schoenoides</i> (Retz.) Vahl	Native	G	SA
	<i>Schoenoplectiella articulata</i> (L.) Lye	Native	G	SA
	<i>Schoenoplectiella juncoides</i> (Roxb.) Lye	Native	G	SA
	<i>Schoenoplectiella mucronata</i> (L.) J.Jung & H.K.Choi	Native	G	SA
Dioscoreaceae	<i>Dioscorea bulbifera</i> L.	Native	H	T
Ebenaceae	<i>Diospyros montana</i> Roxb.	Native	T	SA
Ericaceae	<i>Lyonia ovalifolia</i> C.H.Curtis	Native	T	T
Euphorbiaceae	<i>Acalypha indica</i> L.	Native	H	SA
	<i>Croton boplandianus</i> Baill.	Exotic	H	SA
	<i>Euphorbia heterophylla</i> L.	Exotic	H	SA
	<i>Euphorbia hirta</i> L.	Exotic	H	SA
	<i>Jatropha curcas</i> L.	Exotic	S	T
	<i>Jatropha gossipyfolia</i> L.	Exotic	S	T
	<i>Mallotus nudiflorus</i> (L.) Kulju & Welzen	Native	T	SA
	<i>Ricinus communis</i> L.	Exotic	S	SA
Fabaceae	<i>Acacia catechu</i> (L.) Willd.,Oliv.	Native	T	SA
	<i>Acacia nilotica</i> (L.) P.J.H.Hurter & Mabb.	Native	T	SA
	<i>Acacia pinnata</i> Link	Native	S	T
	<i>Albizia chinensis</i> (Osbeck) Merr.	Native	T	T
	<i>Albizia julibrissin</i> Durazz.	Native	T	SA
	<i>Alysicarpus vaginalis</i> (L.) DC.	Native	H	SA
	<i>Caesalpinia bonduc</i> (L.) Roxb.	Native	S	T
	<i>Cassia fistula</i> L.	Native	T	SA
	<i>Crotolaria mysoriensis</i> Roth	Native	H	SA
	<i>Dalbergia sissoo</i> Roxb.	Native	T	SA
	<i>Desmodium triflorum</i> (L.) DC.	Native	H	SA
	<i>Indigofera linifolia</i> (L.f.) Retz.	Native	H	SA
	<i>Indigofera linnaei</i> Ali	Native	H	SA
	<i>Medicago lupulina</i> L.	Native	H	SA
	<i>Medicago polymorpha</i> L.	Exotic	H	SA
	<i>Melilotus albus</i> Medik.	Exotic	H	SA
	<i>Melilotus indicus</i> (A.) All.	Native	H	SA
	<i>Mimosa himalayana</i> Gamble	Native	S	SA

