Water Pollution in India: Effective Management and Control

Seema Yadav
Departmental of Education, The Bhopal of Social Sciences, Bhopal, India

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Abstract: India, the second-most populous nation in the world, uses more than a third of the world's groundwater resources, more than 90% of which are for agriculture. In order to stop the deterioration of water quality and preserve rivers' aesthetic value for future generations, many developing countries including India urgently need to focus on sustainable management of rivers. Industrial wastewater and home sewage have been produced in significant quantities as a result of urbanisation and industrialization, which has worsened the environment of the river water. In order to improve the accuracy and relevance of water quality management, which will have a substantial impact on the quality of the water environment and the ecological system, it is vital to identify the primary sources and the impact of the present comprehensive water quality

1 INTRODUCTION

According to the United Nations Environmental Programme (UNEP), the dental industry utilises roughly 340 tonnes of mercury annually in dental amalgams (Tibau & Grube, 2019). The United Nations Environment Programme (UNEP) and WHO should assess the state of arsenic poisoning worldwide and initiate a global campaign to raise awareness of this issue among the general public, medical experts, health workers, and administrators (Shaji et al., 2021). Groundwater is the primary source of drinking water for more than 2.5 billion people worldwide, making its provision one of the most pressing issues facing modern society. Although groundwater is regarded as harmless, large levels of heavy metals, such as arsenic (As), can present significant risks to human health (Shaji et al., 2021). The global community is very concerned about the environmental issue of water contamination. Defecating, dumping trash, disposing of industrial waste, washing clothes, and other human activities significantly contribute to water contamination.

Water quality management is given top emphasis globally since surface water quality is one of the most important environmental challenges on the planet. India's river water quality has significantly declined over time, and surface water quality urgently needs to be improved (Matli & Nivedita, 2021). With their unmatched utilitarian qualities at a relatively lower cost, plastics have emerged as the all-pervasive driving force of contemporary society. India, which has a population of nearly 1.2 billion, is now one of the world's top consumers of plastics. However, an estimated 40% of its yearly 9.4 million tonnes of plastic garbage stays uncollected due to inadequate infrastructure and poor waste management practises (Vanapalli, Dubey, Sarmah, & Bhattacharya, 2021). Programs for monitoring water quality are essential for creating water conservation policies, but it is becoming difficult to make sense of the vast and haphazard statistics they produce. Rapid urbanization, industry, and population increase put surface water sources at risk of pollution. Expensive interventions may be unsuccessful, wasting limited financial resources, without cooperation and careful balancing of interests. The difficulties the basin is facing are made worse by the lack of a working governance system for the management of its water resources.

2 WATER POLLUTION AND SOURCES OF WATER POLLUTION

One of the essential resources that sustain life on the earth is water. Surface water sources, primarily rivers, lakes, and reservoirs, are prone to water contamination from many anthropogenic and natural causes, which results in the degradation of water

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quality. While anthropogenic sources include wastewater from home and industrial activity, agricultural runoff, etc., natural sources include erosion, weathering, the breakdown of soil minerals, etc (Matli & Nivedita, 2021). The urban water supply system is seriously threatened by pollution accidents that take place in surface waters, particularly near regions where drinking water is sourced. There are complex conditions for pollutant spreading and a wide range of pollutant concentrations during the localisation of the source of water pollution.

Due to the unlawful transfer of dental mercury into the artisanal and small-scale gold mining industry, crematoria emissions from the deceased, and sewage sludge that is sold to farmers, dental amalgam is a hidden source of mercury contamination throughout the world. These substantial mercury sources lead to contaminated food, water, and air, which adversely affects human health (Tibau & Grube, 2019). Dental amalgams are one product and method that uses mercury, which is a global contaminant and a poison that kills from birth to death (Tibau & Grube, 2019). Even for developing and rising nations, affordable mercury-free dental restoration materials are commonly available. Dental amalgam use will be discontinued, which will stop the current unlawful flow from that source into ASGM and support current non-mercury mining techniques. According to reports, cremation is becoming more commonplace worldwide (Tibau & Grube, 2019).

