The Impact of Aquatic Ecosystem Degradation on Human Health: A Comprehensive Study of Water Quality, Biodiversity, and Disease Transmission

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Abstract: The aquatic ecosystem contains the relationship between human health and water quality, it is the necessary approach for water management policies and diseases. The main waterborne diseases are mostly affected by developing countries in terms of land use, malaria, and cholera. The effects of to increasing water and scarcity related to the human health under the relationship between the dams and waterborne disease in developed countries. The impaired water purification process through the loss of biodiversity causes the ecosystem to increase the other types of pollutants. More than 80% of sewages are generated by human activities with oceans and rivers without have any treatment. The impacts of water pollution related to human health included regional, age, gender, and other differences. The government takes action through water management interventions carried out to improve the water quality and water pollution impacts human health.

Keywords: Water Quality; Waterborne Disease; Ecosystem Services; Human Health; Climate Change; And Public Health.

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I. Introduction

Aquatic eco-system covered with wetlands, ocean, and rivers. Water is an essential resource for all living things, World Water Development released a report related to the use of fresh water should be increased to the past 100 years through 1980. Globally to increase the freshwater growth up to 1%. Author (De Carvalho, 2025) describes the importance of natural systems are providing services related to nutrition, purification of water, and other resources. Nowadays we explore the current ideas related to human health impacts followed by the functions of the earth's natural system. The main aim of this is to illustrate and identify the gap and limitations between future research studies. Understanding these relationships aims to highlight how crucial it is to protect aquatic ecosystems for the sake of human health and the environment. (Singh et al., 2024) One resource that is vital to human survival is water. The use of freshwater has grown by roughly 1% annually since the 1980s and has multiplied six-fold in the last century, according to UNESCO's 2021 World Water Development Report. There are serious problems with water quality as a result of rising water consumption. Urbanization, agriculture, and industrialization have all contributed to environmental pollution and degradation, which hurts the rivers and oceans that are essential to life and, ultimately, human health and sustainable social development. Ecosystems and human health are negatively impacted by the estimated 80% of industrial and municipal wastewater that is released into the environment worldwide without any prior treatment.

II. Environmental Impacts on Water Quality, Biodiversity, and Disease Transmission

Environmental impacts on water quality, the main reason is the human activities related to waste discharge, sewage disposal, and oil spills, here introduced the various pollutants like chemicals, bacteria, and nutrients. Some key impacts of water quality as nutrient pollution, chemical contamination, bacterial contamination, and oil spills. Nutrient pollution, which contains excess nutrients from various fertilizers like blooms, depletes the oxygen level. Chemical contamination means that industrial waste releases toxic chemicals from heavy metals into waterways, the food chain, and harming aquatic organisms. Climate

change, rising temperatures, and the decrease and dissolving of the oxygen level in water impact aquatic life. (Li Lin, 2022) Lin et al., (2022) According to UNESCO (2021) declared as 829,000 people die from diarrhea, reason by to unsafe drinking water and hand hygiene. Around the world, an estimated 80% of municipal and industrial wastewater is released into the environment untreated. with the detrimental impacts on ecosystems and human health. The percentage of developed nations with wastewater treatment and sanitation facilities is shockingly low. The primary causes of water pollution are natural, industrialization, and a lack of sewage treatment facilities for water supplies. Based on water quality, the model forecasts the effects of water purification equipment on human health from an economic perspective. Water purification decreased from 100% to 90% of household water. There was a 96% reduction in the anticipated level of health benefits.

The environmental impacts of biodiversity as climate change, pollution, and habitat loss. (Larissa D. Biasotto, 2018)Biasotto & Kindel, (2018) Describes the impacts of biodiversity related to infrastructure planning and decision-making flowed by the legal framework. As per the various infrastructures, it should create a reasonable evaluation through environmental ideas related to transmission lines during the environmental licensing process. Based on the environmental impacts of Assessment followed by the licensing process. The Environmental Impacts of Assessment is a rational and systematic process, some stages are influenced through decision making. (Ascelin Gordon, 2011) Gordon et al., (2011) Describes the global loss of vegetation and biodiversity contains an unprecedented rate due to increased human activity. Biodiversity and ecosystem conservation are important because they contribute to human well-being in a variety of ways, including security, health, and material welfare. To better understand how offset schemes might impact the ecological values they are meant to protect, modeling and computational techniques can be helpful in this situation. Ecological modeling is increasingly being used as a tool for decision-making, stakeholder engagement, and policy development. Various increasingly sophisticated methods, such as whole-country biodiversity analyses and network games, can be used to investigate stakeholder behavior in biodiversity credit markets. Various conservation strategies are being simulated using multi-agent models as part of the land-use planning and stakeholder engagement process.

