Causes of Water Pollution, the Damaging Effects of Polluted Water, and Possible Solutions to the Problem

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Abstract. All life depends on water, but this water is getting worse and worse every day. More than 70% of the country's fresh water in its liquid form is made unfit for consumption. Thus, it can be said that our life, or access to water, is currently unsafe. Not only does India face this issue, but other nations as well. It has an impact on oceans, rivers, lakes, and drinking water all over the world. As a result, it has negative effects on both the natural environment and human life's health and well-being. Numerous studies have been conducted on the potential of various pollution sources, including sewage discharge, industrial effluents, and agricultural runoff. The purpose of this study is to examine various factors that contribute to water pollution and to provide a general definition of the term. Overpopulation, agricultural practices, soil erosion, industrialization, and urbanization are the primary contributors to water pollution in the area under investigation.

Keywords: Environment, Hydrology, Water, Water Pollution.

1. Introduction

As water makes up 70 percent of the Earth's surface, it's clear how important it is. One of the most vital resources for people, animals, and the planet is our surface waterways. Decision-makers (DMs) need to know where, when, and how much of a spilled pollutant is injected into a water body to improve their capacity to supervise and control any environmental concerns [1]. Predicting the effects of wastewater discharge requires reliable data on the sources of contamination. Businesses in a number of third-world nations may release wastewater into subterranean piping as a means of sanitation. It is difficult to collect figures for these pollution sources [2] since many discharge outlets have not been registered and are not frequently checked by the authorities. It is challenging to determine the original source of pollution because the pollutant degradation coefficient may be affected by a wide variety of parameters, including water temperature and the pollutant properties [3]. As a result, there is a pressing need for innovative strategies to identify the origins of pollution.

Throughout the last several decades, researchers have paid a lot of attention to the challenge of pinpointing the origins of pollution. They evaluated the amount, location, and duration of groundwater contamination sources using these techniques, which include traditional regularisation methods, simulation-optimization approaches, and Bayesian inference methods[4]. Solving the inverse problem using the Tikhonov regularisation method, one of the classical regularisation methods, involves reconstructing the historical distribution of the observed pollutants using the governing equations in reverse order[5-6]. The results demonstrate that the method is robust, easy to implement, and can handle noise in experimental data[7]. Tang . Parameters for modelling river networks are identified in [8] by

combining a hydrodynamic model with an intelligent model developed using the genetic algorithm (GA) approach. By combining the regularisation technique with the optimum perturbation momentum, we are able to determine the multi-point source fractional diffusion equation and examine its properties successfully[9]. Tikhonov regularisation and truncated singular value decomposition (TSVD) approaches were introduced as a hybrid regularisation method by Yang and Wang[10]. A random displacement model (RDM) was suggested by Huai.[11] to estimate the concentration of suspended sediment in vegetated steady open channel flow, which may aid in the investigation of identifying the cause of water pollution. On the assumption of a known source location and source count, the optimum perturbation regularisation approach has also been used to numerical inversion of multipoint source strength. The steady-state flow system and the linear diffusion equation must both be satisfied for this approach to work, making it a very stringent requirement for rivers. Hence, this approach still lacks precision in tackling such inverse issues due to the limits of numerous situations. Several researchers then set their sights on integrating optimisation algorithms into existing water quality modelling frameworks. Constructing the minimal goal function of the actual monitoring concentration and the calculated monitoring concentration is the major focus of the optimisation process, which then uses this function to locate the ideal solution. In addition, other optimisation algorithms are used to identify sources of groundwater pollution. These include hybrid heuristic algorithms that combine simulated annealing (SA), tabu search (TS), and the three-dimensional groundwater flow and solute transport model (MODFLOW-GWT) [12] , a simulated annealing algorithm[13], the harmony search algorithm[14-15], and the artificial neural network algorithm[16]. In order to achieve a more precise value of the pollution sources, the optimisation approach is preferable to the regularisation algorithm. Later, as computers progressed rapidly, probabilistic statistical approaches were eventually applied to the task of identifying the origins of pollution. Zeng[17] adopted the Bayesian method of sparse network difference to determine the location and intensity of pollution sources; Wang and Harrison[18] investigated a statistical learning method to construct a regression model between the source and sensor nodes in the network; and the contaminant profile in Water Distribution Systems was determined using the Bayesian and MCMC approaches. To reconstruct the point source's location, the time of release, and the magnitude of the source intensity, Aurélien and Jean-Francois[19] developed a Bayesian parameter identification approach based on a Markov chain. And Gzyl[20] merged geostatistical techniques with the integrated pumping tests (IPTs, Integral Pumping Tests). Using a combination of the differential evolution algorithm (DEA) and the Bayesian Metropolis-Hastings Markov Chain Monte Carlo (MH-MCMC), Yang [21] developed a novel approach to pinpointing the origins of rapid, widespread water contamination. Wei and Zhang[22] developed a framework for source identification that integrates Bayesian inference with the simulation of Markov Chain Monte Carlo (MCMC) methods to account for the uncertainty of the model's sensitive parameters.

