

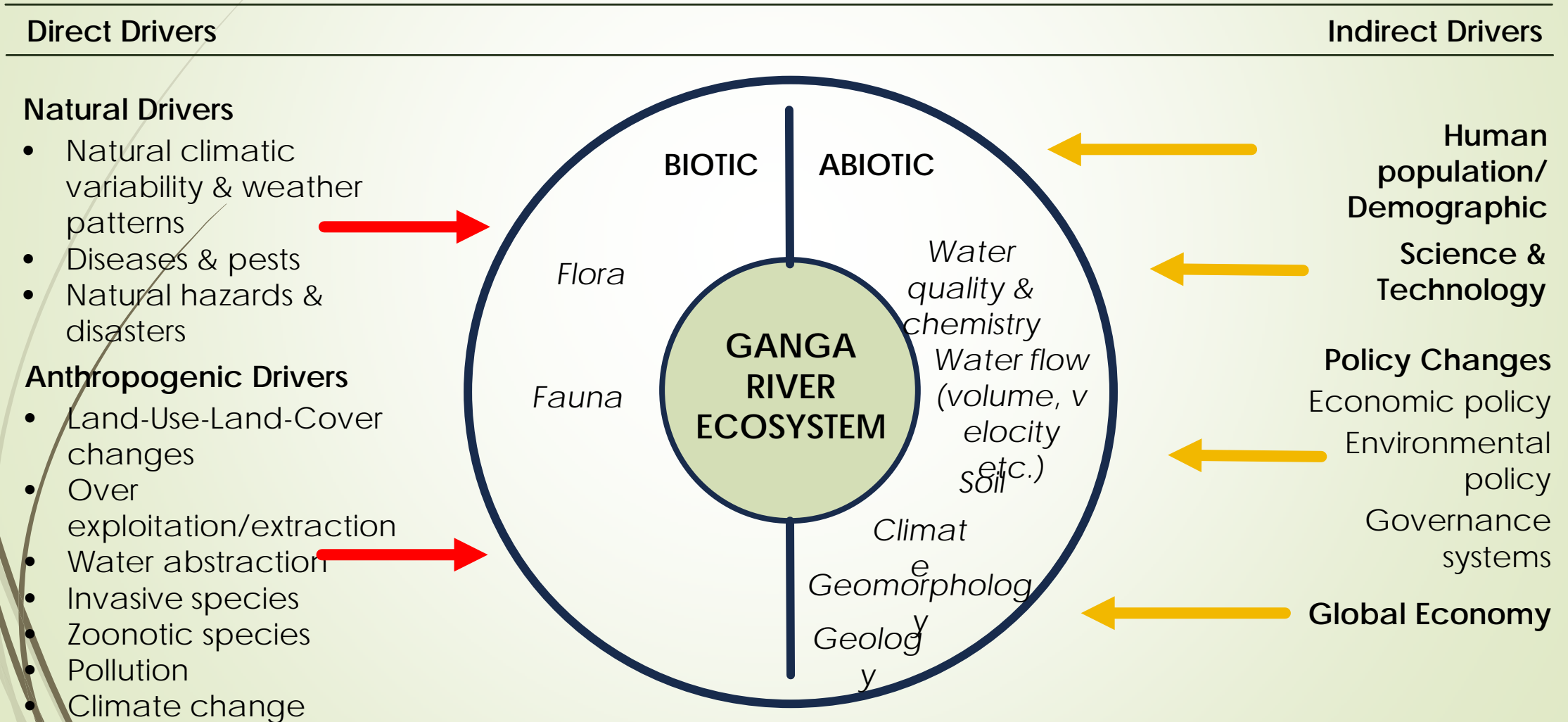


Ecosystem Services of Ganga River



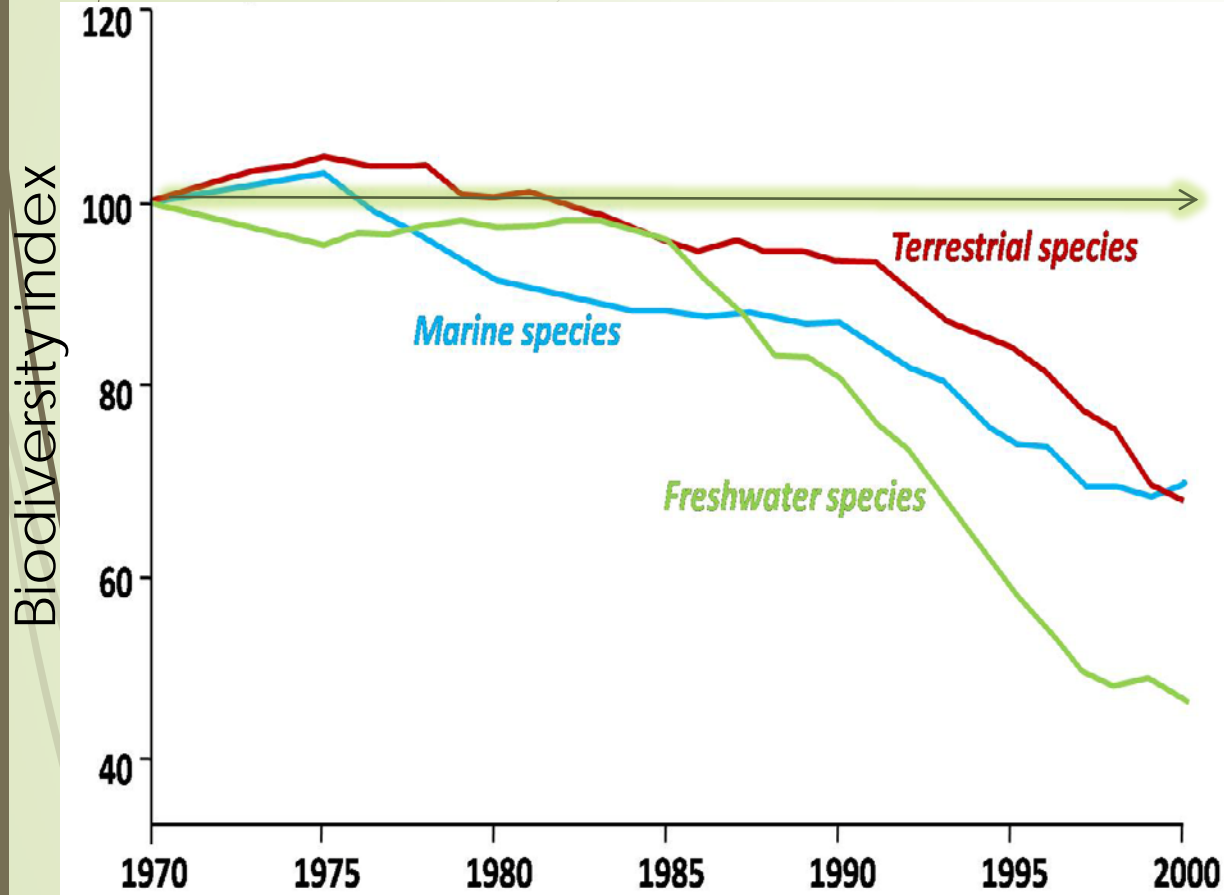
Ruchi Badola
Wildlife Institute of India

ECOSYSTEM SERVICES are the enumerable direct and indirect, tangible and intangible benefits provided by ecosystem functions and processes that contribute to human wellbeing.



