Effects of Water Pollution on the Quality of Fish

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Abstract
Water can be considered as the most important aspect for any creature after oxygen. Several human activities such as the use of harmful chemicals and others are increasing day by day which is increasing contamination of water. Although water pollution is negatively effective on almost all the creatures on this earth, the study specifically sheds light on the effects of water pollution on fish health. The use of secondary sources is appropriate for this study as there are many articles and journals that provide adequate information about water pollution and its effects on fishes. All the key findings from the selected six articles are presented through a table and then narratively discussed for improving the understanding regarding the findings. As a result, it is identified that water pollution disrupts the growth of the fishes and decreases the quality of them. The percentage of fish population decreases as well as the percentage of fish decline also increases due to water contamination. All of these findings are briefly discussed in this study with accurate citation which sustains the significance of this study.

Keywords: Water Pollution, Fish Health, Contamination, Pollutants, Heavy Metals, Human Activities, Quality of Fish

INTRODUCTION & BACKGROUND

Water pollution is one of the major complications in India in recent times which are affecting the lifestyle of humans, creatures and animals. The major effects of water pollution are experienced by fishes as it leads to their habitat degradation. Different human activities are the main causes of water pollution such as septic tanks, domestic wastes, nuclear waste, run-off from agriculture and other industries, pesticides, organic wastes and others (Malik *et al.* 2020). The use of different chemicals in industries has highly increased which is one of the core contributors in water contamination in India. Hence, the increasing level of water pollution is decreasing the quality of fish as well as healths of humans are also affected by this issue.

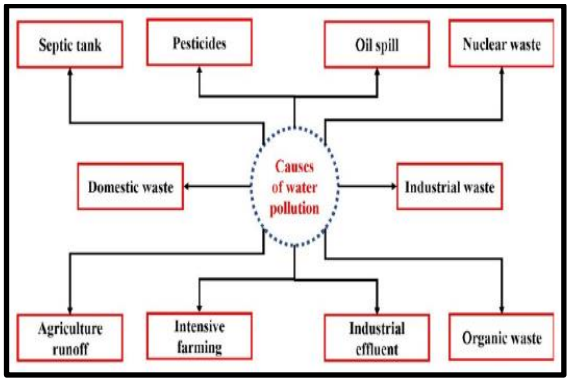

Figure 1: Possible causes of water pollution

(Source: Malik *et al.* 2020)

Urbanisation, population growth, unsuitability, untenable land use and industrialization are the main sources of the pollutants that lead to water pollution.

These sources lead to the increase of gas emissions, wastes and excessive use of water. Thereafter, these actions result in eutrophication, population loss, lethal substances and acidification. In this regard, the effects of water pollution by heavy metals, chemicals and other pollutants on the health and quality of fish are the main focus of this study.

AIM AND OBJECTIVES OF STUDY

The study aims to evaluate the possible effects of water pollution on the quality of fishes in the fishery industries. Considering this, specific objectives are,

- To recognise the heavy metals and other pollutants that contributes to water contamination
- To investigate the effects of the toxicity of water pollution on aquaculture and fish production
- To demonstrate the impacts of water contamination by heavy mental on the health of fishes

RESEARCH QUESTIONS

Particular research questions of this study are,

- What are the pollutants contributing to water pollution and harming the quality of water?
- How does water pollution affect aquaculture and the fish production process?
- What are the impacts of water contamination on the health of fishes and their development?

MATERIALS AND METHODS

Adoption of specific methods and techniques and the use of particular tools are important for conducting a study with appropriate data and making it significant. At first, it is important to choose a research design for maintaining a structure throughout the research study. There are the two major categories of research design such as quantitative design and qualitative design. The use of quantitative design brings numerical and objective data for research study as well as qualitative design helps to gather non-numerical and subjective data (Lowe *et al.* 2018). Although both of the research designs are used for collecting different kinds of data, both of the designs are capable of making a research study significant and relevant. Thereafter, the quantitative design is complex and time consuming and due to that the ***qualitative design*** has been chosen for this study.

