Blended
Capacity Building Programme for Stakeholders of River Ganga

under Namami Gange Programme

04

ECOLOGY OF GANGA

Indian Institute of Public Adminstration

New Delhi

CAPSULE - 04

OVERVIEW

NAME OF PROJECT

BLENDED CAPACITY BUILDING PROGRAM FOR STAKEHOLDERS OF RIVER GANGA

PROGRAMME

NAMAMI GANGA PROGRAMME

PREPARED FOR

NATIONAL MISSION FOR CLEAN GANGA

PREPARED BY

INDIAN INSITITUTE FOR PUBLIC ADMINISTRATION

SPECIFIC FOCUS

STUDY MODULE SERIES FOR COLLEGE STUDENTS

PROJECT TEAM

PROF. V.K. SHARMA (Project Investigator)
DR. SHYAMLI SINGH (Project Investigator)
Ms. CHARU BHANOT
Ms. KANISHKA SHARMA
Ms. IMRANA AKHTAR
Ms. KANIKA

Cover page image: *A scenic view inside Parmarth niketan, Rishikesh by IIPA Team*

Left image: *Kevda tree in the coutyard of Forest Research Institute by IIPA team*

MESSAGE
DIRECTOR GENERAL

My young Companions,

“Students are the hands by which we take hold of heaven.”

The above quotation by Henry Ward Beechar has inspired me to join hands with you in rejuvenation and conservation of our holy river Ganga. I consider your role in the society and believe that your participation in this herculean task can improve the present state of our River.

To make the descent of Ganga worthwhile, you are being made a part part of the project - Blended Capacity Building Programme for Stakeholders of River Ganga under Namami Gange Programme. Ganga lies at the core of our culture and it is our firm belief that your awareness of the complex challenges faced by our national river can bring about behavioural change in the society at large.

Through this booklet, you will be taken to a journey along the Ganges and its basin. I want to create an imprint on you and mould each one of you into responsible adults. This learning process has been tailored for your effective engagement with inclusion of maps, quizzes and puzzles.

I consider the potential of a student in contributing towards a cleaner, breathable future. It is my hope and expectation to meet with your feelings, thoughts and awareness to foster a sense of belonging for River Ganga. I have faith in your tremendous curiosity and capacity & hope that together we can change mindsets and take it to practical application.

S. N. TRIPATHI
Director General, IIPA

PREFACE

Dear Students,

Universally and religiously, water is considered a purifying natural symbol. Indian rivers, besides being the lifeline for many are considered as manifestations of the divine. They connect state to state, past to present. The Ganges is our sacred river with a culturally significant history. It is not just a river but a deity, a cleanser of sins; It is our mother.

Ganga is a part of India’s rich past. It is a symbol of purity and sanctity. It occupies a central space in the collective consciousness of the country, which is why Gangajal is considered the holy water. River Ganga, not only fosters exceptionally rich biodiversity, but it also contributes heavily to the livelihood of India. .

It is unfortunate that despite the admiration and reverence invoked by the river, it has become a dumping junkyard at innumerable points. Human greed and misconduct have degraded the river quality. It is indeed a matter of concern that the river has altered its flow over the years; with that, the National Mission for Clean Ganga (NMCG) has stepped in to keep the river clean, pure and healthy for the benefit of existing and future generations. It is a matter of pride for IIPA to be entrusted by the project “Blended Capacity Building for Stakeholders of River Ganga” under the Namami Gange programme.

With the aim of conserving and rejuvenating River Ganga, This series has been prepared to make students interact with our national river. The book encompasses a holistic view of the river Ganga by posing the challenges and opportunities in and around Ganga basin.

V.K. SHARMA
Senior professor, IIPA

SHYAMLI SINGH
Assistant professor, IIPA

ECOLOGICAL POLLUTION AND ECONOMICS OF **GANGA**

Above Image: *Beatles Ashram in Rishikesh by IIPA*

Human economics and ecology are inextricably linked, and here is why: as living organisms, we live in the earth's biosphere and depend on our ecosystems in order to survive. Our ecosystem, the earth, ultimately controls our economic systems because it provides us with what we need for our economies (and everything else) to actually exist. For example, we must have water, food, and goods that we then buy, sell, or trade with others in order to profit economically. If our sources were depleted, our economy would suffer.

Various economic activities around the Ganga River correspond to the deterioration in the health of the river's ecology and ecosystem service. Many factors that affect Ganga National River's ecological integrity. The 2017-2018 pre-monsoon survey revealed that 40 of the 41 Ganga stretches have been polluted. Three stretches of Uttar Pradesh on the Pandu river and the Varanasi were severely contaminated, while 34 stretches were moderately polluted in Uttarakhand, Uttar Pradesh, Bihar and West Bengal [(1)].

"It is our collective and individual responsibility to preserve and tend to the environment in which we all live."

