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Chapter
[8]

Wastewater pollution induced detrimental impacts on aquatic biodiversity: A review

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Abstract

Freshwater is the most transformed and endangered ecosystem on Earth due to many threats. Water pollution is one of them, which involves both point and non-point sources of human activity. Disposal of polluted water by humans is the root cause of stress for aquatic ecosystems. Industrial, municipal, agricultural activities have been identified as the major contributors to environmental stress, affecting all the components of the aquatic ecosystem. Water pollution along with overexploitation, climate change, flow modification, exotic species invasion, and habitat loss are among the six major threats of aquatic biodiversity loss. Here, we review the major types of pollutants emerging from different anthropogenic sources and their adverse effects on the water quality of the lotic and lentic ecosystem, its harmful effects on aquatic biodiversity, identification of a particular type of pollutant through bio-indicator or bio-monitor. Also stating about biodiversity maintenance, which is the prime key to retain ecosystem services, and how to deal with these situations when it has become an ultimate challenge for mankind so that biodiversity rejuvenation could follow a growing trend.

Keywords Aquatic ecosystem, Biodiversity, Wastewater disposal, Water pollution

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Introduction

Since the beginning of the twenty-first century, humanity is facing several types of severe problems and one of them is related to water quantity or quality issues (WWA, 2009). Water is the most important natural resource for the emergence of life which is present on this earth. According to several reports, only 3% of the total water is drinkable, out of the 3 % of that water surface acquire only 1% of water rest is in a frozen state or underground (Tahir and Soaib, 2020). Even though water is the most important need for any living system, continuous anthropogenic activities have made it harmful and polluted for the life present in water as well as on the land. Presently water pollution is considered one of the top priority universal challenges facing by developing as well as developed countries (Bassem, 2020). The problem of water pollution will become more aggravated in the future by climate change, which results in high water temperatures, increasing sea levels, melting of glaciers, etc. Humans are the major known source of water pollution. Urbanization, human settlements, industries, agricultural practices ultimately affect the water quality of many natural water resources (UNEP, 2016).

Ecosystem services are free and equal for all, making it a major cause for humans for its overexploitation, leading to massive destruction with an unpleasant impact on human health and livelihoods (UNEP, 2016). Continuous increase in the growth of population, economical activities, and climate changes participated in the spoilage of water resources. Several toxic and potentially toxic chemical compounds are released daily into the environment due to continuous human activities. So, it has become requisite to save the water sources from industrial pollutants, fecal contamination, and agricultural wastes. In developing countries, about 90 to 95% of total sewage and about 70% of industrial wastes are disposed of untreated into surface water (Obiakor *et al*., 2012) while according to some study, 80% of municipal wastewater is released untreated into water bodies globally. It has been reported earlier that the freshwater ecosystem is rich in biodiversity has a fast rate of decline than the marine water or land ecosystem making them the world's most threatened ecosystem and vulnerable habitats; their sustainability is being affected by humans (Obiakor *et al*., 2012). Pollutants affect the immune system of fishes either directly or indirectly by altering the water quality (Kumar *et al*., 2019), presence of heavy metal in water sources give rise to the problem of bio-magnification or bio-accumulation when these metals accumulate in the fishes and cause a harmful effect to their body as well as to humans when they take these fishes as food for a healthy diet (Kumar *et al*., 2020; Fatima *et al*., 2020). Wastewater releases from various sources can critically harm the aquatic ecosystems which result in a shift in the diversity of aquatic organisms and even cause the extinction of some aquatic species (Niu *et al*., 2019). Genotoxic pollutants present in water bodies affect the cellular genetic material and its integrity in fishes and other aquatic organisms and finally cause mutation due to its mutagenic activities. It also affects the germ cells and can pass genetic changes down to progeny so, it is considered against the sustainable development principles by WHO (Obiakor *et al*., 2012).