GLOBAL TREND - SPECIES

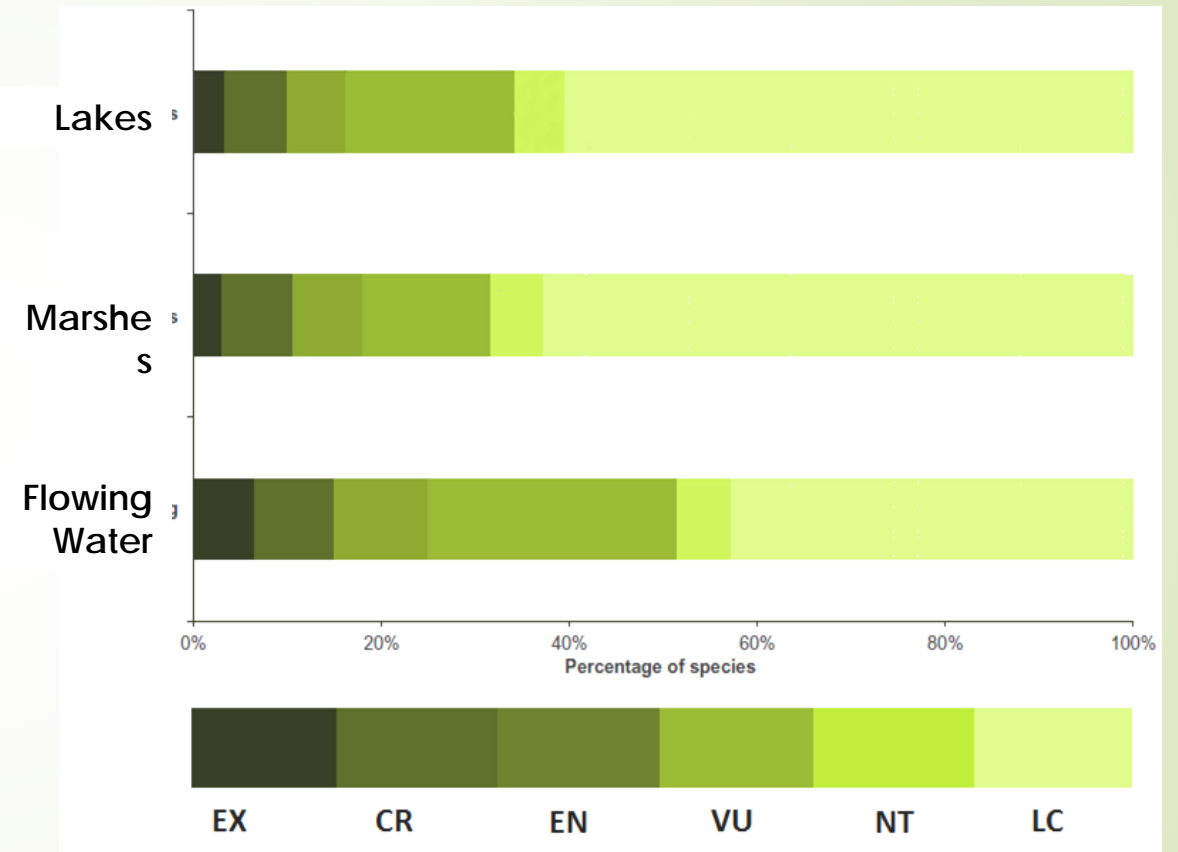
LOSS



Source: WWF, UNEP-WCMC

THREAT LEVEL - AQUATIC SPECIES

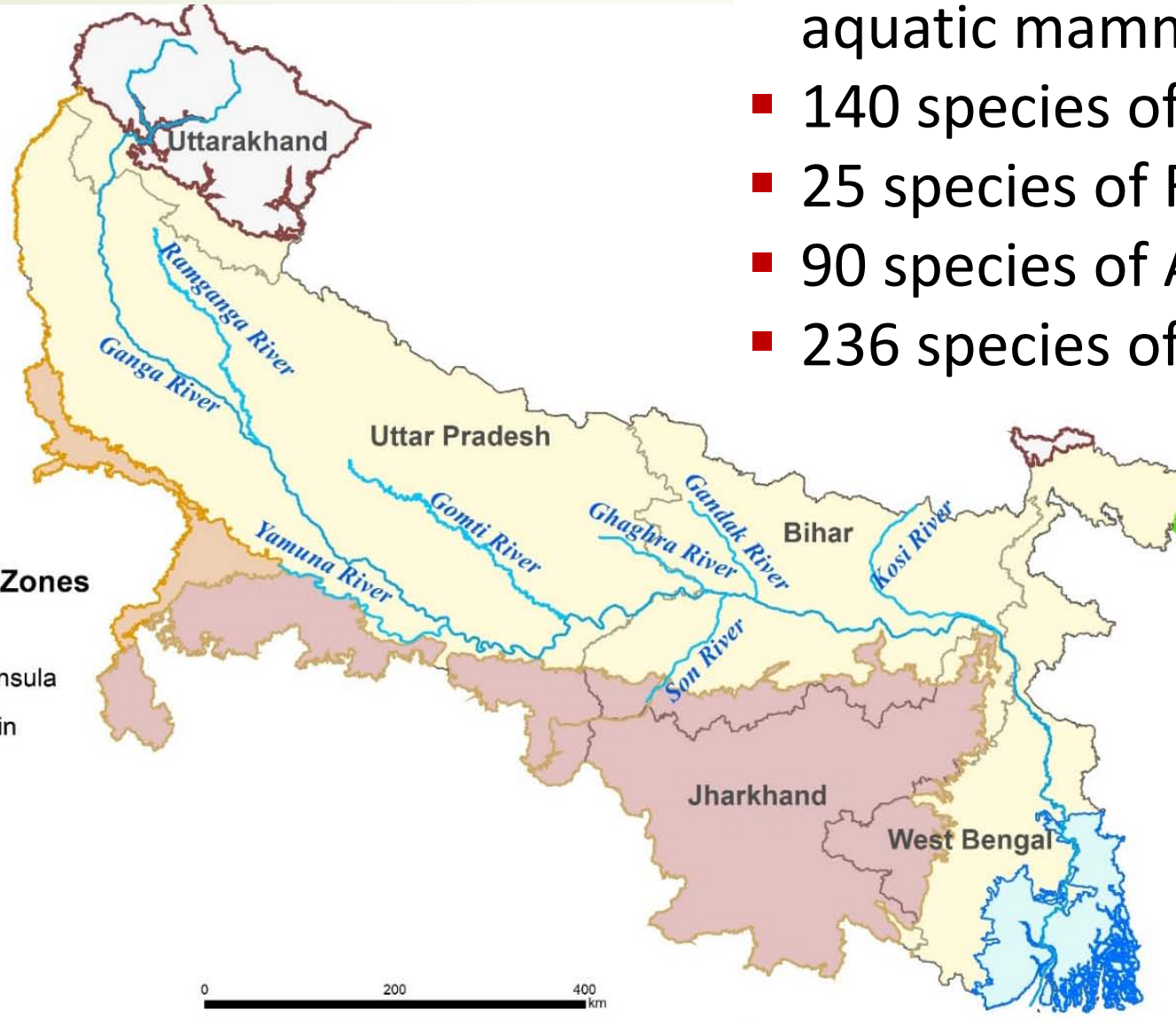
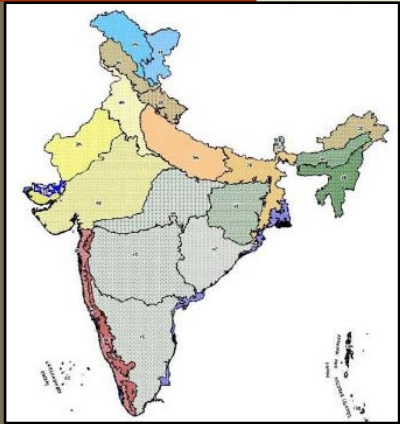
SPECIES



