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THE RIVER OF LIFE, DEATH, LIVELIHOOD AND PILGRIMAGE: AN ASSESSMENT OF THE GANGA IN VARANASI CITY, UTTAR PRADESH (INDIA)

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ABSTRACT

The dynamics of change and time rarely shake the mother river's rich heritage, resilient capability and capacity since immemorial times. However, life on land and below water in Varanasi is increasingly under threat due to several anthropogenic activities, particularly sewage discharge. These activities are negatively affecting the bacteriophage cleaning capacity of the Ganga River. The primary objective of the study is to identify and analyse livelihood security, psychological wellbeing and indigenous knowledge in enhancing the resilience of the ghats from social, political and economic dimensions. A household survey was conducted in Ghats of Varanasi district, Uttar Pradesh. Both primary and secondary data were used, and ethnographic methods were employed to achieve the research objects. The findings indicate that the livelihood security of people is under serious threat due to several factors, notably the declining level of the Ganga water level along the ghats of Varanasi. Although the recent coronavirus pandemic provided temporary relief to the river, significant improvements were observed in water quality, flow and aquatic flora and fauna.

KEYWORDS Livelihood Security**;** Anthropogenic Activities; Threat; Resilient, Indigenous Knowledge

RESUMEN *El río de la vida, la muerte, el sustento y el peregrinaje: una valoración del Ganges en la ciudad de Varanasi, Uttar Pradesh (India)*

La dinámica del cambio y el tiempo rara vez han alterado el rico patrimonio del río madre, su capacidad de resiliencia y su capacidad desde tiempos inmemoriales. Sin embargo, la vida terrestre y subacuática en Varanasi se ve cada vez más amenazada debido a diversas actividades antropogénicas, en particular el vertido de aguas residuales. Estas actividades afectan negativamente la capacidad del río Ganges para depurar bacteriófagos. El objetivo principal del estudio es identificar y analizar la seguridad de los medios de vida, el bienestar psicológico y el conocimiento indígena para mejorar la resiliencia de los ghats desde las dimensiones sociales, políticas y económicas. Se realizó una encuesta de hogares en los

ghats del distrito de Varanasi, Uttar Pradesh. Se utilizaron datos primarios y secundarios, y se emplearon métodos etnográficos para alcanzar los objetivos de la investigación. Los hallazgos indican que la seguridad de los medios de vida de las personas se encuentra gravemente amenazada debido a diversos factores, en particular el descenso del nivel del agua del Ganges a lo largo de los ghats de Varanasi. Si bien la reciente pandemia de coronavirus proporcionó un alivio temporal al río, se observaron mejoras significativas en la calidad del agua, el caudal y la flora y fauna acuáticas.

PALABRAS CLAVE: Seguridad de los medios de vida; actividades antropogénicas; amenaza; resiliente; conocimiento indígena

Introduction

The ancient mythology regards water as the foundation of the entire world, the basis of all life forms and the medicine of immortality (Indian Institute of Public Administration, 2021). In medical science terms, water is considered a healer, while Indian epistemologies describe water as a holder of life, eternity and strength (Bakker, 1996). Water is regarded as an essential source due to its multipurpose usages like cooking, bathing, irrigation, hydro-energy and performing rituals (UNESCO, 2021). Most importantly for drinking not only by humans but also by all the living beings on Earth (Berry, 1959). Flowing water in general and Ganga water, in particular, are perceived as a benefactor of purity and miracles (Jamal & Sen, 2018). The Ganga is one of the longest and the holiest rivers worldwide as it is not just a river but a culture in itself (Indian Institute of Management-Lucknow, 2019). The river is personified as Goddess Ganga, and its basin is renowned for rich spiritual and cultural diversities evident through religious sites like Kashi Vishwanath temple and Sankat Mochan temple (Singh et al., 2019). Boating from one ghat to another and craft festivals are renowned tourist attractions (Gan, 2018). The river acts as a unifying space where Muslims use the holy water for *wazu* (ablution), while Hindus bathe in the river for salvation (World Bank & Government of India, 2018). However, the Ganga has increasingly become a receptacle for human waste in the form of pollution that includes mass bathing, immersion of idols, domestic sewage and industrial effluents (Central Pollution Control Board, 2013). Ecological pollution is now one of the main causes of the degradation of the river (Central Pollution Control Board, 2018). However, the city's infrastructure capacity is insufficient to tackle the rising residential and population explosion (Bajaj et al., 2018).

The water quality of the Ganga is deteriorating rapidly due to the disposal of unburned human dead bodies (Ahmed, 1990). Limited political initiatives for river rejuvenation and the implementation of several projects without consultation with local communities contributes in making ghats non-resilient (Agoramoorthy, 2015). The coronavirus pandemic temporarily provided relief in regaining Ganga water quality during the nation-wide lockdown (Tewary, 2021). However, the throwing of dead bodies the second wave of COVID-19 increased exponentially at the cremation ghats such as Manikarnika whilst others were fully overloaded with the dead bodies (Jamal et al., 2023). According

to an estimate, around 320,000 dead human bodies are cremated yearly in the city's ghats such as Manikarnika ghat and Harishchandra ghat and up to 3,500 tonnes of half-burnt human flesh are dumped into the river (The Economic Times, 2017). The river continues to deteriorate due to multiple anthropogenic pressures, including dumping ashes, plastic items, garlands and human faecal (Department of Landscape Architecture, 2014; Government of Uttar Pradesh, 2022). The Government of India has introduced several programmes to conserve Ganga. This includes Ganga Action Plan, National Mission for Clean Ganga and Namami Gange (Ministry of Jal Shakti. 2021). Our research paper shows that studies have been conducted in the domain of river of life, death, livelihood, pilgrimage and environmental issues related to Ganga in Varanasi. But no concrete study has been done in identifying and analysing the Ganga at a grassroots and holistic level. This current study is one such attempt in this direction to come out with the inclusive and sustainable approach.

Study Area

Varanasi is one of the seventy-five districts of Uttar Pradesh, India having total population of 3.676 million (District Census Handbook, 2011; Indian Institute of Management-Lucknow, 2019; Fig. 1; Table 1). It is among the most sacred regions in the world and holds deep attachment to Buddhism as Gautam Buddha gave his first sermon in Sarnath (Jamal et al., 2021).