Dalai Lama

Ecosystem Services:

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

Example: products such as food and water, regulation of floods, soil erosion and disease outbreaks, and non-material benefits such as recreational and spiritual benefits in natural areas.

Agrosystem:

the basic unit of study in agroecology and is somewhat arbitrarily defined as a spatially and functionally coherent unit of agricultural activity, and includes the living and nonliving components involved in that unit as well as their interactions.

Example: trees are reintroduced into farming landscape to provide shade for crops, sequester carbon, and provide habitat for beneficial organisms, while rice and fish in integrated systems regulate the conditions for each other to flourish.

TO KNOW MORE

SCAN CODES

The Central Pollution Control Board (CPCB), statutory organisation, was constituted in September, 1974 under the Water (Prevention and Control of Pollution) Act, 1974. Further, CPCB was entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981. It serves as a field formation and also provides technical services to the Ministry of Environment and Forests of the provisions of the Environment (Protection) Act, 1986.

Principal Functions of the CPCB: (i) to promote cleanliness of streams and wells in different areas of the States by prevention, control and abatement of water pollution, and (ii) to improve the quality of air and to prevent, control or abate air pollution in the country.

It serves as a field formation and provides technical services to the Ministry of Environment and Forests of the provisions of the Environment (Protection) Act, 1986. Principal Functions of the CPCB, as spelt out in the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981, (i) to promote cleanliness of streams and wells in different areas of the States by prevention, control, and abatement of water pollution, and (ii) to improve the quality of air and to prevent, control or abate air pollution in the country. The CPCB under National Ganga River Basin Authority Project has been monitoring and surveillance of pollution load discharging into river Ganga. Pollution sources are categorized into point and non-point sources. Point sources can be defined as known loads for which the location of discharge is known. Wastewater Discharge and large industry discharge are point sources. All other sources are categorized as non-point sources which include the areal pollution load originating from urban, agricultural and natural processes.

Pollution loads are estimated for the following:

Point sources:

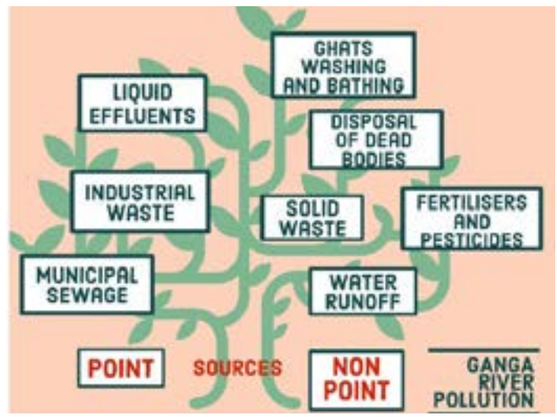
- Generation of pollution load by population

- Pollution load wastewater discharge and large industries

- Pollution load discharged by small-scale treatment units for shopping centers, hospitals, schools etc.

Non-Point sources

- Areal pollutant load reaching the river due to natural, agricultural and urban origin



Above Image: *The various point and nonpoint sources of pollution and degradation in River Ganga*

GROSSLY POLLUTING INDUSTRIES
IN RIVER GANGA BASIN

Both groundwater and surface resources are under stress in India. One reason is the significant increase between 2011 and 2018 in the number of GPI industries. In 2019 136% more grossly polluting industries were reported by the State of India's environment (SoE) [2]. It includes pulp and pulp mills, distilleries, sugar mills, textile units, tanneries, heat power plants, the food, dairy and beverage industries, chemical units, slaughterhouses, etc. GPIs are industries that discharge over 1.000 litres of water and/or hazardous chemicals to the rivers. Nearly 11% or almost 275 industrial units still operate in the country in violation of standards on pollution control. Almost half of these non-compliant GPIs are found in Uttar Pradesh, which pollutes rivers such as Ganga[3]. The main trunk of Ganga has 992 industries, and they are Kali and Ramganga tributaries. Of these, UP has 851 Industrial Units and Uttarakhand has 61, West Bengal has 43 and Bihar has 40. In the catchments of the Ramganga and Kali tributaries, industrial pockets are identified, and Kanpur is an important industrial source of pollution. Kanpur tanneries are also the main contributors and Kosi, Ramganga and Kali river catchment distilleries, paper mills and sugar mills.

