Restoring the Sacred Ganga: Pollution Solutions and Cultural Preservation in Haridwar and Rishikesh

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***Abstract*—The Ganga River, a sacred Hinduism River, is facing a pollution crisis in Haridwar and Rishikesh, particularly in the Triveni Ghat to Janki Setu stretch. Untreated municipal sewage, industrial effluents, and religious offerings have severely degraded the river's water quality, making it non-potable and violating the Water (Prevention and Control of Pollution) Act of 1974. This pollution threatens the river's ecological integrity and human rights by compromising access to clean water. The study criticizes the gross negligence in wastewater management, including the direct discharge of effluents into the river instead of redirecting them to forests or barren lands for irrigation. Despite initiatives like the Namami Gange Programme and the Ganga's legal personhood status, regulatory failures and limited community engagement hinder progress. The research proposes a holistic restoration framework, integrating advanced wastewater treatment, stricter industrial regulations, community-driven conservation, and alignment with global river restoration models like the Thames and Rhine. By redirecting treated effluents to non-potable uses and leveraging religious values, the Ganga's sanctity and ecological vitality can be restored, ensuring compliance with environmental laws and human rights obligations. Urgent action is needed to restore the Ganga's sanctity and ecological health, emphasizing the gross negligence in current practices.**

***Keywords*—Ganga River, pollution, Haridwar, Rishikesh, sacred significance, environmental degradation, heavy metals, wastewater management, Namami Gange, river restoration**

I. Introduction

The Ganga River, considered sacred in Hinduism, flows through Haridwar and Rishikesh, cities steeped in religious and cultural significance. However, the river faces severe pollution challenges, impacting both its ecological health and the religious beliefs of its devotees. This response examines the pollution's effects on these aspects and the role of environmental laws in addressing the issue.

A. Pollution Status and Its Impact on the Ganga River

1) Water quality in Haridwar and Rishikesh

The Ganga River in Haridwar and Rishikesh is subjected to various pollutants, including untreated sewage, industrial waste, and agricultural runoff. Studies indicate that while Haridwar's water quality improved during the COVID-19 lockdown due to reduced human activity, the unlock phases led to a deterioration in water quality [1, 2]. It is seen that (Table 1); the river's Water Quality Index (WQI) in Haridwar was found to be in the "good" category, but parameters like Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD) showed significant variations, indicating ongoing pollution issues [3, 4].

Table 1. Water quality parameters in Haridwar and Rishikesh

Location	Key Parameters	Observations	Citation
Haridwar	DO: 10.32–13.24 mg/L	Indicates good water quality, but seasonal variations exist	[3, 4]
Rishikesh	BOD: 1.08–3.66 mg/L	Suggests moderate pollution levels, with some parameters exceeding safe limits	[3, 5]
Haridwar	Heavy Metals (As, Cr)	Cancer risk values exceed the target risk of 1×10^{-4}, posing health risks	[6, 7]

In Rishikesh, the water quality is generally better than in downstream cities like Kanpur or Varanasi, but it is not entirely free from contamination. The river's suitability for drinking, irrigation, and industrial use has been assessed, with most parameters within permissible limits except for fecal coliforms, which often exceed safe levels [3, 5].

2) Heavy metal contamination

Heavy metal pollution is a critical concern in the Ganga River. In Haridwar, the presence of Arsenic (As) and Chromium (Cr) in the water has been reported, with cancer risk values exceeding the target risk of 1×10^{-4}, posing long-term health risks to the population [6]. Similarly, in Rishikesh, the presence of heavy metals like lead (Pb) and copper (Cu) has been detected, though at lower concentrations compared to downstream regions [7, 8].

B. Impact of Religious and Touristic Activities

Religious activities, such as mass bathing during festivals, significantly impact the river's water quality. In Haridwar, the influx of pilgrims during events like the Kumbh Mela leads to increased levels of BOD, COD, and Total Dissolved Solids (TDS), while DO levels decrease [9, 10]. Despite the river's self-cleansing properties, the sheer volume of pollutants during such events overwhelms its natural restoration capacity [10].

In Rishikesh, the generation of solid waste and discharge of untreated sewage from nearby commercial areas further exacerbate pollution. The river's water quality deteriorates significantly during peak tourist seasons, highlighting the need for stricter waste management practices [3, 11].

C. Impact on Religious Beliefs and Practices

1) Changing perceptions of the Sacred River

The Ganga River is revered as a goddess in Hinduism, and its water is believed to have purificatory properties. However, the increasing pollution has led to a shift in how devotees interact with the river. Many worshippers have reduced their

contact with the river, opting for symbolic rituals rather than direct bathing or drinking the water [12]. This change reflects a growing awareness of the river's deteriorating quality and its potential health risks.

2) Renegotiation of ritualistic practices

Devotees are increasingly adopting alternative practices, such as using bottled water for religious rituals or shifting their worship sites to less polluted stretches of the river [12]. These changes underscore the tension between the river's cultural significance and its environmental degradation. While the Ganga remains a symbol of spirituality, its pollution has forced a reevaluation of traditional practices.

II. Environmental Laws and Governance

A. Existing Legal Frameworks

India has implemented several policies to address Ganga River pollution, including the Ganga Action Plan (GAP) and the Namami Gange Programme. These initiatives aim to reduce pollution through the construction of Sewage Treatment Plants (STPs), industrial effluent treatment, and awareness campaigns [13, 14]. However, the effectiveness of these measures has been limited due to inadequate enforcement and a lack of community involvement [13, 15].

B. Legal Innovations: Granting Personhood to the Ganga

In a landmark judgment, the Uttarakhand High Court granted the Ganga River legal personhood, recognizing it as a living entity with rights to restoration and conservation [15]. This legal innovation aims to enhance accountability for pollution control and ensure the river's ecological integrity. However, the practical implementation of this ruling has faced challenges, including the lack of a clear framework for enforcement [15].

C. Community-Based Solutions

While top-down policies dominate pollution mitigation efforts, there is a growing recognition of the need for community-based solutions. Engaging local communities in river conservation can foster a sense of ownership and responsibility, complementing governmental initiatives [13, 16]. Religious leaders and organizations have also played a role in promoting environmental awareness, linking the preservation of the Ganga to broader cultural and spiritual values [12].

The pollution of the Ganga River in Haridwar and Rishikesh has far-reaching implications for both the environment and religious practices. While the river's water quality has shown improvement during periods of reduced human activity, such as the COVID-19 lockdown, the resumption of normal activities has led to a decline in water quality [1, 2]. The presence of heavy metals and high levels of organic pollution pose significant health risks to the population [6, 7].

The river's cultural significance as a sacred entity has led to a renegotiation of religious practices, with devotees adopting alternative rituals to minimize contact with polluted water [12]. Environmental laws, including the granting of legal personhood to the Ganga, represent a paradigm shift in river governance, though their effectiveness depends on robust enforcement and community engagement [13, 15].

Ultimately, the conservation of the Ganga River requires a holistic approach that integrates scientific, legal, and cultural perspectives. By addressing the root causes of pollution and fostering a sense of stewardship among all stakeholders, it is possible to restore the river's health and preserve its sacred status for future generations.

III. The Ganga as a Sacred and Ecological Lifeline

The Ganga River, one of the most revered rivers in the world, holds a dual significance as both a sacred entity and an ecological lifeline. It is not just a river but a cultural, spiritual, and ecological backbone for millions of people in the Indian subcontinent. This response explores the Ganga's role as a sacred and ecological lifeline, the challenges it faces, and the efforts being made to preserve its integrity.

A. Sacred Significance of the Ganga

The Ganga is deeply embedded in Hindu mythology and culture. It is considered the divine goddess Ganga, who descended from heaven to Earth to purify the souls of humanity and provide sustenance to all life forms. The river is a central element in Hindu rituals, with its waters believed to possess purificatory and emancipatory powers. Millions of devotes bathe in its waters, drink from it, and use it for religious ceremonies, believing it to be a pathway to spiritual liberation (Moksha) [17–19].

The ghats (stepped landings) along the Ganga, particularly in cities like Varanasi, are iconic symbols of its sacredness. These ghats serve as spaces for religious bathing, cremation, and communal gatherings, reinforcing the river's role in both life and death [19–21].

The cultural significance of the Ganga extends beyond religion. It has inspired countless literary and artistic works, with its imagery often symbolizing wisdom, resilience, and the flow of life. The river is personified as "Mother Ganga," nurturing the land and its people, and its flow is seen as a metaphor for the journey of life [17].

B. Ecological Importance of the Ganga

The Ganga is an ecological lifeline, supporting over 500 million people in its basin. It is the largest river basin in India and sustains agriculture, industry, and urban centers. The river's fertile plains are the backbone of India's food production, and its waters support a rich biodiversity, including iconic species like the Ganga dolphin, Ganga shark, and Mugger crocodile [22–24].

The Ganga's self-purifying capacity, attributed to its bacteriophage cleaning properties, has long been a natural asset. However, this capacity is being overwhelmed by increasing pollution and human activities [19, 25].

The river's ecological health is further threatened by climate change, deforestation, sand mining, and the construction of dams and barrages. These factors disrupt the river's flow, sediment transport, and aquatic habitats, leading to a decline in its biodiversity and ecosystem services [22, 26, 27].

