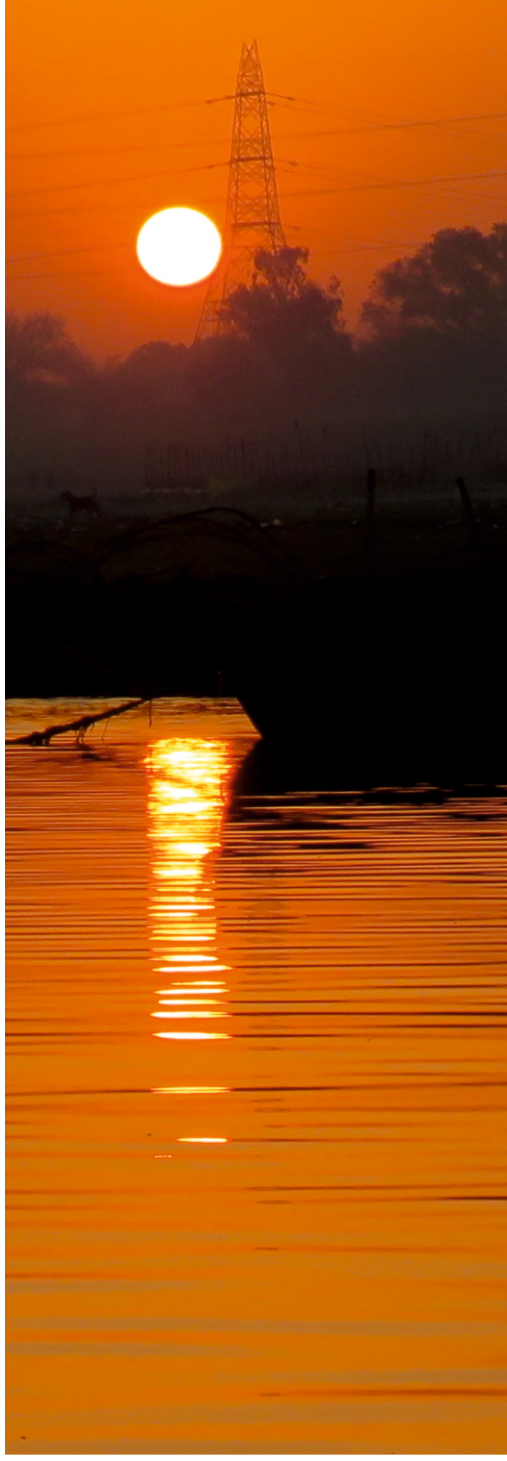

नमामि गंगे

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

THREATS AND POLLUTION HOTSPOTS

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THREATS AND POLLUTION HOTSPOTS

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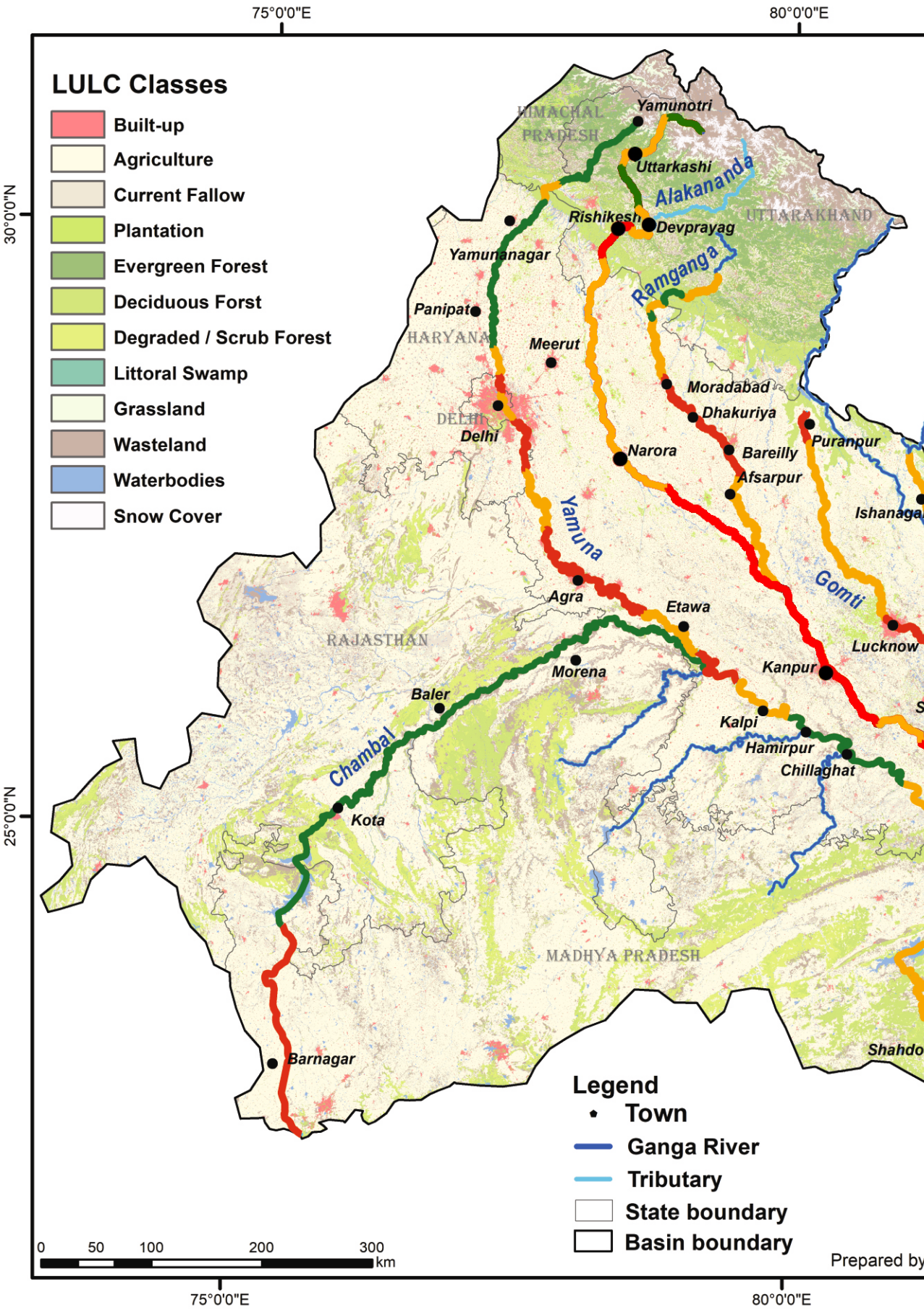
Threats and Pollution Hotspots

This document presents the findings of the study on the threats and ecotoxicological risks to aquatic species posed by contaminants in the Ganga River Basin.

The study revealed a prevalent risk from multiple pollutants in the majority of river stretches. These river stretches have been classified into segments of high, moderate and low ecological risks with varying degrees of severity.

The ecotoxicological seasonal survey was conducted in 2021 to 2023, spanning 143 sampling sites and 33 contaminants in the surface water of 12 rivers of the GRB.


LULC Classes
Built-up
Agriculture
Current Fallow
Plantation
Evergreen Forest
Deciduous Forst
Degraded / Scrub Forest
Littoral Swamp
Grassland
Wasteland
Waterbodies
Snow Cover
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HIMACHAL PRADESH
UTTARAKHAND
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DELHI
RAJASTHAN
MADHYA PRADESH
Yamunotri
Uttarkashi
Alakananda
Rishikesh
Devprayag
Yamunanagar
Ramganga
Panipat
Meerut
Moradabad
Dhakuriya
Delhi
Narora
Bareilly
Puranpur
Afsarpur
Yamuna
Agra
Etawa
Gomti
Lucknow
Morena
Kanpur
Baler
Kalpi
Hamirpur
Chillaghat
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High
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BIHAR
Barhalganj
Supaul
Ganga
Ravelganj
Patna
Hajipur
Bakhtiarpur
Kosi
Jaunpur
Kaithi
Kursela
Prayagraj
Sahibganj
Bhagalpur
Sasaram
Farakka
Varanasi
Son
Ajay
Deoghar
JHARKHAND
Dhanbad
Katwa
Damodar
Illambazar
Bokaro
Steel City
Kashipur
Durgapur
Burdwan
CHHATTISGARH
Rupnarayan
Gaurella
Arambagh
Kolkata
WEST
BENGAL
Noorpur
: NMCG-WII Project, Ecotoxicology Lab - GIS Cell, Ganga Aqualife Conservation Monitoring Centre, 2024
85°0'0"E

GANGA RIVER

POLLUTION THREATS

Municipal Sewage & Industrial Effluents

- Recent monitoring by the Central Pollution Control Board (CPCB) of Sewage Treatment Plants (STPs) across five Ganga-front states indicates several operational and compliance issues requiring attention. The total installed treatment capacity stands at 2,589.3 MLD, while the estimated sewage generation is 3,558.5 MLD, resulting in a treatment gap of approximately 969.2 MLD (27.2%). Furthermore, only 63.6% of the operational capacity (1,646.5 MLD of 2,233.2 MLD) is being utilized. This untreated sewage poses a substantial risk to riverine water quality, public health, and the ecological integrity of the Ganga River.
- The Ganga River receives pollution from a vast network of drains across the five states. In Uttarakhand, untreated flows from pilgrimage towns remain a concern. Uttar Pradesh has the highest pollution load, with 132 domestic and 56 mixed drains, but only 52 are tapped. Bihar's 67 drains are entirely domestic, yet only 4 are tapped, exacerbating pollution in densely populated areas. Jharkhand, though limited to 6 domestic drains, has fully tapped them, reflecting better infrastructure. West Bengal faces complex challenges, with 70 domestic and 24 mixed drains, but only 4 are tapped, particularly near industrial hubs like Kolkata.