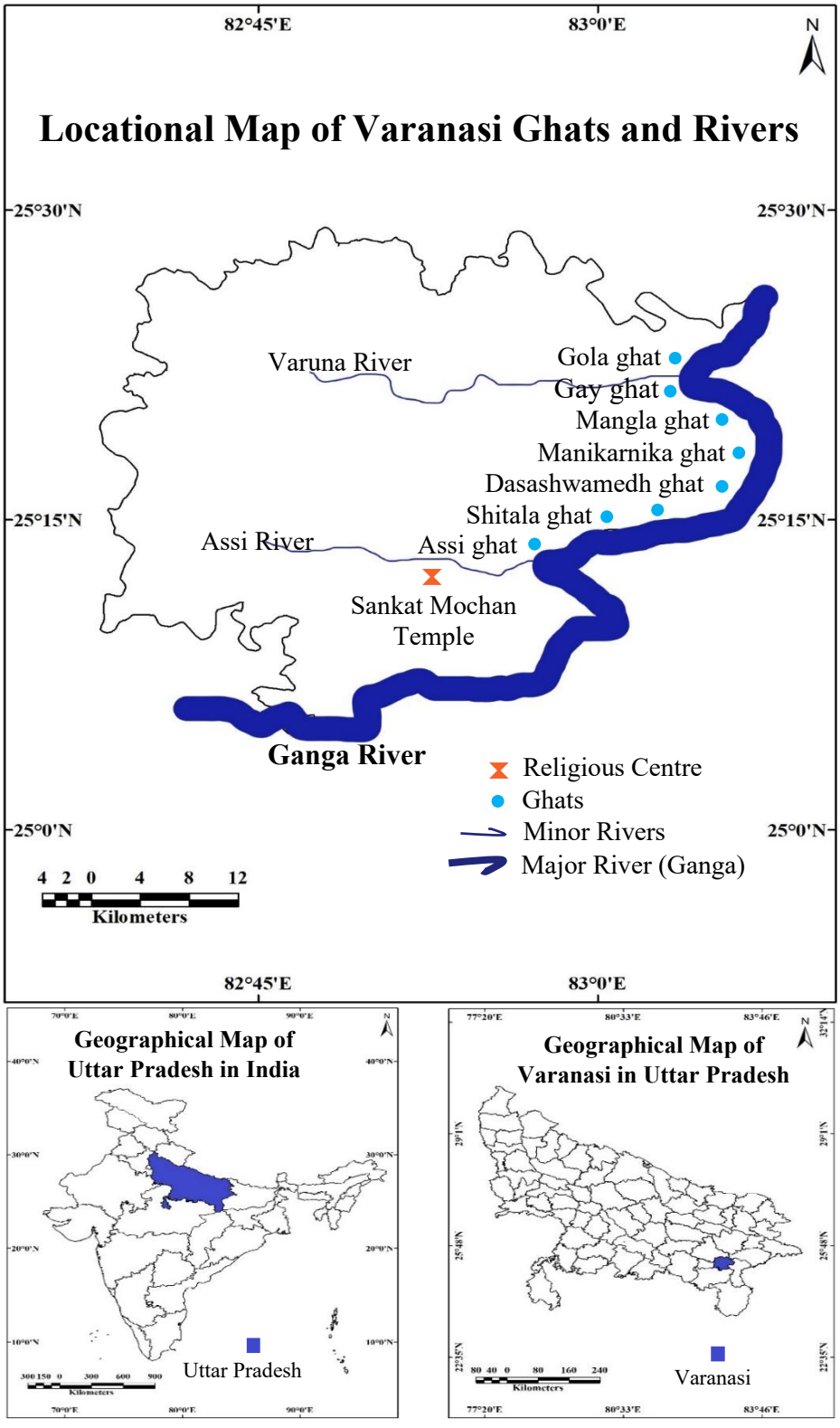

Fig. 1 Prepared by Author, 2024 (Adopted from Department of Landscape Architecture, 2014; Census of India, 2011; Ahmed, 1990)

The river Ganga constitutes a lifeline for millions across its basin, primarily for the inhabitants of Varanasi, who are dependent on the holy water and river (School of Planning and Architecture,

2006). Water sources have historically been at the centre of life-supporting systems, but today different sources of anthropogenic activities are threatening these sources (Jamal, & Sen, 2022; Kutlutürk, 2013). These pressures can take various forms, such as sound, heat or radioactivity, faster than it can be diluted, stored, decomposed and recycled in our environment (Mariya et al., 2019).

Table 1 Socio-economic Profile of Ghats

Elements	**Assi Ghat**	**Manikarnika Ghat**
Total number	200 Pandas/priests (35 families)	250 Doms (40 families)
Kind of Ghat	Tourist attraction	Cremation ground
Caste involved	Tourist guides belong to Nishads, Pandas from upper caste (Brahmin)	Doms from lower caste (Dalit)
Daily earning	Tourist guide ₹2000–₹4000 per trip (4–5 days), Pandas/priests ₹200–₹300 per day (dakshina/fee)	Doms earn ₹2000 per day
Religious Ceremony	Aarti performs in every morning (6 am) and evening (7 pm)	Pyres burn 24 hours a day, 365 days a year
Best time to visit ghat	Brahma muhurta (before sunrise and shortly thereafter)	Any time of the day, month & year
Peak season	October to March	Any time due to religious boon
Dead bodies cremated & burned	–	400–500 daily & 30,000 annually
Ashes of cremated dead body	–	2–3 kg single & 800–1200 kg per day
Charred human flesh into Ganga	–	100 tons daily
Waste flow into Ganga	1ton daily pooja items daily	20 tons animal waste daily
Cost of religious practices	₹1700 for Aarti per family	Dom charges ₹300–₹500 per dead body for cremation
Types of items for religious offerings	Rich prefers 2kg premium quality desi ghee and 5 copper thalis, while poor any quality to perform aarti	Rich prefers sandalwood, poor any wood & required 1 quintal per dead body for cremation
Sacred activity	Pandas/priests perform pooja for 4–5 devotees per day	Doms receive 20–40 dead bodies per day
Prominent program	Subah-e-Banaras	–
Accommodation capacity	23,000 people at a time	–
People frequency	1000 every morning and 2000 every evening	500 people every day and night
Area of domination	Residential area dominated by Tamils	Outskirt dominated by Dom Raja family
Time required to reach	10–15 min driving from the city	8–12 min driving from the city
Peculiarity of ghat	Oldest, southernmost among 84 ghats	Ladder to the heaven, one of the southernmost ghats

Challenges	Threat to tourist guides are packaged tour agents, priests are worried about online religious performances	Doms suffer from respiratory disease due to continuous inhaling of smoke of pyres

Source Department of Landscape Architecture, 2014; Shankar, 2017; Sheker, 2018; Uttar Pradesh Tourism, 2022; Field Survey, 2023; Chandra, 2022

Database and Research Methodology

This study is based on both primary and secondary data. A series of research problems have been encountered in giving the present shape to the study. In the initial stage, a primary survey was conducted at Shitala and Assi Ghat in the Varanasi district of Uttar Pradesh. Approximately one hundred participants between twenty and eighty years were interviewed to achieve the research objective. Focused group discussions were held with members of the Banaras Divisional Task Force members to examine the harmful effects of open defecation or throwing waste on the ghats or in the river. An in-depth interview was also held with several Banaras Divisional Task Force members to channelize different information, including how to make the river clean and encouraging people to participate in encouraging people not to promote unhygienic activities along ghats. Further focused group discussions organised with boatman, tourist guides, and small shopkeepers shared their experiences about their source of livelihood. They pointed out that infrastructure advancement along ghats is causing serious concern for their source of livelihood. The Livelihood Vulnerability Index (LVI) method was used to achieve the desired result. This represents a structure for aggregating and grouping indicators at the local level that can be fragile for adaptation and development. The value ranges from 0 to 1 where 0 indicates the lowest value with the least vulnerability and 1 indicates the highest value with the most vulnerability. The maximum and minimum values will be reversed accordingly. The equation is as follows:

$$\text{Index}$$

$$^{s}_{d} = \frac{(S)d - (S)min}{(S)max - (S)min}$$

- $^{s}_{d}$ is the real sub-component for district *d*.
- *(S)* min is the minimum value.
- *(S)* max is the maximum value.