IV. Challenges Facing the Ganga

A. Pollution and Environmental Degradation

The Ganga is one of the most polluted rivers in the world. Untreated sewage, industrial effluents, agricultural runoff,

and waste from religious practices have severely degraded its water quality. Heavy metals and pollutants in the water pose serious health risks to both humans and aquatic life [12, 25 28].

B. Over-Exploitation of Resources

Excessive water abstraction for irrigation, urban consumption, and industrial use has depleted the river's flow. Dams and barrages have disrupted its natural flow regime, affecting sediment transport and the health of its floodplains [24, 29].

C. Climate Change and Glacier Retreat

The melting of the Gangotri-Gaumukh glacier, the source of the Ganga, due to climate change, threatens the river's long-term sustainability. This not only impacts the river's flow but also jeopardizes the livelihoods and cultural practices of communities dependent on it [27].

V. Efforts to Rejuvenate the Ganga

A. Government Initiatives

The Indian government has launched several programs to clean and restore the Ganga, including the Ganga Action Plan (GAP) and the Namami Gange Programme. These initiatives focus on pollution control, afforestation, and public participation. However, their success has been limited due to inadequate community involvement and centralized planning [20, 25].

B. Community-Based Approaches

Recognizing the limitations of top-down approaches, there is a growing emphasis on community-based models for river management. Local communities, NGOs, and religious leaders are increasingly involved in conservation efforts, blending traditional knowledge with modern scientific practices [18, 30].

C. Ecohydrological Approaches

An integrated ecohydrological approach has been proposed for the Ganga's management. This approach focuses on restoring the river's natural flow, biodiversity, and ecosystem services while addressing the needs of human populations [23, 31].

VI. Ganga

The stretch of the Ganga River between Triveni Ghat and Janki Setu is significantly affected by untreated water pollution, primarily due to the discharge of untreated municipal and industrial waste. This pollution is exacerbated by various anthropogenic activities and environmental challenges, leading to a deterioration in water quality and posing serious ecological and health risks. The following sections provide a detailed analysis of the factors contributing to this pollution and the implications for the river's ecosystem.

A. The Interplay of Sacredness and Ecology

The Ganga's sacredness and ecological health are deeply intertwined. While its religious significance has historically protected it, the growing awareness of its ecological decline is reshaping how people interact with the river. Devotees are increasingly renegotiating their practices, such as reducing direct contact with polluted waters or advocating for pollution abatement [12, 32].

Religious and cultural values are being leveraged to inspire environmental stewardship. For example, the concept of "dharm" (duty) is being invoked to promote sustainable water use and pollution control [18]. Kumar *et al.* [33] emphasize the importance of integrating sustainable practices in India's liquor sector to balance economic growth with public health and environmental considerations.

The Ganga's preservation requires a holistic approach that integrates its sacred and ecological dimensions. This includes:

1. **Community Participation**: Empowering local communities to take ownership of river conservation through education and involvement in decision-making processes [20, 30].
2. **Sustainable Water Management**: Implementing policies to reduce water abstraction, control pollution, and restore natural flow regimes [24, 29].
3. **Ecohydrological Restoration**: Adopting nature-based solutions to enhance biodiversity, improve water quality, and maintain ecosystem services [23, 31].
4. **Cultural and Religious Mobilization**: Leveraging the river's sacredness to inspire environmental action and promote a sense of responsibility among devotees [12, 18].

It is seen that (Table 2) the Ganga is more than a river; it is a symbol of life, spirituality, and cultural identity. Its dual role as a sacred and ecological lifeline makes it a unique case study for integrated river management. While the challenges are immense, the Ganga's resilience and the dedication of its stakeholders offer hope for its rejuvenation. By bridging the gap between science and spirituality, the Ganga can continue to nurture both the soul and the environment for generations to come.

Table 2. Cultural, ecological, and management aspects of the ganga

Aspect	Description	Citation
Cultural Significance	Revered as a goddess with purificatory powers; central to Hindu rituals	[18, 19]
Ecological Importance	Supports 500 million people; rich biodiversity; self-purifying capacity	[23, 24]
Management Challenges	Pollution, over-exploitation, climate change, and inadequate governance	[25, 29]

B. Sources of Pollution

1) Untreated sewage and industrial waste

A significant portion of the pollution in the Ganga River is attributed to untreated sewage and industrial effluents. Daily, millions of liters of untreated waste are discharged into the river, contributing to its degradation [34, 35].

2) Agricultural Runoff

The use of fertilizers and pesticides in agriculture leads to runoff that carries these chemicals into the river, further polluting the water and affecting its quality [34].

3) Sand Mining and Construction

Activities such as sand mining and bridge construction along the riverbanks contribute to the pollution by disturbing

the riverbed and increasing sedimentation [36].

VII. Environmental and Health Impacts

A. Water Quality Degradation

The presence of heavy metals and other pollutants has led to a decline in water quality, as indicated by various water quality indices such as Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) [37, 38].

B. Health Risks

The polluted water poses significant health risks, including waterborne diseases such as diarrhea, which is particularly prevalent among children under five [39].

C. Ecological Damage

The pollution has led to a reduction in biodiversity and has endangered various aquatic species. The reduced flow of the river due to upstream water diversions further exacerbates these ecological issues [26, 40].

VIII. Mitigation Efforts

A. Government Initiatives

The Indian government has launched several initiatives to address the pollution in the Ganga, including the installation of Sewage Treatment Plants (STPs) and the implementation of stricter norms for wastewater treatment [41].

B. Community and Grassroots Movements

Local communities and grassroots organizations have been actively involved in campaigns to clean the river and raise awareness about the importance of maintaining its health [35].

While significant efforts are being made to address the pollution in the Ganga River, challenges remain. The complexity of the issue is compounded by factors such as climate change, which affects water availability and quality. Additionally, the socio-economic implications of water pollution, such as reduced agricultural yields and economic growth, highlight the need for comprehensive and sustainable solutions [34, 39]. Addressing these challenges requires a multi-faceted approach that includes technological innovations, policy interventions, and community engagement to restore the river to its pristine state.

IX. Ganga Pollution

A. Challenges and Solutions

The Ganga River, particularly in the regions of Haridwar and Rishikesh, faces significant environmental and cultural challenges due to pollution. The river, revered as sacred, is heavily polluted by industrial effluents, untreated sewage, and religious activities, which have led to a deterioration in water quality and adverse impacts on human health and the ecosystem. Despite various governmental initiatives, the pollution levels remain high, necessitating a comprehensive approach to address these issues. This response will explore the environmental and cultural impacts of Ganga water pollution and propose potential solutions.

B. Environmental Impacts

1) Water quality degradation

The Ganga River's water quality is severely compromised due to industrial discharges and untreated sewage. Studies have shown that the Water Quality Index (WQI) at Haridwar is poor, with high levels of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), indicating significant organic pollution [4, 7].

2) Heavy Metal Contamination

The presence of heavy metals such as lead, chromium, and cadmium in the river water and sediments poses a serious threat to aquatic life and human health. These metals exceed permissible limits, leading to chronic health issues and ecological damage [42, 43].

3) Ecosystem Disruption

Pollution has led to the degradation of aquatic habitats and loss of biodiversity. The reduced flow of the river due to water diversions further exacerbates the concentration of pollutants, affecting the river's self-purifying capacity [26].

X. Cultural Impacts

A. Religious Practices

The Ganga is central to Hindu religious practices, with millions of pilgrims visiting Haridwar and Rishikesh for ritual bathing. However, the pollution has made the water unsafe for such activities, challenging the cultural and spiritual significance of the river [20, 44].

B. Community Livelihoods

Many communities depend on the Ganga for their livelihoods, including those involved in religious tourism and fishing. Pollution threatens these livelihoods by making the river less attractive to tourists and reducing fish populations [20].

XI. Proposed Solutions

A. Improved Waste Management

Enhancing sewage treatment infrastructure and ensuring the treatment of industrial effluents before discharge into the river are critical steps. This requires investment in modern treatment technologies and strict enforcement of environmental regulations [45, 46].

B. Public Participation and Awareness

Engaging local communities in pollution control efforts and raising awareness about the importance of maintaining river health can foster a sense of ownership and responsibility. Programs like the Namami Gange emphasize community involvement for effective river rejuvenation [20, 25].

C. Restoration of River Flow

Increasing the natural flow of the river by managing water diversions and promoting groundwater-based irrigation can help dilute pollutants and restore the river's ecological balance [46].

D. Policy and Governance

Strengthening governance frameworks, reducing corruption, and enhancing accountability in pollution control agencies are essential for effective implementation of pollution control measures [45].

While the Ganga River faces significant pollution challenges, it is important to recognize the efforts made by

various stakeholders to address these issues. Government initiatives like the Ganga Action Plan and Namami Gange have laid the groundwork for river rejuvenation, although their success has been limited by implementation challenges. A holistic approach that combines technological solutions, community engagement, and policy reforms is crucial for restoring the Ganga's health and preserving its cultural heritage.

XII. Ganga Pollution in Haridwar and Rishikesh

A. Environmental and Cultural Consequences

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While the Ganga River faces significant pollution challenges, it is important to recognize the efforts made by various stakeholders to address these issues. Government initiatives like the Ganga Action Plan and Namami Gange have laid the groundwork for river rejuvenation, although their success has been limited by implementation challenges. A holistic approach that combines technological solutions, community engagement, and policy reforms is crucial for restoring the Ganga's health and preserving its cultural heritage.