Plastic Waste

- The widespread use and poor management of plastic waste - including discarded plastic items, fishing nets, consumer products, and medical devices - have been identified as a significant pollution threat. West Bengal (4.18 lakh TPA) and Uttar Pradesh (3.76 lakh TPA) are among the top plastic waste generators. Bihar (74,264 TPA), Uttarakhand (18,647 TPA), and Jharkhand (20,263 TPA), though smaller contributors, remain substantial sources of plastic waste in the Ganga.

Agricultural Settlements

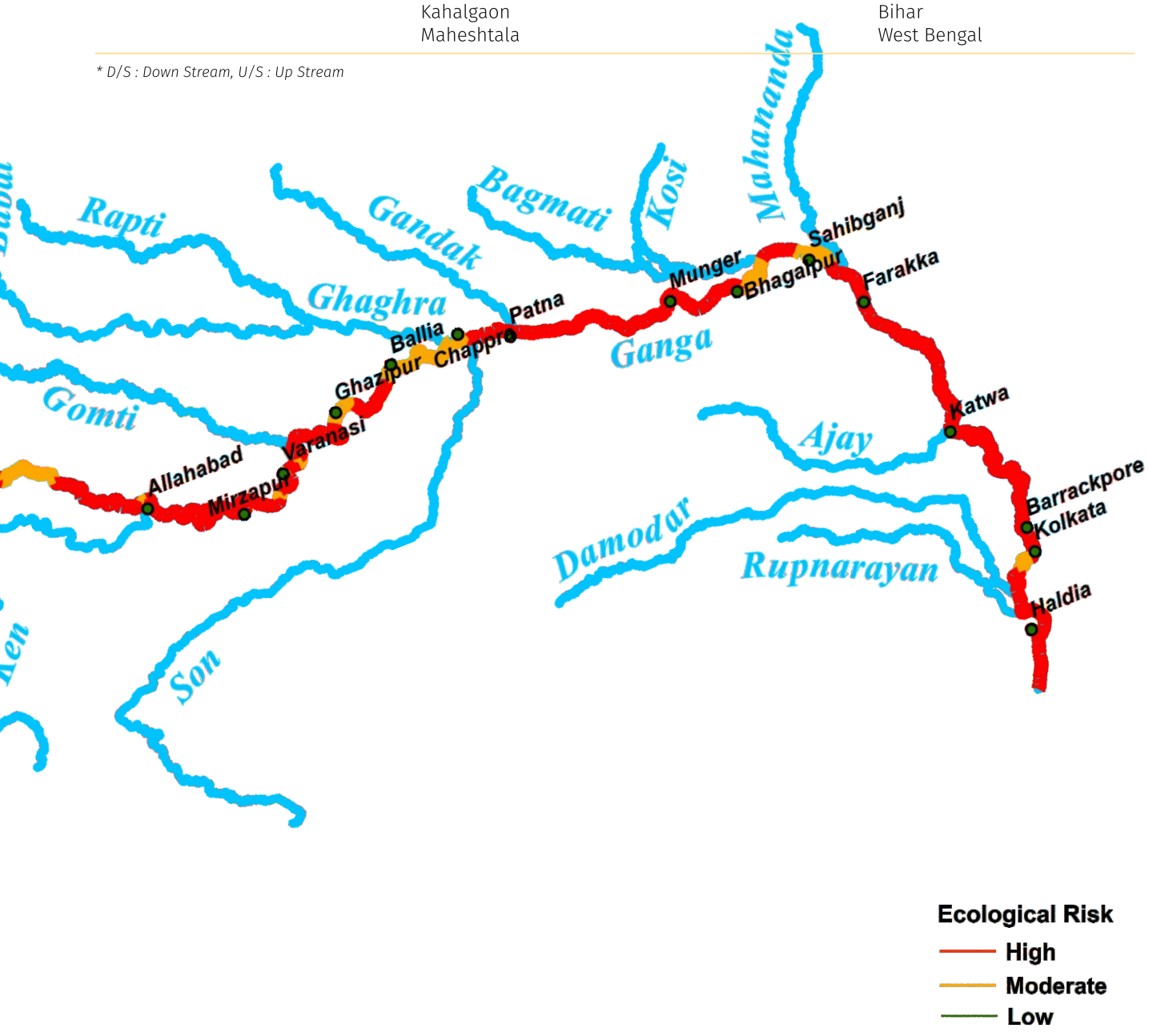
- The catchment of the Ganga is an area of intensive agricultural activity, with a high net irrigation-to-sown ratio (62.6%) compared to the national average (44%). Riverbed cultivation of seasonal vegetables is a common practice during the summer season. While pesticide levels have declined between 2017 and 2023, some stretches still show contamination.

POLLUTION HOTSPOT ASSESSMENT

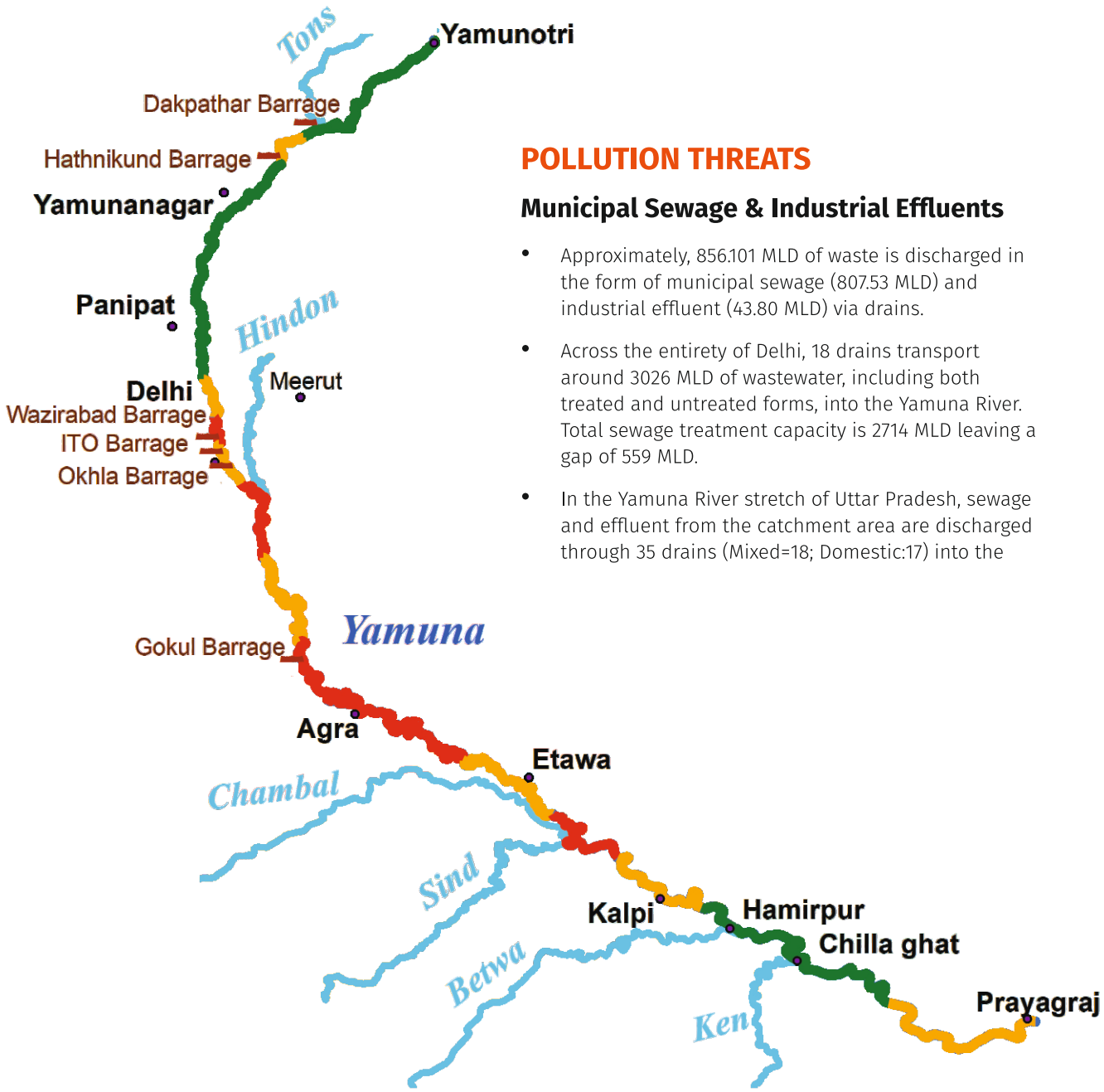
- Over 60% of the river is affected by multiple pollution stressors, with hotspots linked to plastic additives and household contaminants. Targeted and strategic interventions remain necessary for the comprehensive remediation of identified pollution hotspots.