In regard to this, the methods for data collection have been selected for this study. There are two types of methods supported by the qualitative design which are primary methods and secondary methods. Primary qualitative methods include interviewing people whereas secondary qualitative methods include observing articles, journals and other published sources (Ruggiano and Perry, 2019). There are many articles and journals that provide accurate information about the effects of water pollution on fish quality and therefore the use of ***secondary methods*** is suitable for this study. Besides, there were some criteria for selecting articles and journals in regard to collecting data. All the articles needed to be related to the research topic and published between 2018 and 2023. This criterion ensures the collection of reliable and relevant data for this study. Apart from that, doctoral dissertations are excluded for ensuring that all the collected information is correct.

On the other hand, the use of a specific research philosophy is also important for a better understanding of the findings. There are four categories of research philosophy which are positivism, pragmatism, interpretivism and realism. Among all of these, ***interpretivism philosophy*** is used for understanding qualitative data and therefore this is appropriate for the study (Curry, 2020). In addition to that, mobiles, internet, computers, search engines and others were the specific tools or instruments that have been used for gathering

sources and data for the study. All of these instruments contributed to the finding of relevant sources for gathering relevant data. Furthermore, the use of a specific technique for evaluating all the findings is also important. The qualitative design supports five specific techniques such as case studies, grounded theory research, narrative research, ethnographic research and phenomenology research (Lester *et al.* 2020). The ***narrative research*** has been used for evaluating all the data as this is the easiest and simplest method for analysing all data meaningfully.

RESULTS

Table 1: Findings of this study (Source: Self-developed)

Source	Key findings
Singh *et al.* 2020	The article includes discussion about the pollutants that cause water pollution and their sources. As per the author, natural sources, domestic wastes, industrial wastes and agricultural wastes are the core sources of water pollutants. Thereafter, the author has also provided information about the types of water pollution. There are a total of seven categories of water pollutants which are organic pollutants, radioactive pollutants, inorganic pollutants, thermal pollutants, pathogens, suspended solid pollutants and agricultural pollutants. It is identified that water pollution is impactful on the organisms and animals which came in contact with the polluted water.
Sonone *et al.* 2020	Heavy metals such as arsenic, mercury, chromium, thallium, lead, cadmium and others are highly and negatively effective on water. These are the core pollutants that contribute to weather contamination which comes from volcanic eruptions, power plants, mining, electronic waste, agricultural wastes, industrial wastes, biomedical wastes and electroplating. Further, the study discusses the effects of these heavy metals on aquaculture. It is identified that the heavy metals are impactful on development and growth rate of fishes. The metal hits the organs or parts of fishes which disrupts their growth and development as well as negatively affects the reproductive system of fishes. Apart from that, respiratory damage, gill damage, neurotoxin effect, damage of the blood and circulatory system, psychological effects and others impacts of the heavy metals on fishes.
Javed and Usmani, 2019	This article also discusses the impacts of the heavy metals on the health of fishes. The author evaluated that Chromium, Manganese, Cobalt, Iron, Nickel, Copper and Zinc are the heavy metals that come from different sources and contaminate the water. These metals lead to accumulation of tissues such as muscle, gills, kidney, liver and integument of fishes which enhances genotoxicity and oxidative stress among fishes. In this situation, the fishes require more energy and alternation of tissue energy which leads to poor health of the fishes due to less PUFA and protein.