2797 species in lakes, 1281 in marshes, 5374 in flowing water

BIODIVERSITY PROFILE OF GANGA RIVER

4



Legend

— River

Bio-geographic Zones

Coasts

Deccan Peninsula

Gangetic Plain

Himalaya

North-East

Semi-Arid

State

- 5 species of aquatic and semi-aquatic mammals
- 140 species of waterbirds
- 25 species of Reptiles
- 90 species of Amphibians
- 236 species of Fishes

BIODIVERSITY OF GANGA RIVER

5 species of aquatic and semi-aquatic Mammals



140 species of waterbirds



25 species of Reptiles



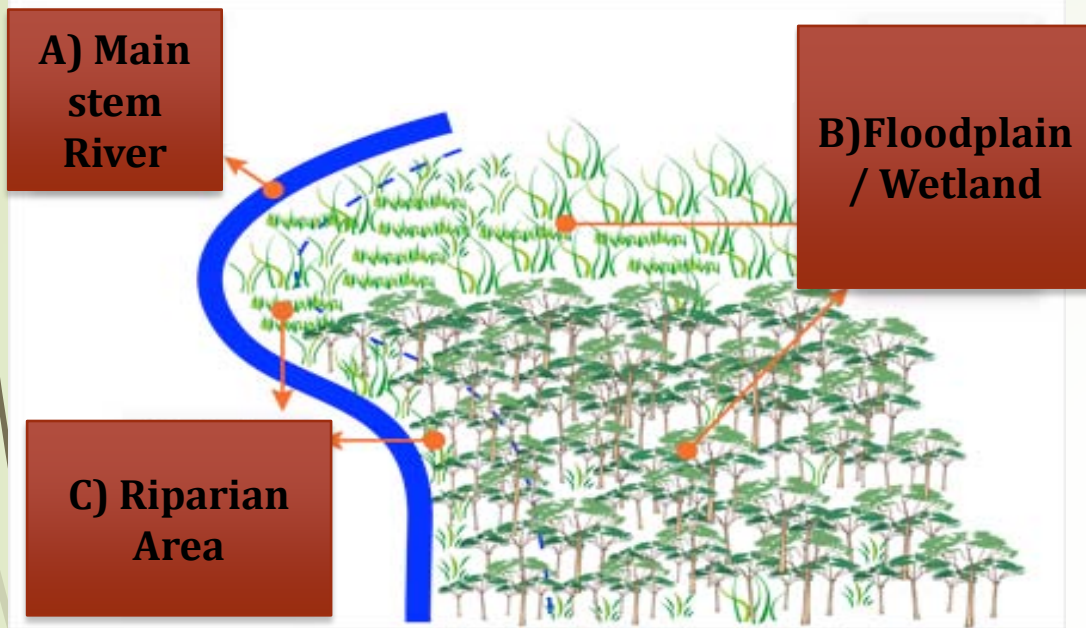
90 species of Amphibians



236 species of Fishes



ECOSYSTEM SERVICES PROVIDED BY RIVERINE ECOSYSTEMS



A) MAIN STEM RIVER	
Consumptive use ❖ drinking, domestic, agriculture & industry Non-consumptive use ❖ power generation & navigation/transport ❖ Aquatic organisms (fish etc.)	❖ Riverbed material (sand, stones etc.) ❖ Maintaining Populations & Habitats ❖ Water cycling ❖ Water purification ❖ Nutrient cycling ❖ Recreation ❖ Religious & Spiritual

Raw (biotic) material

C) RIPARIAN AREA	
❖ Food ❖ Raw (biotic) material ❖ Raw (abiotic) material ❖ Pest control ❖ Climate regulation ❖ Carbon storage & sequestration ❖ Erosion prevention ❖ Flood protection ❖ Soil formation ❖ Waste treatment	❖ Bank stabilization ❖ Maintaining Populations & Habitats ❖ Pollination ❖ Water supply & regulation ❖ Water purification ❖ Nutrient cycling ❖ Recreation ❖ Religious & Spiritual

B) FLOODPLAIN/ WETLAND	
Consumptive use ❖ drinking, domestic, agriculture & industry Non-consumptive use ❖ power generation & navigation/transport ❖ Aquatic organisms (fish etc.)	❖ Riverbed material ❖ Maintaining populations & habitats ❖ Water cycling ❖ Water purification ❖ Nutrient cycling ❖ Recreation ❖ Religious & Spiritual

Raw (biotic) material

Objectives

- To identify the key ecosystem services provided by the Ganga River.
- To develop a framework for assessing the ecosystem services of Ganga River.
- To evaluate select ecosystem services provided by the Ganga River at select sites.

Study Area

Reflecting the variations in geology, geomorphology, soil type, climate, flora and fauna, and social and economic issues, the mainstem of the Ganga River can be divided into **three stretches**.