Pollutants are generated by many sources, as far as the aquatic life is concerned the prime sources of pollutants are Industrial effluents (industrial waste and heavy metals), agricultural runoffs (herbicides, pesticides), municipal sewage, etc. According to (Mohamed *et al*. (2013) effluents coming out from industries are highly toxic and contain heavy metal which combines with suspended solids present in domestic wastewater and forms muck. Discharge of pollutants in the water stream causes widespread toxic pollution, organic pollution, and eutrophication along with severe ecological destruction (Miao *et al*., 2012). Removal or treatment of pollutants in water bodies or aquatic sediments is a difficult, challenging, and very costly task because the diversity and amount of persistent toxic pollutants are so high and increasing continuously (Doust *et al*., 1994). Also, it is necessary to save water resources from fecal contamination and agricultural wastes. Hence, there is an urgency to find a better way to cope with the environment and find a sustainable or eco- friendly way of fighting the increasing levels of pollution for our better tomorrow and the long-lasting sake of our non- renewable resources.

Water pollution threat to aquatic biodiversity

Freshwater is the most important aspect of life, without it, the existence of life cannot be imagined. As a result of over-exploitation of natural resources, human has created numerous environmental problems for us as well as for the flora and fauna all over the world (Fent, 2008). Water pollution is one of them and is now a worldwide challenge for both the developed and developing countries, imposing numerous side effects on humans along with environment. All of this is a result of poor management of wastewater and polluted water in most parts of the world resulting in the scarcity of fresh water globally and many environmental issues. Upon discharging the polluted water, it reaches the water bodies where it is diluted, transported downstream, or gets infiltrated into the aquifers, thereafter affecting the quality of freshwater. The 2030 Agenda for Sustainable Development, admitted the degradation of water quality all around the world and stressed the policies that would ensure control on the water pollution at national and international levels (UNWW, 2017).

Anthropogenic activities are the major cause of water pollution which includes improper human settlements, poor management of waste products released by industries, and agriculture runoff. The sources of water pollution are basically of two types: Point source and Non-point source. Point sources are those sources which dispose pollutants directly into the water (factories, power plants, oil wells, coal mines, etc.) while non-point sources are those whose source of disposing of pollutant are not specific (runoffs from agricultural fields, gardens, household wastes, etc.). Basically, there are 2 forms of water pollution: (1) Change in the type and amount of material carried by water, (2) change in the physical properties of water (temperature, color, odor, etc) (Gupta *et al*., 2008) and this contamination is majorly caused by four types of pollutants (Physical, Chemical, Radioactive, and Biological) resulting as a by-product or waste product from three major sources which are; industrial effluents, agricultural

runoffs, domestic sewage. In addition to these, natural events such as volcanic eruption, algal blooms, and earthquakes are also the cause of water pollution to some extent.

Agricultural Activities; agricultural activities are known to be the major source of surface water pollution. Agricultural uses around 70% of the total freshwater which results in 50% (primary source) of total surface water pollution and third most for the estuaries (Islam and Tanaka, 2004; Agrawal *et al.*, 2010). The major waste products produced by the agricultural practice which results in water pollution are paddy husks, sugarcane bagasse, animal excreta, pesticides, insecticides. The water bodies receive this waste as a result of erosion of soil (containing organic pollutants) and post precipitation run-off of chemicals used as fertilizers and pesticides etc. (Nagendran, 2011). As the world population had increased exponentially, farmers started using fertilizer to great extent in all parts of the world due to easy availability and low cost to increase productivity. Fertilizers are the major non-point source of nitrogen and phosphorus. The United States of America saw an increase in the use of nitrogen-based fertilizers by 20 times between the period of 1945 to 1993. In figures, this number was from 0.5 million metric tons to 1.9 million metric tons per year. Studies estimate that farmers use fertilizers in excess by 24% - 34% more than that is required due to the uncertainty of weather and nutritional status of the soil (Puckett, 1995, Lu *et al.*, 2015).

Few Asian countries (India, China, Bangladesh, and Myanmar, etc.) with higher agricultural productivity contribute significantly to aquatic pollution from agricultural sources. Bangladesh uses 9000 metric tons of different types of pesticides and 2 million metric tons of fertilizers annually (Islam and Tanaka, 2004). Fertilizers, pesticides, and various chemicals are also carried by wind over a long distance, contaminating water bodies a thousand miles away (For instance, pesticides used in tropical regions were found in Arctic mammals). Runoff of these chemicals leads to contamination of water bodies and its biota in various ways like eutrophication, affecting the health or the reproductive efficiency of the fishes and other aquatic animals. Pesticides and their derivatives are one of the most devastating agents for the aquatic biodiversity and ecosystem affecting the food chain from top-level to the lowest (Islam and Tanaka, 2004).