Risk Zone	Stretch (% Stretch of River)	State
High Risk Zone (67%)	Rishikesh-Haridwar	Uttarakhand
	Kachla-Bhitoura	Uttar Pradesh
	Manikpur-Mirzapur	Uttar Pradesh
	Varanasi-Saidpur	Uttar Pradesh
	D/S* Chappra-Bhagalpur	Bihar
	D/S Sahibganj-Kolkata	West Bengal
	Batanagar-Haldia	West Bengal
Moderate Risk Zone (29%)	Harshil-Dharasu	Uttarakhand
	Shivpuri-U/S* Rishikesh	Uttarakhand
	Bijnor-Narora	Uttar Pradesh
	Between Bhitoura-Manikpur	Uttar Pradesh
	Ghazipur	Uttar Pradesh
	Ballia-Chappra	Bihar
	Kahalgaon	Bihar
	Maheshtala	West Bengal

** D/S : Down Stream, U/S : Up Stream*



YAMUNA RIVER



POLLUTION THREATS

Municipal Sewage & Industrial Effluents

- Approximately, 856.101 MLD of waste is discharged in the form of municipal sewage (807.53 MLD) and industrial effluent (43.80 MLD) via drains.
- Across the entirety of Delhi, 18 drains transport around 3026 MLD of wastewater, including both treated and untreated forms, into the Yamuna River. Total sewage treatment capacity is 2714 MLD leaving a gap of 559 MLD.
- In the Yamuna River stretch of Uttar Pradesh, sewage and effluent from the catchment area are discharged through 35 drains (Mixed=18; Domestic:17) into the river. A significant gap of approximately 70% exists between treated and untreated wastewater. The catchment houses 300 grossly polluting industries (GPIs), with major industrial units involved in Pulp & Paper, sugar, Textile, Distillery, and other sectors.
- Widespread usage and poor solid waste management of plasticizers, associated with discarded plastic waste, fishing nets, consumer household products, and medical devices is also identified as the potential pollution threats.

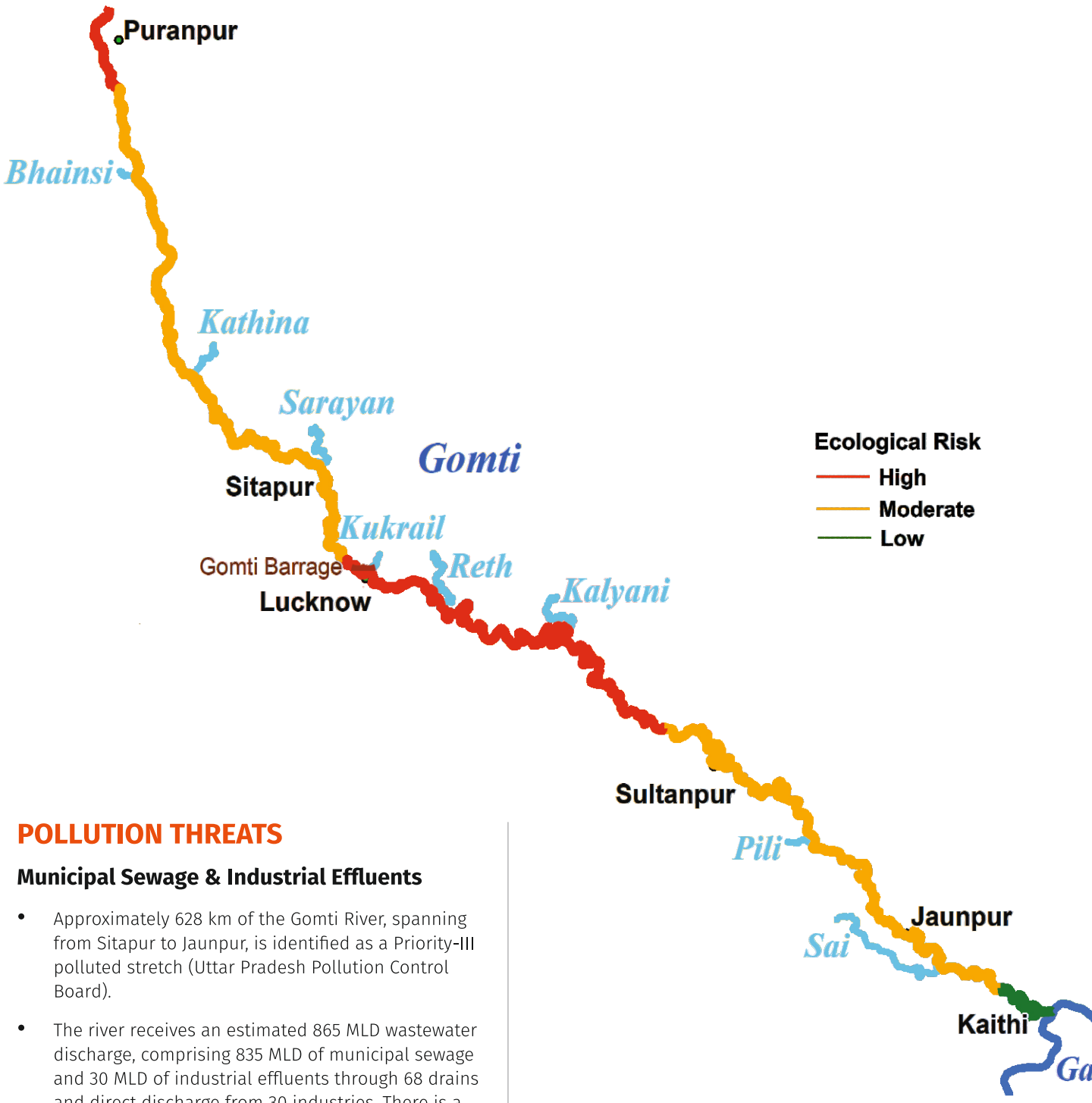
Agricultural Settlements

The Yamuna basin, particularly in Haryana and the western districts of Uttar Pradesh, is known for its high fertility and abundant food grain yield. Various stretches of the Yamuna River have reported elevated levels of pesticide contamination.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors is observed in over 90% of the Yamuna River. Hotspots, identified through ecological risk assessments of water quality parameters and chemical pollutants, spotlight specific areas demanding focused intervention. The identified pollution hotspots are

Risk Zone (%stretch of river)	Sampling Site	Districts
High Risk Zone (13%)	Wazirazbad Barrage -Hindon Confl. Mathura-Shahidpur Chambal Confluence	Delhi, Gautam Budh Nagar Mathura, Agra Etawa
Moderate Risk Zone (22%)	Paonta Sahib Baghpat Vrindavan Etawa Kalpi	Sirmaur Baghpat Mathura Etawa Jalaun



POLLUTION THREATS

Municipal Sewage & Industrial Effluents

- Approximately 628 km of the Gomti River, spanning from Sitapur to Jaunpur, is identified as a Priority-III polluted stretch (Uttar Pradesh Pollution Control Board).
- The river receives an estimated 865 MLD wastewater discharge, comprising 835 MLD of municipal sewage and 30 MLD of industrial effluents through 68 drains and direct discharge from 30 industries. There is a 47% gap between treated and untreated sewage in the polluted stretch of the Gomti River.
- In the polluted stretch, Municipal Solid Waste totals 1798.84 TPD, with processing facilities available only in Lucknow and Barabanki (1230 TPD capacity). Other districts lack processing facilities, creating a gap of 568.84 TPD in the catchment area.
- Widespread usage and poor solid waste management of plasticizers, associated with discarded plastic waste, fishing nets, consumer household products, and medical devices is also identified as the potential pollution threats.