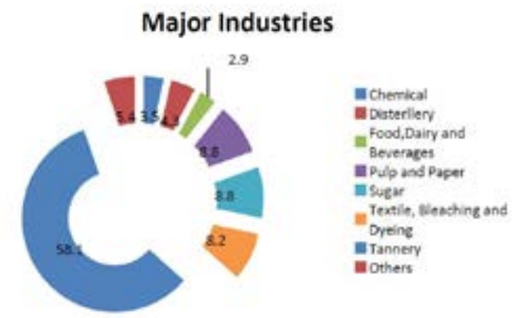
In all the states of Ganga basin with industry the total water consumption of these generations is 1123 MLD and the generation of wastewater is 501 MLD. Uttar Pradesh is the dominant state regarding water consumption and wastewater production, followed by Uttarakhand (62 percent of total consumed water). In terms of total water consumption, wastewater generation is almost 45%. The pulp and paper industry consume maximum water. Sugar industries follow consumption while chemical industries follow generation [1]. In this section we will discuss 4 major grossly polluting industries:

Tannery
Paper and Pulp Industry
Sugar Mills
Textile bleaching and dyeing

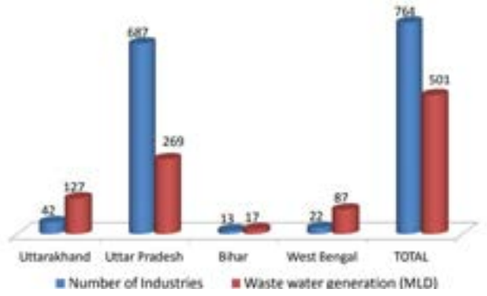
These industries have also been polluting River ganga by dumping heavy metals which later become carcinogenic for the human health. The presence of heavy metals also leads to biomagnification.

TO KNOW MORE

SCAN CODES



Above Image: *Major industries in Ganga Basin*



Above Image: *States and their respective waste water generation*

Arsenic (As)	• Pesticides, fungicides, metal smelters
Cadmium (Cd)	• Welding, electroplating, pesticides, fertilizer, batteries, nuclear fission plant
Chromium (Cr)	• Mining, electroplating, textile, tannery industries
Copper (Cu)	• Electroplating, pesticides, mining
Lead (Pb)	• Paint, pesticides, batteries, automobile emission, mining, burning of coal
Manganese (Mn)	• Welding, fuel addition, ferromanganese production
Mercury (Hg)	• Pesticides, batteries, paper industries
Nickel (Ni)	• Electroplating, zinc base casting, battery industries
Zinc (Zn)	• Refineries, brass manufacture, metal plating, immersion of painted idols

Above Image: *Sources of heavy metals from industries*

Paper and Pulp Industries:

One of the major contributors to decreased status for different bodies of water (surface and sub-surface) in the Ganga River Basin is the pulp and paper industry (PPI). PPIs. The demand for paper is increasing with the ever-growing population and increasing literacy rates. Chemical blanking is a process of producing apart from thin sheet metal by chemically etching the periphery of the desired shape. The material is removed by chemical dissolution. Chemical blanking is used for parts that are otherwise typically produced by mechanical blanking presses from thin plates and foil material. With mechanical presses, vibrations, backlash, and part distortion will make smaller parts difficult to produce [5]. Benefits of blanking chemicals such as chlorine, hypochlorine and chlorine dioxide are increased as market demand for paper of different colors and strengths [6]. During the pulping stage, a large amount of wastewater is generated, while the bleaching stage produces chlorine, which is mainly toxic wastewater. Chlorine creates continuous organic contaminants such as dioxins norm as hazardous chemicals (POPs) [7]. The fluid includes dyes, chlorinated agents, complete fatty acids, tannins, Sulphur resin acids, and the derivatives of the fluid suspended solids.

Above Image: *Pul paper making process*

Due to the presence of lignin and its derivatives of unprocessed cellulosic products, the effluents produce high biochemical oxygen demands (BODs) and chemicals oxygen demands (CODs). In most PPIs, partial waste is discharged into rivers or streams that threaten fauna and flora. The Central Pollution Control Board recognized the effect of the pulp and paper industry on water systems by setting up a charter – water recycling and pollution prevention. In most PPIs, partial waste is discharged into rivers or streams that threaten fauna and flora. The Central Pollution Control Board recognized the effect of the pulp and paper industry on water systems by setting up a charter – water recycling and pollution prevention. The charter was adopted by the CPCB to upgrade the status of the PPIs as regards process technology, procedures, environmental efficiency and freshwater use reduction, wastewater generation and environmental enforcement. The Charter has suggested few policies and practices that different stakeholders can pursue. There have been eight core stakeholders listed {SPIs, PPI Partnerships IT, NEERI, CPPRI, SPCBs/PCCs, CPCB, MoEF and NMCG}.