Animal manure is another pollutant that is responsible for water contamination produces by agricultural activities. In the USA itself, around 5.9 million and 1.9 million metric tons of nitrogen and phosphorus are released by the manure every year. The cattle's grazing freely scatters manure all over the land making a non-point source for water pollution while farms, where cattle are not allowed to freely move, are the point source for water pollution. This organic waste material affects the quality of water in various ways like alteration in the turbidity, odor, and color of the water. It is one of the major sources of pathogens in the water which not only affects the native population of the water but is also deadly for humans (Karcı and Balcıoğlu, 2009).

Industries are responsible for the destruction of our environment. The waste produced by industries affects all aspects of the environment, be it water, air, soil, or biodiversity. They are a major point

source for aquatic pollution. Unchecked effluents released by the industries directly into the water bodies are the major reason for water pollution through industries. These effluents consist of a variety of pollutants that vary from industries to industries. The effluents are majorly released by industry oils, heavy metals, and organic chemicals. Pollution through oil has to gain attention since the end of the 20th century with an increase in industrial effluents, oil tanker operations, oil usage, and marine tanker accidents resulting in spillage of oil (Moiseenko *et al*., 2017). Coastal refineries are another source of oil pollution as crude oil purified and processed to produce a variety of products, during these operations small scale pollution occurs continuously through leakage, breakage, and sills (Soromotin, 2011). A study by Nelson (2000) suggests that in addition to spills as a result of various regions, an estimated volume of 16,000 tons of oil reaches the aquatic ecosystem as run-off and waste from land-based industries in Australia only. Similar results were expected from developed European and Asian countries (Moskovchenko *et al*., 2020).

Heavy metal and trace element are the by-products of various industrials processes which reaches water sources through land-based or water-based effluents (Nordstorm, 2002). The other source of heavy metals which pollutes the water source is natural. This occurs due to weathering of rocks of sedimentary rocks releasing various metals such as Iron, Zinc, Calcium, Chromium, Cadmium, etc. Industries majorly discard more dangerous heavy metals (Mercury, Lead, Iron, Nickel, Manganese, etc.) as compared to natural processes (Saha and Paul, 2016). Ni, Fe, And Mn reach the aquatic system by corrosion of metal pipes and containers. Paints, petroleum compounds, and aerosols are the major source for the lead contamination of water. Cadmium and Chromium reach through metallurgical industrial discharge, refractories, and breakdown of galvanized pipes and containers. The major portion of heavy metal pollution is through acid mine drainage (AMD) which releases high levels of sulfides, As, Cd, Cu, and Zn, etc. Saha and Paul (2016) and Razo *et al*. (2003).

Synthetic Organic chemicals are other industrial effluents that are of great concern for the aquatic as well as terrestrial biodiversity due to high-level toxicity and high persistence in the biological system. The major synthetic organic chemicals are Organochlorines, Organophosphates, Organometals, HCH, and PAHs (Islam and Tanaka, 2004). Now a day the traces of these xenobiotic compounds can be found in every part of the aquatic life system from the Antarctic to Artic and from intertidal to abyssal. These synthetic organic chemicals are non- biodegradable which increases the concern for its presence in the environment (Loganathan *et al*., 2020).

Sewage is a well-known participant in water pollution as it contributes to the greatest volume of water waste. Highly populated cities produces a humongous amount of sewage containing all sources like municipal waste, industrial waste, slaughterhouse waste, animal farm waste and all sorts of domestic wastes including fecal matter and many more (Islam and Tanaka, 2004). These effluents either are purposely dumped into the freshwater bodies or are washed off with the rain. One of the major problems conceived due to sewage is the increased BOD levels hence, decreasing dissolved oxygen.