Upper Ganga
Gaumukh to Haridwar
~ 294 Km

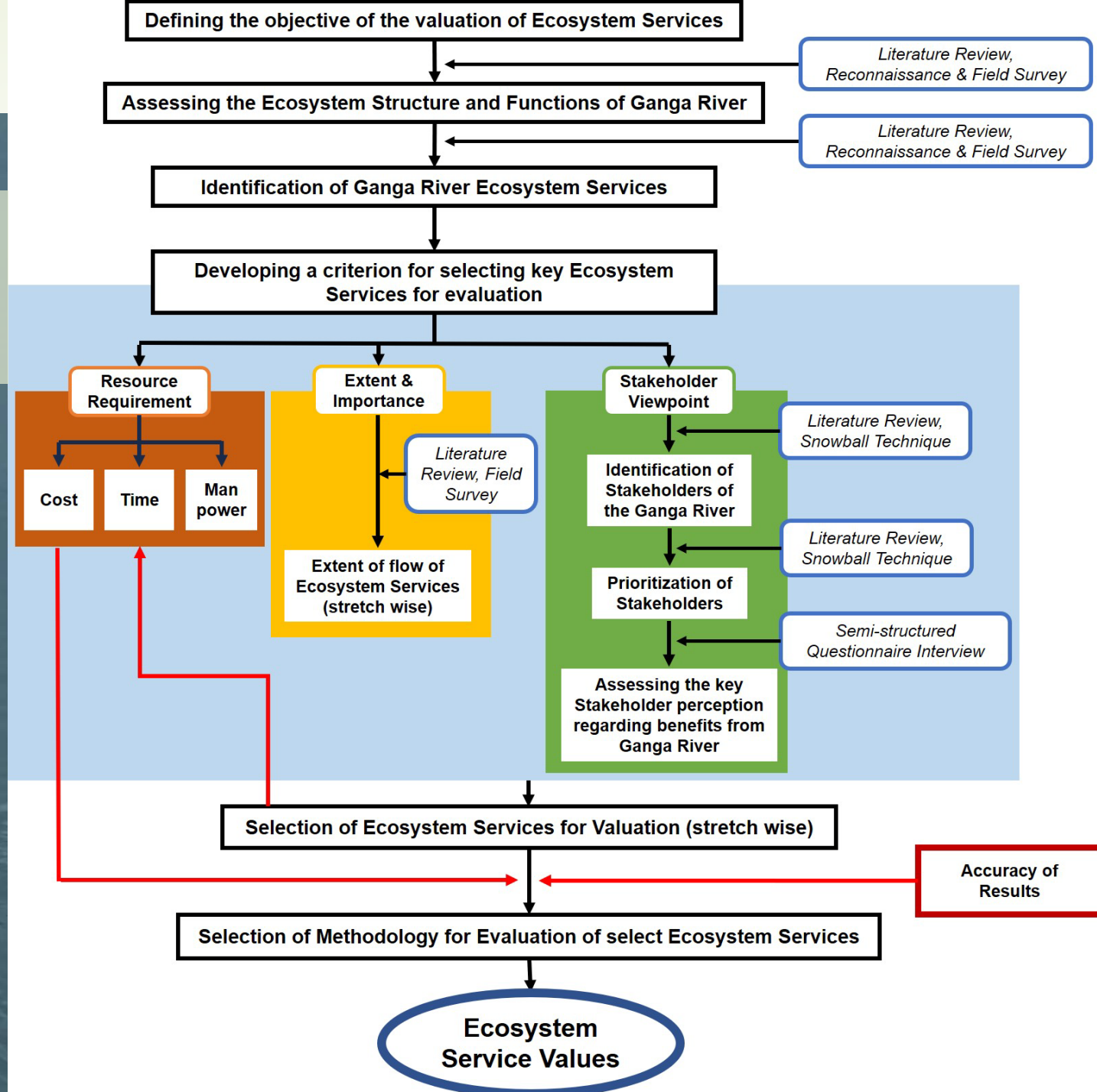


Middle Ganga
Haridwar to Varanasi
~ 1082 Km



Lower Ganga
Varanasi to Ganga Sagar
~ 1134 Km

A framework was designed that accounts for resource constraints and relevance of the ecosystem services provided.



Stakeholder Perception Assessment

- Total 503 respondents surveyed in Upper, Middle and Lower Ganga.
- Upper Ganga, water for drinking most cited ecosystem service (60.90%), followed by water for irrigation (56.41%) and religious/spiritual services (44.87%).
- Middle Ganga, water for irrigation most cited ecosystem service (55.91%), followed by religious/spiritual services (39.37%), and water cycle and water for drinking (28.35%).
- Lower Ganga, water for irrigation most cited ecosystem service (65.48%), followed by provision of fish (50.60%), and water for drinking and religious/spiritual services (48.21%).
- 10.90%, 23.62% and 26.19% of the respondents in Upper, Middle and Lower Ganga, respectively, mentioned that Ganga River maintains population and habitat for diverse floral and faunal species.