XIV. The Sacred Ganga

A. Faith, Culture, and the Crisis of Pollution

The Ganga River holds immense cultural and religious significance in Hinduism, symbolizing purity, life, and spiritual liberation. It is revered as a goddess and is central to numerous rituals and pilgrimages, particularly in sacred cities like Haridwar and Rishikesh. However, the river's sanctity is under threat due to severe pollution, which many view as a desecration and a crime against faith. This paradox of reverence and neglect highlights the complex relationship between cultural practices and environmental stewardship.

B. Religious Importance in Hinduism

The Ganga is considered the most sacred river in Hinduism, personified as a goddess with purificatory powers. Bathing in its waters is believed to cleanse individuals of sins and aid in achieving Moksha, or liberation from the cycle of reincarnation [12, 32]. The river is central to many Hindu rituals and festivals, such as the Kumbh Mela, which attracts millions of devotees seeking spiritual renewal [47].

C. Role in Rituals and Pilgrimages

Haridwar and Rishikesh are prominent pilgrimage sites where the Ganga's spiritual significance is celebrated through

rituals like the Ganga Aarti, a daily worship ceremony involving fire offerings [47]. Pilgrims often collect Ganga water for use in religious ceremonies, believing in its divine properties [32].

D. Pollution as a Crime Against Faith

Despite its sacred status, the Ganga is one of the most polluted rivers globally, with pollution levels far exceeding safe limits. This pollution is primarily due to untreated sewage, industrial waste, and heavy metals [43, 44, 48]. The degradation of the river is seen by many as a violation of its sanctity, prompting calls for stricter environmental regulations and a shift in public attitudes towards conservation [26, 49].

E. Cultural and Historical Significance

The Ganga is deeply embedded in Indian culture and history, influencing literature, philosophy, and religious practices. It is associated with life and death, symbolizing both creation and purification [50]. The river has inspired countless works of art and literature, reflecting its integral role in shaping Indian identity and spirituality [51].

While the Ganga's religious and cultural significance remains profound, the ongoing pollution crisis poses a significant challenge to its sanctity. Efforts to address this issue require a balance between traditional reverence and modern environmental practices. The river's plight underscores the need for a collective commitment to preserving its purity, not only as a matter of faith but also as a crucial environmental and cultural resource.

XV. India's Water Pollution Laws

A. Gaps Between Legislation and Enforcement

India's water pollution laws, primarily the Water (Prevention and Control of Pollution) Act of 1974, aim to prevent and control water pollution through a comprehensive regulatory framework. Despite these laws, regulatory failures in monitoring and enforcement have led to widespread non-compliance, particularly in the discharge of untreated and poorly treated waste. This situation is exacerbated by the lack of resources and effective enforcement mechanisms, resulting in significant environmental and public health challenges. The following sections delve into the specifics of these issues.

B. Overview of Indian Water Pollution Laws

The Water Act of 1974 was the first major legislative effort in India to address water pollution, establishing central and state pollution control boards to enforce regulations [52]. The Environment (Protection) Act of 1986 further strengthened water quality regulations, providing a broader framework for environmental protection. Legal actions, including public nuisance suits and the common law rights of riparian owners, supplement these statutory measures. The Supreme Court of India and the National Green Tribunal have played active roles in enforcing these laws through judicial interventions [53].

C. Regulatory Failures in Monitoring and Enforcement

Despite the existence of robust legal frameworks, enforcement is weak due to insufficient funding, manpower, and political will. Pollution control boards often lack the resources to effectively monitor and enforce compliance, leading to widespread violations [54]. The Central Pollution Control Board identified severely polluted stretches on 18 major rivers, highlighting the failure of regulatory mechanisms in urban areas [55]. The Public Accounts Committee has noted that water pollution weakens ecosystems and poses serious health risks, yet enforcement remains inadequate [56].

D. Discharge of Untreated and Poorly Treated Waste as Legal Non-compliance

Untreated sewage is the largest source of water pollution in India, with millions of liters entering water bodies daily, often without adequate treatment [34]. Industrial clusters contribute significantly to pollution, with many industries discharging untreated toxic waste into rivers and lakes [54]. The lack of compliance with environmental rules is widespread, with serious violations being the norm rather than the exception [57]. Agricultural runoff and unregulated small-scale industries further exacerbate the pollution problem, affecting both surface and groundwater quality [34].

While India's legal framework for water pollution is comprehensive, the effectiveness of these laws is undermined by poor enforcement and regulatory failures. The discharge of untreated waste remains a significant issue, highlighting the need for improved monitoring and stricter compliance measures. Addressing these challenges requires not only legal reforms but also increased public awareness and participation in environmental protection efforts.

XVI. Pollution Sources in Haridwar and Rishikesh

A. A Multifaceted Challenge

The pollution in Haridwar and Rishikesh, two significant cities along the Ganga River, is a multifaceted issue involving various sources. These include human waste, industrial effluents, ineffective wastewater treatment, and other contributors such as religious offerings, tourism, and urban runoff. Each of these sources contributes to the degradation of water quality, impacting both the environment and public health. The following sections delve into each of these pollution sources, supported by findings from relevant studies.

B. Human Waste: Sewage and Domestic Effluent

Untreated sewage is a major source of pollution in the Ganga River, with a significant portion of it being discharged directly into the river without adequate treatment. This is a common issue across many Indian cities, including Haridwar and Rishikesh [34, 58]. The presence of high levels of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in the river indicates the substantial organic pollution from domestic effluents [4, 59].

C. Industrial Waste: Effluent from Factories and Small Industries

The SIDCUL industrial area in Haridwar is a significant contributor to industrial pollution, with effluents containing high levels of Total Suspended Solids (TSS), BOD, and COD, which exceed permissible limits [60–61]. Heavy metals such as iron, lead, manganese, and cadmium have been detected in the river water, posing risks to human health and aquatic life [42].

D. Ineffective Wastewater Treatment

The inefficiency of sewage treatment plants in Haridwar exacerbates the pollution problem, as untreated or partially treated sewage is released into the river [4]. Observations from Triveni Ghat to Janki Setu highlight the inadequacy of current wastewater treatment facilities, which fail to handle the volume of waste generated by the population and tourists [59].

E. Other Contributors: Religious Offerings, Tourism, and Urban Runoff

Religious practices, such as the disposal of offerings and ashes, contribute to the pollution load in the river. These activities are culturally significant but environmentally detrimental [58]. Tourism, a major economic activity in Haridwar and Rishikesh, leads to increased waste generation, including plastic and other non-biodegradable materials [4]. Urban runoff, particularly during the monsoon season, carries pollutants from streets and urban areas into the river, further degrading water quality [62].

While the pollution in Haridwar and Rishikesh is a pressing issue, efforts to address it are ongoing. Government initiatives like the Ganges Action Plan aim to improve wastewater treatment and reduce industrial discharges [58]. However, the success of these programs depends on comprehensive strategies that include public awareness, stricter enforcement of environmental regulations, and the adoption of eco-friendly technologies [38]. Balancing cultural practices with environmental sustainability remains a challenge, but it is essential for the long-term health of the Ganga River and the communities that depend on it.

F. Environmental and Health Impacts of Ganga River Pollution

The Ganga River, a vital waterway in India, faces significant environmental and health challenges due to pollution. Industrial discharges, heavy metal contamination, and bacterial pollution have severely degraded water quality, impacting aquatic ecosystems and posing public health risks. Efforts like the Namami Gange project have been initiated to address these issues, but challenges remain. This response explores the degradation of water quality, impacts on aquatic ecosystems, public health risks, and biodiversity loss in the Ganga River.

G. Degradation of Water Quality: Non-Potable Ganga Water

Industrial pollution is a major contributor to the degradation of the Ganga's water quality. Untreated and semi-treated industrial wastes alter the river's physicochemical properties, making the water non-potable [63]. Heavy metal contamination, including lead, cadmium, and chromium, exceeds permissible limits, further compromising water quality [43, 64]. Bacterial contamination, with high levels of total coliforms and fecal coliforms, poses significant health risks, making the water unsafe for drinking and bathing.

H. Impact on Aquatic Ecosystems

The discharge of pollutants leads to bioaccumulation and biomagnification in aquatic organisms, disrupting the food web and affecting biodiversity [63]. Heavy metals in water and sediments pose ecological risks, particularly in the middle and lower reaches of the river, threatening sediment dwellers and aquatic life [65]. Efforts under the Namami Gange project have shown improvements in water quality and some restoration of aquatic habitats, but continuous monitoring and management are necessary to sustain these gains [66].

I. Public Health Risks from Contaminated Water

Exposure to heavy metals in the Ganga has been linked to severe health issues, including neurotoxicity, kidney damage, and cancer [43, 67]. Bacterial contamination from untreated sewage and industrial effluents increases the risk of waterborne diseases, with significant cases reported during mass bathing events [68, 69]. The presence of pathogens and high bacterial density in the water underscores the urgent need for improved sanitation and pollution control measures [68].

J. Loss of Biodiversity in the Ganga

Pollution and habitat degradation have led to a decline in biodiversity, with many aquatic species at risk [63]. The Namami Gange project has facilitated some biodiversity recolonization, but the overall loss remains a concern due to ongoing pollution and habitat disruption [66]. The river's ecological health is further threatened by climate change, deforestation, and unsustainable land use practices [26]. While initiatives like the Namami Gange project have made strides in improving water quality and restoring ecosystems, the Ganga River continues to face significant challenges. Persistent pollution from industrial, agricultural, and domestic sources, coupled with inadequate infrastructure and management, hampers efforts to fully restore the river's health. A comprehensive, multi-faceted approach involving continuous monitoring, community engagement, and stricter enforcement of pollution controls is essential to safeguard the Ganga's ecological and public health integrity.