Above Image: *Cluster of PPIs as per CPCB Charter, 2015 in Ganga basin*

Sugar Industry:

While the sugar industry plays an important role in the economy of India, ecological pollution is high in both aquatic and terrestrial habitats due to the effluents produced. The effluents also modify the physical and chemical features of aquatic bodies, as well as their flora and fauna. Furthermore, environmental dumping of sugar factory effluent presents a major health risk for rural and half-urban communities using water and river waters for farming and home use [8]. The Ganga Plain River basin of Chhoti Gandak is one of the most active Industrial Cane Sugar Belts in India. In the rural economy of the Deoria and Kushinagar districts, the sugar industry is a main factor. The industry generates the huge volumes of waste (solid, liquid and gas) that have caused many pollution and environmental problems. In several sugar factory regions, the water quality and water quality issues are especially serious and pose a health danger.

Although the sugar industry is the cornerstone of the rural economy, environmental issues must be reviewed. One of the most important plants in the region studied is sugarcane. This plant needs to be irrigated and various phosphatic fertilizers input. There is an important amount of heavy metals in phosphatic fertilizers [8], while certain low-quantity heavy metals are critical micronutrients for plants and animals. Heavy metals like pb not only posed an extensive health risk, but also reduced crop productivity [8]. Soils are the location where rocks, water, air and the living environments communicate in several different ways. However, it is a side effect that the soil and the nutrients may be contaminated [9]. Soil may also be contaminated by irrigation of wastewater.

Tanneries:

When concentrated in clusters within a small area such as Unnao where more than 790 times approved chromium norm is dumped into the river (almost 1,125 tonnes) entire farms are burnt off Tanneries account for large quantities of harmful toxins [4].Lack of the dilution ability and therefore pollution becomes particularly toxic and dangerous is the continuous toxic contamination of the river. The government has taken tough measures against the discharge of contaminating industries – mainly tanneries and distilleries.

Above image: *Heavy metals found in Ganga*

Below image: *Belts a product of Kanpur Tanneries*

Textile bleaching and dyeing:

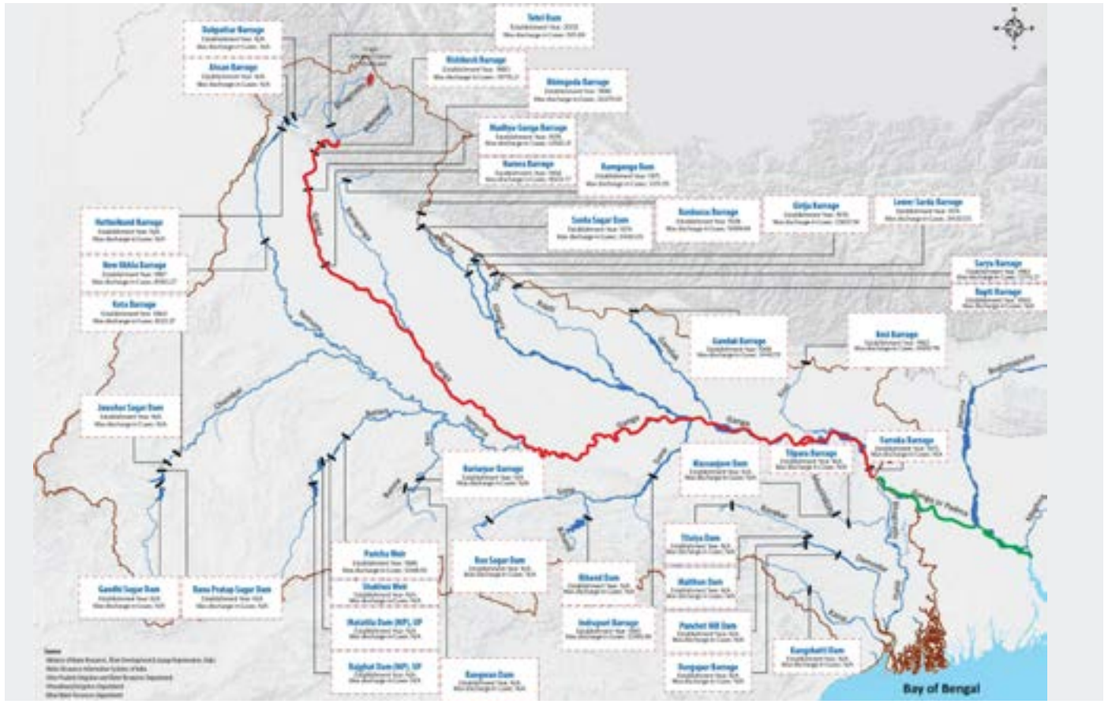
Considering the volume and composition of the wastewater industrial effluents, dyeing (both manufacturing and application) industry is rated as one of the foremost industrial sectors that pollutes environment. To dye 1 kg of cotton, it requires 70-150 L water, 30- 60 g dyestuff, 0.6-0.8 kg NaCl, which at the end of the process generates nearly 20-30% of applied unfixed dyes at a concentration of 2000 ppm along with high salt content and other auxiliary compounds. The raw materials used for the manufacturing of dyes and dye intermediates are benzene, toluene, xylene and naphthalene along with certain heavy metals. The dyeing industry uses different dyes, fastening and binding agents, soda-ash, caustic soda, organic sequestering agents, and other accessory chemicals depending on the dyeing method and fabric use for dyeing. The improper and indiscriminate disposal of textile effluents in natural waters and land is posing serious problems. Furthermore, the improper and indiscriminate disposal of textile effluents in natural waters and land is of great concern [10]. The textile effluent contains organic and inorganic chemical species which have adverse effect on water quality and growth of all plants and animals. The water containing textile effluent used for irrigation contains heavy metals (Cd, Cr, Cu, Hg, Ni, Pb, Zn etc.), which accumulate in various parts of plants that result in various clinical problems in animals as well as in human beings including hepatic and renal system damages, mental retardation, and degradation of basal ganglia of brain and liver [10, 11]. An example of sustainable textile industrial cluster in Rooma, Kanpur which has been developed by UPSIDC Kanpur.