Ecosystem Services provided by Ganga River and their extent

Ecosystem Services	Upper	Middle	Lower	Ecosystem Services	Upper	Middle	Lower
Provisioning Services				Regulating & Supporting Services			
<i>Consumptive use of water</i>				Maintaining population & habitat			
Drinking	•	●	●	Regulation of micro climate	●	●	●
Domestic use	●	●	●	Soil fertility	•	●	●
Agriculture (irrigation)	•	●	●	Soil formation (sediment deposition)	○	●	●
Livestock (drinking, bathing)	•	●	●	Water purification and waste management	●	•	•
Industry	•	●	●	Water cycle	•	●	●
<i>Non-consumptive use of water</i>				Storm protection (through mangroves)			
Power generation	●	•	•	Cultural Services			
Transportation	○	●	●	Tourism			
<i>Resource Material</i>				Religious/Spiritual			
Fish and other aquatic fauna for food	•	●	●	Aesthetic			
Fuelwood	•	•	●	Heritage sites			
Riverine vegetation for multiple uses	•	•	•	Ecosystem Services derived: ○ → none; • → little/sometimes: ● → medium: ● → large			
Riverbed material	●	●	●				

Methodology adopted for evaluating the select Ecosystem Services at Select sites

Ecosystem Service	Study Site	Methodology
Water for drinking and domestic use	Upper Ganga (Srinagar, Uttarkashi) Middle Ganga (Meerut, Kanpur, Mirzapur, Varanasi) Lower Ganga [Patna Urban Area, Bhagalpur, Kolkata Municipal Corporation, Southwest Kolkata (Joka) & Eastern Kolkata (Anandapur & Patuli)]	Benefit Transfer Data: Secondary data from Government departments/reports; peer reviewed literature
Benefits to agriculture (water for irrigation and soil fertility)	Lower Ganga (Bihar)	Market Price Data: Secondary data from Government departments/reports
Water for power generation	Ganga River mainstem & Alaknanda	Benefit Transfer Data: Secondary data from Government departments/reports; peer reviewed literature
Water for transportation	Middle & Lower Ganga [National Waterway 1 (NW 1) (Allahabad to Haldia)]	Avoided Cost Data: Secondary data from Government departments/reports
Riverbed material	Middle Ganga (Uttar Pradesh)	Market Price Data: Secondary data from Government departments
Provision of fish	Middle Ganga (Varanasi, Narora)	Market Survey Data: semi-structured questionnaire-based interview survey
Recreational/ religious/	Middle Ganga	Market Survey Data: semi-structured questionnaire based

River plastic quantities show high correlation with

(Best 2019)