Most studies analysed groundwater, whereas much too little was done to pinpoint the origins of surface water contamination. Several researchers have recently focused on pinpointing the origins of surface water contamination; for example, Liu[23] used a genetic algorithm to determine which parameters in a model of surface water quality best identify sources of pollution. Using a simple genetic algorithm, Zhang and Xin[24] reversed the effects of pollution from a single source as well as from numerous areas (BGA). Zhu[25] used a Bayesian inference and genetic algorithm to investigate how to identify the origin of pollution in rivers, and then used that information to create a decision-support model for use in emergency situations. Yet, the genetic algorithm has many flaws as a conventional optimisation method, including a high reliance on the starting value, poor accuracy, and a

propensity to quickly settle on a suboptimal solution. Particle swarm optimisation is only one example of the intelligent optimisation method that has been progressively developing and finding widespread usage today[26–28]. The outcome demonstrates the algorithm's robust global search capacity and independence from the starting point. This method was developed by Drs. Eberhart and Kennedy as a biological evolution computation tool inspired by their work on avian predation behavior[29, 30].

2. The Causes of Water Pollution

One of the most crucial elements in maintaining life on Earth is water. Sadly, it is also heavily polluted. This is mainly because water is an all-purpose solvent that can dissolve a variety of compounds. Despite the fact that we use this lovely feature on a daily basis in tasks like cooking, cleaning, and taking medications, it is also the very trait that makes water so easily contaminated.

- Rapid Urbanization

The concentration of a large population in a small area creates physical chaos in a country. Construction of new roads, housing and industry impacts water cleanliness through the use of detergents, chemicals and exhaust fumes. These chemicals end up in the rivers, streams, and eventually the drinking water supply when it rains.

- Improper disposal of sewage

Inadequate sewage disposal is increasingly emerging as a major global problem. Every time people flush, the garbage is directed to a wastewater treatment facility, from which the residual sewage is discharged into the oceans.

- Run-off of fertilizer

Fertilizers are a major contributor to the global problem of water pollution, being used by everyone from people trying to keep their yards vibrantly green and free of weeds to farmers trying to keep up with the growing population. Algal blooms are the result, which are dangerous and ultimately result in the extinction of numerous underwater plants and fish.

- Oil Leaks

You might think of large oil spills like Exxon Valdez, these spills pollute the water, but oil leaks from cars and mechanics are also major sources of water pollution. Spilled oil mixes with groundwater before flowing into streams and rivers.

- Dumping of chemical waste

Chemicals are notoriously dumped into the ocean by large factories. Every day, highly toxic substances like lead, polychlorinated biphenyls, and detergents are released into the environment.

- Release of Radioactive Waste

Our nation is home to numerous nuclear power plants, and the government permits the daily release of "permissible levels" of radioactive water into the environment. And even though it is permissible, that does not mean it is secure. In a similar vein, mishaps have been known to result in the release of appallingly large quantities of harmful radioactive chemicals into the soil, water, and air.

- Dropping

The majority of water bodies are turned into dump sites by nearby communities. Additionally, given that the dump contains plastic, aluminum, glass, Styrofoam, and other materials, this presents a significant challenge. Furthermore, since every one of the burn through carves out opportunity to debase in the water, they will generally hurt the oceanic life until corrupted.