HYDRO-PROJECTS
IN RIVER GANGA BASIN

Building barrages in the Ganga Basin has had a major effect on its free flow and habitats, both inside and around the river and on the water. The Upper Ganga Canal near Haridwar, the Lower Ganga Canal near Narora, Tehri Dam on the Ganga tributary, the Bansagar Dam, and the Rihand Dam, which were installed on Son tributary and the Farrakka dam on the Hooghly tributary of Ganga, are some of the main hydraulic interventions in Ganga. The Ganga flow has lost its continuity and is seriously fractured due to the large number of minor hydraulic structures.E-Flows are a regime of flow in a river that mimics the natural pattern of river's flow. E-Flows refer to the quality, quantity and timing of water flows required to maintain the components, functions, processes, and resilience of aquatic ecosystems that provide goods and services to people (28). The 2007 Water Quality Analysis and Assessment suggested that Himalayan Rivers e-flow should be above 2.5%, and annually reliable flow 75% (12). Hydropower development's has environmental and social effects changes in the natural flow system, overwhelming environmental disorders, increased earthquakes, loss of local livelihood with community displacement and aesthetic value of Ganga is disturbed.

Above Image: *Ganga Barrage at Kanpur*

Interlinking of Indian Rivers
Interlinking of River (ILR) programme is of national importance and has been taken up on high Priority. The mission of this programme is to ensure greater equity in the distribution of water by enhancing the availability of water in drought prone and rainfed area.Under the National Perspective Plan (NPP) prepared by Ministry of Water Resources, NWDA has already identified 14 links under Himalayan Rivers Component and 16 links under Peninsular Rivers Component for inter basin transfer of water based on field surveys and investigation and detailed studies.

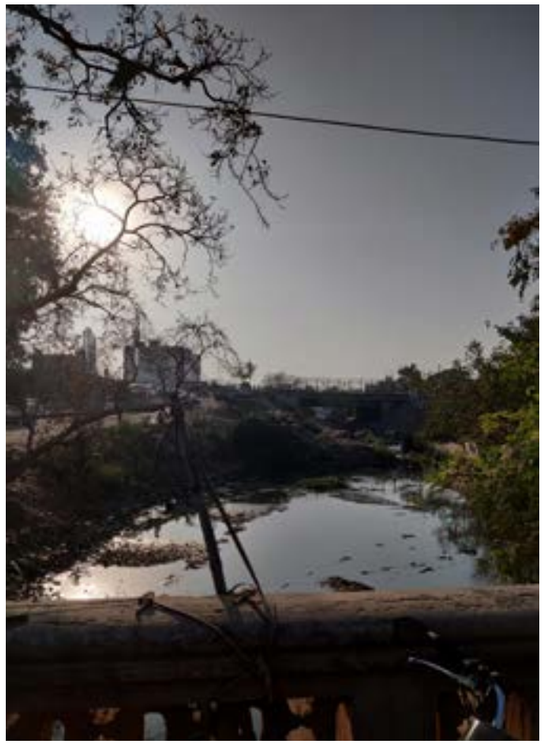


SEWAGE POLLUTION
IN RIVER GANGA BASIN

Untreated wastewater is the main cause of the Ganga water quality degradation. Organic matter, nutrients (i.e., Nitrogen, Phosphorus, Potassium), inorganic matter (dissolved minerals), hazardous chemical products (heavy metals and pesticides), and pathogenic products are the major elements of wastewater ([13]. The Census of India has classified towns into six categories based on their population where Class 1 towns with more than 1, 00,000 population and Class II towns with 50,000 to 99,999 population [29]. It is estimated that in the year 2011, the amount of wastewater discharged into the river by 36 Class I and 14 Class II towns situated along the mainstream of river Ganga, was 2723 MLD (14). Of this quantity, the capacity to treat it was limited to only 1209 MLD. Several studies indicated that in upper Ganga, such as Rishikesh, water does not serve the water supplies guideline [15], whereas water is unsuitable for bathing and other livelihood activities in various places in the centre of and below Ganga [15].