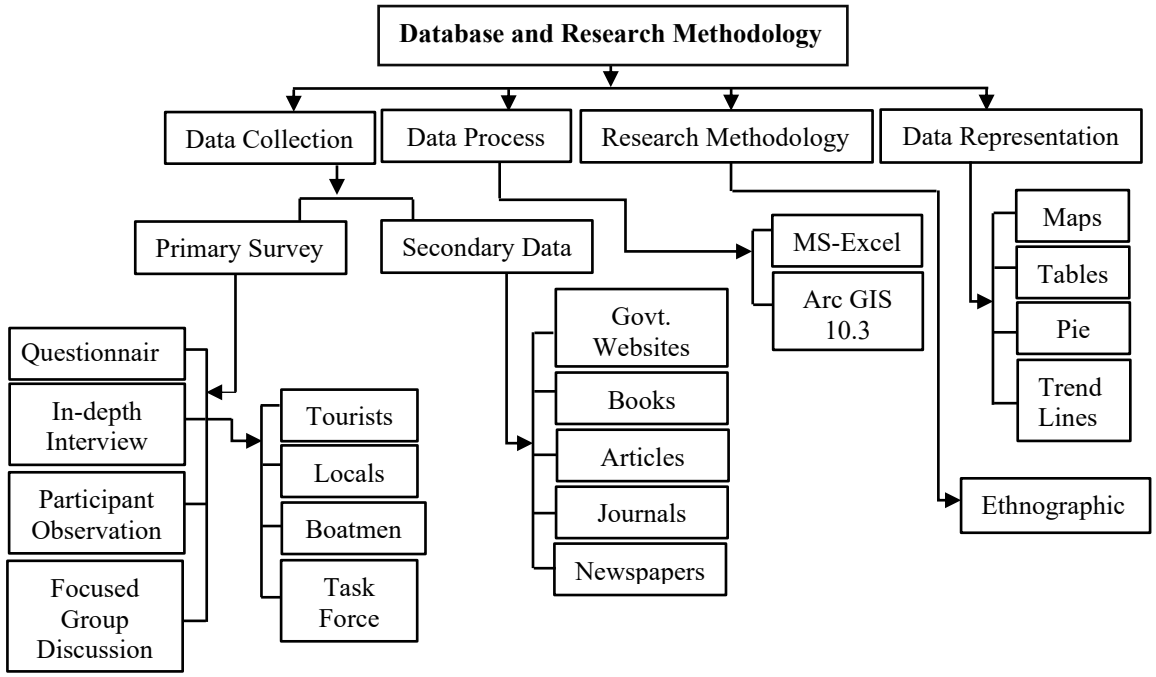

Fig. 2 Diagrammatic Representation of Database and Research Methodology (Prepared by Author, 2024)

Several studies based on people's perception and indigenous knowledge of the Ganga River and the impact of anthropogenic activities at the community level and ghats were collected through participatory observation. The Indian Institute of Public Administration, National Mission for Clean Ganga, Central Pollution Control Board and Department of Landscape Architecture was used for secondary data. Furthermore, the Ministry of Jal Shakti, District Census Handbook (2011), and Ministry of Environment Forest and Climate Change reports, books, journals, research articles, newspapers and web portals were accessed to achieve the desired outcome. Computer-aided software like Arc GIS 10.3 was used for preparing the required maps, and MS-Excel was used to prepare tables, pie, trend lines, bars and radar diagrams to represent the research findings (Fig. 2).

Results and Discussions

a. Infrastructural Development

The construction of a barrage and platform in the river basin has had a vital impact on the river habitat and free flow. As a result, the Ganga water in Banaras is turning green due to the construction of the Vishwanath corridor platform that links one ghat to another so as to attract customers, tourists. The growth of green algae along Assi and Shitala ghat is becoming common, negatively impacting upon the aquatic organisms, which end up dying due to eutrophication. The ghats are slowly being abandoned as no devotees or tourists take the holy dip or bath, which would impact the local economy. This trend affects those dependent on the ghat economy for their livelihoods, such as boatmen, tourist guides, and small shop owners (Table 2). These phenomena have been increasing in ghats premises over the years, whereby several canals and check dams are being constructed on the river bank to facilitate water

extraction and supply from water surplus to water deficit region. The collected water is later supplied for household, irrigation and industrial purposes.

Table 2 Suitability of River Ganga at Different Spots in Varanasi

Drinking (Class A)				
Key Parameters	**Permissible Limit**	**Malviya Bridge**	**Manikarnika Ghat**	**Assi Ghat**
Dissolved Oxygen (DO)	>6 mg/l	7.4 mg/l	9.5 mg/l	8.2 mg/l
Bio Chemical Oxygen Demand	<2 mg/l	3.9 mg/l	1.7 mg/l	2.6 mg/l
Total Coliform	<50 MPN/100ml	22000 MPN/100ml	17000 MPN/100ml	1700 MPN/100ml
pH	6.5–8.5	8.28	8.06	8.35
Drinking (Class C)				
Dissolved Oxygen (DO)	>4 mg/l	7.4 mg/l	9.5 mg/l	8.2 mg/l
Bio Chemical Oxygen Demand	<3 mg/l	3.9 mg/l	1.7 mg/l	2.6 mg/l
Total Coliform	<5000 MPN/1000ml	22000 MPN/100ml	17000 MPN/1000ml	1700 MPN/1000ml
pH	6.0–9.0	8.28	8.06	8.35
Bathing (Class B)				
Dissolved Oxygen (DO)	>5 mg/l	7.4 mg/l	9.5 mg/l	8.2 mg/l
Bio Chemical Oxygen Demand	<3 mg/l	3.9 mg/l	1.7 mg/l	2.6 mg/l
Fecal Coliform	Max. 2500	13000	11000	1100
pH	6.5–8.5	8.28	8.06	8.35

Source Central Pollution Control Board, 2022 (Compiled by Author, 2024)

The extraction of water for linking one area to other leads to the continuous decline in the river's natural flow, water level and volume. The fluctuating water level sometimes results in flood-like situations submerging at several ghats during monsoon. The parameters defined for water quality and the quality of water available in ghats were very different, with the ghat water being very polluted (Table 3).

Table 3 Best Use Water Quality Criteria, 2019

Class of Water	**Designated Best Use**	**Criteria**
A	Drinking water source without convention treatment but after disinfection	• Total coliforms organism MPN/100ml shall be 50 or less. • pH between 6.5 and 8.5. • Biochemical oxygen demand 5 days 20C 2 mg/l or less. • Dissolved oxygen demands 6 mg/l or more.

B	Outdoor bathing (organized)	• Total coliforms organism MPN/100ml shall be 500 or less. • pH between 6.5 and 8.5. • Biochemical oxygen demand 5 days 20C 3 mg/l or less. • Dissolved oxygen demands 5 mg/l or more.
C	Drinking-Water source after conventional treatment and disinfection	• Total coliforms organism MPN/100ml shall be 5000 or less. • pH between 6 and 9. • Biochemical oxygen demand 5 days 20C 3 mg/l or less. • Dissolved oxygen demands 4 mg/l or more.
D	Propagation of fisheries and wildlife	• pH between 6.5 and 8.5. • Dissolved oxygen demands 4 mg/l or more. • Free Ammonia 2 mg/l or less.
E	Industrial cooling, irrigation, controlled water disposal	• pH between 6.0 and 8.5. • Electrical conductivity at 25C micro mhos/cm max. 2250. • Sodium absorption ratio max. 26. • Boron max. 2 mg/l.
Below E		• Not meeting A, B, C, D, & E

Source Central Pollution Control Board, 2022 (Compiled by Author, 2024)

The real-time water quality monitoring system for different ghats is of great cause of concern for all living organisms. The total organic carbon for Varuna River is 13.88 mg/l, Gomti river is 8.62 mg/l, and other details are described in the table 4. It was also found that the locals residing on the bank of the river reported increasing cases of cancer, attributed to the increment of carcinogenic elements in the river

Table 4 Real-Time Water Quality Monitoring System, Varanasi

Parameters	**Bathing Ghat, Varanasi River Varuna**	**Bridge at River Gomti, Varanasi**
Biological Oxygen Demand (BOD) (mg/l)	17.4	2.37
Dissolved Oxygen (DO) (mg/l)	8.95	8.9
pH	6.2	7.7
Temperature (°C)	28	34
Ammonia (mg/l)	26.4	0.31
Chloride (mg/l)	57.4	25.19
Chemical Oxygen Demand (mg/l)	81.94	13.33
Total Suspended Solid (mg/l)	35.36	36.19
Turbidity (NTU)	25.57	15.51
Nitrate (mg/l)	0.9	1.42
Benzene, Toluene, and Xylene (µg/*m*l)	0.02	0.05
Total Organic Carbon (mg/l)	13.88	8.62