XVII. Gross Negligence in Wastewater Management

A. Key Challenges and Insights

Gross negligence in wastewater management is a multifaceted issue that encompasses inefficiencies in Sewage Treatment Plants (STPs), misrepresentation of treated water, lack of accountability and oversight, and socioeconomic factors driving negligence. These issues are prevalent across various regions, as evidenced by studies from Morocco, India, South Africa, and other parts of the world. The inefficiencies in STPs often stem from technological, financial, and human resource challenges, which are exacerbated by inadequate regulatory frameworks and socioeconomic pressures. This answer will explore these aspects in detail, drawing on insights from the provided research papers.

B. Inefficiencies in Sewage Treatment Plants (STPs)

1) Technological limitations

Many STPs, particularly in developing regions, suffer from outdated or inappropriate technologies that are not suited to the local sewage characteristics. For instance, in India, the Narela STP operates at only 17.5% of its capacity due to technological and maintenance challenges [70]. Similarly, in

South Africa, poor maintenance of wastewater infrastructure contributes significantly to water pollution [71].

2) Operational challenges

The lack of skilled manpower and inadequate training are critical issues affecting the efficiency of STPs. In India, unskilled operations have been identified as a major factor in the low efficiency of sewage treatment plants [72]. This is compounded by financial constraints that limit the ability to invest in training and advanced technologies.

C. Misrepresentation of "Treated" Water

1) Quality standards

There is often a discrepancy between the reported and actual quality of treated water. In Morocco, while some STPs meet WHO and FAO standards, a significant portion of wastewater is discharged without adequate treatment [73]. This misrepresentation can lead to the reuse of inadequately treated water, posing health risks.

2) Regulatory compliance

In South Africa, the lack of compliance with effluent discharge standards results in the release of poor-quality effluents, increasing health risks [74]. This highlights the need for stringent regulatory oversight to ensure that treated water meets safety standards.

D. Lack of Accountability and Oversight

1) Regulatory gaps

The absence of robust regulatory frameworks and enforcement mechanisms allows for negligence in wastewater management. In South Africa, there is no precedent for criminal liability in cases of negligence in wastewater treatment, which undermines accountability [74].

2) Monitoring and evaluation

Effective monitoring systems are often lacking, which hinders the ability to assess and improve the performance of STPs. In China, despite significant infrastructure investments, challenges persist due to inadequate monitoring and evaluation practices [75].

E. Socioeconomic Factors Driving Negligence

1) Financial constraints

Limited budgets and high costs of advanced technologies are significant barriers to improving wastewater management. This is particularly evident in developing countries where financial resources are scarce.

2) Public awareness and involvement

Socioeconomic factors, such as public awareness and involvement, play a crucial role in driving improvements in wastewater management. In Africa, enhancing public participation and government support is essential for addressing wastewater management challenges [76].

While the challenges in wastewater management are significant, there are also opportunities for improvement. Innovative solutions, such as the adoption of AI and IoT technologies, can enhance the efficiency of STPs. Additionally, developing indigenous technologies and strengthening regulatory frameworks can help address the root causes of negligence. By focusing on these areas, it is possible to improve wastewater management practices and mitigate the associated environmental and health risks.

F. Strategies for Sustainable Wastewater Management

Sustainable management of wastewater is crucial for addressing water scarcity and environmental pollution. The proposed solutions for sustainable management include redirecting treated wastewater for forest irrigation, upgrading and monitoring sewage treatment infrastructure, enforcing stricter industrial effluent standards, involving community awareness and religious leaders, and implementing policy reforms for better enforcement of environmental laws. These strategies aim to optimize resource use, reduce environmental impact, and enhance community engagement in sustainable practices.

1) Redirecting treated wastewater for forest irrigation

Utilizing treated wastewater for forest irrigation can significantly contribute to water conservation and ecosystem restoration. This approach not only helps in managing water scarcity but also supports the growth of vegetation, which can improve air quality and biodiversity [77, 78]. Nature-Based Solutions (NBS) such as constructed wetlands and willow systems can be employed to treat wastewater naturally, making it suitable for irrigation purposes [77].

2) Upgrading and monitoring sewage treatment infrastructure

Upgrading sewage treatment infrastructure is essential to handle the increasing wastewater generated due to urbanization and population growth. Modernizing these systems can reduce freshwater contamination and improve public health [79]. Real-time monitoring and control systems in wastewater treatment can enhance the quality of treated water and provide early warnings for any treatment failures [80].

3) Enforcing stricter industrial effluent standards

Stricter regulations on industrial effluents are necessary to prevent the release of untreated wastewater into municipal systems, which can lead to severe water pollution. Advanced treatment technologies such as membrane technology and electrochemical processes can be implemented to ensure that industrial wastewater is treated effectively before reuse [81, 82].

4) Community awareness and religious leader involvement

Raising community awareness about the importance of sustainable wastewater management can lead to more responsible water usage and support for environmental initiatives. Involving religious leaders can be an effective strategy to influence community behavior and promote sustainable practices, as they often hold significant sway in many communities [83].

5) Policy reforms for better enforcement of environmental laws

Policy reforms are crucial to ensure the effective enforcement of environmental laws and regulations. This includes setting clear guidelines for wastewater treatment and reuse, as well as penalties for non-compliance. Integrating wastewater management into the broader framework of Sustainable Development Goals (SDGs) can help align national policies with global sustainability targets [84].

While these solutions offer promising pathways for

sustainable wastewater management, challenges remain in their implementation. The high costs associated with upgrading infrastructure and adopting new technologies can be prohibitive for some regions. Additionally, achieving community buy-in and compliance with stricter regulations requires ongoing education and engagement efforts. Balancing these challenges with the need for sustainable practices is essential for long-term success in wastewater management.

6) Learning from global river restorations

The restoration of rivers is a complex process that involves understanding the unique challenges and opportunities presented by each river system. Successful models, such as those implemented for the Thames and Rhine Rivers, offer valuable insights into effective strategies for river restoration. These models emphasize the importance of comprehensive planning, community involvement, and the integration of scientific and traditional knowledge. Applying these global practices to the Ganga River, while considering lessons from other Indian river cleaning initiatives, can provide a framework for effective restoration efforts.

XVIII. Successful River Restoration Models

A. Thames River

The restoration of the Thames River in the UK has been successful due to high levels of sewage treatment and strict regulation of industrial effluents, which have significantly improved water quality. The Biochemical Oxygen Demand (BOD) and Dissolved Oxygen (DO) levels in the Thames are maintained at healthy levels, demonstrating the effectiveness of these measures [85].

B. Rhine River

The Rhine River restoration involved international cooperation and comprehensive pollution control measures, including the reduction of industrial discharges and the restoration of natural habitats. This has led to improved water quality and increased biodiversity [86].

XIX. Applicability of Global Practices to the Ganga

A. Integrated Management

The Namami Gange Program (NGP) is an integrated conservation mission that aims to rejuvenate the Ganga by implementing sustainable water management practices. This approach aligns with global practices that emphasize the need for coordinated efforts and technology preparedness [87].

B. Community Involvement

Successful global models highlight the importance of community engagement. The Ganga Action Plan and subsequent initiatives have struggled due to limited public participation. Enhancing community involvement could improve the effectiveness of these programs [20].

C. Pollution Control

Like the Thames, the Ganga requires stringent regulation of industrial and municipal waste. The establishment of Sewage Treatment Plants (STPs) under the Namami Gange Program has shown improvements in water quality, indicating the potential for further success with continued investment and regulation [66].

XX. Lessons from Other Indian River Cleaning Initiatives

A. Gomti River

The Gomti River restoration emphasizes the need for holistic wastewater management and sustainable urban planning. These strategies are crucial for mitigating pollution and enhancing river health, providing a model for the Ganga [88].

B. Hindon River

The Hindon River's challenges highlight the importance of treating sewage and industrial effluents. Lessons from the Thames River suggest that focusing on these areas can lead to significant improvements in water quality [85].

While global practices offer valuable insights, the unique cultural, social, and environmental context of the Ganga River presents distinct challenges. The religious significance of the Ganga and its role in daily life for millions of people necessitate a culturally sensitive approach that integrates traditional practices with scientific management. Additionally, the scale of pollution and the diverse sources of contamination require tailored solutions that address both point and non-point sources of pollution. By learning from both global models and local initiatives, a comprehensive and culturally appropriate strategy can be developed to restore the Ganga River.

XXI. Spiritual River, Environmental Crisis

The Ganges River, or Ganga, holds immense religious significance for Hindus, serving as a site for sacred rites and daily life activities. However, it faces severe pollution challenges due to untreated sewage, industrial effluents, and reduced water flow from dam constructions. Efforts to clean the river have been ongoing, yet they often struggle to balance religious sentiments with environmental protection. This complex issue requires a multifaceted approach involving government, NGOs, local communities, and a long-term vision for sustainability.