Wastewater pollution in Ganga accounts for 75% of its pollution, with millions of liters per day produced in the cities along the Ganga River [15]. For the purification and conservation of ganga, NGRBA was set up in 2009. Recent CPCB studies however have shown that there is a substantial increase in the difference between the waste production and treatment capacity and more than 50 percent of sewage is still untreated directly or by tributaries into the Ganga river.The total wastewater generation in the Ganga basin from 222 cities is 8250 MLD, according to CPCB (2014), while treatment facilities are only offered for the 3500 MLD category. Continuously increased untreated wastewater discharge into Ganga has had a serious impact on the physical and microbial properties of river water in all lengths. The main cause of these pollutants in rivers is wastewater and household wastewater.

In West Bengal, the highest waste generation from class I city is from Kolkata (1429.2 MLD followed mainly by Utter Pradesh (653.8 MLD) from Kanpur and Allahabad. Though in Uttar Pradesh (52 per cent, MLD 63.5) wastewater production for cities class II is highest, Bihar and Uttarakhand are the second largest. Up to 548 MLD, followed by Uttar Pradesh (461 MLD, 52 per cent), is also the most frequent discharge of untreated sewages from Western Bengal (CPCB, 2013). The total urban waste generations in the five states of Indo-Gangetic Plain (IGP) are 15,435 MLD, while the built process capability is only 3458 MLD, in accordance with the Environmental Information System, New Delhi [15]. Therefore, the untreated wastewater discharge into the river Ganga is spent over several million rupees.



Above Image: *Varanasi city waste water draining in Assi River , a tributary of Ganga*

Above Image: *The state of Ganga river in the city of Bithoor as waste and sewage water gets drained into th e river.*

RITUALS
IN RIVER GANGA BASIN

a. Dead Body Disposal:

In India, the human soul is thought to go straight to heaven if dead corpses are incinerated on the banks of the River Ganga. It has been observed, because of this religious religion, that about thirty-two thousand dead bodies of ten thousand tonnes dry wood are burned on mostly two cremation grounds in Varanasi called Harischandra and Manikarnika ghats each year. It was found from this burning that the Ganga River, with its higher levels of nitrogen, phosphorus, and potassium, contains 300 tonnes of ash content. It has been found that corpses are not fully burned during the cremation of dead bodies. More than two hundred tonnes of half-burnt meat, along with a large quantity of ashes, are also released to the Ganga River each year.

In the past, dead bodies from remote areas have also been brought to the Ganga riverbank for cremation because of the increased transport infrastructure. It is estimated that approximately 40% dead bodies are transported from remote areas in Varanasi. In addition to flaming dead bodies, approximately 3,150 human beings and 6,270 dead animal bodies, that are thrown into the river Ganga without burning. These bodies are eaten by carnivorous birds and builds unhealthy river ecosystem [19].

b. Flower pollution in river Ganga:

It is estimated that 16 percent of the total pollutant in the Ganga river is floral waste [19].About 1,000 tonnes of garland and flowers have found to be thrown into the river daily.These flowers cause physical contamination and disintegrate into the water and increase bacterial population growth resulting in a decrease in DO water quality. In religious practice, flowers have a holiness, a reverence that requires them to be discarded in the water with dignity. But what also pollutes: arsenic, plum and cadmium from farm runoffs are found inthe bulbs.

They are full of pesticides and insecticides pumped. While in the Ganges, theirlarge residues dissolve to combine with chemicals and begin to rot, killing fish, suppressing the amount of oxygen, and generating toxic compounds. There are many plastic bags eventhrown down to the river used for puja items. This causes physical water contamination.

Above Image: *Last rites of dead odies being peformed by of the deceased at the Ghats of Ganga.*

Above Image: *Flowers left after perfroming rituals by the devotees on the banks of the holy river Ganga by devotees.*

AGRICULTURE
IN RIVER GANGA BASIN

The key livelihood source for approximately half of NRGB's population and much of its rural population is agriculture [16]. It is also possible to note here that most agricultural crops in the basin are corn, wheat and sugar cane. Rice and sugarcane are among these high-water crops, whose growth depends not only on mineral fertilizer but also on increasing irrigation of ground water (e.g., groundwater irrigation covered about 80 percent of the gross irrigated area in the Middle Ganga Basin in 2007-08, vide IITC, 2014). Secondly, the use of fertilizers is far from equilibrated, and nitrogen fertilizers represent approximately 75% of the overall use of [16].