Source Central Pollution Control Board, 2022 (Compiled by Author, 2024)

b. The Social System

The social system within the ghat shows the monopoly of a particular caste in the day-to-day function of the ghat system. A selected group of people (also known as *pandas*) perform rituals such as worshipping, cleaning temple premises, and taking major decisions of the ghats like renovation and recreation work. In the social setup, a particular caste is involved in the disposing of human and animal waste, cleaning ghats, and other routine tasks. The caste-based segregation defies the fundamental right, which may hamper the effective implementation of the inclusive programme of the Government of India. The social system in place keeps religion as a cultural essence. More than 40,000 perople are cremated yearly whose remains are later offered in the form of the ash which serves to complete the circle of birth and attain salvation. Community bathing is a common practice during festivals on several occasions. It can be said that the river system is a lifeline for the economy and the cultural setup. Reports show a decline in Chemical Demand for Oxygen (COD) and Biological Demand of Oxygen (BOD) (Fig. 3), which could be attributed to anthropogenic activities. COD is the amount of oxygen (O_2) needed to break down pollutants chemically, whereas BOD is the quantity of O_2 microorganisms required to decompose sewage in aerobic conditions. These elements play a vital role in regularly cleaning Ganga water, and their concentration need to be increased to make the river healthy. The minimum required BOD is 3 mg/litres, and below3 mg/litres is a matter of grave concern, which may require suspending all the recreational activities and day-to-day activities which impacts the local economy. At the same time, it has been found that the concentration of Total Suspended Solids (TSS) and ammonia nitrogen are increasing exponentially, making water hazardous, which may result in aquatic organisms' death turning the holy Ganga into toxic (Trombadore et al., 2020).

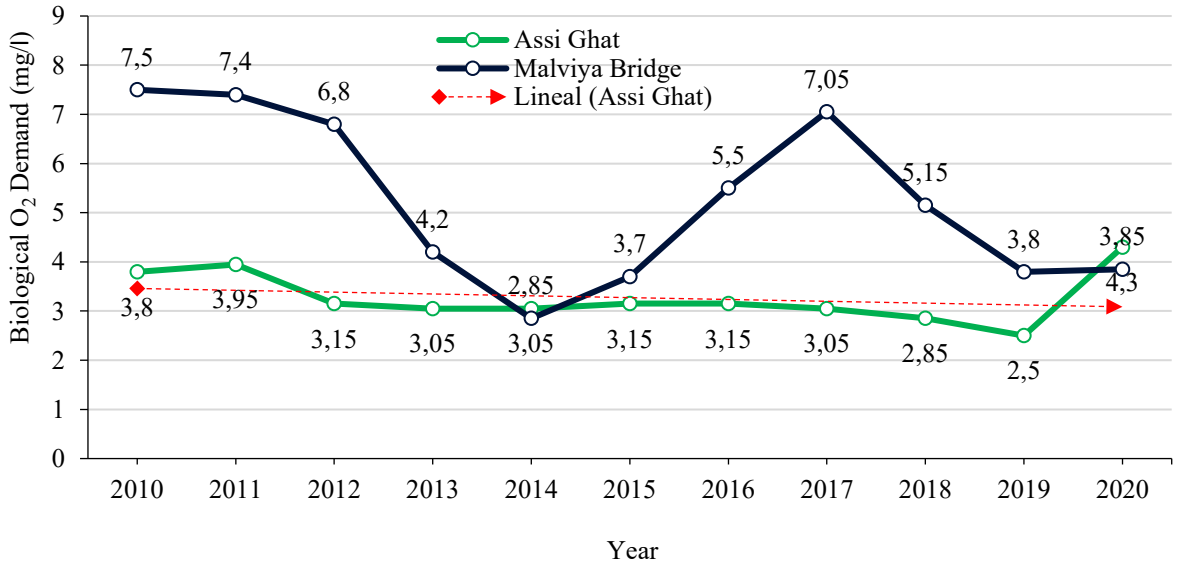

Fig. 3 Water Quality of Ganga River in Varanasi (Central Pollution Control Board, 2022)

Flower showering in temples and flowing in the Ganga are regarded as a sign and symbol of devotion to God (Fig. 4). Unfortunately, these flowers rot, clog the water bodies, and cause havoc in the fragile aquatic ecosystem. The ghats have several micro industries producing plastic materials (Fig. 5) and plastic contamination from ghost fishing, wherein abandoned fishing nets cause a threat to aquatic organisms like endangered Gangetic dolphins, sea turtles and others. Thousands of idols, made up of harmful chemicals, are immersed, containing paints, plaster of Paris, small rods, zinc, lead, mercury, arsenic, and cadmium responsible for the eutrophic ecosystem in the river. These religious practices endlessly reduce the concentration of bacteriophage capability of Ganga, which is given to cancer patients and applied in phage therapy (Singh et al., 2019).

Fig. 4 Temples as Symbol of Heritage

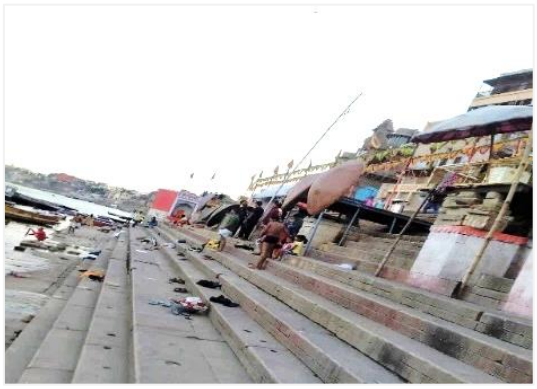

Fig. 5 Garbage Thrown on Ghats

c. Ghat Economy

Thousands of people thrive and earn their livelihood engaging in various activities around the ghats. Economic activities like boating, religious offerings, tourism, and informal activities take place in the ghats across Varanasi, contributing to the ghat economy (Table 5). In recent years, illegal sand mining has become common phenomenon in changing river's ecology and threatening the survival of flora and fauna. Although mining is banned along the seven kilometers stretch Rajghat to Ramnagar Fort, enforcement remains uneven. The primary findings suggest a large-scale migration, death of wildlife, and declining water level by more than 60 per cent between 1960 and 2020. Foreign tourists constitute a significant part of ghat income and economy yet fall prey to cheating, overpricing, safety and security concerns, vis-a-vis domestic tourists who fare differently among locals also have their problems. These factors impact the ghat economy.

Table 5 Socio-economic Profile of Boatmen along the Ganga Ghats in Varanasi

Elements	**Description**
Total number of boatmen	2000
Monthly income of boatmen	₹8,000–₹10,000
Cost of making a new boat	₹10–12 lakh
Type of Boat	74% hand-driven & 26% motorboats
Total number of boats	750

Peak season	March to October
Lean season	Monsoon from June to September
Number of family members	6–8
Number of Passenger	10–15 (daily)
Caste	Scheduled Castes (SCs)
Health insurance	No
Kind of house	Jhuggi (hut) or khaprail or rent
Educational standards	80% are 8th pass & 20% 10th and above
Religion	Hindus
Relation of work	Ancestral right
Main threat to livelihood	Luxury cruise vessel
Suffered from disease	Dengue, flu, pneumonia
Reason for spread of disease	Contaminated river water

Source Gan, 2018; Doron, 2013; Mutha, 2022; Field Survey, 2023

Boatmen locally known as *Nishads* and *Manjhis*, provide a boat ferry service yet face livelihood insecurity due to heavy competition from newly introduced speed boats and cruise ships. Boats are eco-friendly, while the modern cruise releases nitrogen and sulphur dioxide that pollutes Ganga water. Cremation activities are vital in the ghat economy in places such as Harishchandra Ghat and Manikarnika Ghat, where tonnes of wood are used to perform the cremation. According to an estimate, more than one tonne of wood is used to burn a single dead body, creating a considerable demand on timber supply. This promotes deforestation which leads to soil erosion and a decline in rainfall and disturbing the bio-geochemical cycle. There is a provision of room on rent in the close premise of the ghats, which is locally renowned as kothri (Mutha, 2022).