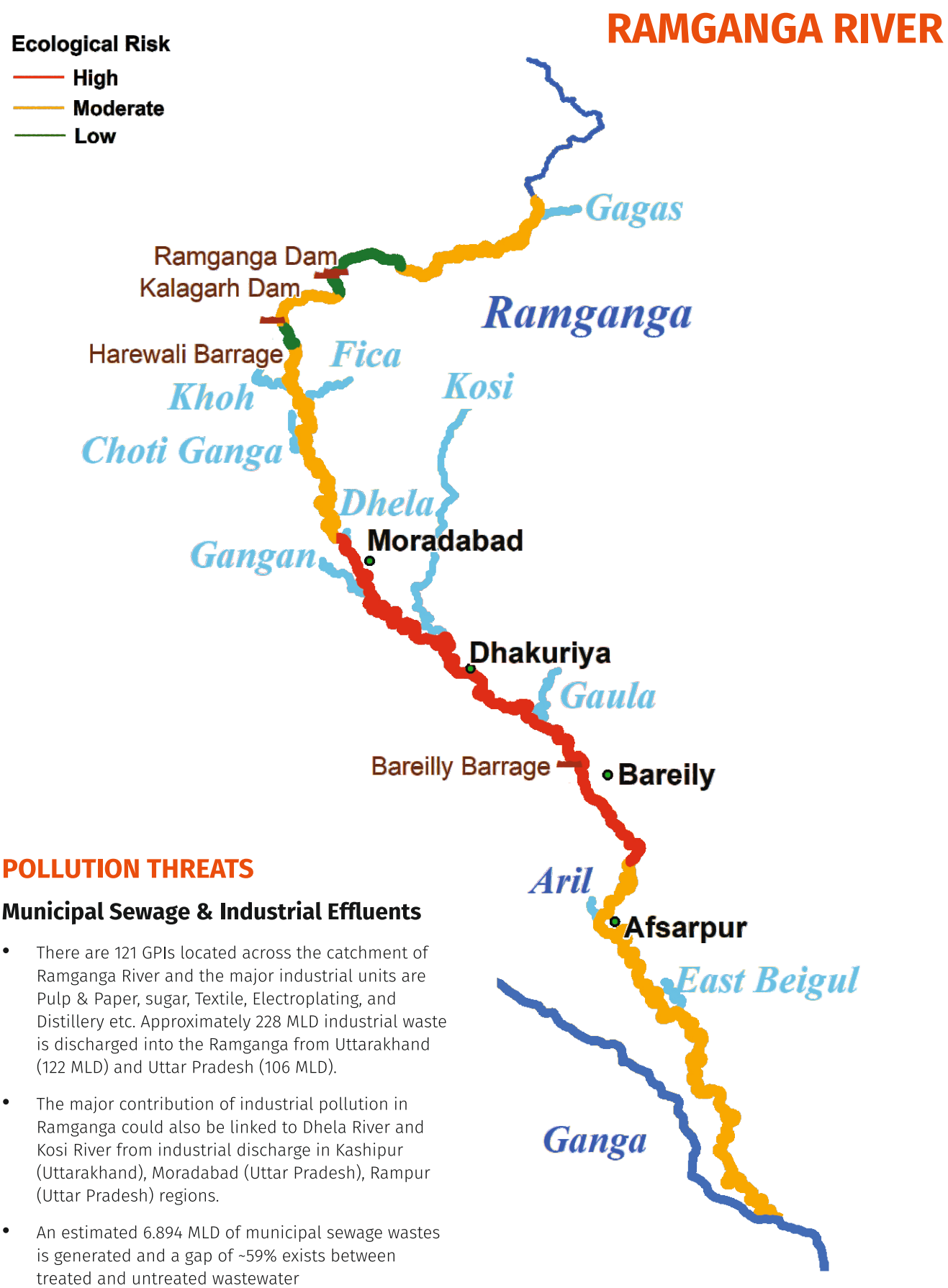
Agricultural Settlements

As part of highly fertile and agriculturally productive Uttar Pradesh, agriculture comprises the major land-use pattern in the Gomti Basin. This exerts multiple pressures on the river, including water abstraction and pesticide pollution.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors is observed in the entire Gomti River. Hotspots, identified through ecological risk assessment of water quality parameters and chemical pollutants, spotlight specific areas demanding focused intervention. The identified hotspots are:

Risk Zone (%stretch of river)	Sampling Site	Districts
High Risk Zone (36%)	Origin D/S Kukrail Confluence-Pipri Jaunpur	Pilibhit Lucknow Jaunpur
Moderate Risk Zone (57%)	Puranpur-Kukrail Confluence Sultanpur D/S Jaunpur-Chandwak Bridge	Shahjahanpur, Sitapur Lucknow Sultanpur Jaunpur



POLLUTION THREATS

Municipal Sewage & Industrial Effluents

- There are 121 GPIs located across the catchment of Ramganga River and the major industrial units are Pulp & Paper, sugar, Textile, Electroplating, and Distillery etc. Approximately 228 MLD industrial waste is discharged into the Ramganga from Uttarakhand (122 MLD) and Uttar Pradesh (106 MLD).
- The major contribution of industrial pollution in Ramganga could also be linked to Dhela River and Kosi River from industrial discharge in Kashipur (Uttarakhand), Moradabad (Uttar Pradesh), Rampur (Uttar Pradesh) regions.
- An estimated 6.894 MLD of municipal sewage wastes is generated and a gap of ~59% exists between treated and untreated wastewater

- Moradabad, Rampur & Bareilly contributes approx. total 801.93 TPD Solid Waste and there has been lack of processing facility in the catchment.
- Widespread usage and poor solid waste management of plasticizers, associated with discarded plastic waste, fishing nets, consumer household products, and medical devices is also identified as the potential pollution threats.
- The brass industries in Moradabad are a significant source of copper pollution, with impacts observed downstream up to Bareilly.

Agricultural Settlements

The major land use in Ramganga basin is agriculture settlements and high level of pesticides contamination have been reported from different stretches of Ramganga mainly along the Bijnor to Moradabad district.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors is observed in over 85% of the Ramganga River. Hotspots, identified through ecological risk assessments of water quality parameters and chemical pollutants, spotlight specific areas demanding focused intervention. The identified pollution hotspots are:

Risk Zone (%stretch of river)	Sampling Site	Districts
High Risk Zone (31%)	D/S Moradabad-Goula Confluence	Moradabad, Rampur, Bareilly
Moderate Risk Zone (56%)	Marchula Nagina Barrage Dhampur Farrukhabad	Ramnagar Nagina Bijnor Shahjahanpur

GHAGHRA RIVER

POLLUTION THREATS

Municipal Sewage

- The Gorakhpur - Deoria stretch is classified as polluted stretch by CPCB and UPPCB, and receives untreated municipal sewage by 9 drains. There is gap of 21.11 MLD in sewage treatment in this stretch owing to the absence of a sewage treatment facility.
- Approximately 142.30 TPD of solid waste is generated in this stretch, with no facilities for its treatment.
- Widespread usage and poor solid waste management of plasticizers, associated with discarded plastic waste, fishing nets, consumer household products, and medical devices is also identified as the potential pollution threats.

Agricultural Settlements

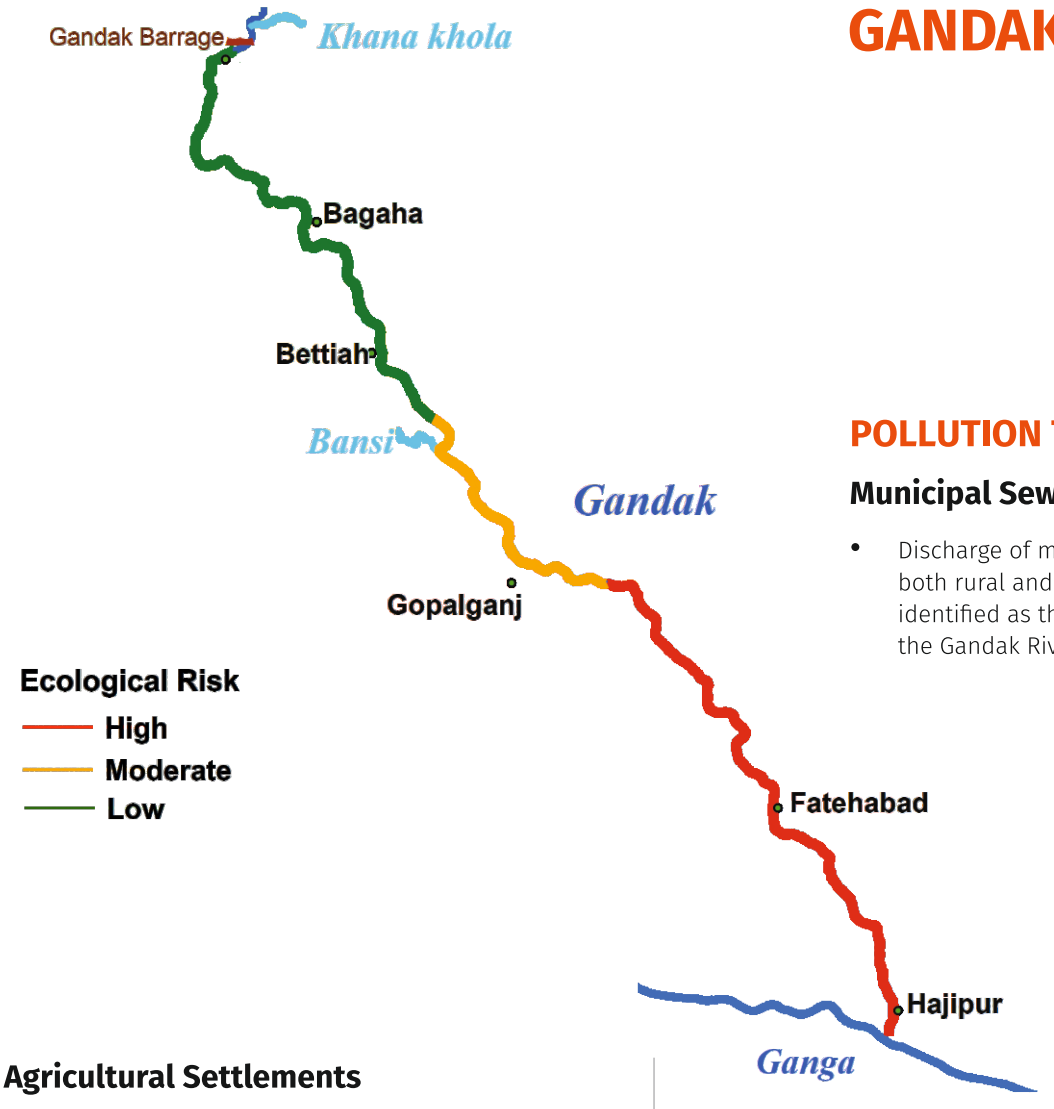
Agricultural land forms the major class of land use in the Ghaghra basin. There is therefore a potential risk of pesticide pollution through surface runoff.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors is observed in entire river stretch of the Ghaghra. Ecological Risk Assessment of water quality and pollutant concentrations reveal the following high- and moderate-risk hotspots in the river:

Risk Zone (% stretch of River)	Stretch	District
High Risk Zone (60%)	Chahlari ghat - Tanda Darauli - Revelganj	Ayodhya Ambedkar Nagar Siwan Saran
Moderate Risk Zone (40%)	Kailashpuri - Zalimnagar Pul Barhalganj - Rapti confluence	Bahraich Gorakhpur Deoria

GANDAK RIVER



POLLUTION THREATS

Municipal Sewage

- Discharge of municipal sewage from both rural and urban settlements is identified as the pollution threat in the Gandak River