The degradation of water quality is caused by an increase in pollution from industry, residential sources, and agriculture (cultivation, animal farming, and aquaculture). China's ambient water contamination is still primarily caused by industry. Then comes home pollution and agricultural pollution, with the latter having the least effect on the quality of the water (Xu, Gao, & Yuan, 2022). The effects of pollution sources on the quality of the water varies greatly between basins. The Yangtze and Yellow River Basins' primary sources of water pollution are industrial and domestic activity, respectively. The two basins' primary agricultural causes of water pollution, respectively, are cultivation and aquaculture. Seasonal fluctuations can affect how agriculture pollution affects water quality (Xu et al., 2022). Due to the growth of plastic waste in a variety of sectors, microplastics (MPs) are pervasive in the aquatic environment. The number of studies examining their prevalence, distribution, and toxicity in various regions of India has increased dramatically in recent years. The main objective of this paper is to assess the sources, abundance, and properties of MPs reported in the sediments, water, and biota of the aquatic ecosystems in India (Vanapalli et al., 2021). Accidental pollution in surface waters, particularly near sources of drinking water, poses a serious threat to the city's water supply system. There are complex conditions for pollutant dispersal during the localisation of the source of water pollution, and pollutant concentrations range widely.

3 IMPACTS OF WATER POLLUTION

Water is a necessary and widely distributed element needed to maintain life. Groundwater is an incredibly significant resource and is very helpful to people. However, the toxic substances released from sources like industries, landfills, as well as non-point causes of pollution like pesticides and fertiliser from the previous year showed high levels of pollution in ground water. As a result, it is extremely important to assess the water quality not only for its current usage, but also an its capacity to develop as a sustainable source of water for human use. In metropolitan locations, overpopulation causes water contamination to worsen. The main contaminants in agnatic environments are residential, agricultural, and industrial wastes. When dumped into freshwater bodies, sewage is the largest pollutant. Sewage is the largest and healthiest source of water pollution in society, and the discharge of untreated sewage into a river is tremendous (Owa, 2013). Long-term exposure to arsenic-contaminated groundwater causes serious health problems such bronchiectasis, arsenicosis, hyperkeratosis, skin, lung, kidney, and bladder cancer. Since geogenic processes are the primary source of arsenic in groundwater, the extent of pollution is intricately tied to the geometry and characteristics of the local aquifer (Shaji et al., 2021). By building up in the tissues of fish due to contaminated river water, cadmium and arsenic may be transferred to people via the food chain. In order to identify an effective, affordable, and environmentally appropriate opponent to heavy metal contamination, regular water quality monitoring is required (Sarah, Tabassum, Idrees, Hashem, & Abd_Allah, 2019). A solution to this issue involves assessing the dangers to human health in places with high uranium prevalence, developing effective remediation technology, and, most importantly, putting preventive management practises into practise.

4 WATER POLLUTION IN INDIAN CONTEXT

With 1.324 billion people, India has the second-largest population in the world after China, which is essential for industrialization and fast urbanisation. Indian cities are experiencing environmental problems as a result of the vast amount of solid garbage that is produced daily by the country's developing population moving from villages to cities. One to four percent of all solid trash is made up of plastic waste, the majority of which is produced by household, industrial, food, and water bottle use (Padgelwar, Nandan, & Mishra, 2021). For India, the country with the second-largest population, the need for river conservation and revitalization is currently crucial. Development of natural water resources, such as springs, rivers, and groundwater supplies, must be environmentally sustainable. Sustainable utilisation of water resources will be facilitated by a process-based understanding of the river basin ecology. The environmental flow concept aids in determining the development of river water resources within sustainable bounds (Parihar, 2021). In order to overcome its water crisis, India today sorely needs solutions. Improving the production of fresh water for drinking is a major challenge the nation faces. Without guaranteeing a consistent supply of high-quality drinking water, neither socioeconomic progress nor even political stability can ever be achievable. It follows that river revitalization will require a national approach (Parihar, 2021).