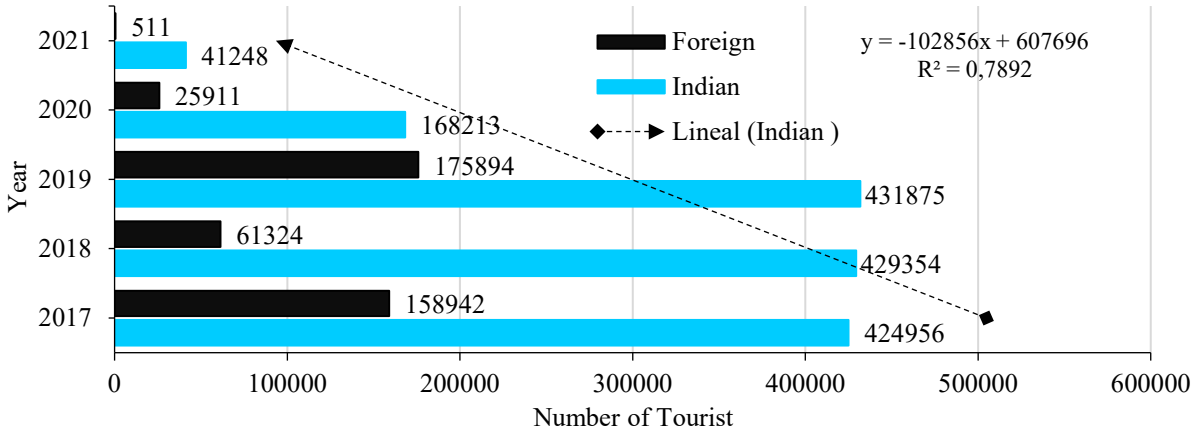

Fig. 6 Annual Tourist Visits to Ghats in Varanasi (Adopted from Uttar Pradesh Tourism, 2022; Prepared by Author, 2024)

Long-term visitors who come to write a book or research the cultural economy of ghats occupy rooms along the ghats. This *kothri* rent is a major source for the *pandas'* livelihood alongside the Assi and Shitala ghats. Apart from these economic activities, some other income-generating activities are real estate, where houses are sold and purchased in the name of locals, alongside people who are engaged in foreign-currency exchange to support their livelihood. Also, reports of fake marriages

extending foreign tourist visas are becoming common, which puts further pressure on the cultural heritage of Varanasi ghats. During COVID-19, international tourism declined to the lowest level ever in the Varanasi as all countries across the world closed their borders to contain the spread of the pandemic (Fig. 6).

d. Industrial Effluents

Wastewater pollution accounts for more than 75 per cent of Ganga pollution which causes degradation in water quality. The sewage generation is 207.8 million litres per day (MLD), while the treatment capacity is 167.1 (MLD) (Table 6). It indicates that around 80 per cent of waste generated in Varanasi is treated, while the rest is kept untreated, causing several kinds of diseases to human beings and animals apart from polluting the environment. This deficit in treatment capacity contributes to degrading water quality, making it unsuitable for bathing (Fig. 10).

Table 6 Sewage Generation in Different Cities of Uttar Pradesh

City	Sewage Generation in Million Litres per Day (MLD)	Treatment Capacity in Million Litres per Day (MLD)	Deficit in Sewage Treatment Capacity (MLD)
Allahabad	215	102	113
Ballia	21.2	8.6	12.6
Farrukhabad	40.2	12.4	27.8
Kanpur	400	217.3	182.7
Mirzapur	31.5	18.9	12.6
Unnao	32.7	22.1	10.6
Varanasi	207.8	167.1	40.7

Source Central Pollution Control Board, 2018 (Compiled by Author, 2023)

Elevated levels of faecal coliform bacteria cause waterborne diseases, and the presence of the bacteria indicates that water is polluted with faecal from humans and animals. The presence of faecal coliform bacteria in Varanasi is 35000 most probable number (MPN) per 100 ml (Central Pollution Control Board, 2018; Fig. 7), which may force suspending holy baths and religious possessions.

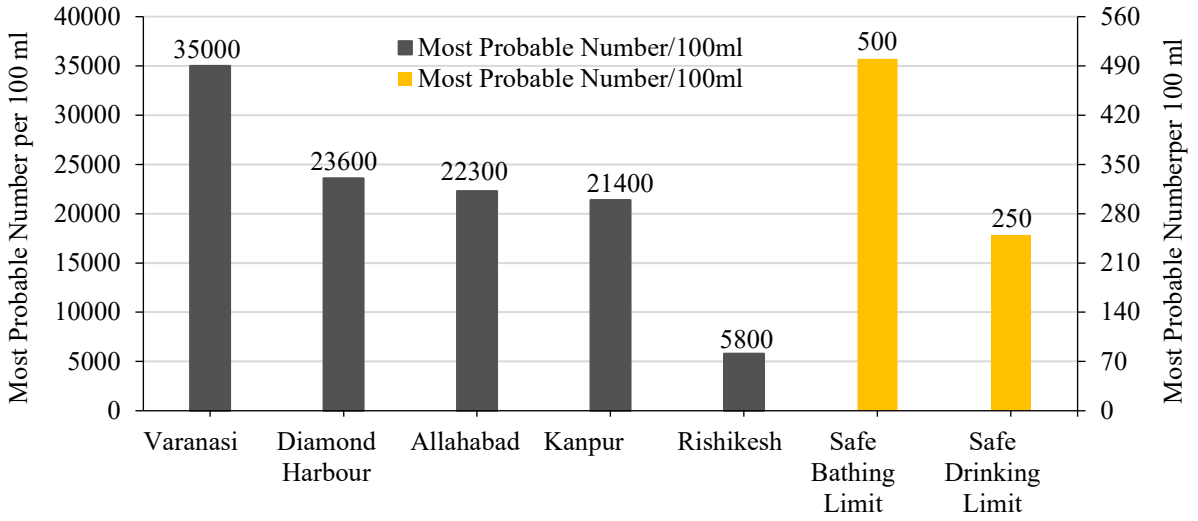

Fig. 7 Fecal Coliform Bacteria in the Ganga (Adopted from Rowlatt, 2016)

The dying industry discharges harmful dyes containing chemicals such as caustic soda and soda ash, binding and fostering agents promoting water pollution. When irrigated in nearby agricultural fields of rice, sugarcane, wheat and corn, the chemically polluted water may contaminate the soil and crop. Agricultural mechanization, irrigation, soil erosion and agricultural waste have increased, making the river bank vulnerable to a series of extreme events (Table 7).

Table 7 Ranking of Pollution Level in Rivers

Parameters	Ranking			
	Highly Polluted	**Moderate Polluted**	**Less Polluted**	**Least Polluted**
DO (mg/l)	0–2	2–4	4–6	>6
BOD (mg/l)	>30	3–30	2–3	0–2
Fecal coliform	>5000	500–5000	50–500	0–50
pH	1–1.25	6.5–8.5	7.5–8.5	6.5–7

Source Bureau of Indian Standards, 2020

e. Wastewater Discharge

There has been a significant increase in household wastewater over the years. The major drains at Assi, Ramnagar, Varuna, Shivala and Rajghat Discharge million litres per day (MLD) containing domestic sewage and industrial and agricultural waste (Fig. 8). The discharge from industries is the deadliest among these sewages as it contains several carcinogenic substances.