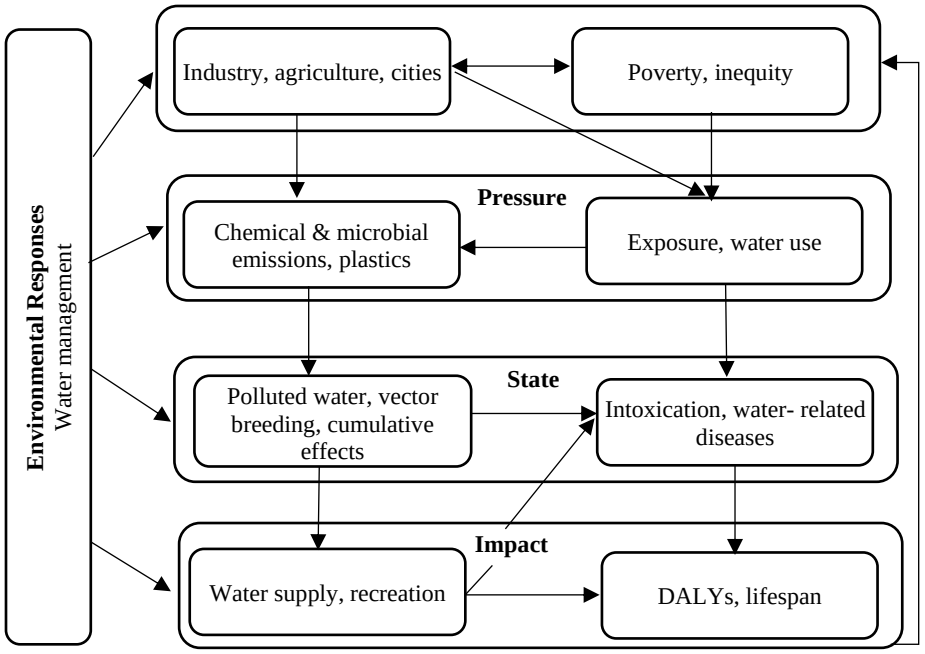

Figure 1: Conceptual Framework for Water Quality, Biodiversity, and Disease Transmission

This conceptual framework Figure 1 is followed by drivers, pressures, impacts, state, and responses regarding water and health. To analyze the water-related health issues adopted to environmental and human health. This structure contains various levels such as cause and effect relations. The overall drivers have

included the global level of autonomous population growth and climate change. Climate change is the steering of economic activities in different sectors such as food production and social drivers. These drivers lead to an analysis of the ecosystem alteration followed by the various types of determinants such as land use, urbanization, and agricultural intensifications. Dupas et al., (2024) Human behavior and interactions with environments are also influenced by these kinds of drivers, which in turn impacts environmental pressure. Both human health and the health of the aquatic environment should be impacted by the pressure. Disease transmission is occurring, ecosystem services are being adversely affected, and the environmental condition is getting worse. In order to address the drivers, pressure, state, and impacts, we concluded. Boelee et al., (2019) The significance of environmental factors that directly affect current services has been acknowledged by the health sectors. To organize and control the environment, which is followed by the usual reactions like farming, urban planning, and the effects of health problems related to water.

Increased pollution from the disposal of waste by infected people, changes in ecosystems as a result of diseased animal populations, the possibility of pathogen contamination of water sources, air pollution from waste management procedures, and disruptions to local economies as a result of disease outbreaks are just a few of the negative effects of disease transmission on the environment. These effects can be made worse by subpar sanitation and healthcare systems. The following factors are included in the impacts of disease transmission waterborne diseases, Waste management, vector-borne diseases, animal populations, and climate changes. Here describe some specific environmental impacts such as air pollution, economic disruption, biodiversity loss, and deforestation. Some strategies are used for this one to improve sanitation, vector control, and sustainable land-to-use practices. (priti Meena, 2023) (Meena & Jha, 2023)

III. Impact of Aquatic Ecosystem Degradation on Human Health

Aquatic ecosystem degradation has significant impacts on human health, and these effects can be direct or indirect. Here's how the deterioration of water ecosystems affects public health such as contamination of water sources, loss of biodiversity and food security, impacts of air quality, increased frequency of natural disasters, climate change, and its health effects, Impacts of traditional health practices, and mental health consequences. Water contamination frequently results from degraded aquatic ecosystems, either as a result of pollution or the disintegration of natural filtering systems (like wetlands). Plastics, heavy metals, chemicals (such as pesticides), and dangerous pathogens can all be found in contaminated water. Waterborne illnesses may develop if this water is consumed or comes into contact with the body. diseases like typhoid fever, dysentery, and cholera. George, (1997) Poisoning by chemicals, Lead, arsenic, and mercury are among the contaminants that can harm a child's development and nervous system. Toxin bioaccumulation, when toxic substances build up in the food chain, they can hurt human health when consumed in contaminated fish or seafood. Loss of Food Security and Biodiversity Numerous food sources are found in aquatic ecosystems, particularly in riverine and coastal communities. When environmental conditions deteriorate Fish population decline: For millions of people, fish and seafood are an essential source of protein and nutrients, but their availability is diminished as a result of overfishing, pollution, and habitat destruction. Aquatic plant loss: Significant aquatic plants are also affected, depriving communities of food sources and even therapeutic plants (such as seaweed and freshwater vegetation). The use of plants, fish, and animals from wholesome aquatic environments in traditional medicine and healing is common among rural and indigenous populations. degradation of ecosystems as Depletion of medical resources: These communities' health suffers as a result of the loss of fish and medicinal plants used in traditional medicine due to the destruction of aquatic habitats. (Lara et al., 2012) Aquatic ecosystem degradation has an impact on human health both directly and indirectly, in addition to endangering biodiversity. For the environment and the people who depend on it to remain healthy, these ecosystems must be managed and restored effectively. Wetlands and mangroves can be preserved while addressing pollution, overfishing, and climate change to lessen their effects.