Garai *et al.* 2021	This particular article also includes the discussion about the heavy metals that come from different sources and contaminate the water. These metals are poorly impactful on bioaccumulation of fishes which are described in this article. It is identified that Chromium harms kidney, gills, heart and muscle of the fishes as well as Cadmium is another heavy metal which harms gills, liver, intestine and heart of the fishes. Apart from that, Copper, Nickel, Zinc, Mercury, Lead and Mercury are the other metals that affect almost all the organs of fishes. This leads to poor development of the fishes and reduces the quality of them.
Isangedighi and David, 2019	The authors have focused on the effects of the heavy metals on the health of fishes and humans as well. As per this article, there are several intrinsic and extrinsic factors that are affected by the heavy metals. Thereafter, nutritional state, throughput of water, stage of moult cycle, surface impermeability and others are the intrinsic factors that are negatively affected by the heavy metals. Apart from that, temperature, chelating agents, other metals, dissolved metal concentration and salinity are the extrinsic factors that are influenced by heavy metals and that impact the health of the fishes poorly. In contrast, these metals come into the human body through the fishes and that harms kidney, lungs, heart and other organs in the human body.
Taslima *et al.* 2022	This article highlights the impacts of heavy metals on the growth, development and reproduction of fishes. As per the author, heavy metals are the core pollutants which decreases the safety level of the water and enhances toxicity and that even cause the death of the fishes. It is identified that heavy metal impacts the embryos and larvae development of fishes and disrupts the growth of the fishes. Apart from that, the metal disrupts nutritional adequacy for fishes and that reduces the size and growth performance of them. Thus, it can be stated that the heavy metals enhance water contamination and reduce the quality of the fishes.

DISCUSSION

All the key findings from the six particular articles are presented in the table above and briefly discussed in this section of the study. Singh *et al.* (2020) have broadly discussed the origins of the water pollutants and how the pollutants contaminate the water. It is identified that there are two types of sources of water pollutants which are direct sources and indirect sources. Domestic wastes, industrial wastes, agricultural wastes and others are the direct sources as well as water supply from groundwater, rainwater and other sources associated with the atmosphere are the indirect sources. Intentional and unintentional release of these pollutants enhances toxic chemicals, harmful chemicals and contaminants in oceans, lakes, rivers and other water sources. The huge use of technological devices is also contributing to the enhancement of water pollution in India (Cheng *et al.* 2020). It is identified that the electronic wastes includes the harmful heavy metals which pollutes the water sources.

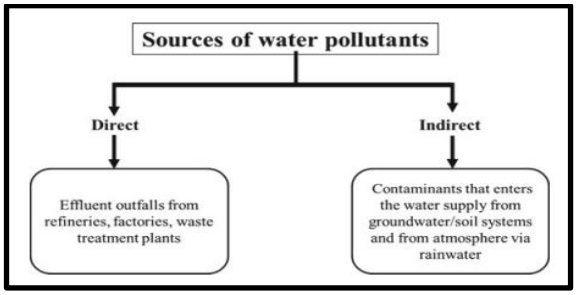

Figure 2: Two types of sources of water pollutants (Source: Singh *et al.* 2020)

In addition to that, it is also identified that there are different categories of water pollutants. Organic pollutants include hydrogen, Sulphur, carbon, nitrogen and oxygen which generally come from factories, industries and agriculture. Apart from that, inorganic pollutants are heavy metals, ammonium nitrate, nitrite and other harmful chemicals which also come from factories and agriculture (Schweitzer and Noblet, 2018). On the other hand, Sonone *et al.* (2020) have opinionated about the effects of heavy metals and other pollutants on aquaculture which showcases that power plants, biochemical wastes, agricultural activities, electronic wastes, volcanic eruptions and others are the core sources of the heavy metals that affects the aquatic environment and the health of the fishes. Metal bioavailability and metal accumulation leads to habitat loss of the fishes and that creates a poor aquatic environment which eventually negatively affects the health of the fishes (Madhav *et al.* 2020). Moreover, heavy metals disrupt aquatic ecosystems such as aquatic fauna and aquatic flora.

As per the opinions of Javed and Usmani (2019), the emergence of industrialisation and globalisation has enhanced waste in business organisations, which has directly affected water quality. Increased pollution has already polluted river water, while groundwater has also started to be affected. Additionally, increased waste has enhanced heavy metals in water bodies which have directly affected the health and survival of fish living in these water bodies. These heavy metals are non-biodegradable and dangerously toxic in nature. Consequently, these aspects have affected fish quality as well as affecting the health of their consumers. It has been observed that the high toxicity of these heavy metals plays a major role in changing the chemical and physiological structure and process of fish's body systems. Chromium is among the most common and available pollutants along with iron.