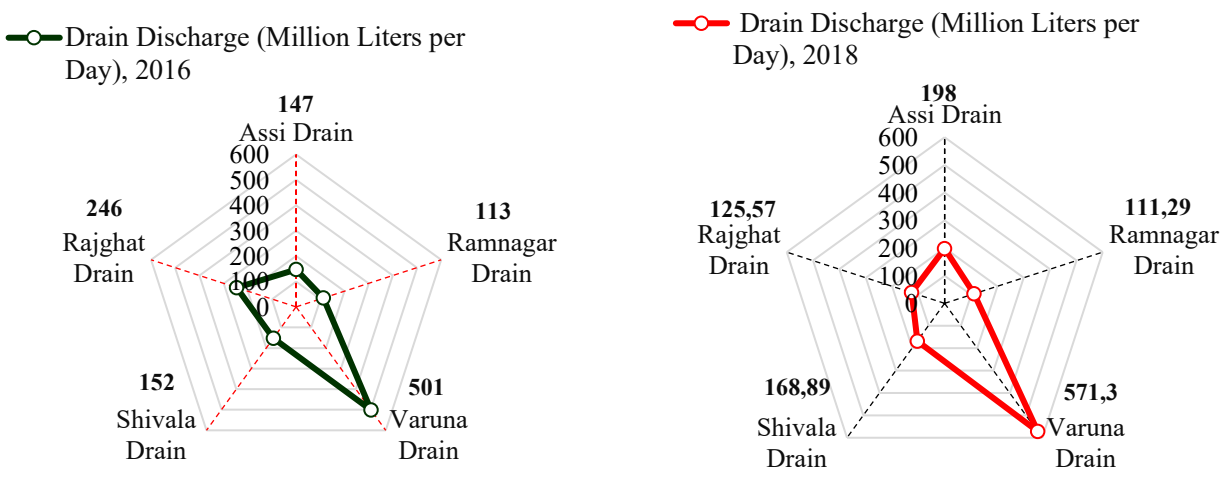

Fig. 8 Drains Discharge into the Ganga during Monsoon between 2016 and 2018 (Compiled from Central Pollution Control Board, 2016 and 2018 and Prepared by Author, 2024)

The Assi drain has discharged 147 MLD, the Ramnagar drain 113 MLD, the Varuna drain 501 MLD, the Shivala drain 152 MLD and the Rajghat drain 246 MLD in 2016 (Central Pollution Control Board, 2018). The Assi drain discharged 198 MLD, Ramnagar drain discharged 111.29 MLD, Varuna drain discharged 571.3 MLD, Shivala drain discharged 168.89 MLD and Rajghat drain discharged 125.57 MLD in 2018. Varuna drain accounts for the highest Discharge, while the maximum reduction in the release was noted in Rajghat drain from 2016 to 2018.

Table 8 Drains Discharging into Ganga River during Post-monsoon in the Catchment of Varanasi, 2020

Parameters	**Name of the Drain**				
	Nagwa/ Assi Drain	**Ramnagar Drain**	**Varuna Drain**	**Shivala Drain**	**Rajghat/ Khirkiya Drain**
Confluence River	Ganga Left	Ganga Right	Ganga Left	Ganga Left	Ganga Left
Pollution Sources	Domestic	Domestic, Agriculture, Industrial	Domestic, Agriculture, Industrial	Domestic, Agriculture, Industrial	Domestic
Flow (MLD)	177.74	14.74	318.92	–	53.08
BOD Load (TPD)	12.09	1.06	2.68	–	2.97
BOD (Mg/l)	68	72	8.4	–	56
Tapped/Untapped/ Interim	Interim	Untapped	Untapped	Tapped	Interim
Discharge Status	Flow	Flow	Flow	Stagnant	Flow

Source Central Pollution Control Board, 2022

The highest Discharge could be due to the high population density through which the drain passes, and the city is continuously observing growth in population (Central Pollution Control Board, 2022; Table 8). The continuous drain of sewage has increased the average temperature of the water throughout the banks and ghats as these sewages are untreated. The maximum temperature increased from 29 °C to 31.5 °C; similarly minimum average increased from 18 °C to 21.5 °C, signalling an upward trend in temperature.

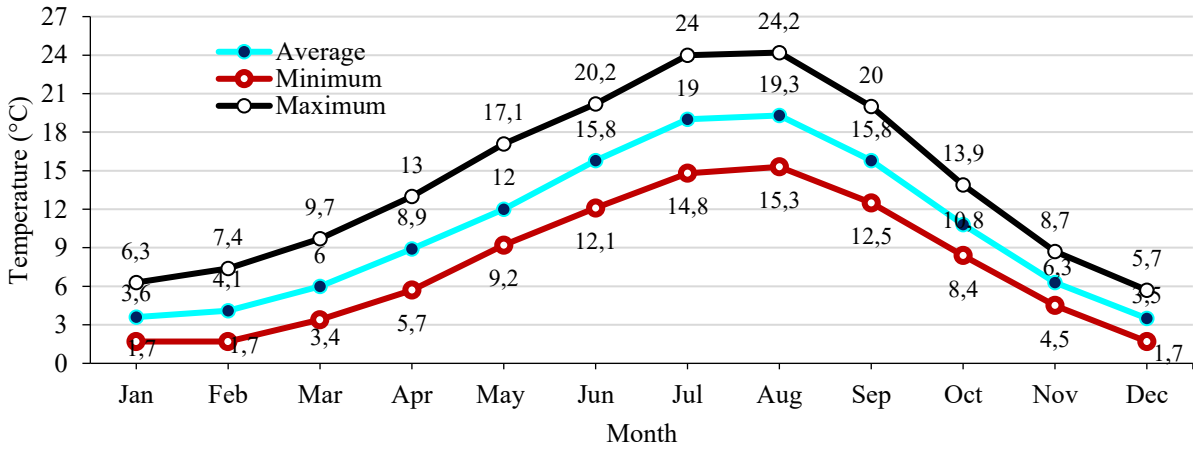

Fig. 9 Ganga Monthly Temperature from 1991–2021

The temperature trend was in line with global warming as a prime factor for climate change. The minute increase in water's temperature causes disruption in the entire food chain for life on land and life below water. The optimal temperature where most aquatic organisms survive is 25 °C, but such temperature has been breached several times (Fig. 9). The water quality of the Ganga River has changed in Varanasi over the years (Table 9). The water quality at different stations, including Assi ghat and Malviya bridge is discussed from 2010–2020. The pH value of both the stations is continuously increasing from 2010–2020, which is making the Ganga water more alkaline and other details are discussed in the table 9.