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
	<i>Mimosa pudica</i> L.	Exotic	H	SA
	<i>Pithecellobium dulce</i> (Roxb.) Benth.	Exotic	T	T
	<i>Senna alata</i> (L.) Roxb.	Exotic	S	T
	<i>Senna occidentalis</i> (L.) Link	Exotic	S	T
	<i>Senna sophora</i> (L.) Roxb	Exotic	S	SA
	<i>Senna tora</i> (L.) Roxb.	Exotic	H	SA
	<i>Senna uniflora</i> (Mill.) H.S.Irwin & Barneby	Exotic	S	SA
	<i>Vicia hirsuta</i> (L.) Gray	Native	H	SA
	<i>Vicia sativa</i> L.	Native	H	SA
	<i>Zornia gibbosa</i> Span.	Native	H	SA
Gesneriaceae	<i>Didymocarpus pedicellatus</i> R.Br.	Native	H	SA
Hydrocharitaceae	<i>Hydrilla verticillata</i> (L.f.) Royle	Native	H	A
	<i>Najas marina</i> L.	Native	H	A
	<i>Najas minor</i> All.	Native	H	A
	<i>Vallisneria natans</i> (Lour.) H. Hara	Native	H	A
Juncaceae	<i>Juncus bufonius</i> L.	Native	G	SA
	<i>Juncus prismatocarpus</i> R.Br.	Native	G	SA
Lamiaceae	<i>Anisomeles indica</i> (L.) Kuntze	Native	S	SA
	<i>Callicarpa macrophylla</i> Vahl	Native	S	SA
	<i>Clerodendrum viscosum</i> Vent.	Native	S	SA
	<i>Colebrookia oppositifolia</i> Sm.	Native	S	SA
	<i>Hyptis suaveolens</i> (L.) Point.	Exotic	S	SA
	<i>Leucas biflora</i> (Vahl) Sm.	Native	H	SA
	<i>Leucas cephalotes</i> (Roth) Spreng.	Native	H	SA
	<i>Nepeta hindostana</i> (B. Heyne ex Roth) Hanines	Native	H	SA
	<i>Ocimum americanum</i> L.	Native	H	SA
	<i>Pseudocaryopteris bicolor</i> (Roxb. ex Hardw.) P.D.Cantino	Native	S	SA
	<i>Salvia plebeian</i> R.Br.	Native	H	SA
	<i>Vitex negundo</i> L.	Native	S	SA
	<i>Micromeria biflora</i> (Buch.-Ham. ex D.Don) Benth.	Native	S	T
Lauraceae	<i>Machilus gamblei</i> King ex Hook.f.	Native	T	SA
Linderniaceae	<i>Lindernia anagallis</i> (Burm.f.) Pennell	Native	H	SA

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Linderniaceae	<i>Lindernia ciliata</i> (Colsm.) Pennell	Native	H	SA
	<i>Lindernia crustacea</i> (L.) F.Muell.	Native	H	SA
	<i>Lindernia dubia</i> (L.) Pennell	Native	H	SA
	<i>Lindernia viscosa</i> (Hornem.) Merr.	Native	H	SA
	<i>Mazus pumilus</i> (Burm. f.) Steenis	Native	H	SA
Lythraceae	<i>Ammania baccifera</i> L.	Native	H	SA
	<i>Ammania multiflora</i> Roxb.	Native	H	SA
	<i>Ammannia auriculata</i> Willd.	Native	H	SA
	<i>Rotala rotundifolia</i> (Buch. -Ham. ex Roxb.) Koehne	Native	H	SA
	<i>Woodfordia fruticosa</i> (L.) Kurz	Native	S	A
	<i>Rotala rotundifolia</i> (Buch.-Ham. ex Roxb.) Koehne	Native	H	T
Malvaceae	<i>Abitulon indicum</i> (L.) Sweet	Native	S	T
	<i>Bombax cebia</i> L.	Native	T	T
	<i>Corchorus aestuans</i> L.	Native	H	T
	<i>Malvestrum coromandelianum</i> (L.) Garcke	Native	H	T
	<i>Sida acuta</i> Burm.f.	Native	H	SA
	<i>Sida cordata</i> (Burm.f.)	Native	H	SA
	<i>Sida cordifolia</i> L.	Native	H	SA
	<i>Sida rhombifolia</i> L.	Native	H	SA
	<i>Triumfetta rhomboidea</i> Jacq.	Native	H	SA
	<i>Urena lobata</i> L.	Native	S	SA
Meliaceae	<i>Toona ciliata</i> M. Roem.	Native	T	SA
Menispermaceae	<i>Tinospora cordifolia</i> (Thunb.) Miers	Native	C	SA
Molluginaceae	<i>Glinus lotoides</i> L.	Native	H	SA
	<i>Glinus oppositifolius</i> (L.) Aug.DC.	Native	H	SA
	<i>Mollugo pentaphylla</i> L.	Native	H	SA
Moraceae	<i>Morus alba</i> L.	Exotic	T	SA
	<i>Artocarpus heterophyllus</i> Lam.	Native	T	SA
	<i>Artocarpus lacucha</i> Buch. -Ham.	Native	T	T
	<i>Broussonetia papyrifera</i> (L.) Vent.	Exotic	T	SA
	<i>Ficus benghalensis</i> L.	Native	T	T
	<i>Ficus hispida</i> L.f.	Native	T	SA
	<i>Ficus palmata</i> ssp. <i>virgata</i> (Roxb.) Browicz	Native	S	SA