- Acid rain

Although acid rain may appear to be a natural issue, it is important to remember that it is brought on by acidic airborne particles. Acid rains are the result of these atmospheric particles mixing with water vapor.

3. Sources of Water Pollutants

Water contamination is a serious issue in the modern world. Water is the most susceptible natural resource to contamination. Industrialization, plastics and polythene bags, pesticides and fertilizers, sewage and other oxygen-demanding wastes, domestic sewage, population growth, urbanization, eutrophication, mining, agro-chemical wastes, nutrient enrichment, thermal pollution, oil spillage, disruption of sediments, acid rain pollution, radioactive waste, climate change, and other factors are all major contributors to water pollution. Sewage from homes is responsible for between 75% and 80% of water contamination. Pesticides, sugar, textile, paper, and pulp waste from the electroplating industry are all contributing to water pollution. The unpleasant odor and reduced biodiversity of polluted water and water sources are major drawbacks. The availability of safe drinking water is threatened for eighty percent of humanity. The majority of home sewage is dumped into an untreated river in large quantities. Solid trash, toxicants, plastic litter, and microbiological pollutants are all found in domestic sewage, and they all contribute to water pollution. One of the biggest causes of water pollution is the dumping of untreated industrial waste into rivers.
Table 1 explains the difference between point and non-point sources of water contamination.

Table 1. Point and nonpoint sources

Point Sources	**Nonpoint Sources**
Water that drains from mines, oil fields, and other factories that don't have sewers.	Runoff from agriculture
Wastewater effluent	Contaminant-generating land activities,
Combined storm and sewage system overflows	Runoff from abandoned mines
Runoff and infiltration from animal feedlots	Septic tank leachate and runoff from failed septic systems
Runoff from construction sites >2 ha	Runoff from pasture and range
The discharges of cities with populations of 100,000 or more	Deposition from the atmosphere onto a body of water
Pollution from landfill runoff and leaking landfill leachate	Runoff from construction sites

	Sewerage and non-sewerage zones of cities with populations below 100,000

Pollutants in waterways might originate from either a point source or a nonpoint source. Pointsource contamination occurs when contaminants enter the environment from one specific location, such a factory. Pesticides and fertilizers are examples of nonpoint-source pollution. Insecticides, fungicides, and bactericides are all examples of pesticides. Pesticides, which often include harmful chemicals, have a direct impact on water quality via pollution. Dangers to the agricultural ecology might result from improper use or storage of pesticides. Since most of the suspended material in dams eventually settles to the bottom, water that flows out of them is frequently less nutrient-rich and more salty than water that flows in, which may have a negative impact on agriculture and fisheries farther downstream. The biological effects, quantity, and consumption of pollutants all contribute to the water contamination grade. Most pollution is caused by human activity, however many pollutants have natural origins (biological, chemical, or physical processes). Sometimes when it rains, the water flows through the land and into the earth, picking up pollutants like pesticides and fertilizers from farms and lawns, animal waste, oil and road salt from cities, and hazardous materials from decommissioned mines.

The rising human population is a major contributor to water pollution since it increases the amount of trash that must be disposed of. Human garbage, both solid and liquid, is dumped into rivers, polluting the water supply. There are several bacteria that are harmful to humans and may be discovered in water that has been tainted. Combined, these causes contribute to urbanization's twin problems of water contamination and overuse. Water contamination is often caused by deforestation and urban expansion.

Concentration and modification of naturally occurring substances may result in the development of some pollutants (agrochemicals, pesticides, petrochemicals hydrocarbons, heavy metals, and radio nuclides, etc.) during their residential, agricultural, or industrial usage. Many of these substances do not exist naturally and are wholly synthetic. Serious environmental and water quality issues have resulted, for instance, from the synthesis of numerous pesticides, surfactants, plastics, and petrochemicals.

Destroying wetlands causes water pollution because it eliminates habitats and natural filters that may store and degrade various pollutants. Wetlands are nature's method of cleansing water and also damming water.