Sewage, being organic is highly subjected to bacterial decay (Islam and Tanaka, 2004). This oxygen deficit water is not only unhealthy for consumption but also creates a negative ecosystem for the existing aquatic flora and fauna. Not only the sewage itself but the sewage treatment plants (STPs) are a major threat to the marine ecosystem. Some of the well-functioning urban citizens efficiently treat the sewage waste before releasing it into the water bodies. But sadly the separation of efficiency from their plants gets dumped into seas and oceans. Other disease-causing agents that may be present in sewage include enteric viruses, *Salmonella*, and the Hepatitis A virus (Tewari *et al*., 2017). Plastic also contributes significantly to marine contamination. They are dumped in huge quantities everywhere around the world which reaches water bodies. The survey on the beaches of two countries (Japan and Russia) reported that plastic waste contributes up to 72.9% (by number) and 53.8% (by weight) of the total waste in the beaches (Islam and Tanaka, 2004; Sigler, 2014).

Impact of industrial wastewaters on the aquatic ecosystem

Industrial waste contamination has seen steady growth and the marine ecosystem is the worst affected. Chemical waste is a major contaminant, whether it is air, land, or the water environment. Town sewage and industrial waste dumped into the rivers are the most polluting of these. Industrial waste is characterized as waste generated by fabrication or industrial processes. Cafeteria garbage, dirt, and gravel, masonry and concrete, scrap metals, rubbish, oil, solvents, chemicals, weed grass and trees, wood and scrap lumber, and the like are among the types of industrial waste produced. An industrial waste - which may be solid, liquid, or gases held in containers - is divided into hazardous and non-hazardous waste. Hazardous waste can result from fabrication processes or other industrial processes. Some commercial goods may also be classified as hazardous waste, such as cleaning fluids, paints, or pesticides discarded by commercial establishments or individuals (Lawson, 2018). Non-hazardous industrial waste is that which does not follow the definition of hazardous waste by the EPA (Environmental Protection Agency) which is not municipal waste. Since the Industrial Revolution industrial waste has been a concern this may be toxic, flame retardant, corrosive, or reactive if treated poorly, this waste can have harmful implications for health and the environment. In the United States, the amount of hazardous waste produced by the country's manufacturing industries grew from an estimated 4.5 million tons per year after World War II to some 57 million tons by 1975. By 1990, the number had fired at around 265 million tons. This waste is produced in the manufacturing process, use, and disposal of the manufactured products at every point. Thus, the advent of many modern home and office goods-computers, medications, textiles, paints, and dyes, plastics-also brought hazardous waste into the environment, including toxic chemicals. These, too, need to be handled with great caution to prevent adverse effects on the environment or human health. In 1980, the EPA estimated that more than 70,000 different chemicals were manufactured in the U.S., with some 1,000 new chemicals added each

year. The human health and environmental impact of many of these chemicals are largely unknown. High levels of toxic pollutants have been found in animals and humans, particularly those who are constantly exposed to these waste streams, such as farmworkers and oil and gas workers. Wastewater from industrial processing or chemical processes leads to water contamination.

Industrial wastewater typically contains different chemical compounds that can be readily identified. Within a few subsectors, water pollution is concentrated mostly in the form of toxic waste and organic pollutants. A significant portion of this can be attributed to industrial chemical production and the food goods industry. Most major companies have industrial effluent treatment facilities but this is not the case with small-scale factories that can not afford huge investments in pollution control equipment because their profit margin is very slim. The consequences of water contamination are harmful not only for humans but also for wildlife, fish, and birds. Contaminated water is unsuitable for drinking, leisure, farming, and industry. The visual standard of lakes and rivers is reduced. More importantly, contaminated water is killing aquatic life and reducing its reproductive capacity. This is essentially a threat to public health. No one may avoid the consequences of polluting water.

The dry-cleaning fluids and the embalming fluids are two forms of industrial waste of particular concern. Dry cleaning fluids have polluted groundwater sources in all parts of the USA. PCE (perchloroethylene, or tetrachloroethylene, $Cl_2C = CCl_2$) is one of the most dangerous pollutants. PCE must be eliminated from the water to very small levels, as a potential carcinogen (Domestic, and Fast, 1986).