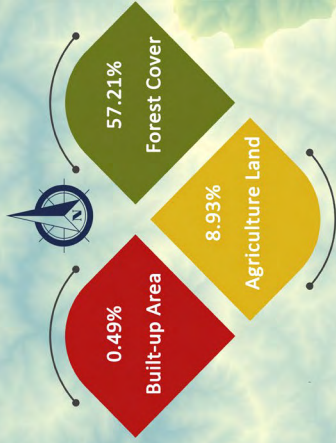
Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
	<i>Ficus racemosa</i> L.	Native	T	SA
	<i>Ficus religiosa</i> L.	Native	T	SA
	<i>Ficus semicordata</i> Buch.Ham. ex Sm.	Native	T	SA
	<i>Ficus virens</i> Aiton	Native	T	SA
Moringaceae	<i>Moringa oleifera</i> Lam.	Native	T	SA
Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels	Native	T	T
Nyctaginaceae	<i>Boerhavia diffusa</i> L.	Native	H	SA
Nymphaeaceae	<i>Nymphaea nouchali</i> Burm.f.	Native	H	A
Onagraceae	<i>Ludwigia adscendens</i> (L.) H.Hara	Native	H	SA
	<i>Ludwigia octovalvis</i> (Jacq) P.H.Raven	Native	H	SA
	<i>Ludwigia perennis</i> L.	Native	H	SA
Orobanchaceae	<i>Lindenbergia macrostachya</i> (Benth.) Benth.	Native	H	SA
	<i>Lindenbergia muraria</i> (Roxb. ex D.Don)	Native	H	SA
Oxalidaceae	<i>Oxalis corniculata</i> L.	Native	H	SA
Papaveraceae	<i>Argemone mexicana</i> L.	Exotic	H	SA
Phyllanthaceae	<i>Phyllanthus emblica</i> L.	Native	T	SA
	<i>Phyllanthus niruri</i> L.	Native	H	T
	<i>Phyllanthus reticulata</i> Poir.	Native	S	SA
	<i>Phyllanthus urinaria</i> L.	Native	H	SA
	<i>phyllanthus virgatus</i> G.Forst.	Native	H	SA
Pinaceae	<i>Pinus wallichiana</i> A.B.Jacks.	Native	T	T
	<i>Pinus roxburghii</i> Sarg.	Native	T	T
Plantaginaceae	<i>Baccopa monnieri</i> (L.) Wettst.	Native	H	SA
	<i>Limnophila connata</i> (Buch. -Ham. ex D.Don) Hand. -Mazz.	Native	H	SA
	<i>Mecardonia procumbens</i> (Mill.) Small	Exotic	H	SA
	<i>Plantago major</i> L.	Native	H	SA
	<i>Scoparia dulcis</i> L.	Exotic	H	SA
	<i>Veronica anagallis-aquatica</i> L.	Native	H	SA
Poaceae	<i>Urochloa ramosa</i> (L.) T.Q. Nguyensyn.	Native	G	SA
	<i>Apluda mutica</i> L.	Native	G	SA
	<i>Arundinella bengalensis</i> (Spreng.) Druce	Native	G	SA
	<i>Arundo donax</i> L.	Native	G	SA
	<i>Axonopus compressus</i> (Sw.) P.Beauv.	Exotic	G	SA
	<i>Cenchrus ciliaris</i> L.	Native	G	SA