Agricultural Settlements

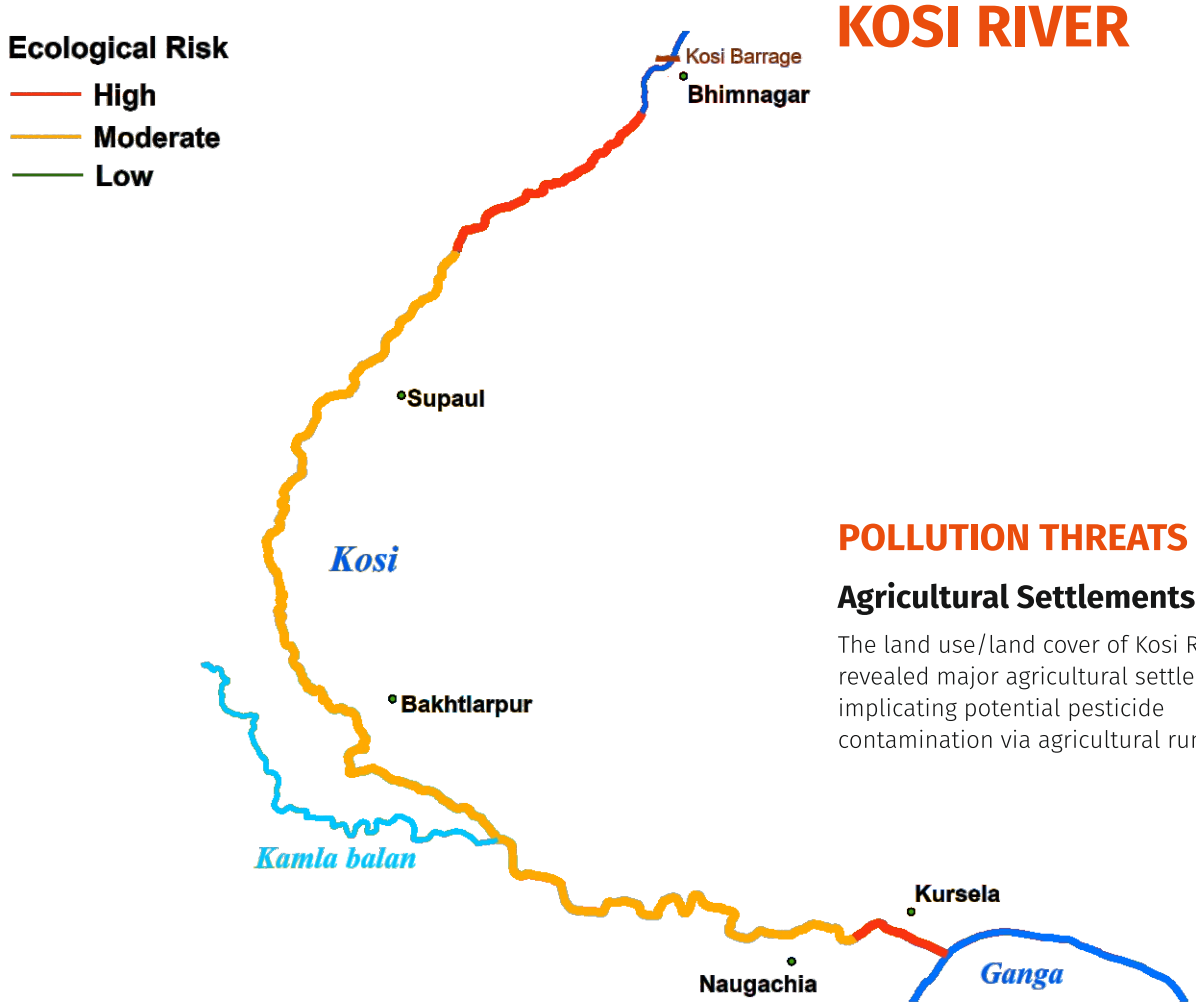
Potential pesticide pollution through surface runoff from agricultural area, which comprises majority of the land use.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors is observed in entire river stretch of the Gandak. Ecological Risk Assessment of water quality and pollutant concentrations reveal the following high- and moderate-risk hotspots in the river:

Risk Zone (% stretch of River)	Stretch	District
High Risk Zone (60%)	Dumariaghat - Sonepur-Hajipur Bridge	Gopalganj Chappra Vaishali
Moderate Risk Zone (20%)	Gopalganj	Gopalganj

KOSI RIVER



POLLUTION THREATS

Agricultural Settlements

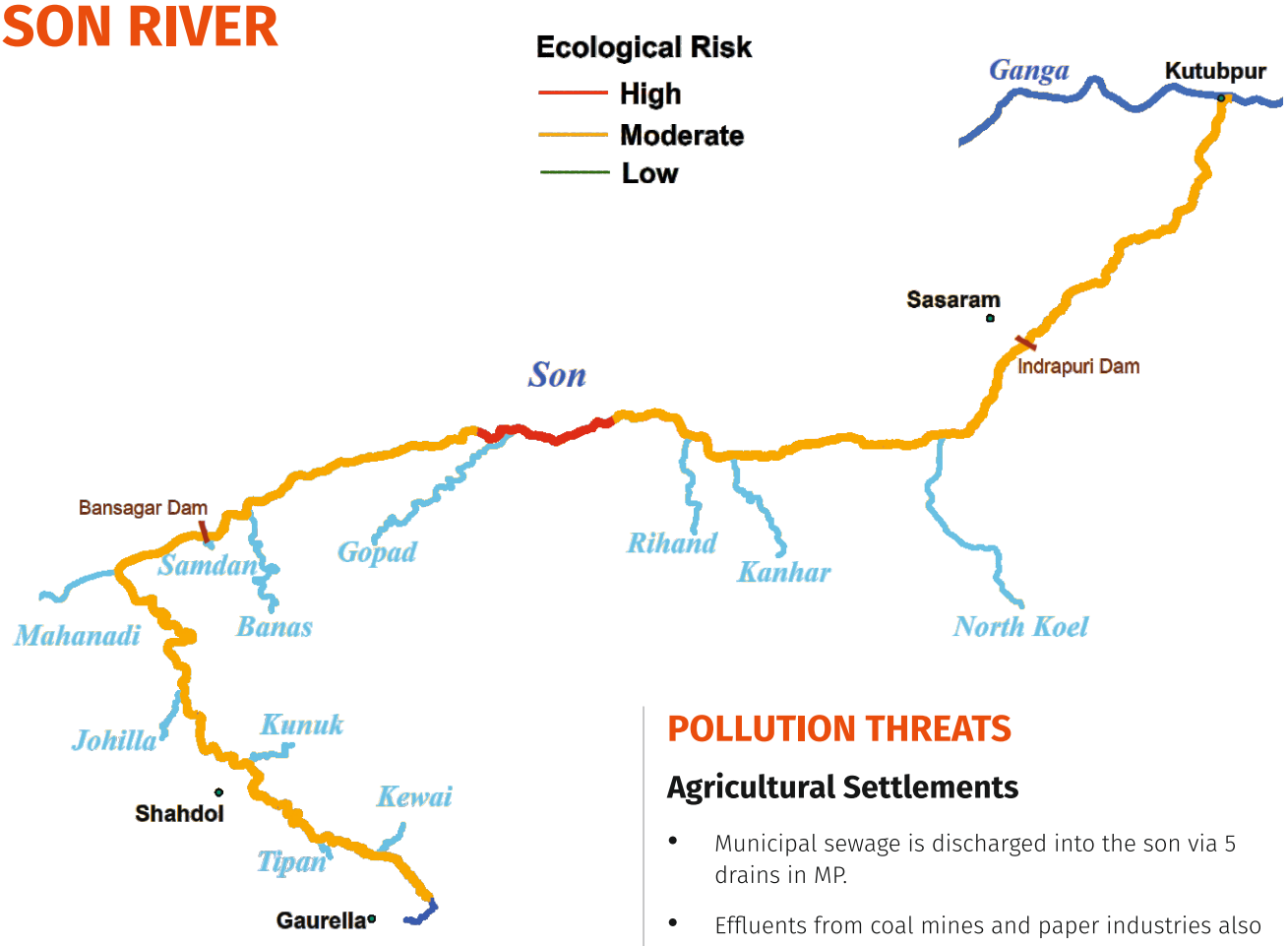
The land use/land cover of Kosi River revealed major agricultural settlements implicating potential pesticide contamination via agricultural run-off.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors, particularly plasticizers, is observed in entire river stretch of the Kosi.

Risk Zone (% stretch of River)	Stretch	District
High Risk Zone (40%)	Piprahigot Kursela Bridge	Supaul Katihar
Moderate Risk Zone (60%)	Nemua-Agrahan	Supaul Saharsa Munger

SON RIVER



Agricultural Settlements

The land use/land cover of Son River revealed agricultural settlements at some stretches implicating potential pesticide contamination via agricultural run-off.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors is observed in over 90% of the Son River.