The minimum contaminant level (MCL) for PCE in drinking water in the United States EPA is 5 ppb (5 parts per billion, or 5 mg / L). States such as New Jersey have set MCLs at public water supplies as low as 1 ppb for PCE. Cemeteries can be a source of contamination of the groundwater caused by the degradation of organic matter and embalming fluids. There are a variety of historical records of water-well contamination in the area of cemeteries. Carcinogens involve embalming fluids. The possibility of contaminating the water supply by embalming fluids has caused several cities to reduce the size of the proposed large cemeteries. There's no question with our aging population that embalming fluids will become increasingly a source of water contamination unless anything changes.

How marine life is impacted by toxic waste?

Bioaccumulation allows toxic chemicals to accumulate in the tissues of aquatic plants and animals at high concentrations. They are not disintegrated into marine species and instead remain preserved in their bodies, which ultimately leads to death. Owing to bioaccumulation, aquatic life consumes even toxic metals like copper, mercury, and lead. Thermal pollution in oceans happens when there are rapid changes in the temperature of the water. This is mainly caused due to factories and power plants discharging hot or cold water in oceans. This threatens marine life's survival, as most species have

different temperature requirements and cannot tolerate sudden temperature changes (Help Save Nature, 2009). It can also affect the behavior and reproductive patterns of animals such as fish. For example, fish reproduction may still occur but excessive temperature can cause the release of immature eggs or impede the healthy development of certain eggs. When chemicals are discharged into the aquatic environment, they are absorbed easily into the web of aquatic food. This can result in harmful mutations in marine organisms as well as serious diseases that lead to changes in tissue matter, biochemistry, and development.

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Pollution caused by industrial wastewater can increase the turbidity of the water as a result of which the sunlight cannot reach the bottom of the bodies of water. Thus marine plants inhabiting the lower layers are unable to perform the photosynthesis process (Domestic and Fast, 1986). And animals like fish will suffer from the excessive turbidity of the water. It can obstruct the fish's gills and make consuming Dissolved oxygen or DO from the surrounding water hard for them (Figure 1). The extraction of offshore oil and the shipping of oil by sea are causing oil spills in oceans. When this oil floats on the surface it blocks sunlight which prevents the use of sunlight for photosynthesis by marine plants. Oil also threatens the coral reefs that are home to many marine creatures. It clogs up fish gills, consumes plankton, and also hurts the sea birds.

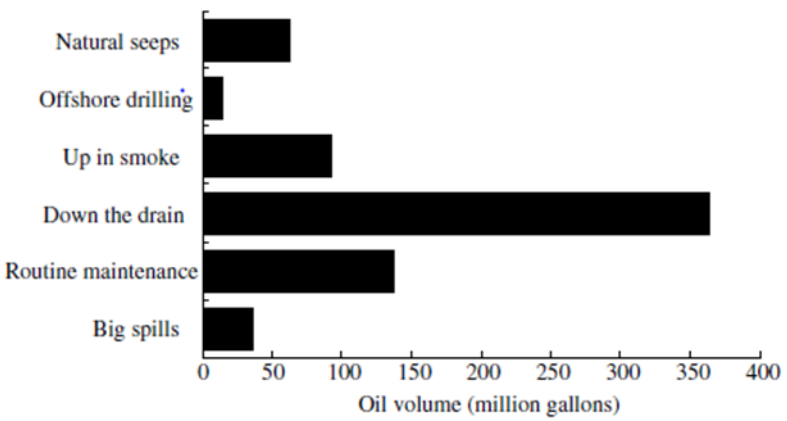

Figure 1. Oil spillage into the coastal and marine ecosystem worldwide each year from various sources in million gallons (Source: Islam and Tanaka, 2004).

Pollutants may harm the DO concentration. This is because most chemicals cause low levels of oxygen, making it impossible for marine species to live. After all, animals like fish die when the DO levels drop below 5 ppm (Sanger, and Reed, 2000). Proper waste management and recycling will help to reduce the waste from the oceans. Strict policies and efficient waste management implementation will help to significantly curb and avoid pollution of the oceans (Table 1). Affordable emission control equipment and competitive opportunities will help motivate companies to take appropriate steps to control the amount and quantity of waste that they are disposed of. Through concerted efforts from businesses and governments, small measures will bring about a sea shift.