Over the decades, agricultural mechanization also grew fast. In addition to the expulsion of eroded soils as well as many nutrients beyond the increasing croplands and adversely affecting the basin's ecosystems, the consequences of the compositional agriculture in the Ganga Basin agroecosystems can easily be conceived of (including the Ganga river network). Agroecosystems are deliberately disrupted ecosystems which are driven into States that differ from the natural systems from which they are derived by human influences [17].

The improvement in an agroecosystem's condition is mainly caused by changes in its soil conditions.

In many respects, the effect of modern farming on land has been negative, and soil erosion in many parts of the world is troubling. The rate is calculated to be about 1.54 (±0.32) mm/year on average, while the level of soil formation of traditional agricultural lands is only around 1.075 (±0.05) mm/year [18]. In addition, soil properties have deteriorated, and several kinds of soil depletion has occurred. Economically, India's soil depletion in the 1980s and 1990s ranged from 11 to 26% of its Gross Domestic Product [16]. In terms of intensively cultivated farmlands, the general image is possibly the same for NRGB. This reduction in the amount of chemical fertilizers and pesticides needed to compensate for losses of soil fertility and pest resistance, the effects of which are evident for the NRGB agroecosystems.

Evaluation of soil erosion and soil fertility (soil structures, nutrient base, and biodiversity), as well as safeguarding the various other natural resources of that area (including water, nutrients, biodiversity, and forests) from the negative effects of agriculture must be urgently implemented.

Above Image: *Agro-forestry in Forest Research Institute Campus.*

PLASTIC POLLUTION
IN RIVER GANGA BASIN

Indeed, the river Ganga, which has huge cultural, religious, and industrial importance, is one of the fast-developing countries with significant lack of plastic pollution. The Bay of Bengal is native to Gangotri and is crossed by many industrial towns and effluent points, primarily in the lower section [22]. The river connects Hooghly Estuary and Fraser Ganj, West Bengal, as the transition zone of the sea and the river. The river has many dense cities and factories, particularly in lower areas and the burden of plastic pollutants (radius industries, lacquer and milk industries), on its banks is considered to be huge [23;24]. The concentration of microplastics and meso is observed in the lower section of Ganges River in comparison with the world's other rivers. In few Ganga sights (Buxar, Patna and Barrackpore), however, high plastic waste in the river was found due to direct inflow of plastic debris by wastewater, whereas plastic waste created through impaired fishing gears and plastic accumulation through tidal fluxes at estuary sites can be attributed to plastic waste [24]. According to an international team including scientists from the Wildlife Institute of India, plastic contamination from discarded fishing gear on the Ganga River poses a threat to wildlife, such as the severely endangered three-striped roofed tortoise and Ganga dolphin in risk. The research shows that waste fishing gear is at its highest in the vicinity of the sea, with surveys reported along the river from the mouth in Bangladesh to the Himalayas in India. The consumption of plastic can damage the wildlife, but our threat evaluation focusses on jamming known to harm and destroy many aquatic species. Nylon 6 collection and recovery has high potential as a solution as it reduces plastic waste and generates revenues [26].

Above Image: *Ghats along Ganga with plastics waste scattered all around.*

Above Image: *Raw water pimping station at Mayer Ghat*

WATER EXTRACTION
IN RIVER GANGA BASIN

There are many dams and railway canals built on the Ganga River that extract and supply huge amounts of fluvial water to agriculture, industry, and the home. A dam was installed on Bhagirathi to generate hydropower in Uttarakhand near Tehri In Haridwar, Ganga opens up into the Gangetic plains, which convey a significant amount of its water into the upper Ganga Canal via a dam. At Bijnor, the Madhya Ganga Canal is accessed by yet another dam. In Narora the lower Ganga canal has further water diversion. There are also several lift channels on Ganga, that extract water and irrigation resources for crop fields in vicinity. The water fluid is decreased due to intense extraction, leading to a decline in river dilution.