A. Balancing Religious Sentiments and Environmental Protection

The Ganges is deeply intertwined with Hindu religious practices, which complicates efforts to implement strict environmental regulations. Rituals such as bathing and cremation contribute to pollution but are integral to the cultural and spiritual life of millions [20, 48]. Religious teachings can be leveraged to promote environmental stewardship. Integrating spiritual values with environmental ethics can foster a sense of ecological responsibility among the faithful [89, 90]. Successful examples of religious teachings influencing environmental behavior suggest that a religious framework could support conservation efforts, potentially bridging the gap between religious practices and environmental needs [90, 91].

B. Challenges in Implementing Sustainable Solutions

Despite significant financial investments, such as the $27 billion allocated by the Indian government, pollution levels

remain high due to systemic issues like corruption, lack of accountability, and insufficient infrastructure [46]. The Ganga Action Plan and subsequent initiatives have been criticized for their centralized approach, which often excludes local communities from decision-making processes, limiting their effectiveness [20]. The high levels of toxins and bacteria in the river pose severe health risks, necessitating a shift towards zero discharge policies and the promotion of wastewater recycling and reuse [48].

C. Role of Government, NGOs, and Local Communities

Government initiatives like the Namami Ganga Project aim to clean the river, but require more inclusive strategies that involve local communities and NGOs to ensure sustainable outcomes [92]. NGOs and local communities can play a crucial role in monitoring pollution, advocating for policy changes, and educating the public about sustainable practices [26]. Collaborative efforts between religious leaders, environmental organizations, and government bodies can enhance public participation and foster a collective sense of ownership over the river's health [89, 91].

D. Long-Term Vision for a Clean Ganga

A sustainable model for Ganga rejuvenation, such as the Arth Ganga Project, emphasizes economic development alongside environmental conservation, aiming to create a symbiotic relationship between the river and its surrounding communities [92]. Long-term strategies should focus on enhancing river flow, reducing pollution sources, and promoting alternative irrigation methods to preserve water levels [46]. Integrating religious and cultural values into environmental policies can help align conservation efforts with the spiritual beliefs of the local population, ensuring broader support and compliance [93, 94]. While the religious significance of the Ganges presents unique challenges to its conservation, it also offers opportunities to engage communities in sustainable practices. By incorporating religious teachings into environmental policies and fostering collaboration among various stakeholders, a more holistic approach to river rejuvenation can be achieved. This requires a shift from purely technocratic solutions to those that respect and integrate cultural and spiritual dimensions, ultimately leading to a cleaner and healthier Ganga.

E. Restoring the Sanctity of the Ganga: A Call for Collective Action

The Ganga River, revered as a sacred entity in Indian culture, faces severe pollution challenges that have transformed it from a symbol of purity to one of the most polluted rivers globally. This paradox of sanctity and contamination necessitates urgent action to restore its ecological and cultural integrity. The pollution stems from untreated sewage, industrial effluents, and cultural practices, compounded by inadequate infrastructure and policy enforcement. Addressing this issue requires a multifaceted approach involving policy reform, community engagement, and technological innovation.

F. Pollution as a Cultural and Environmental Crime

The Ganga River is heavily polluted due to the discharge of untreated sewage and industrial waste, with pollution levels exceeding WHO safety limits by 3000 times [48]. Cultural practices, such as the disposal of human and animal corpses, contribute significantly to the river's pollution [46]. The river's pollution is not only an environmental issue but also a cultural crime, as it undermines the river's sacred status and the health of millions who depend on it [44, 95].

G. Clarion Call for Action: Restoring the Ganga's Sanctity

Despite significant financial investments, such as the $27 billion allocated by the Indian government, efforts to clean the Ganga have been largely ineffective due to systemic issues like corruption and lack of accountability [46]. The Ganga Action Plan, initiated to construct and renovate treatment plants, has seen limited success due to infrastructural and administrative challenges [96]. There is a pressing need for a new strategy that involves all stakeholders, including local communities, to restore the river's sanctity [13, 46].

H. Recommendations for Policy, Community, and Technological Interventions

1) Policy interventions

Implement zero discharge policies for industrial and municipal waste, and promote the reuse and recycling of wastewater [48].

2) Community engagement

Encourage community-based solutions and integrate religious sentiments to foster a collective responsibility towards the river [58].

3) Technological innovations

Develop cost-effective sewage treatment technologies and enhance river flow management to dilute pollutants [46, 97].

4) Infrastructure development

Rapidly build and upgrade sewerage infrastructure in cities along the Ganga to prevent untreated sewage discharge [46].

XXII. A Collective Responsibility to Protect the Holy River

The restoration of the Ganga requires a collective effort from government bodies, local communities, and international organizations [26]. There is a need for interdisciplinary approaches that combine natural sciences with social sciences to develop holistic solutions [13]. The involvement of religious and cultural leaders can play a crucial role in mobilizing public support and fostering sustainable practices [58]. While the Ganga's pollution is a significant challenge, it also presents an opportunity for India to demonstrate leadership in environmental conservation and cultural preservation. The river's restoration is not just a governmental responsibility but a collective one, requiring the active participation of all stakeholders. By integrating policy reforms, community engagement, and technological advancements, the Ganga can be revitalized, preserving its sanctity for future generations.

XXIII. Criminal Liability for Ganga River Pollution under Indian Laws

The following outlines key legal provisions under Indian environmental laws and the Bharatiya Nyaya Sanhita (BNS), 2023, establishing criminal liability for polluting the Ganga

River. The focus is on the Water (Prevention and Control of Pollution) Act, 1974, the Environment (Protection) Act, 1986, constitutional provisions, and the Jan Vishwas Act, 2023.

Legal provisions:

A. Water (Prevention and Control of Pollution) Act, 1974

This Act regulates water pollution, including in the Ganga, by prohibiting harmful discharges and enforcing compliance through criminal penalties.

Section 24: Prohibits knowingly causing or permitting the discharge of poisonous, noxious, or polluting substances into streams like the Ganga, contravening standards set by State Pollution Control Boards.

Section 43: Violators of Section 24 face imprisonment from 1.5 to 6 years and a fine. Continued violations incur additional daily fines.

Section 44: Non-compliance with orders from Central/State Pollution Control Boards (e.g., ceasing polluting discharges) results in up to 3 years imprisonment, a fine, or both, with harsher penalties for repeat offenses.

B. Environment (Protection) Act, 1986

This Act provides a comprehensive framework to protect the environment, including the Ganga, with stringent penalties for pollution.

Section 15: Violations, such as discharging untreated effluents into the Ganga, are punishable with up to 5 years imprisonment, a fine up to ₹1 lakh, or both. Ongoing violations attract an additional fine of up to ₹5000 per day.

Section 16: Company officers (e.g., directors, managers) are liable for corporate offenses unless they prove lack of knowledge or due diligence, facing penalties as per Section 15.

C. Bharatiya Nyaya Sanhita (BNS), 2023

The BNS, effective from July 2024, replaces the Indian Penal Code and addresses Ganga pollution through public nuisance and negligent conduct provisions.

Section 270: Defines public nuisance as acts causing common injury, danger, or annoyance to the public. Polluting the Ganga, impacting public health or access to clean water, incurs a fine, community service, or both.

Section 271: Penalizes negligent conduct involving substances endangering human safety, such as toxic effluent discharges into the Ganga, with up to 6 months imprisonment, a fine up to ₹5,000, or both.

D. Constitutional Provisions

The Constitution supports criminal liability for Ganga pollution through fundamental rights and duties.

Article 21: Guarantees the right to life, including access to a pollution-free environment. Ganga pollution violates this right.

Article 48-A: Mandates the State to protect and improve the environment, including rivers like the Ganga.

Article 51-A(g): Imposes a duty on citizens to protect the natural environment, including rivers, reinforcing liability for polluters.

E. Jan Vishwas (Amendment of Provisions) Act, 2023

This Act decriminalizes certain minor offenses under environmental laws, replacing imprisonment with civil penalties to support environmental restoration.

1) Water pollution remediation fund

Collects fines for minor violations under the Water Act, used for initiatives like Ganga cleanup.

2) Environmental protection fund

Collects penalties for minor violations under the Environment Act, funding restoration projects for polluted water bodies like the Ganga.

Serious offenses, such as large-scale industrial or municipal discharges into the Ganga, remain subject to criminal penalties under the Water Act (Sections 43, 44) and Environment Act (Sections 15, 16). The continued lack of enforcement, despite the presence of strict legal provisions, has diminished their effectiveness and contributed to growing public disillusionment with the legal system.

XXIV. Suggestions for Restoration

The redirection of treated effluents can significantly reduce the pollution load on the Ganga by diverting treated wastewater to forests and barren lands for irrigation, thereby supporting ecosystem restoration. Nature-based solutions such as constructed wetlands can be implemented to treat and repurpose wastewater sustainably [75, 76]. Simultaneously, stricter industrial regulations are essential, especially in industrial hubs like Haridwar's SIDCUL area. Enforcing zero-discharge policies and mandating real-time monitoring will ensure compliance with effluent standards, while immediate penalties for non-compliant industries will serve as a deterrent [48, 98]. Engaging communities and religious leaders can leverage the Ganga's sacred status to promote eco-friendly rituals, such as using treated water for offerings and minimizing polluting practices during festivals like Kumbh Mela [58, 83]. Ecohydrological restoration through managed water diversions and wetlands can help restore the Ganga's natural flow, enhance biodiversity, and dilute pollutants, drawing inspiration from successful global models [23, 75]. Policy reforms and enforcement should focus on strengthening the Water Act of 1974 and the legal personhood ruling for the Ganga by increasing funding for pollution control boards, establishing clear accountability frameworks, and imposing stringent penalties for non-compliance [15, 84]. Sustainable tourism management in Haridwar and Rishikesh is also crucial; this includes enforcing waste segregation, banning single-use plastics, and promoting environmentally responsible practices during religious events to minimize solid waste pollution [4]. Public participation models, such as community-based monitoring programs inspired by the Thames River restoration, can foster local ownership and accountability in pollution control efforts [20, 85]. Innovative water use, particularly the promotion of treated wastewater for agriculture and forest irrigation, aligns with sustainable development goals while reducing the freshwater demand and pollution load on the Ganga [76]. Lastly, valuable lessons from Indian initiatives like the Gomti and Hindon river restoration projects, which emphasize holistic wastewater management and urban planning, can guide the development of tailored strategies for restoring the Ganga [85, 88].