Ecological Risk Assessment of water quality and pollutant concentrations reveal the following high- and moderate-risk hotspots in the Son:

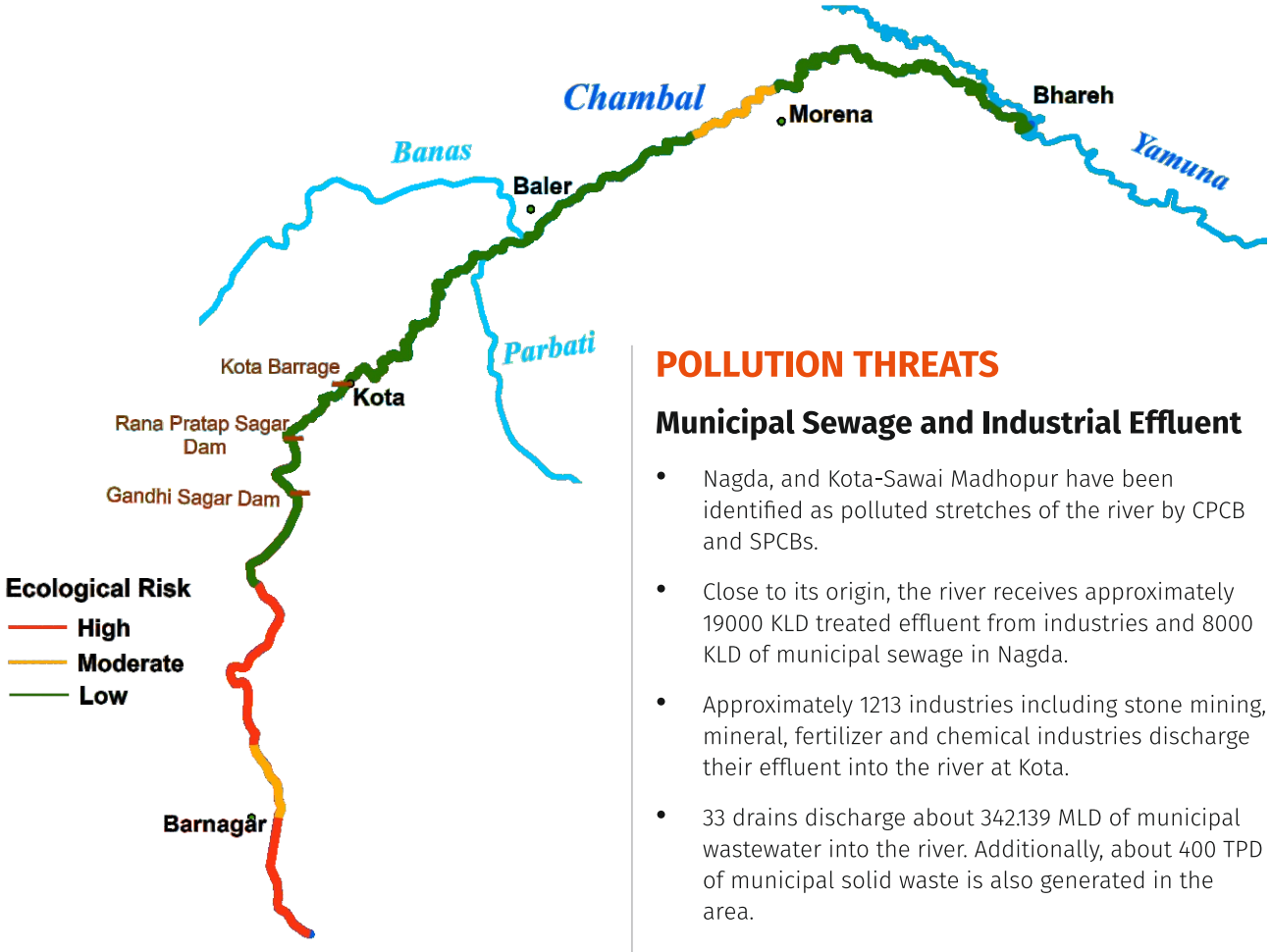
Risk Zone (% stretch of River)	Stretch	District
High Risk Zone (11%)	Gopad river Confluence, Bardi	Sidhi
Moderate Risk Zone (78%)	Cholna - Jogdaha Bridge	Anooppur Shahdol Rewa Sidhi

POLLUTION THREATS

Agricultural Settlements

- Municipal sewage is discharged into the son via 5 drains in MP.
- Effluents from coal mines and paper industries also pollute the river.

CHAMBAL RIVER



Agricultural Settlements

Agriculture is extensively practiced downstream of Kota and forms about 35% of the area's land use, posing as a potential source of pesticides for the river.

POLLUTION HOTSPOT ASSESSMENT

Exceedance for multiple pollution stressors is observed in over 27% stretch of the Sone River. Ecological Risk Assessment of water quality and pollutant concentrations reveal the following high- and moderate-risk hotspots in the river:

Risk Zone (% stretch of River)	Stretch	District
High Risk Zone (27%)	Origin Kalisindh Confluence	Indore Mandsaur
Moderate Risk Zone (18%)	Nagda Dholpur	Ujjain Dholpur

POLLUTION THREATS

Municipal Sewage and Industrial Effluent

- Nagda, and Kota-Sawai Madhopur have been identified as polluted stretches of the river by CPCB and SPCBs.
- Close to its origin, the river receives approximately 19000 KLD treated effluent from industries and 8000 KLD of municipal sewage in Nagda.
- Approximately 1213 industries including stone mining, mineral, fertilizer and chemical industries discharge their effluent into the river at Kota.
- 33 drains discharge about 342.139 MLD of municipal wastewater into the river. Additionally, about 400 TPD of municipal solid waste is also generated in the area.

DAMODAR RIVER

POLLUTION THREATS

Municipal Sewage and Industrial Effluent

- The river is polluted by over 19000 KDL of municipal wastewater recieved from 9 drains in Jharkhand and 184 MLD from 11 drains in West Bengal. The gap between municipal wastewater generation and treatment is over 170 MLD.
- 3600 KLD of industrial effluent is discharged into the river in Jharkhand. In West Bengal, 30 industries directly discharge 99000 KLD of treated wastewater into the river. The major industries contributing to pollution in the river are coal mining and coal washery, thermal power plants, steel plants and fertilizer industry.

Agricultural Settlements

Agriculture accounts for 46% of the land use in the Damodar catchment, posing the potential risk of pesticide exposure to the river via surface runoff.

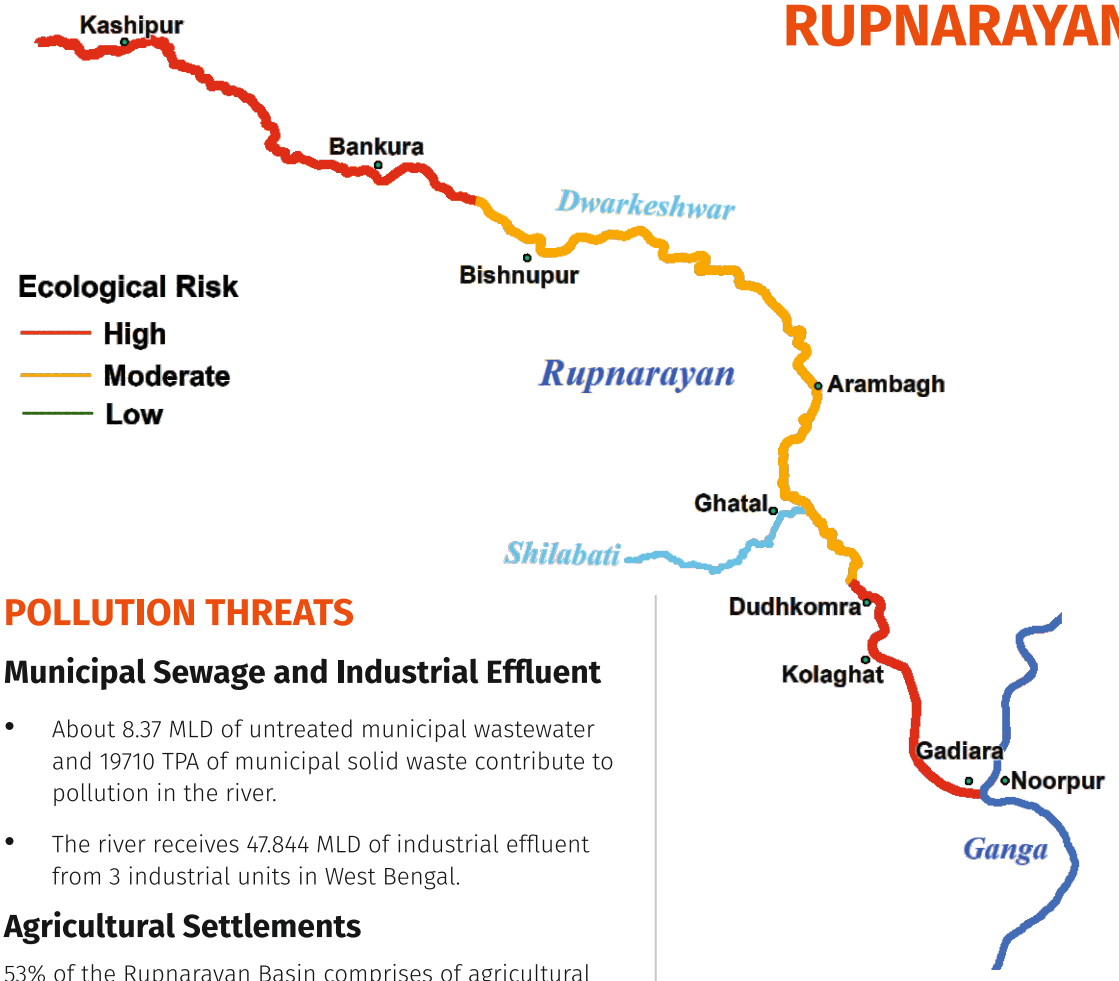
POLLUTION HOTSPOT ASSESSMENT

Exceedance of thresholds for multiple pollution stressors was observed in entire stretch of the Damodar River.