BIBLIOGRAPHY

1.https://nmcg.nic.in/pdf/pollution%20assessment.pdf
2. Rajit Sengupta and Kiran Pandey. 2019., State of India's Environment 2019: In Figures (eBook). Centre for Science and Environment.pp10-110. ISBN: 978-81-941339-0-2.
3. https://www.downtoearth.org.in/news/pollution/grossly-polluting-industries-more-thandoubled in-8-years-soe-in-figures-64962
4. https://www.gangaaction.org/actions/issues/industrial-waste-management/
5. Nanjundeswaraswamy, T.S., Chemical Blanking and Chemical Milling Process an Outline.
6. http://cganga.org/wp-content/uploads/sites/3/2019/06/PulpPaper_Ganga-Pollution- Assessment-Document_final-Single.pdf
7. WHO (2016). Dioxins and their Effects on Human Health. https://www.who.int/newsroom/ fact-sheets/detail/dioxins-and-their-effectson-human-health. Accessed 10 Dec 2020.
8. McLaughlin, M. J., Tiller, K. G., Naidu, R., & Stevens, D. P. (1996). Review: The behaviour and environmental impact of contaminants in fertilizers. Australian Journal of Soil Research, 34, 1–54.
9. Adriano, D. C. (1992). Biogeochemistry of trace metals. In S. J. Buckland, H. K. Ellis & R. T. Salter (Eds.), Ambient concentrations of selected organochlorines in soils. Organochlorines programm==e. Wellington, New Zealand: Ministry for the Environment 1998 (96 pp.). Boca Raton, Florida: Lewis.
10. ABM Egborge. Industrialization and heavy metal pollution in Warri River, University of Benin Press, Inaugural lecture series, 1991, 32.
11. Federal Environmental Protection Agency (FEPA). Water Quality, Federal Water Standards, Guidelines and Standard for Environmental Pollution Control in Nigeria, National Environmental Standards – Part 2 and 3, Government Press, Lagos, 1991, 238
12. Ayyasamy P.M, Yasodha R, Rajakumar S, Lakshmanaperumalsamy P, Rahman Lee S. 2008. Impact of sugar factory effluent on the growth and biochemical characteristics of terrestrial and aquatic plants. Bull. Environ. Contam. Toxicol., 81: 449- 454
13. Adams, 2009
14. Kümmerrer, 2001
15. Untreated wastewater is the main cause of the Ganga water quality degradation. Organic matter, nutrients (i.e., N, P, K), inorganic matter (dissolved minerals), hazardous chemical products (heavy metals and pesticides), and pathogenic products are the major elements of wastewater (Vega et al., 1998).
16. GUIDELINES FOR PREPARATION OF DPRs FOR WORKS OF INTERCEPTION AND DIVERSION OF DRAINS AND SEWAGE TREATMENT PLANTS (August 2018) https://nmcg.nic.in/pdf/13_Guide%20Lines%20IAndD%20and%20STP%20-%20Final.pdf
17. WQAA. 2007. Report of the Working Group to advise Water Quality Assessment Authority (WQAA) on the Minimum Flows in the Rivers, Central Water Commission, Ministry of Water Resources, and Government of India.
18. IITC [2014]:"Reform Imperatives for Agricultural Sustainability in Ganga Basin", GRBMP Thematic Report – Report Code: 052_GBP_IIT_ SEC_ANL_15_Ver 1_May 2014.
19. Elliott, E.T. and Cole, C.V., 1989. A perspective on agroecosystemscience. Ecology, 70(6), pp.1597-1602.
20. Parikh, S.J. & B.R. James [2012], "Soil: The Foundation of Agriculture," Nature Education Knowledge 3(10):2 [Accessed on April 02, 2014 from: http://www.nature.com/scitable/knowledge/library/soil-the-foundationof-agriculture-84224268]
21. Tripathi, B.D. and Tripathi, S., 2014. Issues and challenges of river Ganga. In Our National River Ganga (pp. 211-221). Springer, Cham.
22. https://www.downtoearth.org.in/news/waste/in-these-temples-offerings-do-not-go-waste- 60758
23. Gowd, S.S., Reddy, M.R., Govil, P.K., 2010. Assessment of heavy metal contamination in soils at Jajmau (Kanpur) and Unnao industrial areas of the Ganga Plain, Uttar Pradesh, India. J. Hazard. Mater. 174 (1–3), 113–121.
24. Vass, K.K., Das, M.K., Srivastava, P.K., Dey, S., 2009. Assessing the impact of climate change on inland fisheries in river Ganga and its plains in India. Aquat. Ecosyst. Health Manag. 12 (2), 138–151
25. Yeung, L.W.Y., Yamashita, N., Taniyasu, S., Lam, P.K.S., Sinha, R.K., Borole, D.V., Kannan, K., 2009. A survey of perfluorinated compounds in surface water and biota including dolphins from the Ganges River and in other water bodies in India. Chemosphere 76 (1), 55–62.
26. Sarkar, D.J., Sarkar, S.D., Das, B.K., Manna, R.K., Behera, B.K. and Samanta, S., 2019. Spatial distribution of meso and microplastics in the sediments of river Ganga at eastern India. Science of the Total Environment, 694, p.133712.
27. https://www.hindustantimes.com/india-news/plastic-pollution-from-fishing-netsthreatening- wildlife-in-ganga-study-finds/story-Ma4r298OWOb3pO8NsW5x7L.html
28. https://sandrp.in/2015/04/15/mowr report-on-assessment-of-e-flows-is-welcome needsurgentimplementation/#:~: text=It%20defines%20E%2Dflows%20as,goods%20and%20services%20to%20people.%E2%80%9D
29. https://planningtank.com/demography/classification-of-towns-cities-india

"A river sings a holy song conveying the mysterious truth that we are a river and if we are ignorant of this natural law, we are lost."

-Thomas Moore