XXV. Conclusion

The Ganga River, a sacred and ecological lifeline for millions, is facing a severe pollution crisis in Haridwar and Rishikesh due to untreated sewage, industrial effluents, and cultural practices. This contamination violates the Water (Prevention and Control of Pollution) Act of 1974 and infringes on human rights by denying access to clean drinking water. Initiatives like the Namami Gange Programme and the Ganga's legal personhood status represent significant efforts, but their impact is limited by inadequate infrastructure, weak enforcement, and insufficient community engagement. A sustainable path forward requires integrating advanced wastewater treatment, stricter industrial regulations, and community-driven conservation with the Ganga's spiritual significance. By redirecting treated effluents for non-potable uses and drawing inspiration from global models like the Thames and Rhine, alongside Indian initiatives like the Gomti and Hindon, the Ganga's ecological and cultural integrity can be restored. This collective responsibility, rooted in respect for the river's sanctity and adherence to environmental laws, is essential to transform the Ganga into a thriving symbol of India's heritage for future generations.

Conflict of Interest

The author declares no conflict of interest.

References

[1] G. Matta, A. Kumar, A. Nayak, and P. Kumar, "Appraisal of spatial-temporal variation and pollution source estimation of Ganga River system through pollution indices and environmetrics in Upper Ganga basin," *Applied Water Science*, 2022. https://doi.org/10.1007/s13201-021-01552-9

[2] K. S. Prasad and B. Prasad, "Impact of COVID-19 nationwide lockdowns and unlock phases in India on river water quality of upper part of the Ganga River," *Applied Environmental Research*, 2023. https://doi.org/10.35762/aer.2023007

[3] G. Matta, "Evaluation and prediction of deviation in physico-chemical characteristics of River Ganga," *International Journal of Advancements in Research and Technology*, vol. 4, no. 6, pp. 14–30, 2015.

[4] M. Ruhela, P. Kumar, V. Tyagi, F. Ahamad, and K. Ram, "Assessment of water quality of River Ganga at Haridwar with reference to water quality index," *Environment Conservation Journal*, 2018. https://doi.org/10.36953/ECJ.2018.19306

[5] A. K. Haritash, S. Gaur, and S. Garg, "Assessment of water quality and suitability analysis of River Ganga in Rishikesh, India," *Applied Water Science*, vol. 6, pp. 383–392, 2016. https://doi.org/10.1007/S13201-014-0235-1

[6] S. Subuddhi, A. Kansal, P. Pandey, T. Ghoshal, and N. K. Singhal, "Impact examination of the lockdown on the status of the heavy metal pollution index and health risk of Ganga River water quality," *Environmental Engineering Research*, 2022. https://doi.org/10.4491/eer.2022.507

[7] D. Kumar, D. Kumar, D. S. Malik, N. Kumar, N. Gupta, and V. Gupta, "Spatial changes in water and heavy metal contamination in water and sediment of river Ganga in the river belt Haridwar to Kanpur," *Environmental Geochemistry and Health*, vol. 42, pp. 2059–2075, 2020. https://doi.org/10.1007/S10653-019-00471-8

[8] D. Tiwari, R. Kumar, M. Yadav, S. Rai, and S. K. Singh, "Holistic analysis of Ganga basin water quality: A statistical approach with WQI, HMCI, HMQI, and HRI indices," 2024. https://doi.org/10.21203/rs.3.rs-4139270/v1

[9] S. Bhadula and B. D. Joshi, "Impact of religio-touristic activities on the water quality of Ganga river and solid waste generation within haridwar city, India," *The International Journal of Plant, Animal and Environmental Sciences*, vol. 4, pp. 213–220, 2014.

[10] S. Dwivedi, P. S. Chauhan, S. Mishra *et al.*, "Self-cleansing properties of Ganga during mass ritualistic bathing on Maha-Kumbh," *Environmental Monitoring and Assessment*, vol. 192, p. 221, 2020. https://doi.org/10.1007/S10661-020-8152-2

[11] M. J. Bowes, D. S. Read, H. Joshi *et al.*, "Nutrient and microbial water quality of the upper Ganga River, India: Identification of pollution sources," *Environmental Monitoring and Assessment*, vol. 192, p. 330, 2020. https://doi.org/10.1007/S10661-020-08456-2

[12] S. B. Kedzior, "Pollution and the renegotiation of river goddess worship and water use practices among the Hindu Devotees of India's Ganges/Ganga River," in *Water and Sacred Architecture*, A. K. Tayob and J. L. Corrigan, Eds. Routledge, 2015. https://doi.org/10.1007/978-94-017-9376-6_28

[13] R. Sigdel, G. J. Carlton, and B. Gautam, "Resolving the Ganges pollution paradox: A policy-centric systematic review," *River*, vol. 2, no. 1, pp. 82–96, 2023. https://doi.org/10.1002/rvr2.35

[14] D. Singh, A. K. Shukla, S. Yadav, G. Pandey, and V. Dutta, "The Ganga River water pollution status in India characterize with river Gomti," *Ecology, Environment and Conservation*, vol. 28, no. 3, pp. 1364–1371, 2022. https://doi.org/10.53550/eec.2022.v28i03.074

[15] S. Jolly and K. S. R. Menon, "Of Ebbs and flows: Understanding the legal consequences of granting personhood to natural entities in India," *Transnational Environmental Law*, vol. 10, no. 1, pp. 139–156, 2021. https://doi.org/10.1017/S2047102520000424

[16] F. L. de. Micheaux, "Political Ecology of a sacred river: Hydrosocial cycle and govemance of the Ganges, India," Ph.D. dissertation, Université de Lausanne, 2019.

[17] A. Bhatt, P. Srivastava, and P. K. Yadav, "Ganga: A subtle overview of names and glory in Sanskrit literature and the current scenario," *Dev. Sanskriti: Interdisciplinary International Journal*, vol. 22, pp. 54–60, 2023. https://doi.org/10.36018/dsiij.22.224

[18] C. K. Chapple, "Hinduism and ecology: the intersection of earth, sky, and water," *Journal of the American Oriental Society*, vol. 122, no. 4, pp. 812–817, 2002. https://doi.org/10.2307/3217681

[19] The River of Life, Death, Livelihood and Pilgrimage: An assessment of Ganges in Varanasi, Uttar Pradesh," 2022. https://doi.org/10.21203/rs.3.rs-1681048/v1

[20] P. Das and K. Tamminga, "The ganges and the GAP: An assessment of efforts to clean a sacred river," *Sustainability*, vol. 4, no. 8, pp. 1647–1668, 2012. https://doi.org/10.3390/SU4081647

[21] K. D. Alley, *On the Banks of the Ganga: When Wastewater Meets a Sacred River*, University of Michigan Press, 2002.

[22] C. P. Kala, "Cultural significance and current conservation practices of the Ganga's ecosystem and environment," *Advances in Environmental Engineering and Sustainability*, 2018. https://doi.org/10.12691/AEES-6-4-4

[23] R. Singh and G. Singh, "Integrated management of the Ganga River: An ecohydrological approach," *Ecohydrology & Hydrobiology*, vol. 20, no. 2, pp. 153–165, 2020. https://doi.org/10.1016/J.ECOHYD.2019.10.007

[24] R. K. Sinha and K. Prasad, "Management of water quality and biodiversity of the river Ganga," in *The Ganga River Basin: A Hydrometeorological Approach*, S. K. Gupta, S. C. S. R. K. Prasad, and N. C. Ghosh, Eds. CRC Press, 2020. https://doi.org/10.4324/9781003157847-5

[25] J. N. Vyas, S. Nath, R. B. Deogade, and P. Chandra, "Rejuvenation of rivers in India: A case study on efforts for Rejuvenation of River Ganga," in *River Conservation and Water Resource Management*, P. K. Singh, R. B. Deogade, S. K. Singh, A. K. Shukla, and S. S. Gedam, Eds. Springer, 2023. https://doi.org/10.1007/978-981-99-3687-8_8

[26] S. Das, "Ganga—Our endangered heritage," in *Our National River Ganga*, G. Singh and V. L. G. K. Kalpagam, Eds. Springer, 2014. https://doi.org/10.1007/978-3-319-00530-0_2

[27] G. Drew, "A retreating goddess? Conflicting perceptions of ecological change near the Gangotri-Gaumukh Glacier," *Journal for The Study of Religion, Nature and Culture*, vol. 6, no. 3, pp. 344–362, 2012. https://doi.org/10.1558/JSRNC.V6I3.344

[28] M. Bhargawi, G. G. J, and M. V.N, "Biological health of River Ganga, in the light of metal pollution: A review," *International Journal of Zoological Investigations*, vol. 9, no. 2, pp. 649–662, 2023. https://doi.org/10.33745/ijzi.2023.v09i02.056

[29] R. Kumar and R. Kumar, "Preliminary assessment and attempt to maintain minimum ecological flows in upper and middle Ganga River," in *River System Analysis and Management*, S. K. Singh and V. L. G. K. Kalpagam, Eds. Springer, 2017. https://doi.org/10.1007/978-981-10-1472-7_17

[30] B. A. Nadi and M. M. Mohib, "Importance and solutions for environmental protection in the light of Islamic teachings," *Basirah Research Quarterly*, vol. 1, no. 1, pp. 1–10, 2024. https://doi.org/10.61438/bsrqj.v1i1.53

[31] M. Munawar, M. Fitzpatrick, and I. F. Munawar, "Application of the Laurentian great lakes 'ecosystem approach' towards remediation and restoration of the mighty River Ganges, India," *Aquatic Ecosystem*

Health & Management, vol. 25, no. 2, pp. 1–15, 2022. https://doi.org/10.14321/aehm.025.02.01

[32] S. B. Kedzior, "Ganga: The benevolent purifier under siege," Master's thesis, University of Waterloo, 2014.