According to Dwivedi, (2018), increased water pollution indicates enhanced microbial contamination causing high health risks and risk of cancer. In this regard, regular consumption of this water or fish can affect the health of consumers and can even cause cancer. The process of accumulating toxic substances in living organisms has been regarded as bioaccumulation. It has been observed that the level of organochlorines in the water of the Ganga is beyond the limits of drinking, which indicates that health risks associated with the consumption of fish from this water. The main sources of the pollutants vary and these pollutants can be divided into organic and inorganic contaminants. The Ganga water also consists of a significant contribution to the national economy due to fish diversity.

As stated by Garai *et al.* (2021), nowadays, environmental pollution due to heavy metals has enhanced rapidly due to increased industrialisation and the destruction of natural resources. Consequently, releasing organic and inorganic waste has also enhanced business organisations, which has affected the quality and health of water, especially rivers situated near industrial areas. These practices have introduced various types of contaminants, though heavy metals are regarded as the major sources of environmental pollution. The main sources of heavy metals are industrial waste, wastewater treatment plants, mines and fossil fuel combustion. Regarding this, the prevalence of heavy metals in the water has influenced bioaccumulation in aquatic animals, mainly fishes. It has been observed that these heavy metals can dissolve in water and enter the organisms of fish and other aquatic animals. Therefore, the quality and health of these fishes have been affected highly and consuming these as food can affect human health.

As highlighted by Madhav *et al.* (2020), water has been considered to be the most vital natural resource

for the survival of every living creature, whereas water pollution has caused destructive impacts on the health and biological and chemical features of the dependants. There are several methods for the identification of water pollution, including investigating aquatic animals, especially fish. It has been identified that the availability of diverse groups of fish indicates the good quality of water, while the identification of fewer or no fish reveals a high level of water pollution. Therefore, it can be stated that fish stands among the main aquatic creatures and can reveal the actual quality of the water they are living in. Additionally, focusing on the health and quality of fish can help to identify and understand the quality and pollution level of the water. Consuming fish belonging to polluted water has the potential to affect human health and impact various organisms.

As stated by Isangedighi and David (2019), fish can be regarded as among natural sources of high protein and environmental contaminants can affect the health and reproduction system. The main reason behind this impact is toxic metals and contaminants are non-biodegradable in nature, which makes them more dangerous for the environment. Additionally, the biomagnifications and bioaccumulation aspects have encouraged this prevalence as due to these habitats, fish cannot escape environmental impacts. Regarding this, the waste-releasing activities of business organisations have to be maintained more effectively along with implementing sustainability practices and approaches in order to reduce the prevalence of heavy metals and other organic or inorganic harmful waste releases. Focusing on adopting effective waste management approaches and principles can help to reduce water pollution and associated impacts.

As per the statements of Olmos *et al.* (2020), the increased focus on seafood, fish oil and fish protein has increased a major imbalance in aquaculture. Apart from this, considering the commercial profitability, farming of fish in ponds has also enhanced which is changing their chemical, physiological and biological nature and systems. These practices have also affected the immune system and in this regard, the application of probiotics can help to improve the immune system. Along with that, heavy metals have been regarded to be a destructive threat to the aquatic environment (Taslima *et al.* 2022). In order to prevent these impacts, proper optimisation and adoption of relevant strategies are required.

CONCLUSION

Considering the overall aspects, it can be stated that the increasing prevalence of environmental pollution has posed crucial impacts on water level and the creatures living in it. Various sources of water pollution have been identified and divided into two groups, which are direct and indirect contaminants. These contaminants are formed through different activities, including domestic waste, industrial and agricultural waste. Heavy metals are the major sources of water pollution and it has been observed that heavy metals causes high damage in fish health that ultimately affects human health. These pollutants have also affected the diversity of fish and have created a major imbalance in aquaculture.

Therefore, heavy metal toxicity has impacted the health and quality of fish and consuming them can affect the nervous system and damage sensitive organisms. The prevalence of pollutants and heavy metals has caused a major impact on the health and diversity of fish. Water is among the most important aspects associated with regular activities and the survival of living creatures. Hence, business organisations can focus on improving their waste releasing practices and incorporate sustainability approaches to improve the nature of waste and reduce harmful waste. Adopting these practices can

help to improve the quality of water by reducing pollution and also improve fish quality and health.

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