4. Negative Effects of Water Pollution

Water pollution refers to the contamination of surface and subsurface bodies of water. Toxic water is water that contains compounds that alter its physical, chemical, and biological qualities, altering its natural structure in a way that is harmful to human and animal health. To say that water contamination is bad for the environment is an understatement. Increased water contamination has a negative impact on plant development. Forests cannot develop because the minerals necessary for photosynthesis are unavailable. Pollutant-filled sewage water becomes much more polluted when wastes are added to it. Diseases caused by bacteria,

viruses, and parasites are not the only ones spread by dirty water. Algae growth is detrimental to marine ecosystems because it blocks oxygen from reaching fish and other marine animals.

The soil and groundwater are both poisoned by the unrestricted flow of poisonous fluids in nature. The destruction of the soil endangers the local fauna. Sewage water being dumped into the oceans has a negative impact on marine life. Loss of marine and freshwater life is a major indication of pollution, poor living conditions, overfishing, and irresponsible use of technology. Illness and death are the results of chemical exposure. When organisms consume these chemicals, they throw off their internal equilibrium and perish. Water contamination is strongly linked to health issues. Many infectious diseases and illnesses transmit from person to person through water. Diseases affecting the respiratory system, the reproductive system, the digestive system, the nervous system, and the cardiovascular system are all exacerbated by exposure to dirty water.

Water is incredibly malleable since that is how it was created. Without crossing international or national boundaries, it goes out into the globe. This implies that a community in one region of the globe might be negatively impacted by pollution in another. This makes it challenging to establish uniform guidelines for the use and conservation of Earth's water. Most people think of pollution in freshwater bodies like rivers, lakes, aquifers, and oceans when the topic of water pollution is brought up. Polluting water sources endangers aquatic life and has devastating health effects on the surrounding community. The impacts of water contamination on human health are also devastating. Inadequate sanitation, poor hygiene habits, and polluted water supply are only a few of the environmental risk factors that contribute to the high rates of mortality associated with certain illnesses in third world nations. One of the primary outcomes of these variables is gastrointestinal illness. Hepatitis, diarrhea, and cholera are some of the most notable disorders linked to contaminated water.

5. Conclusion

Water is the essence of life since every living thing on Earth needs it to survive. It's essential to their survival, yet dirty water poses serious health risks. Drinking dirty water is very harmful to human health. The major components of our environment are the air, water, and soil. Environmental education is crucial in the fight against pollution. Education on environmental and water pollution aims to instill in students the attitudes and abilities they'll need to save the planet for future generations. You may do your part to reduce water pollution by learning about the state of the world's water supply and advocating for conservation efforts. Protecting water supplies should be a top priority, thus learning about the causes and effects of water contamination is an essential part of any water education program. Education on water pollution is a powerful method of raising public consciousness. Media should be used in water pollution awareness campaigns, people should be educated on the importance of all natural resources for survival, producers should be educated by experts on the importance of proper fertilization, peoples should be educated on the recycling process and waste materials, and peoples should be educated on the harms of excessive consumption. The most effective method for lowering widespread water pollution is to restrict or eliminate the use of chemicals in farming, manufacturing, and household settings.

The effects of dirty water on the global population are dire, and water pollution is a problem on a global scale. Waste should be properly disposed of and treated before being dumped into the river, as per recommendations. To curb pollution, events like seminars and workshops aimed at raising public awareness and education are needed. Preventing such a catastrophic event requires immediate action. Diseases, aquatic animal deaths, economic expenditures of cleaning methods, ecological degradation, and food chain disruption are only few of the

numerous negative outcomes of water pollution. Water pollution education is crucial in this context since it encourages individuals to adopt the best possible behaviors in this area. Efforts to educate the public about the need of water conservation and provide them with the tools they need to do so should be supported and funded. Those who have received an education in environmental issues are better able to analyze the pros and cons and act responsibly because of it. Before individuals pollute water supplies, it is crucial that they be made aware of the dangers of doing so. Water contamination is the root of our lack of self-control and carelessness. No one wants to see water pollution increase because of how precious water is. Nothing alive can function in the absence of water. As a result, it's up to the general public to ensure that water isn't contaminated in any way. Because nature provides for and aids us in our daily lives, let us be self-disciplined and responsible enough to conserve, protect, and maintain not just water sources but also other natural resourses.

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