[33] G. Kumar *et al.* (2024). Crafting responsibility: Strategies for balancing economic growth with public health and environmental sustainability in India's Liquor Sector. [Online]. Available: https://www.researchgate.net/profile/Raj-Yadav-28/publication/384478762_Crafting_Responsibility_Strategies_for_Balancing_Economic_Growth_with_Public_Health_and_Environmental_Sustainability_in_India's_Liquor_Sector/links/66fb9cf7f599e0392fb0c48f/Crafting-Responsibility-Strategies-for-Balancing-Economic-Growth-with-Public-Health-and-Environmental-Sustainability-in-Indias-Liquor-Sector.pdf

[34] S. K. Sharma, "Water pollution: An analysis," *International Journal of Science and Research*, vol. 10, no. 6, pp. 1753–1757, 2021. https://doi.org/10.21275/sr21625172301

[35] R. Stone, "A remedy at last for the ailing Ganges," *Science*, vol. 332, no. 6028, p. 412, 2011. https://doi.org/10.1126/SCIENCE.332.6028.412

[36] M. M. Zafar and A. Kumari, "Spatio-temporal evaluation of the impact of anthropogenic stressors on physico-chemical characteristics and water quality of the River Ganga using GIS-based approach in the middle Gangetic Plains at Patna, Bihar, India," *Water Science and Technology*, 2024. https://doi.org/10.2166/wst.2024.053

[37] M. Chaudhary, S. Mishra, and A. Kumar, "Estimation of water pollution and probability of health risk due to imbalanced nutrients in River Ganga, India," *International Journal of River Basin Management*, vol. 15, no. 1, pp. 53–60, 2017. https://doi.org/10.1080/15715124.2016.1205078

[38] A. K. Shukla, C. S. P. Ojha, S. Shukla, and R. D. Garg, "Water quality challenges in Ganga River Basin, India," in *Water Quality Management*, S. K. Sharma and A. K. Shukla, Eds. Springer, 2021. https://doi.org/10.1007/978-3-030-60869-9_1

[39] R. C. Trivedi, "Water quality challenges in Ganga Basin, India," in *Our National River Ganga*, G. Singh and V. L. G. K. Kalpagam, Eds. Springer, 2014. https://doi.org/10.1007/978-3-319-00530-0_7

[40] M. M. Adel, "Downstream ecocide from upstream water piracy," *American Journal of Environmental Sciences*, vol. 8, no. 5, pp. 528–548, 2012. https://doi.org/10.3844/AJESSP.2012.528.548

[41] S. Singh, F. Ahmad, D. Raghuvanshi, G. Dublish, R. Satavan, and A. K. Vidyarthi, "Policy interventions towards sewage management and improvement in water quality of River Ganga," *The Indian Forester*, vol. 149, no. 4(a), pp. 445–453, 2023. https://doi.org/10.36808/if/2023/v149i4(a)/169910

[42] A. Patil and M. Arya, "Water quality assessment and heavy metal analysis of Ganga River system and effluent water of SIDCUL at Haridwar through atomic absorption spectroscopy," *Journal of Mountain Research*, vol. 19, no. 1, pp. 201–209, 2024. https://doi.org/10.51220/jmr.v19-i1.19

[43] M. S. Sankhla, M. Kumari, K. Sharma, R. S. Kushwah, and R. Kumar, "Heavy metal pollution of Holy River Ganga: A review," *International Journal of Research*, vol. 7, no. 5, pp. 242–248, 2018.

[44] D. C. Jhariya and A. K. Tiwari, "Ganga River: A paradox of purity and pollution in India due to unethical practice," in *Prco. IOP Conference Series: Earth and Environmental Science*, vol. 597, 2020, 012023. https://doi.org/10.1088/1755-1315/597/1/012023

[45] F. Baba, "Water pollution: Causes, impacts, and solutions: A critical review," *Journal of Sustainable Health*, vol. 76, pp. 1–18, 2024. https://doi.org/10.37376/jsh.vi76.5785

[46] T. Shah, C. Ray, and U. Lele, "How to clean up the Ganges," *Science*, vol. 359, no. 6374, pp. 255–256, 2018. https://doi.org/10.1126/SCIENCE.AAV8261

[47] L. Vemsani, "Ganga: The multi-form feminine divine," in *Feminine Journeys of the Mahabharata*, Palgrave Macmillan, 2021. https://doi.org/10.1007/978-3-030-73165-6_10

[48] A. Saini, R. Saini, A. Gupta, and R. Grover, "Ganga deterioration and conservation of its sanctity," *International Journal of Applied Research*, vol. 1, no. 9, pp. 121–124, 2015.

[49] K. Dobriyal, "Cultural significance of Ganga, the Indian National River," *Himalayan Journal of Social Sciences*, vol. 16, no. 1, pp. 99–103, 2021. https://doi.org/10.51220/hjssh.v16i1.10

[50] M. Shi-chang, "Ganges—A Holy River that symbolizes Indian culture," *South Asian Studies Quarterly*, no. 4, pp. 79–84, 2010. https://doi.org/10.3969/j.issn.1006-2815.2010.04.040

[51] A. Doron, R. Barz, and B. Nelson, *An Anthology of Writings on the Ganga: Goddess and River in History, Culture, and Society*, Oxford University Press, 2017.

[52] A. Singh, "Water pollution: The water Act 1974 a critical analysis," *Journal of Pollution Effects and Control*, vol. 9, p. 288, 2021.

[53] S. Divan and A. Rosencranz, "Water pollution control," in *Environmental Law and Policy in India*, Eds. Oxford University Press, 2022. https://doi.org/10.1093/oso/9780192865458.003.0008

[54] G. Agoramoorthy, "India's pollution nightmare: Can it be tackled?" *Environmental Science & Technology*, vol. 46, no. 3, pp. 1307–1308, 2012. https://doi.org/10.1021/ES204684V

[55] S. Kumar and M. N. Murty, "Water pollution in India: An economic appraisal," *India Infrastructure Report*, pp. 285–298, 2011.

[56] L. S. Secretariat, "Water pollution in India: Eighth report of the (Sixteenth Lok Sabha) Public Accounts Committee (2014-15)," *Research Papers in Economics*, 2015.

[57] M. D. Ostroff, "Noncompliance with environmental rules is worse than you think," in *Environmental Rule of Law: Trends and Prospects*, Cambridge University Press, 2022. https://doi.org/10.1093/oso/9780197656747.003.0003

[58] A. K. Chopra, G. Prasad, and D. R. Khanna, "Ganges water pollution and its management through religion," *Environment Conservation Journal*, vol. 5, no. 1–3, pp. 1–5, 2024. https://doi.org/10.36953/ecj.2004.0512305

[59] S. Shirin and A. K. Yadav, "Physico-chemical analysis of municipal wastewater discharge in Ganga River, Haridwar District of Uttarakhand, India," *Current World Environment*, vol. 9, no. 2, pp. 536–543, 2014. https://doi.org/10.12944/CWE.9.2.39

[60] P. Kumar and P. K. Bharti, "Effluent quality assessment of different drains in SIDCUL industrial area at Haridwar (Uttarakhand)," *Environment Conservation Journal*, vol. 13, no. 1&2, pp. 1–5, 2012.

[61] P. Kumar and P. K. Bharti, "Effluent quality assessment of different drains in SIDCUL industrial area at Haridwar (Uttarakhand)," *Environment Conservation Journal*, vol. 13, no. 1&2, pp. 1–5, 2012. https://doi.org/10.36953/ecj.2012.131221

[62] R. Shankar, S. Nale, P. Prakash, G. P. Singh, and S. Singh, "The physiochemical, biological quality and seasonal variability of River Ganges in Varanasi, Uttar Pradesh, India," *Indian Journal of Community Health*, vol. 30, no. 2, pp. 170–175, 2018. https://doi.org/10.47203/ijch.2018.v30i02.010

[63] M. Roy and F. Shamim, "Research on the impact of industrial pollution on River Ganga: A review," *International Journal of Engineering Research & Technology*, vol. 9, no. 5, pp. 1074–1078, 2020.