Population Density

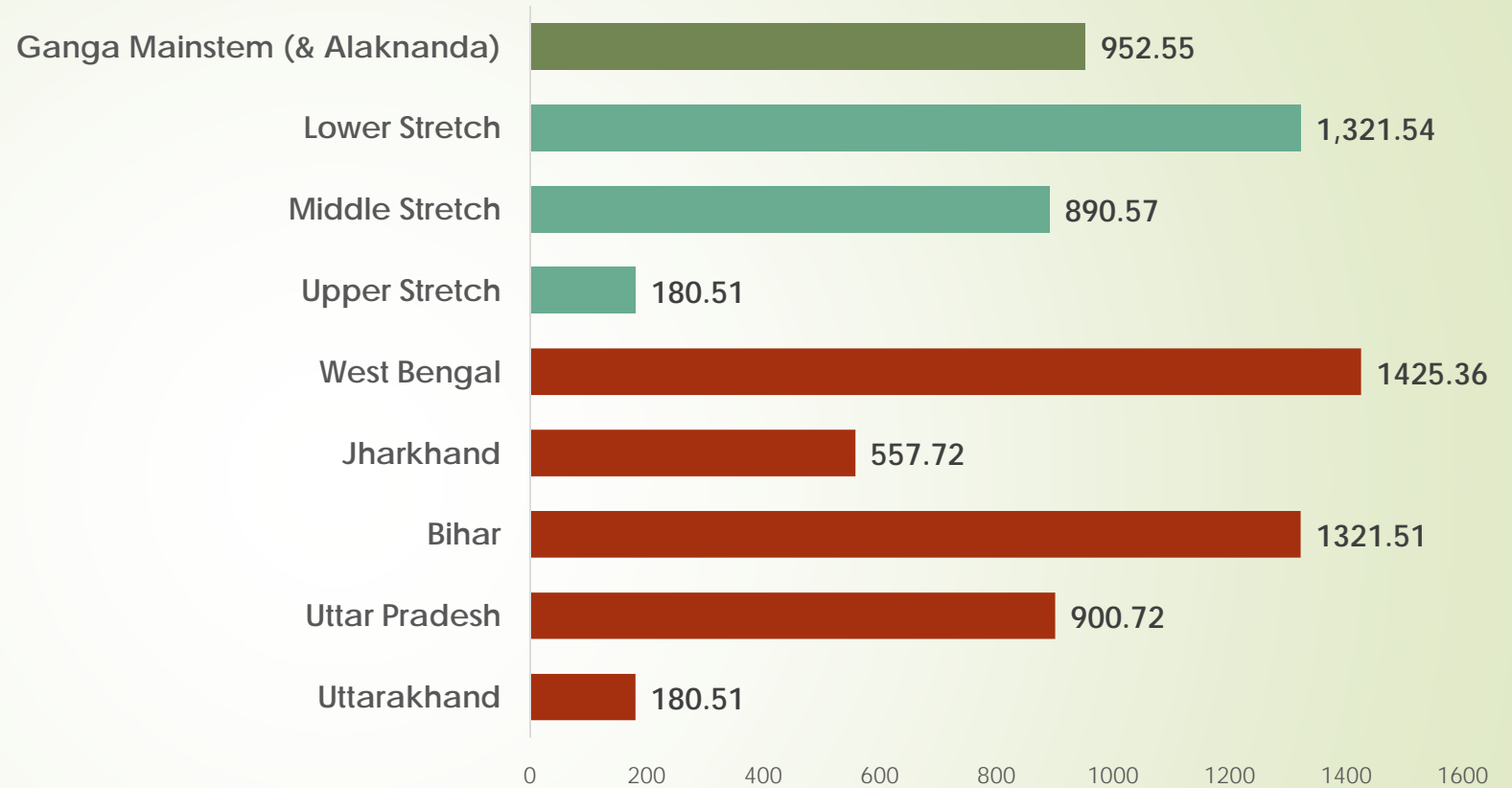
Urbanization

Wastewater Treatment

Waste Management

Two top plastic waste generating states of India are along Ganga (*UNIDO, 2018*):
Uttar Pradesh: 1,30,777, Jharkhand:
35,854

Population density along the Ganga River Mainstem



54 'Class-I' cities and 30 'Class-II' towns situated within 10 km from banks of Ganga

Benefit of dumping waste in the river = cost of infrastructure/resources to manage the waste generated

“In India, municipal agencies spend about 5%–25% of their budgets on solid waste management. Urban local bodies spend around ₹500 to ₹1,500 per metric tonne of solid waste, out of which 60% to 70% is usually spent on collection alone, and 20% to 30% is on transportation.”

– EPW (Balasubramanian, 2015)

Typical waste management costs by disposal type (US\$/t)