Ecological Risk Assessment of water quality and pollutant concentrations reveal the following high- and moderate-risk hotspots in the river:

Risk Zone (% stretch of River)	Stretch	District
High Risk Zone (17%)	D/S Tenuaghat Reservoir Kulgachia	Bokaro Howrah
Moderate Risk Zone (42%)	Basaria - Gadhaunia D/S Kapat Ghat Asansol - Durgapur	Dhanbad Ramgarh Bokaro Paschim Bardhaman Bankura

RUPNARAYAN RIVER



POLLUTION THREATS

Municipal Sewage and Industrial Effluent

- About 8.37 MLD of untreated municipal wastewater and 19710 TPA of municipal solid waste contribute to pollution in the river.
- The river receives 47.844 MLD of industrial effluent from 3 industrial units in West Bengal.

Agricultural Settlements

53% of the Rupnarayan Basin comprises of agricultural land, posing the risk of introducing agrochemicals into the river through surface runoff.

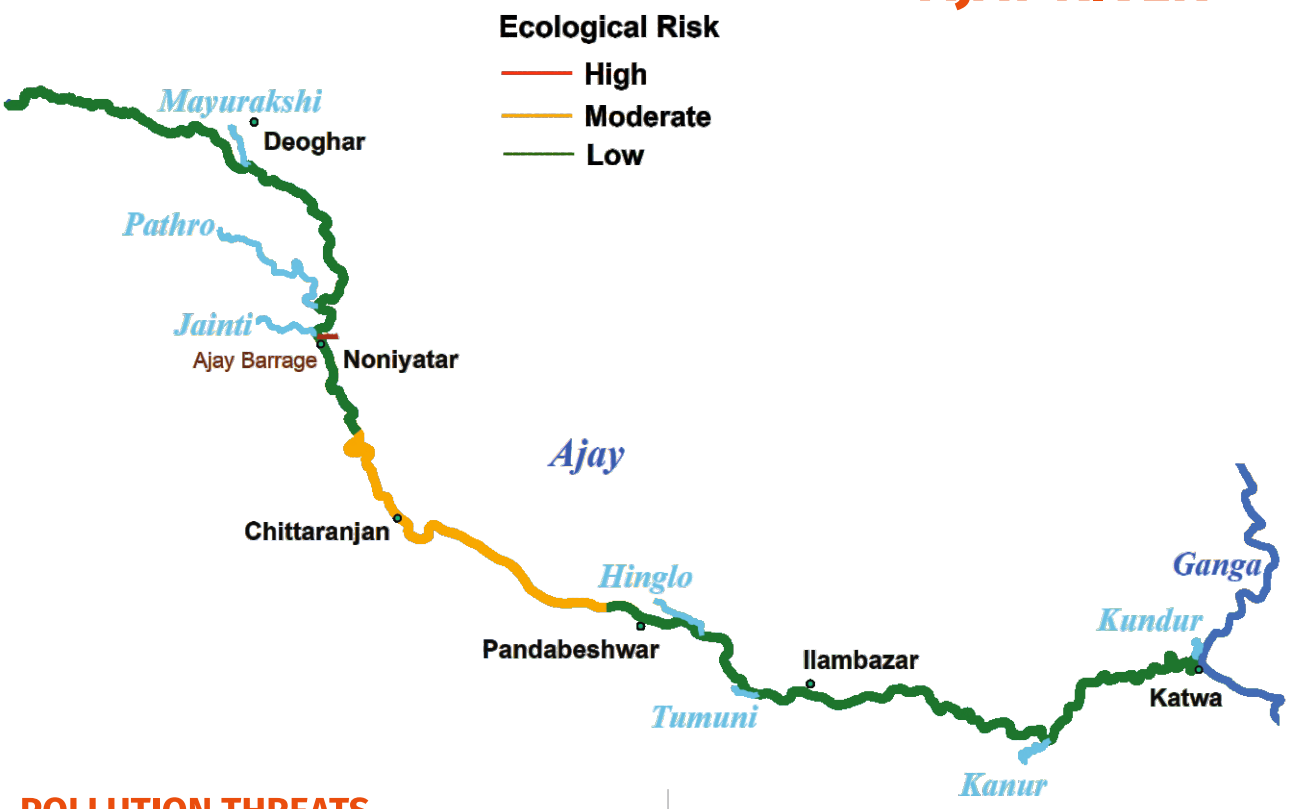
POLLUTION HOTSPOT ASSESSMENT

Exceedance of safe thresholds for multiple pollution stressors was observed entire stretch of the Rupnarayan River.

Ecological Risk Assessment of water quality and pollutant concentrations reveal the following high- and moderate-risk hotspots in the river:

Risk Zone (% stretch of River)	Stretch	District
High Risk Zone (57%)	Origin - Dwarakeshwar Bridge	Purulia
	Kolaghat - Tamluk	Bankura East Medinipur
Moderate Risk Zone (43%)	Dom Doma Ferry Ghat - Shilabati Confluence	Bankura Hoogly West Medinipur

AJAY RIVER



POLLUTION THREATS

Municipal Sewage and Industrial Effluent

- 29% of the Ajay River basin is represented by residential land use, and therefore receives both municipal wastewater and solid waste as pollutants.

Agricultural Settlements

Agriculture is practiced in 71% of the basin area of the Ajay River, posing a potential risk to the river's ecosystem through pesticide pollution.

POLLUTION HOTSPOT ASSESSMENT

Exceedance of thresholds for multiple pollution stressors was observed in entire stretch of Ajay River.

Ecological Risk Assessment of water quality and pollutant concentrations reveal the following high- and moderate-risk hotspots in the river:

Risk Zone (% stretch of River)	Stretch	District
Moderate Risk Zone (17%)	Sidhu kanhu Bridge	West Burdwan

Management Framework

To achieve a good ecological status of select rivers of the Ganga River Basin through integrated management, a strategic framework is provided in Table 2.1. The framework formulates objectives for pollution management and abatement in the Ganga and its tributaries, with specific measures identified to ensure a comprehensive and effective strategy for river health improvement.

Table 2.1: Framework for sustainable pollution abatement in selected rivers of Uttar Pradesh

Strategies/actions	Objectively verifiable indicators (OVI)	Means of verification (MOV)
Objective 1: Reduce pollution level in rivers		
1.1. Establish adequate functional infrastructure for treatment of industrial and municipal waste water discharge.	Percentage of industries with functional treatment facilities Percent of households connected to the STPs Level of discharge of untreated waste.	Reports of SPCBs and Municipalities Reports on compliance management and performance evaluations such as: • Operational Checks, key monitoring parameters, effluent quality testing, sludge management • Regular Water quality monitoring and risk assessment across large spatiotemporal scales
1.2. Identification, tapping, and monitoring of high priority drains in rivers • Drains in Kanpur, Prayagraj, Varanasi, Patna, Kolkata, Moradabad, Bareilly, Agra, Lucknow, Kota, etc.	Number of priority drains identified based on pollutants load and flow Interception and diversion of priority drains to STPs/ETPs/WWTPs	Municipality Records Water quality reports

	Assumptions	Agencies responsible	Supporting organizations
	Strict implementation of guidelines/protocols • Compliance with Zero Liquid Discharge Rules • Water Prevention and Control of Pollution Act 1974 and of the Environment Protection Rules of 1986 • National Green Tribunal Act, 2010 • Municipal Solid Waste (Management and Handling) Rules • Plastic Waste Management (Amendment) Rules, 2021, Extended Producer Responsibility (EPR) • State-level legislation	Industrial sectors such as Sugar, Paper, Textiles, Breweries and Tanneries MoEFCC, Municipal agencies/ Ministry of Jal Shakti/Central/State Pollution Control Boards (CPCB/SPCBs) NGT	Companies involved in developing and disseminating emerging technologies for wastewater treatment
	Govt. commitment to divert identified priority drains to STPs/ETPs/WWTPs Legislation including Guidelines on Water Quality Monitoring, 2017 is functional	Ministry of Jal Shakti, MoEFCC, CPCB/UPPCB, in collaboration with multiple competent research institutions	Ministry of Jal Shakti, MoEFCC, CPCB/SPCBs, in collaboration with multiple competent research institutions

Strategies/actions	Objectively verifiable indicators (OVI)	Means of verification (MOV)
1.3. Ensure effective functioning of above infrastructure using supportive laws and promoting good practices	Multi-tier evaluation approach in place Agencies identified for evaluation of effective functioning of existing and newly established infrastructure Number of training and workshops undertaken for sensitization of different stakeholders such municipalities, state pollution control board, industrial sectors, PWD A framework established for assessing the quality of reclaimed wastewater and sludge reuse	Regular Audits/Monitoring Reports for status of priority pollutants in wastewater/sludge Regular data on quantity of reclaimed wastewater/sludge Number of industries and farmers using the reclaimed wastewater and sludge
1.4. Reduce the use of toxic pesticides and fertilizers in river bank agriculture and riverbed cultivation through adoption of green agriculture practices (organic farming, hydroponics, integrated farming)	Number of farmers adopting green agriculture practices Extent of area under green agriculture practices	Agriculture department records Survey of farmers involved green agriculture.
1.5. Develop eco-friendly public transport-electric rickshaws and buses	Number of intra- and inter-city buses operating Number of electric buses/rickshaws/trains operating	Emission reports Pollution control reports for public vehicles
Objective 2: Address knowledge gaps through systematic research and monitoring		
2.1. Establish a network of institutions dedicated to conducting inter-disciplinary research and monitoring programs incorporating experts in ecotoxicology, biodiversity, aquatic ecology and habitat assessment.	Number of institutions/ universities in the network Aquatic life standards for priority contaminants/ river water quality parameters developed Ecosystem health indices developed	Records of network of institutions Number of research papers published under collaborations