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Poaceae	<i>Cenchrus setigerus</i> Vahl	Native	G	SA
	<i>Chloris barbata</i> Sw.	Native	G	SA
	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Native	G	SA
	<i>Chrysopogon zizanioides</i> (L.) Roberty	Native	G	SA
	<i>Coix lacryma-jobi</i> L.	Native	G	SA
	<i>Cynodon dactylon</i> (L.) Pers.	Native	G	SA
	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Native	G	SA
	<i>Dendrocalamus strictus</i> (Roxb.) Nees	Native	G	SA
	<i>Desmostachya bipinnata</i> (L.) Stapf	Native	G	SA
	<i>Dichanthium annulatum</i> (Forssk.) Stapf	Native	G	SA
	<i>Echinochloa colona</i> (L.) Link	Native	G	SA
	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Native	G	SA
	<i>Eleusine indica</i> (L.) Gaertn.	Native	G	SA
	<i>Eragrostis tenella</i> (L.) P.Beauv. ex Roem. & Schult.	Native	G	SA
	<i>Eragrostis unioides</i> (Retz.) Nees ex Steud.	Native	G	SA
	<i>Eriochloa procera</i> (Retz.) C.E.Hubb.	Native	G	SA
	<i>Heteropogon contortus</i> (L.) P.Beauv. ex Roem. & Schult.	Native	G	SA
	<i>Imperata cylindrica</i> (L.) Raeusch.	Native	G	SA
	<i>Ischaemum rugosum</i> L.	Native	G	SA
	<i>Leptochloa chinensis</i> (L.) Nees	Native	G	SA
	<i>Oplismenus compositus</i> (L.) P.Beauv.	Native	G	SA
	<i>Paspalum dilatatum</i> Poir.	Exotic	G	SA
	<i>Paspalum distichum</i> L.	Exotic	G	SA
	<i>Paspalum scorbiculatum</i> L.	Native	G	SA
	<i>hragmites karka</i> (Retz.) Trin. ex Steud.	Native	G	SA
	<i>Polypogon monspeliensis</i> (L.) Desf.	Native	G	SA
	<i>Saccharum spontaneum</i> L.	Native	G	SA
	<i>Setaria pumila</i> (poir.) Roem. & Schult.	Native	G	SA
	<i>Thysanolaena latifolia</i> (Roxb. ex Hornem.) Honda	Native	G	SA
	<i>Urochloa distachyos</i> (L.) T.Q. Nguyen	Native	G	SA
	<i>Urochloa mutica</i> (Forssk.) T.Q.Nguyen	Exotic	G	SA
	<i>Urochloa reptans</i> (L.) Stapf	Native	G	SA

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Polygonaceae	<i>Persicaria lapathifolia</i> (L.) Delarbre	Native	H	SA
	<i>Persicaria orientalis</i> (L.) Spach	Native	H	SA
	<i>Polygonum barbatum</i> L.	Native	H	SA
	<i>Polygonum glabrum</i> (Willd.) M. Gomez	Native	H	SA
	<i>Polygonum lanatum</i> Roxb.	Native	H	SA
	<i>Polygonum plebeium</i> R.Br.	Native	H	SA
	<i>Rumex dentatus</i> L.	Native	H	SA
	<i>Rumex nepalensis</i> Spreng.	Native	H	SA
Pontederiaceae	<i>Pontederia hastata</i> L.	Native	H	A
	<i>Pontederia vaginalis</i> Burm.f.	Native	H	SA
	<i>Pontederia crassipes</i> Mart.	Exotic	H	SA
PortulacaceaeJuss	<i>Portulaca oleracea</i> L.	Exotic	H	SA
	<i>Portulaca Pilosa</i> L.	Exotic	H	SA
Potamogetonaceae	<i>Potamogeton crispus</i> L.	Native	H	A
	<i>Potamogeton natans</i> L.	Native	H	A
	<i>Stuckenia pectinata</i> (L.) Boerner	Native	H	A
Primulaceae	<i>Anagallis arvensis</i> L.	Exotic	H	SA
Putranjivaceae	<i>Putranjiva roxburghii</i> Wall.	Native	T	SA
Ranunculaceae	<i>Clematis gouriana</i> Roxb. Ex DC.	Native	H	A
	<i>Ranunculus muricatus</i> L.	Native	H	SA
	<i>Ranunculus sceleratus</i> L.	Native	H	T
Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	Native	H	SA
	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	Native	S	SA
Rosaceae	<i>Rubus ellipticus</i> Sm.	Native	S	T
	<i>Rubus niveus</i> Thunb.	Native	S	SA
Rubiaceae	<i>Galium aparine</i> L.	Native	H	SA
	<i>Oldenlandia corymbosa</i> L.	Native	H	SA
Rutaceae	<i>Aegle marmelos</i> (L.) Correa	Native	T	T
	<i>Glycosmis pentaphylla</i> (Retz.) DC.	Native	S	T
	<i>Murraya koenigii</i> (L.) Spreng	Native	S	T
	<i>Murraya paniculata</i> (L.) Jack	Native	S	T
Sapindaceae	<i>Aesculus indica</i> (Wall. ex Cambess.) Hook.	Native	T	T
Scrophulariaceae	<i>Buddleja asiatica</i> Lour.	Native	S	SA
	<i>Verbascum chinense</i> (L) Santapau	Native	H	SA