The survival of all life on earth depends heavily on water, which is a natural resource that is necessary. The primary supply of water to provide the daily water needs for home, agricultural, and industrial activities is natural freshwater bodies such as rivers, lakes, and wetlands. The Ganga River System is India's largest river system, and it has a delicate ecosystem. Because of its values in terms of culture, economy, and the environment, it is vulnerable to anthropogenic disturbances. Heavy metals (HM) poisoning of the Ganga River is caused by biotic (anthropogenic sources) and abiotic (pesticides, fertilisers) sources, and it is a grave health risk to people, plants, and edible fish life. The atomic absorption spectrometer's chemical examination of the water samples it collected revealed the accumulation of heavy metals like arsenic (As), lead (Pb), cadmium (Cd), iron (Fe), and zinc (Zn) (Sarah et al., 2019). Environmental pollution has frequently been linked to the textile industry. In India, particularly in central India, the consequences of living close to manufacturing enterprises on health are not well understood. The Ganga Basin in India encounters issues with water availability, water quality, and ecological degradation as a result of excessive surface and groundwater extraction, the presence of different hydraulic infrastructure, the discharge of untreated sewage water, and other point and non-point source pollution. Since industrial pollution impacts several environmental matrices and a variety of human organ systems, it is a multifaceted problem.

Due to the fact that these regions are heavily inhabited, industrialised, and the centres of several electronic businesses, there is a strong likelihood that cadmium will accumulate there. The Moradabad district likewise had high quantities of Cd in its water samples (Sarah et al., 2019). The river water should not be consumed by humans. In order to restore ecological health, it is necessary to control the direct flow of wastewater into rivers.

India is a developing nation, so it goes without saying that sustainable development is important at every level of its development. The effective management of plastic trash in the country is one such essential element that supports its sustainable development (Padgelwar et al., 2021). Programmes for monitoring water quality are essential for creating water conservation policies, but it has become difficult to make sense of the vast and haphazard statistics they produce. Surface water bodies in India are under risk of contamination as a result of rapid urbanisation, industrialization, and population increase.

5 MANAGEMENT OF WATER POLLUTION FOR SUSTAINABILITY

The accuracy and relevance of water quality management must be improved, and this will have a substantial impact on the quality of the water environment and the ecological system. The identification of the primary sources and the impact of the current comprehensive water quality are crucial (Xu et al., 2022). It is essential to comprehend the quality and degree of groundwater pollution in order to safeguard future sources of safe drinking water. The secret to reducing water pollution and improving water management is the highly accurate prediction of water quality. Environmental pollution has frequently been linked to the textile industry. In India, particularly in central India, the consequences of living close to manufacturing enterprises on health are not well understood.

To address the issue of water pollution, it is necessary to update India's current programme for monitoring water quality, assess the risks to human health in areas with a high uranium prevalence, develop effective remediation technologies, and, most importantly, put preventive management practises into practise (Coyte et al., 2018).

Priority should be given to reducing industrial and urban pollution in the succeeding environmental pollution control processes, together with more specialised regional pollution management. In order to lessen the unfavourable environmental effects brought on by production, it is also crucial to increase inter-basin and inter-regional synergistic control, taking full consideration of the top-level design of environmental regulations and other basin-area factors (Xu et al., 2022). Before using river water for drinking, it should first be pre-treated using hygienic techniques such as reverse osmosis, ultrafiltration, ion exchange, membrane separation, etc. In order to preserve the aesthetic value of the river and aquatic life, it is also advised that pre-treatment of industrial effluent be performed before discharge into the river. In order to prevent future degradation of the river's water quality and to restore the river's capacity for ecological assimilation, these steps must be taken into account by industries located near the river's catchment and afterwards by governing authorities.

To address the excessive plastic trash generation and enhance societal health and environmental quality, creative measures are required. There is enough information supplied to demonstrate the enormous plastic usage and garbage production in each Indian state (Padgelwar et al., 2021).

The notion of environmental flow and the development strategy for water resources must be integrated by planners and policymakers. The government also understands that access to high-quality water is a must for all advancements, including improving the health of the populace (Parihar, 2021).

To prevent mercury contamination, governmental regulatory organisations should make it mandatory in developed and developing nations alike to employ current methods. Every nation may stop using dental amalgam (Tibau & Grube, 2019). This can be done by using mercury-free substitutes, such as atraumatic restorative therapy, and removing a significant mercury pollution source in the process (Tibau & Grube, 2019).