	Low-income countries	Lower-middle-income countries	Upper-middle-income countries	High-income countries
Collection and transfer	20–50	30–75	50–100	90–200
Controlled landfill to sanitary landfill	10–20	15–40	20–65	40–100
Open dumping	2–8	3–10	–	–
Recycling	0–25	5–30	5–50	30–80
Composting	5–30	10–40	20–75	35–90

Source: World Bank Solid Waste Community of Practice and Climate and Clean Air Coalition.

Note: – = not available.

'Sea to Source plastic expedition' Ganga River 2019 (WII-NGS). Amounts of plastic waste coming to Ganga is less than other rivers for which data is available.

This could be probably due to recent ban on single-use plastics and Gol's *Swatchh Bharat Abhiyan*.

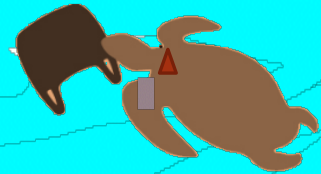
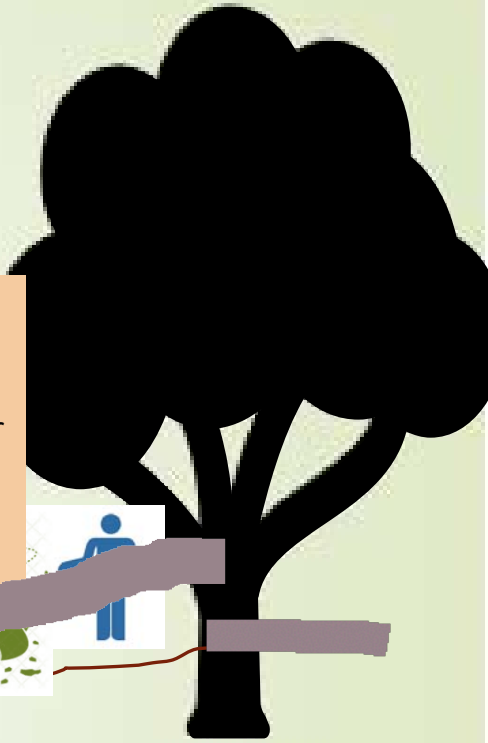
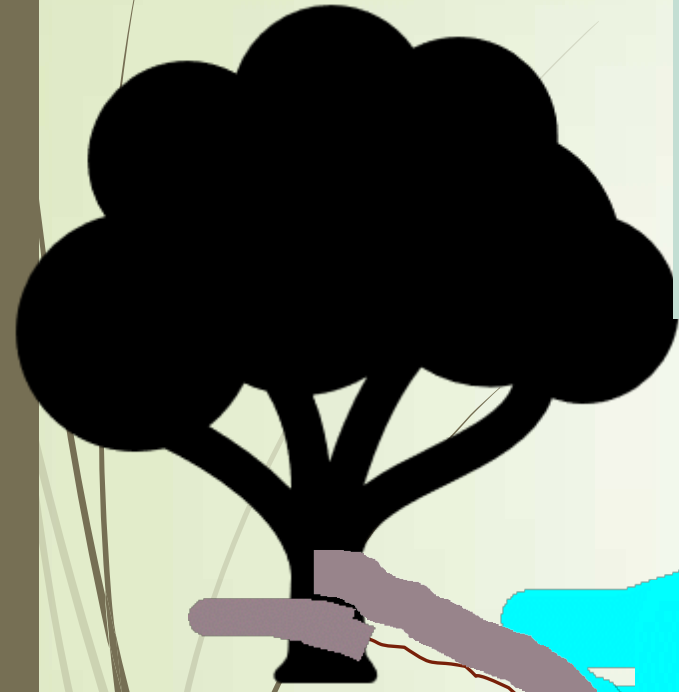
Plastic on river bank and deposited after floods