Family	Plant Name (Botanical name)	Nativity	Habit	Habitat
Simaroubaceae	<i>Ailanthus excelsa</i> Roxb.	Native	T	T
Solanaceae	<i>Nicotiana plumbaginifolia</i> Viv.	Exotic	H	SA
	<i>Nicotiana rustica</i> L.	Exotic	S	T
	<i>Physalis minima</i> L.	Exotic	H	SA
	<i>Solanum chrysotrichum</i> Schltdl.	Exotic	S	SA
	<i>Solanum nigrum</i> L.	Native	H	SA
	<i>Solanum sisymbriifolium</i> Lam.	Exotic	H	SA
	<i>Solanum torvum</i> Sw.	Exotic	S	SA
	<i>Solanum viarum</i> Dunal	Exotic	S	SA
Typhaceae	<i>Typha angustifolia</i> L.	Native	G	SA
	<i>Typha elephantina</i> Roxb.	Native	G	SA
Ulmaceae	<i>Holoptelea integrifolia</i> (Roxb.) Planch.	Native	T	SA
Urticaceae	<i>Pilea microphylla</i> (L.) Liebm.	Exotic	H	SA
	<i>Pouzolzia pentandra</i> (Roxb.) Benn.	Native	H	SA
	<i>Pouzolzia zeylanica</i> (L.) Benn.	Native	H	SA
	<i>Pouzolzia hirta</i> (Blume) Hassk.	Native	H	SA
Verbinaceae	<i>Lantana camara</i> L.	Exotic	S	SA
	<i>Lippia alba</i> (Mill.) N.E. Br. Britton & P.Wilson	Exotic	S	SA
	<i>Phyla nodiflora</i> (L.)	Native	H	SA
	<i>Verbena officinalis</i> L.	Native	H	SA
Zygophyllaceae	<i>Tribulus terrestris</i> L.	Native	H	SA

Abbreviation: **Habit.** T- Tree, S- Shrub, H- herb, C- Climber, G- Grass. **Habitat.** T- Terrestrial, SA-Semi-aquatic, A- Aquatic.



Source: Land Use Land Cover, NRSC/ISRO (2018-19)
*Not to scale



* NP = National Park, WLS = Wildlife Sanctuary

This image shows a full page of white paper with horizontal ruling lines. The word "NOTES" is printed at the top center. Below it are approximately 28 evenly spaced horizontal lines extending across the width of the page.



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

NMCG

National Mission for Clean Ganga,
Department of Water Resources, River
Development & Ganga Rejuvenation
Ministry of Jal Shakti, Major Dhyan Chand
Stadium, India Gate, New Delhi 110001

WII

Wildlife Institute of India
Chandrabani, PO Box #18,
Dehradun 248001, Uttarakhand
t.: +91135 2640114-15, +91125 2646100,
f.: +91135 2640117
wii.gov.in/nmcg/national_mission_for_clean_ganga

GACMC/NCRR

Ganga Aqualife Conservation Monitoring Centre/
National Centre for River Research
Wildlife Institute of India, Dehradun
nmcg@wii.gov.in