Case study of a wide range of Mediterranean mollusc assemblies

Potential effects of sewage discharge in the Mediterranean subtidal rock ecosystem on spatial patterns of highly diverse mollusks can assemblies have been studied. Nine squares of approximately 20 cm were removed from each of the three sites (80m-100m apart) in a potentially affected area near a sewage outflow.

Table 1. Hazardous waste generated by industries (Sanger, and Reed, 2000).

Waste producer	Types
Chemical manufacturers	Acids and bases
	Reactive waste
	Spent solvents
	Waste water containing organic constitute
Printing industry	Heavy metal solutions
	Waste inks
	Solvents
	Ink Sludge's containing heavy metals
Petroleum refining industry	Wastewater containing
	Benzene and other
	Hydrocarbons
	Sludge from refining process
Leather products manufacturing	Toluene and benzene
Paper industry	Paint waste containing
	Heavy metals
	Ignitable solvents
Construction industry	Ignitable paint waste
	Spent solvents
	Strong acids and bases
Metal manufacturing	Sludges containing heavy metals
	Cyanide waste
	Paint waste

Source: Environmental Protection Agency, Solving the Hazardous Waste Problem: EPA's RCRA Program (Washing Washington, DC: EPA, 1986)

The mollusc diversity of Shannon was marginally lower but no distinction was observed between locations for the total number of species. There was a strong difference between the layout of the assembly at me and the control location improves water quality by partitioning of niches (Gomes-dos-Santos *et al*., 2020). Excessive nutrient loading of water bodies is the leading cause of global water pollution. Many environmental programs are primarily aimed at controlling nutrient levels in watersheds. Ecosystems with more species are more effective in extracting soil and water nutrients than those with fewer species. Many environmental programs are primarily aimed at controlling nutrient levels in watersheds. Research has shown that species-rich habitats are more effective in the extraction of soil and water nutrients.

Role of bioindicators in water pollution monitoring

Worldwide anthropogenic stresses have been subjected to various aquatic ecosystems, which result in a change in nutrients input, food and habit availability, an increase in nutrient inputs, and exposure to contaminants (Belore *et al*., 2002). For a biological assessment of the water quality, there is a need for bioindicators. Bioindicators are the types of biotic resources (i.e. animals, planktons, plants, and microbes) that are used to screen the health of the natural ecosystem in the environment. These are mainly used to examine environmental health and biogeographic changes (positive or negative) that occurred in the environment (Belore *et al*., 2002). Bioindicators are slightly different from biomonitors, during environmental studies the quality of change is determined by bioindicators while the quantitative information on the quality of the environment is determined by biomonitors (Chakrabortty and Paratkar, 2006). Some factors which govern the existence of bioindicators in the environment are- water, temperature, the transmission of lights, and suspended solids (Khatri and Tyagi, 2015).
Below are some major advantages of bioindicator

- To observe the synergistic and antagonistic effects of pollutants on a living entity.
- Biological footprints can be determined.
- Prior diagnosis as well as detrimental effects of toxins or pollutants can be monitored on living organisms.
- The economically applicable alternative concerning other specialized measuring systems.

Plant indicators

Plants are considered a sensitive tool for forecast and recognition environmental stress. Marine plants give important information regarding the status of the oceanic environment because they are immobile and quickly obtained equilibrium with their surroundings (Klemm, 1990). *Wolffia globosa* a flowering plant commonly known as Asian water meal or duckweed is an important tool for identifying cadmium contamination because it shows sensitivity to cadmium. Changes in the diversity or

population of phytoplankton *(Euglena clastica, Trachelonanas, Phacustortus,* etc.) indicates pollution in marine ecosystems (Parmar *et al*., 2016). Phytoplankton has a specific place in terms of bioindicators because they react quickly to environmental changes, require short growth time, fast reproduction rate, and hence viewed as an excellent indicator of water quality (Parmar *et al*., 2016). Phytoplankton or microalgae are identical to terrestrial plants (contains chlorophyll) require sunlight for growth and development that's why they are light and swims on the upper portion of the water so that they can get light. These microalgae are very sensitive to contaminants like heavy metals and this thing is reflected in their population when there is a diversity change is observed in planktonic species it indicates pollution of the marine ecosystem (Hosmani, 2014, Panthari, 2017).