Floating Plastic

Plastic in Biota

Plastic in Sediments

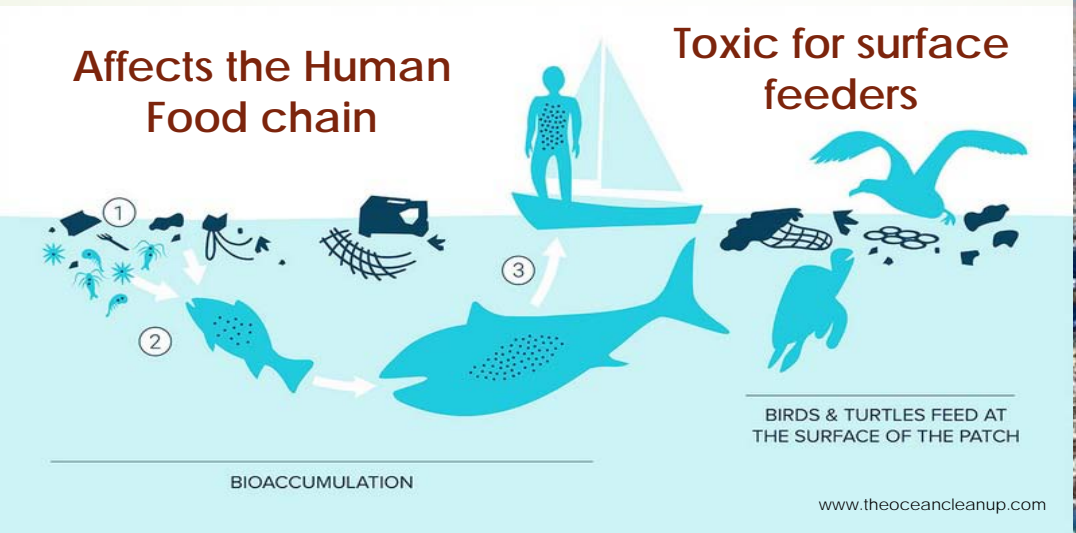
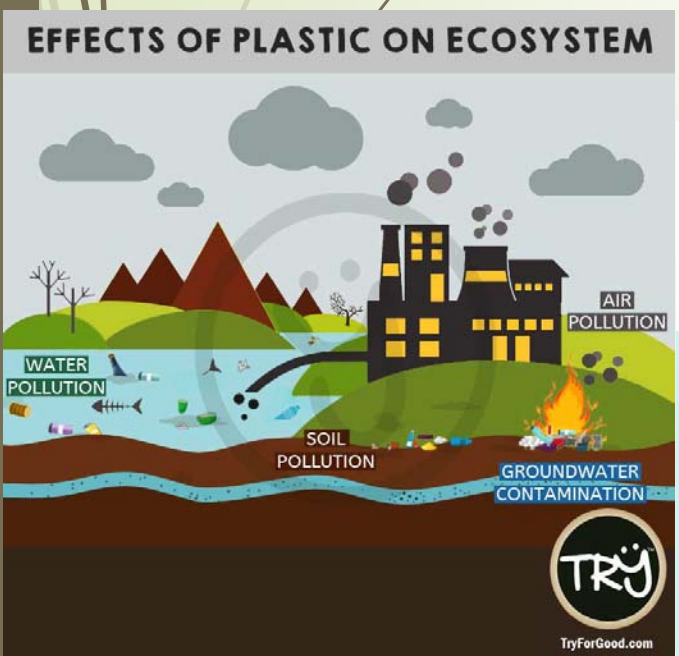
Impact of Plastic on riverine biodiversity



Physical impact on biodiversity:
 entanglement, ingestion, starvation
 Chemical impact: build up of
 persistent Bio-accumulative
 Transport of invasive species and
 pollutants from polluted rivers to
 remote areas in the ocean
 Economic impact: damage to
 fisheries, shipping, and tourism
 Health impact: Affects human food
 chain through bioaccumulation



IS THE TRADE-OFF WORTH IT?



Some ways forward

- Understand plastic waste generation at community level
- Demand and supply of plastic waste, circular economy
- Engage communities, mass awareness, social movements (Ganga Praharis)
- Financial and policy interventions: Local governments cover c 50% of investment costs for waste systems, rest from national government subsidies and private sector.
- For macroplastics entering into sea, NMCG is setting surface and submerged trash scrapers
- For microplastics, natural solutions such as strengthening mangrove forests of Sundarbans.
- Trans-border cooperation between India and Bangladesh
- Working closely with GoI programs: Financing solid waste management a challenge, more for operational costs than for capital investments.
- Cost recovery for waste services differs across income levels, full cost recovery largely limited to high-income countries.





**Thank
You**



AVOID PLASTICS

***Eco-Friendly
Alternatives***