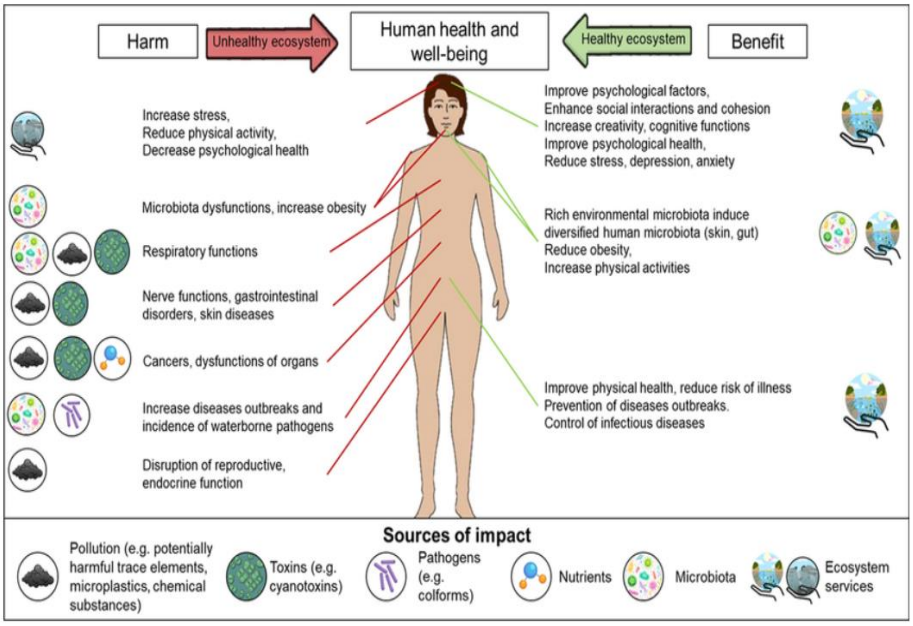

Figure 2: Impact of Aquatic Ecosystem Degradation on Human Health (De Carvalho et al., 2025)

Figure 2 describes the effects of aquatic ecosystems on human health and welfare is one example. It includes both healthy and unhealthy ecosystems, as well as direct and indirect effects. Enhancing physical health, moods, and behavior is directly related to the positive effects of a healthy ecosystem. The integrity of the aquatic ecosystem, pollution control, regular standards, and good chemical and ecological status are the primary goals of this framework for water management. The European Commission oversees the water framework and assists with sophisticated forms of shared evaluation. Human health and well-being are intimately related to the direct and indirect benefits that aquatic ecosystems provide. In addition to offering necessities like food, medicine, and clean water, these ecosystems are also vital for controlling the climate, averting natural disasters, and promoting mental well-being. Water quality is the ability of clean aquatic ecosystems to produce safe drinking water and lower the risk of waterborne illnesses. However, deteriorated ecosystems result in tainted water sources, which raises the possibility of conditions like chemical poisoning, gastrointestinal disorders, and increased pathogen exposure. Myers et al., (2013) By taking up carbon, aquatic ecosystems like mangroves and wetlands aid in climate regulation. Their deterioration fuels climate change, which in turn causes more frequent extreme weather events and altered disease trends, both of which have a domino effect on human health. Human health and the condition of aquatic ecosystems are closely related, with both direct and indirect effects. To protect public health, these ecosystems must be preserved and restored. We can lower the risks to human health by reducing climate change, protecting biodiversity, and maintaining water quality. To guarantee the ongoing advantages of aquatic ecosystems for future generations, concerted efforts in pollution control, sustainable resource management, and ecosystem conservation are necessary.

IV. Conclusion

An aquatic ecosystem has effects on human health such as “biodiversity, water quality, and disease transmission”. The aquatic ecosystem is a major component of earth's biosphere, it provides various types of services to humans. The summary of water pollution, which contains freshwater sources, reduces the availability of clean water for domestic and international use. The result of the ecosystem has multiple impacts related to human health. Following the analysis, we develop and assess the health related to an aquatic ecosystem over the past years. It is also linked to human health risk. Followed by Water Framework Directive provides the tool containing the applicable measures.

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