Local water management, which involves collecting and replenishing ground water where it falls, can only be accomplished by community involvement. Localised river rejuvenation is a cost-effective strategy (Parihar, 2021). Remedial actions must be planned based on the afflicted area's source-mineral, climatological, and hydrogeological scenarios. The available corrective techniques include, among other things, the installation of nano-filters, the exploration of deeper or alternative aquifers, the treatment of the aquifer itself, the diluting method by artificial recharge to groundwater, and concomitant use. The vast majority of those harmed by arsenic contamination in Asian nations are the underprivileged who reside in rural regions and are not familiar with the symptoms of arsenic poisoning and how to treat it (Shaji et al., 2021).

It could be necessary to receive global financial and logistical support to lower arsenicosis. The understanding of the incidence, origin, distribution pattern, and removal of arsenic in groundwater should also be the focus of creative, interdisciplinary study (Shaji et al., 2021).

In order to lessen the effects of Arsenic poisoning in ground-water resources and to increase the use of safe water in impacted places around the world, WHO and other pertinent bodies develop new policy recommendations. Each of the affected nations, especially those in Asia, should start a public awareness campaign about arsenic treatment technology or safe water treatment methods. They should also look for additional sources of safe water, like rainwater and groundwater that has been treated (Shaji et al., 2021). To prevent unforeseen threats to human health, it is advised that river water be treated before being utilised for drinking.

For the global Arsenic pollution of groundwater mitigation programme, WHO or UNEP must establish a dedicated budget. It is crucial to create comprehensive management plans that fall under the purview of primary healthcare and include sufficient medical, paramedical, and infrastructure assistance (Shaji et al., 2021). To address the arsenic issue in drinking water, a Global Policy for Arsenic Mitigation and Strategic Plan (GPAMSP) may be created (Shaji et al., 2021). It is necessary to conduct sustainable treatment of raw water by various suitable physical and chemical procedures before it is utilised for drinking purposes because water is not suitable for direct consumption. The re-establishment of the community's sense of belonging to the rivers and the development of grassroots government-public collaborations for greater effectiveness of intervention measures in India, where people see the river as alive and sacred, can both be facilitated by a socio-emotional connection.

The quality of the environment can be improved by a short shutdown. It might hurt the economy, but if we

consider a sustainable economy that coexists with the surrounding environment, that is the only option. The global lockdown has given us a good opportunity to recognize how nature is being strained and how patient it is. However, if pollution sources are successfully controlled, a vibrant earth can result, and the right to life on our planet earth can be established (Mandal & Pal, 2020). In particular, environmental education should be used in schools and should be included in the curriculum there. They will be less likely to contaminate the water this way (Owa, 2013). Policymakers and stakeholders should adopt catchment area treatment plans in advance to preserve the aesthetic value and ecological life. To stop the deterioration of the water quality and aquatic life, it is recommended that a strategic eco-conservation plan be created and implemented in advance. To reduce unforeseen dangers to human health, river water must be treated before being used for drinking. It is advised that the water resource planners and managers take the required steps to preserve the scenic value of the rivers and further promote aquatic biodiversity. Monitoring water quality is a crucial first step in protecting the environment and managing water resources, two crucial concerns for socially sustainable development.

6 CONCLUSION

The degradation and pollution of the environment, caused in large part by human activities such as industrialisation and agricultural practises, has a negative impact on water bodies (such as rivers and the ocean), which are essential for life. UNEP and WHO should give the issue of worldwide arsenic poisoning top priority, initiate a global initiative for surveillance, raise public awareness among people and professionals, and seek to discover practical remedies. It is vital to combine investments in wastewater treatment and reservoir capacity with actions that minimise water demand, notably for agriculture, in order to maintain a balance between the use of surface and groundwater to enable long-term economic growth and a river that is ecologically sound. The effects of socioeconomic development will outweigh those of climate change by a wide margin. Combining investments in wastewater treatment and reservoir capacity with actions that reduce water demand, particularly for irrigation, and that increase river flow during the dry season is necessary to maintain a balance between the use of surface and groundwater to support sustained economic growth and an ecologically healthy river. It is advised that future directions be given to academics, conservationists, planners, and managers of water resources so that they can take the required steps to preserve the aesthetic value of rivers and further promote aquatic biodiversity.

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