[64] A. Saxena, R. K. Srivastava, S. B. Singh, R. N. Ram, and N. Pandey, "Heavy metals in fishes, water and macrophyte of the Ganga River and risk related to their consumption," *Toxicology International*, vol. 31, no. 2, pp. 327–336, 2024. https://doi.org/10.18311/ti/2024/v31i3/36636

[65] E. Siddiqui and J. Pandey, "Assessment of heavy metal pollution in water and surface sediment and evaluation of ecological risks associated with sediment contamination in the Ganga River: A basin-scale study," *Environmental Science and Pollution Research*, vol. 26, pp. 10926–10940, 2019. https://doi.org/10.1007/S11356-019-04495-6

[66] D. K. Chaurasia, N. K. Rana, and V. N. Sharma, "From pollution to preservation: Impacts of the Namami Gange project on the Ganga River ecosystem in the Varanasi Urban Area," *Journal of Environmental Science and Public Health*, vol. 8, no. 1, pp. 1–8, 2024. https://doi.org/10.35629/2532-10100108

[67] D. Paul, "Research on heavy metal pollution of river Ganga: A review," *Annals of Agrarian Science*, vol. 15, no. 2, pp. 278–286, 2017. https://doi.org/10.1016/J.AASCI.2017.04.001

[68] K. S. Bilgrami and S. Kumar, "Bacterial contamination in water of the river Ganga and its risk to human health," *International Journal of Environmental Health Research*, vol. 8, no. 1, pp. 5–13, 1998. https://doi.org/10.1080/09603129873606

[69] V. K. Tyagi, A. Bhatia, R. Z. Gaur, A. Khan, M. Ali, A. Khursheed, A. A. Kazmi, and S.-L. Lo, "Impairment in water quality of Ganges River and consequential health risks on account of mass ritualistic bathing," *Desalination and Water Treatment*, vol. 51, no. 10–12, pp. 2121–2129, 2013. https://doi.org/10.1080/19443994.2013.734677

[70] S. Yadav, S. Anand, P. Paramjit, and J. Singh, "Efficiency assessment of sewage treatment plants for treating wastewater: Case study of Narela sewage treatment plants in Delhi, India," in *Advances in Water Resources Management for Sustainable Use*, P. K. Singh, R. B. Singh, and S. K. Singh, Eds. Springer, 2021. https://doi.org/10.1007/978-981-15-8237-0_5

[71] V. Mema, "Impact of poorly maintained wastewater sewage treatment plants—Lessons from South Africa: Wastewater management," *The First Resource*, vol. 1, no. 1, pp. 1–10, 2010.

[72] P. Chatterjee, M. M. Ghangrekar, and S. Rao, "Low efficiency of sewage treatment plants due to unskilled operations in India," *Environmental Chemistry Letters*, vol. 14, pp. 407–416, 2016. https://doi.org/10.1007/S10311-016-0551-9

[73] M. Zarri, S. A. Benichou, A. Fahde, F. Amraoui, and M. Tahiri, "Compliance with WHO and FAO standards for treated water from the

Nouaceur and Mediouna's wastewater treatment plants for reuse in watering and irrigation," in *Water Resources in the Mediterranean Region*, Elsevier, 2024. https://doi.org/10.1007/978-3-031-47079-0_26
[74] A. S. J. Karsten, "Criminal liability: Negligence and environmental health: Opinion," *Occupational Health Southern Africa*, vol. 21, no. 5, pp. 28–29, 2015.
[75] D. Ghernaout and N. Elboughdiri, "Domestic wastewater treatment: Difficulties and reasons, and prospective solutions—China as an example," *Open Access Library Journal*, vol. 7, p. e6141, 2020. https://doi.org/10.4236/OALIB.1106141
[76] E. J. Omohwovo, "Wastewater management in Africa: Challenges and recommendations," *Environmental Health Insights*, vol. 18, 2024. https://doi.org/10.1177/11786302241289681
[77] M. Choudhary and S. Ray, "Sustainable wastewater management: Exploring nature-based treatment," *International Journal on Environmental Sciences*, vol. 15, no. 2, pp. 1–8, 2024. https://doi.org/10.53390/ijes.2024.15202
[78] A. Ulusoy, A. Atılgan, R. Rolbiecki, B. Jagosz, and S. Rolbiecki, "Innovative approaches for sustainable wastewater resource management," *Agriculture*, vol. 14, no. 12, p. 2111, 2024. https://doi.org/10.3390/agriculture14122111
[79] A. Agarwal, A. Kaur, and S. Saxena, "Achieving sustainable development goal related to water and sanitation through proper sewage management," in *Sewage Management*, IntechOpen, 2023. https://doi.org/10.5772/intechopen.109970
[80] R. Rame, P. Purwanto, and S. Sudarno, "Sustainable and integrated industrial wastewater treatment as a base of green industry 4.0," in *Proc. AIP Conference Proceedings*, vol. 2586, 2023, p. 030001. https://doi.org/10.1063/5.0112441
[81] T. Hailemariam, "Sustainable technologies for treatment of industrial wastewater and its potential for reuse," in *Sustainable Industrial Wastewater Treatment and Pollution Control*, Springer, 2023. https://doi.org/10.1007/978-981-99-2435-6_9
[82] K. Thara, G. Selvabharathi, and N. Sampathkumar, "The overview of sustainable technologies for the treatment of industrial waste water and its potential for reuse," in *Sustainable Industrial Wastewater Treatment and Pollution Control*, Springer, 2024. https://doi.org/10.58532/v3bdcs18ch13
[83] A. Lako and E. Çomo, "Sustainable water management: An integrated approach to solving the problems of wastewater treatment," *Qubahan Academic Journal*, vol. 4, no. 1, pp. 1–10, 2024. https://doi.org/10.58429/qaj.v4n1a267
[84] K. Obaideen, N. Shehata, E. T. Sayed, M. A. Abdelkareem, M. E. Mahmoud, and A. Olabi, "The role of wastewater treatment in achieving Sustainable Development Goals (SDGs) and sustainability guideline," *Energy Nexus*, vol. 5, 100112, 2022. https://doi.org/10.1016/j.nexus.2022.100112
[85] V. Sharma, H. Joshi, and M. J. Bowes, "A tale of two rivers: Can the restoration lessons of river thames (Southern UK) be transferred to River Hindon (Northern India)?" *Water Air and Soil Pollution*, vol. 232, p. 271, 2021. https://doi.org/10.1007/S11270-021-05152-W
[86] N. Friberg, N. Friberg, N. Angelopoulos *et al.*, "Effective river restoration in the 21st Century: From trial and error to novel evidence-based approaches," in *Advances in Ecological Research*, vol. 55, pp. 535–611, 2016. https://doi.org/10.1016/BS.AECR.2016.08.010
[87] A. Balkrishna, S. K. Singh, S. Ghosh, S. Banerjee, S. Verma, and V. Arya, "An analytical review on the integrated management of river resources through Namami Gange," *Water Policy*, 2024. https://doi.org/10.2166/wp.2024.209
[88] Ar. D. Pandey and Ar. P. Rastogi, "Unlocking the potential: transforming the Gomti river into a model of river health," *EPRA International Journal of Economic Growth and Environmental Issues*, vol. 12, no. 3, pp. 1–5, 2024. https://doi.org/10.36713/epra16390
[89] M. A. Andira, D. Pallu, I. Sari, H. Maria *et al.*, "Weaving spirituality and the environment: A theological review of natural salvation," *Silihasih*, vol. 1, no. 2, pp. 1–12, 2024. https://doi.org/10.54765/silihasih.v1i2.53 (in Indonesian)
[90] M. H. Imran, "Religious solutions to environmental problems," in *Environmental Sustainability and Climate Change Adaptation Strategies*, Bentham Science, 2024. https://doi.org/10.2174/9789815274820124010006
[91] M. Palmer and V. Finaly, *Faith in Conservation: New Approaches to Religions and the Environment,* World Bank, 2003. https://doi.org/10.1596/0-8213-5559-7
[92] P. K. Pal, "Arth Ganga: A sustainable model for Ganga River rejuvenation," in *Blue-Green Infrastructure for Water Resilience and Environmental Sustainability*, Springer, 2023. https://doi.org/10.52756/boesd.2023.e02.009
[93] I. Nandi, A. Tewari, and K. Shah, "Evolving human dimensions and the need for continuous health assessment of Indian Rivers," *Current Science*, vol. 111, no. 2, pp. 263–271, 2016. https://doi.org/10.18520/CS/V111/I2/263-271
[94] F. Zagonari, "Comparing religious environmental ethics to support efforts to achieve local and global sustainability: Empirical insights based on a theoretical framework," *Sustainability*, vol. 12, no. 7, p. 2590, 2020. https://doi.org/10.3390/SU12072590
[95] M. C. Baruah, "Reducing waste by restoring rivers with special reference to river ganga," *Abhinav-National Monthly Refereed Journal of Research in Commerce & Management*, vol. 6, no. 6, pp. 1–8, 2017.
[96] E. M, *The sacred and the profane*, Harper & Row, 1992.
[97] V. B. Mishra, "The Ganga at Varanasi and a travail to stop her abuse," *Current Science*, vol. 88, no. 5, pp. 755–756, 2005.
[98] A. Vijayanandan, A. A. Kazmi, and L. Philip, "Domestic and industrial wastewater treatment: Current status and challenges in India," in *Water and Wastewater Management*, IWA Publishing, 2023. https://doi.org/10.2166/9781789063714_0025