Assumptions	Agencies responsible	Supporting organizations
Regular evaluation for STPs/ ETPs/ WWTPs for efficacy/ performance by multiple competent organization Policy upgradation & implementation Enhanced Acceptance of Using Reclaimed Wastewater and Sludge	Ministry of Jal Shakti, MoEFCC, CPCB/SPCB, in collaboration with multiple competent research and legal organizations	Central and State Legal Institutions State Legal Services Authorities Academic Law Institutions
Govt. bodies vigilance on tracking/ controlled use of pesticides Govt. commitment to provide subsidies on organic/ Ecofriendly Pesticides & fertilizers Willingness of the farmers to accept/adopt ecofriendly and modern agricultural practices	Ministry of Agriculture & Farmers Welfare, (Central and State), Directorate Of Plant Protection, Quarantine & Storage, Forest Department, Ministry of Panchayati Raj, Local Administrative dept., MoEFCC	Krishi Vigyan Kendras State Agriculture Universities
Availability of adequate funds for investment in vehicles and infrastructure Incentives for switching to eco-friendly transportation provided	MoEFCC CPCB/SPCBs State Transport Department State Road Transport Corporations Technological Universities	Central and State technological universities State Transport Department State Road Transport Corporations
Institutes are willing and/or incentivized to collaborate Funds are mobilized by the Government for such purposes Rules and legislation support frequent monitoring over larger sampling sites, for example Expansion of National Water Monitoring Programme (NWMP) 2019	Ministry of Jal Shakti, MoEFCC State Forest Departments	Central, State institution, universities and NGOs including, but not limited to: Wildlife Institute of India, Indian Institute of Toxicological Research Central and State Academic Institutins State Agriculture Universities WWF- India Wildlife Trust of India

Strategies/actions	Objectively verifiable indicators (OVI)	Means of verification (MOV)
2.2. Conduct systematic and regular monitoring and holistic ecological risk assessments to evaluate the ecological impact of legacy and emerging contaminants (ECs) on a large spatiotemporal scale, with a focus on the habitats of endangered apex predators	Competent organization/body for regular monitoring constituted Number of scientific research grants Number of Master's and Doctoral theses published	Number of scientific and technical reports/publications Scientific reports to support the policies for effective mitigation plans
2.3. Development of data repositories	Regular compilation of data from reports and research papers into a common repository	Regular updates and cross-verification from data sources Syntheses in the form of review papers and meta-analyses
2.4. Ensuring data availability	Number of popular articles/ news reports published Number of open access scientific publications Number of citations per publication	
Objective 3: Develop sustainable pollution abatement with a focus on plastic management		
3.1 Implementing effective plastic waste collection systems · Decentralized waste segregation	Reduction in plastic waste along riverbanks and in water	Regular monitoring reports and visual inspections
3.2 Enhancing recycling programs · Integrated plastic waste management and recycling	Increase in the volume of plastic waste recycled	Recycling facility records and reports
3.3. Public awareness campaigns on plastic reduction	Increased public awareness and participation in waste reduction activities	Surveys and feedback from community members
3.4 Promoting the use of sustainable alternatives	Decrease in the use of single-use plastics	Sales data of sustainable products and reduced plastic waste in audits

Assumptions	Agencies responsible	Supporting organizations
Adequately trained personnels available Government mandate to include ECs in National monitoring Programme Government commitment to establish, upgrade and support such studies/facilities Incentives to early career researchers and university students	Ministry of Jal Shakti MoEFCC including State Forest Departments	Multi academic and research institutes working in the domain, including, but not limited to: Wildlife Institute of India, Dehradun IITs State Agriculture Universities
Coordination between different stakeholders Adequately trained, dedicated personnel	Ministry of Jal Shakti MoEFCC including State Forest Departments	Central and State government set up of dedicated bodies
Legislation facilitating data sharing and availability Adequate funds for publishing open access peer-reviewed research Involvement of mass media and popular media	Central, State institutions, universities	DST Respective research institutions and universities
Adequate funding and resources are available Effective Implementation of Plastic Waste Management (Amendment) Rules, 2024	Central and State Governments, Policy Makers, Ministry of Jal Shakti, MOEFCC, Central/State Pollution Control Board	Local Municipal Corporations, NGOs, Community Groups
Public participation in recycling programs Effective Implementation of Plastic Waste Management (Amendment) Rules, 2024	Central and State Governments, Policy Makers, Ministry of Jal Shakti, MOEFCC, Central/State Pollution Control Board	Private Recycling Companies Local Municipal Corporations
Effective communication strategies and public engagement Effective Implementation of Plastic Waste Management (Amendment) Rules, 2024	Central and State Governments, Policy Makers, Ministry of Jal Shakti, MOEFCC, Central/State Pollution Control Board State Water Resources Departments	Educational Institutions, Media Outlets, NGOs, Village Panchayats District administrations, Local Municipal Corporations
Availability and affordability of sustainable alternatives	Central and State Governments, Policy Makers, Ministry of Jal Shakti, MOEFCC, Central/State Pollution Control Board State Water Resources Departments	Manufacturers, Retailers, District administratio, Village Panchayats, Educational Institutions, Media Outlets, NGOs

Strategies/actions	Objectively verifiable indicators (OVI)	Means of verification (MOV)
3.5 Enforcing regulations on plastic production and disposal	Compliance with plastic waste management regulations	Inspection and compliance reports
3.6 Strictly implementing Extended Producer Responsibility (EPR) and Polluter Pays principle	Industries take responsibility for the lifecycle of plastic products and bear the cost of pollution	Industry compliance reports, financial records of pollution management
Objective 4: Develop supportive institutional mechanisms for management and developing solutions		
4.1. Establish a multitier institutional mechanism for programme implementation at State, district and local level and engaging different stakeholders.	Effective functioning of different institutions at different levels	Government notifications and order for establishing dedicated monitoring committee Implementation reports
Objective 5: Engage and empower the local communities and other stakeholders for promoting sustainable resource use in the rivers and associated water bodies		
5.1 Put in place a system for regulated mining practices in the river ecosystem, through supportive policy, legal and administrative framework.	Stretches of high mining activities identified and mapped. Area under regulated mining Number of violations	Mining and offence records of concerned districts

Assumptions	Agencies responsible	Supporting organizations
Strong regulatory framework and enforcement mechanisms	Central and State Government, State Water Resources Departments	Legal Bodies, Industry Associations
Strong regulatory framework and industry cooperation& effective Implementation of Plastic Waste Management (Amendment) Rules, 2024	Central and State Governments, Ministry of Jal Shakti, MoEFCC, District administration	NGOs, Environmental Agencies
Continuation of Policy support at Centre and state level Continued political will and funding for river management initiatives. Adequate human and financial resources are available for its functioning	MoEFCC, Ministry of jal Shakti Uttar Pradesh Jal Nigam: Implementation of water treatment and pollution control measures. State Pollution Control Boards: Monitoring and enforcing pollution regulations. Department of Irrigation: Implementing riverfront development plans and flood management. Local Municipal Corporations: Ensuring proper waste management and sanitation practices along riverbanks. NGOs and Community Organizations: Engaging in awareness campaigns and community-driven conservation efforts.	NGOs, Community Organizations, and Wildlife Institute of India, Dehradun: Engaging in awareness campaigns and community-driven conservation efforts.
Continued political support Continued support from concerned departments Adequate Environmental Assessment Reviews conducted and recommendations adhered to Adhere to the Sustainable Sand Management Guidelines (SSMG) 2016 and Enforcement and Monitoring Guidelines for Sand Mining 2020	MoEFCC, Ministry of Jal Shakti, Ministry of Mines, Mining corporations	Hindustan Zinc Limited (HZL) National Mineral Development Corporation (NMDC) State Mining Corporations Jaypee Group Dalmia Bharat Group ACC Limited UltraTech Cement Reliance Cement Birla Corporation Limited

Strategies/actions	Objectively verifiable indicators (OVI)	Means of verification (MOV)
5.2 Develop and incentivize sustainable, chemical-free agriculture and aquaculture practices among local farmers and fish farmers	Number of National Programme for Organic Production (NPOP) certificates issued Number of Aquaculture Stewardship Council (ASC) Certificates issued Global G.A.P. Aquaculture Certification	Records of agriculture department Records of fisheries department
5.3. Organize a series of awareness, sensitization and capacity building programme for local communities.	Number of programmes conducted Number of stakeholders sensitized. Support of local community	Official records Community surveys
5.4. Involve local communities and other stakeholders in protection and management of river ecosystem.	Number of local institutions/ communities participating in river protection/ management programmes	Official records Community surveys

Assumptions	Agencies responsible	Supporting organizations
Streamlined extension activities Incentives and subsidies for switching to sustainable practices	Ministry of Agriculture & Farmers Welfare, (Central and State), Directorate Of Plant Protection, Quarantine & Storage Krishi Vigyan Kendras Ministry of Micro, Small & Medium Enterprises (M/o MSME)	ICAR State Agriculture Universities Krishi Vigyan Kendras Research Institutions
Willingness of local communities to participate Continued support from concerned local institutions	MoEFCC, Ministry of Jal Shakti, State Biodiversity board, State Forest Department, WWF	Wildlife Institute of India, Dehradun Village panchayats
Motivated local communities and other stakeholders are available in the region	Ministry of Panchayati Raj, Local Administrative dept., Ministry of Rural development	Village panchayats Local fishermen Local farmers Schools Municipal bodies Local NGOs

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

NMCG

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