Table 9 Water Quality of River Ganga: Varanasi

Year	Station	pH		Conductivity (µmhos/cm)		BOD (mg/l)		DO (mg/l)	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Water Quality Criteria		**6.5-8.5**		**<2250 µmhos/cm)**		**<3 mg/l**		**<4 mg/l**	
2010	Assi Ghat	7.3	7.7	256	358	3.4	4.2	7.4	8.7
2010	Malviya Bridge	7.8	8.8	282	385	4.2	10.8	6.8	7.7
Total		**15.1**	**16.5**	**538**	**741**	**7.6**	**15.0**	**14.2**	**16.4**
2011	Assi Ghat	7.5	7.8	224	266	3.7	4.2	7.5	7.8

2011	Malviya Bridge	7.9	8.1	240	290	5.2	9.6	7.0	7.2
Total		**15.4**	**15.9**	**464**	**556**	**8.9**	**13.8**	**14.5**	**15.0**
2012	Assi Ghat	7.7	8.5	230	278	2.8	3.5	7.3	8.6
2012	Malviya Bridge	7.5	8.5	240	310	5.1	8.5	7.1	7.6
Total		**15.2**	**17.0**	**470**	**588**	**7.9**	**12.0**	**14.4**	**16.2**
2013	Assi Ghat	7.6	8.4	268	370	2.9	3.2	6.9	8.8
2013	Malviya Bridge	7.7	8.4	306	392	3.3	5.1	6.4	8.3
Total		**15.3**	**16.8**	**574**	**762**	**6.2**	**8.3**	**13.3**	**17.1**
2014	Assi Ghat	7.2	8.0	272	378	2.3	3.8	8.2	8.7
2014	Malviya Bridge	8.0	8.4	282	392	2.4	3.3	7.3	9.2
Total		**15.2**	**16.4**	**554**	**770**	**4.7**	**7.1**	**15.5**	**17.9**
2015	Assi Ghat	7.3	8.3	280	382	2.8	3.5	8.3	8.8
2015	Malviya Bridge	7.9	8.5	302	391	3.1	4.3	6.8	9.6
Total		**15.2**	**16.8**	**582**	**773**	**5.9**	**7.8**	**15.1**	**18.4**
2016	Assi Ghat	7.4	8.5	320	496	2.8	3.5	7.4	9.8
2016	Malviya Bridge	7.3	8.6	338	544	4.2	6.8	6.4	8.6
Total		**14.7**	**17.1**	**658**	**1040**	**7.0**	**10.3**	**13.8**	**18.4**
2017	Assi Ghat	7.8	8.6	340	535	2.8	3.3	7.5	8.8
2017	Malviya Bridge	8.1	8.8	372	594	6.4	7.7	6.4	7.7
Total		**15.9**	**17.4**	**712**	**1129**	**9.2**	**11**	**13.9**	**16.5**
2018	Assi Ghat	8.2	8.4	345	488	2.5	3.2	7.4	9.2
2018	Malviya Bridge	8.1	8.3	366	588	4.5	5.8	6.1	7.8
Total		**16.3**	**16.7**	**711**	**1076**	**7**	**9**	**13.5**	**17**
2019	Assi Ghat	8.1	8.4	364	512	1.7	3.3	7.2	10
2019	Malviya Bridge	7.9	8.7	392	528	3.4	4.2	6.5	7.9
Total		**16**	**17.1**	**756**	**1040**	**5.1**	**7.5**	**13.7**	**17.9**
2020	Assi Ghat	7.9	8.6	242	512	2.1	6.5	6.5	10.4
2020	Malviya Bridge	7.8	8.7	254	546	3.5	4.2	5.8	9.5
Total		**15.7**	**17.3**	**496**	**1058**	**5.6**	**10.7**	**12.3**	**19.9**

Source Central Pollution Control Board, 2022

The ghat economy is purely based on day-to-day economic activities such as foreign tourist visits, religious activities, but during the COVID-19 lockdown, everything was shut down, and tourists were also banned. This led to widespread hunger among the boatmen, shopkeepers, vendors and others who directly and indirectly depend on ghats to feed their families. The study finds that more than 90 per cent

of respondents lost their livelihood during the COVID-19, registering a decline of about 90% of tourists in the city (Uttar Pradesh Tourism, 2022).

Table 10 Monthly Income Profile of Respondents

Monthly Income	Number of Respondents	Respondents (%)	LVI
<₹3,000	10	10	0.333333333
₹3,000–₹6,000	18	18	0.866666667
₹6,000–₹9,000	20	20	1
₹9,000–₹12,000	12	12	0.466666667
₹12,000–₹15,000	11	11	0.4
₹15,000–₹18,000	14	14	0.6
₹18,000–₹21,000	10	10	0.333333333
>₹21,000	5	5	0
Total	100	100	4

Source Field Survey, 2023

To better understand the livelihood sustainability of the locals, the Livelihood Vulnerability Index (LVI) was calculated. It states that the higher the value, the poor the condition, and the lower the value better the condition. Hence, around five percent of respondents have a monthly income above ₹21,000, and their value is 0, while twenty percent of respondents' monthly payment varies from ₹6,000–₹9,000, and their value is 1 (Table 10). Respondents moving toward 0 values are in better condition than those moving towards 1. The Livelihood Vulnerability Index (LVI) for shopkeepers is 1 which means they are the most vulnerable, followed by priests with 0.6 value, while Ganga Praharis are the least susceptible with 0 value, followed by task force workers (table 11).

Table 11 Occupational Profile of Participants

Occupational Profile	Number of Participants	Participants %	Livelihood Vulnerability Index (LVI)
Fishermen	10	10	0.333333333
Boatman/Boatmen	12	12	0.466666667
Priests/Pandas	18	18	0.866666667
Doms	16	16	0.733333333
Task Force	8	8	0.2
Ganga Prahari	5	5	0
Shopkeepers	20	20	1
Sanitary Workers	15	15	0.666666667
Total	100	100	4.266666667

Source Field Survey, 2023

Way Forward

a. Cradle of Civilization

For local communities, the Ganga is part of a spiritual ad cultural identity, and they will never allow ghats to be treated as the centre of recreational activities such as picnic spots and swimming pools. They will sacrifice their lives to preserve and protect the rich heritage of Varanasi. The ghats are renowned for being a symbol of unity where Muslims and Hindus perform their respective religious activities using the same Ganga water. People perform several routine activities on ghats other than the religious ones in the early morning, including physical exercise, yoga, excursion and many others. Several trained yoga persons are there, helping and teaching the learner to perform yoga with proper postures and techniques. These ghats are everything to them because they are born there and brought up amidst them and will eventually perish as ashes in the river with the hope of new life in heaven.

b. Turtle Wildlife Sanctuary

Turtles are crucial in cleaning river water as they act as a natural sweeper for life below water. This has motivated the district environment authority to set up a turtle wildlife sanctuary in Varanasi. The sanctuary is spread for seven kilometers from the Malviya road/rail bridge to Ramnagar fort to conserve their population. Turtles feed on unburned human corpses and contribute to improving the water quality because they contribute to a significant reduction in aquatic pollution. More than 55,000 turtles have been released into the Ganga River so far. The turtle rehabilitation plan was started, and under the plan, two sites were selected, the first at Kukrail forest in Lucknow and the second at Sarnath in Varanasi (Sonkar et al., 2019).

c. Bioremediation

Bioremediation is a natural waste management method wherein organisms such as bacteria, fungi and earthworms are used to break down hazardous substances into non-toxic substances either in ex-situ or in-situ. These organisms work either in aerobic or anaerobic conditions in the presence or absence of oxygen (O_2). In Bioremediation, the breakdown activity of these microorganisms is accelerated, and then the decomposition process of contaminated substances accelerates. Several exogenous microbes are nurtured and introduced to clean contaminated sites to accelerate bioremediation. With this method, there is no use of chemicals, and instead naturally occurring purifiers such as microorganisms are employed. The procedure is very cheap and requires a significantly less time of six months or even less for commissioning, while sewage treatment plant is costly.

d. People's Participation and Awareness

Grassroots initiatives such as Green Good Deeds, sensitize tourists, visitors and devotees to not throw plastic products in the river and avoid littering the ghats. Ganga Gram Yojana is another programme launched to decrease the rural water pollution load. Under the yojana, it is necessary to make people aware of the harmful effects of open defecation and contaminated household water that directly enter

the Ganga through drains and nallas. Around fifty-four villages were selected in the yojana from Varanasi that mainly constitute three blocks such as Cholapur, Chiraigaon and Kashi Vidyapeeth. In the adopted villages, wherever open drain flows into the Ganga are now diverted, and an alternative sewage treatment plant is to be installed (Table 8). Ganga Hariteema Yojana was launched in Varanasi to control soil erosion and increase green cover along the catchment area of the Ganga. *One Person, One Tree* is the slogan of Ganga Hariteema Yojana, wherein a tree-planting drive was carried out, and people from all sections of the society took part. Ganga Praharis is another people's participation drive that consists of highly skilled, trained and motivated volunteers such as students, teachers, and devotees, mainly encouraging the local community.

e. Plans and Policies

The Ganga Action Plan (GAP), launched in 1985, aimed to inhibit pollutants from reaching the water bodies and bring Ganga water quality to the desired level. It primarily focused on diversion and interception to treat municipal sewage in towns. Later, National River Conservation Plan (NRCP) was launched in 1995 and merged with GAP Phase-II to prevent river pollution. It emphasized afforestation, riverfront development, construction of sewage treatment plan and low-cost sanitation facilities. National River Ganga Basin Authority (NRGBA) followed this was launched in 2009 to complete the objectives laid down in GAP. NRGBA focused on conserving the river in a more comprehensive and synergized way. The residents were given a free hand and proper space to pool their indigenous knowledge about the Ganga to work on planning and management tasks in NRGBA. It develops synergy between traditional and modern knowledge to address the continuous changing dynamics of the aquatic ecological system. Later, National Mission for Clean Ganga (NMCG) was registered as a society under Societies Registration Act, 1860, in 2011 to fulfil the river's geological and cultural functions. It involves judicious use of aquatic resources and water, keeping in mind their sustainable development. Further, it scrutinizes human activities in an accountable and more transparent framework. But none of them has lived up to their expectation, but Namami Gange is proving them wrong by rightfully delivering the goods.

f. Changing Livelihood Dynamics and Social System

People living around ghats are compelled to give one or two rooms of their house for rent because they don't have any other suitable source of livelihood to support their families. Traditional works such as teaching Sanskrit in *pathshaalas* (schools) are lesser forms of sustaining a livelihood. Their formal employment was affected by the COVID-19 pandemic due to government guidelines that prohibited physical pathshaala/schooling. They also want their children to receive computer-aided modern education and be part of a mainstream education system, but the livelihood dynamics constitute a

significant hurdle. They offer resistance as regards a compromising of those principles inherited from their ancestors, but are now slowly adapting to the changing dynamics so as to survive the effects of inflation and the pandemic. The changing river dynamics threaten livelihood dynamics, river ecology and long-term sustainability.

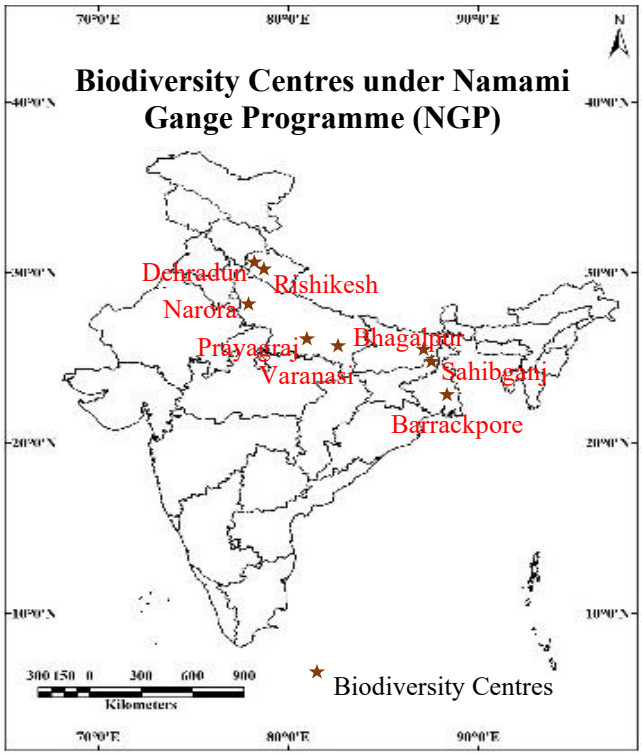

Fig. 10 Eight Biodiversity Centres (Ministry of Jal Shakti, 2021; Prepared by Author, 2023)

h. Namami Gange Programme (NGP)

The Namami Gange Programme (NGP) is an integrated conservation mission launched in June 2014 to solve the problem of pollution in the Ganga and rejuvenate the river in all its forms. It is an umbrella programme aiming to merge all past and ongoing programmes under one initiative. NGP is divided into three categories: entry-level for immediate impact, medium-term within five years, and long-term for 10 years. The programme has initiated several projects such as Ganga rejuvenation, biodiversity conservation, Gangetic Dolphin conservation, and fish and fishery conservation. Regarding this, eight biodiversity conservation centres were declared across India. It includes the areas of Prayagraj, Sahibganj, Rishikesh, Varanasi, Narora, Barrackpore, Bhagalpur and Dehradun to restore multiple identified species (Fig. 10).

In Varanasi, to stop the drain water flow in the river, five sewage pumping stations (SPS) have been developed at several places. It includes Trilochan ghat SPS, Mansarovar ghat SPS, Jalasena ghat SPS, Dr R.P. ghat SPS and Harishchandra ghat SPS. In case of pollution abatement in Varuna River, 3 sewers are constructed: Chaukaghat SPS, Phulwariya SPS and Saraiya SPS. The river is also polluted

by Ramnagar sewage, hence all sewers of Ramnagar are destined be diverted and treated in nearby areas or points of origin. The mission comprises geological guarding, river hazards management, basin protection, environmental knowledge, sustainable agriculture and ecological restoration. The thrust area contains geographical information system (GIS) and spatial planning, research projects, conserving Gangetic aquatic life, Ganga task force, Panchayati Raj Institutions and many others. The projects under NGP are divided into short-term, medium-term and long-term. It includes river surface cleaning, aquatic water flow, industrial sewage management, water quality monitoring, memorandum of understanding (MoU) with ministries, afforestation, Ganga gram and biodiversity conservation.

Recommendations and Suggestions

State-of-the-art technology such as modern skimmers and robots are a better option, and are a viable option to clean the Ganga as it is an ecological asset for the nation. There should be a complete ban on the use of single-use plastic products like bottles, glass and polybags, as proposed from the first of July, 2022. Adequate funding is needed to achieve the objectives of several government programmes as most of the crucial work is stuck due to inadequate or lack of funds. Construction of check dams, tunnels and bridges, and sand mining on the Ganga should be stopped with immediate effect. Eco-friendly practices such as turtle wildlife sanctuary and rainwater harvesting should be encouraged along the river's bank. People's participation from all the sections of society is highly appreciable because people are the heart and soul of the success of any programme.

Conclusion

The Ganga is more than a river; it is a sustaining force that has shaped life and culture in Varanasi for millennia. Yet this sacred lifeline is now under severe ecological stress from sewage discharge, ritual practices, cremation, and the accumulation of waste along the ghats. Protecting the Ganga therefore requires recognising that cultural reverence must be matched by responsible stewardship. Measures such as bioremediation, expanded wastewater treatment, composting, and restoring biodiversity along the riverbanks can collectively rejuvenate the river’s health, but only if supported by sustained public participation and policy commitment. Although the Ganga was granted the status of a living entity in 2008, this symbolic recognition must translate into everyday awareness and accountable action. A resilient future for Varanasi depends on collaborative decisions involving geographers, planners, environmental activists, scientists, and the local community. Maintaining the dignity and aviral dhara of the river is not only a duty to the present but a promise to future generations. The path ahead is long, but essential.

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