Animal indicators

A decrease in the number of individuals of a particular species indicates the harmful changes arise due to pollutants into the ecosystem. Negative changes in population density indicate the presence of pollutants but it may result in competition for food resources (Parmar *et al*., 2016). Animal indicator plays an important role in detecting the amount of toxin present in animal tissue. Frogs are the important bio-indicators as they are influenced by changes that occur in their freshwater and terrestrial habitat, on the other hand, zooplanktons like *Cyclops, Mesocylops, Aheyella,* etc. are zone-based pollution indicators (Hosmani, 2014). Several invertebrates and diatoms can act as bioindicators. Invertebrates live near the benthic region (also called benthos or micro invertebrates) and are a powerful indicator of watershed health because they are not distinguishable in the lab, have restricted motility, live more than a year, and integrators of ecological conditions (Khatri and Tyagi, 2015). Belore *et al*. (2002) compared the effectiveness of diatoms and micro invertebrates as indicators of environmental conditions in the lotic ecosystem and found both as potential bioindicators. Cooper *et al*. (2009) reported that coral reefs (symbiotic association between plant and animal) can also act as bioindicators of water quality.

Microbial indicators

Microorganisms are frequently used as a pollution indicator in terrestrial as well as in the aquatic ecosystem due to their abundance, easy availability, and simple testing. Some microorganisms develop stress proteins when they come in contact with heavy metals or unfavorable environments, these stress proteins are treated as early warning signs of pollution (Parmar *et al*., 2016). A group of gram-negative, rod-shaped, aerobic or facultative anaerobic bacteria known as coliforms, are the strong indicator of polluted or contaminated water with feces. Mukherjee *et al*. (2020) reported that a decrease found in the level of total coliforms in Ganges water during the COVID-19 lockdown period (April 2020) resulted in a sudden increase in water quality due temporary halt in anthropogenic activities (Adelodun *et al*., 2020). Microorganisms are also an important part of marine ecosystem biomass, they possess a rapid

growth rate and have the ability to react even low concentrations of contaminants. By using bioluminescent bacteria one can easily monitor the presence of toxins in the water. Toxins disturb the food utilizing the abilities of microbes which result in alteration in the amount of light emitted by bioluminescent bacteria (Parmar *et al*., 2016).

Future aspects

Population growth, economic development, urbanization, and climate change would have a major impact on water issues by 2050. Around 780,000 people die every year from drinking dirty water, compared to 1,100 from drought and 6,000 from floods. When chemicals and other foreign pollutants leach into the atmosphere, air, and water, pollution occurs. These pollutants contain toxins that adversely affect the environments within them and the living creatures. According to the Environmental Protection Agency, between 1975 and 2015, an estimated 11% of all marine species will be extinct every decade. Water contamination is caused by industrial and agricultural runoff and, in addition to posing a danger to aquatic organisms; water pollution also impacts humans-because the loss of marine species adversely affects the food chain. When the amount of contaminants increases, human exposure to toxins may also increase. The Environmental Protection Agency states that exposure to toxins is directly linked to cancer and heart disease. Air pollution is a primary problem in urban areas and for people living near major roads, as vehicles produce high concentrations of pollutants. When air pollution increases, researchers expect that the adverse health effects of exposure will also increase. There are often negative connotations of the term "greenhouse effect" but the greenhouse effect is a natural and beneficial mechanism in which Earth's ozone prevents heat from escaping into the atmosphere. Because carbon dioxide causes Earth's temperature to rise, the ability of the ozone layer to hold heat close to the surface can cause global warming as pollutant levels rise.

Pollution may have a huge impact on the world economy due to its potential to cause disease in humans. The World Health Organization maintains that the increased risk of illness due to contamination places a financial burden on insurance providers, the government-funded health services, and the people themselves. Moreover, the more people who fall ill, the less efficient workers are available to carry out the tasks required to keep a company running. Students who are absent from school due to pollution-related illnesses that lose educational opportunities that they may otherwise have enjoyed — further increasing the potential economic burdens that communities may face as a result of pollution.

Conclusion

Freshwater is the most transformed and endangered ecosystem on Earth due to many threats. Water pollution is one of them, which involves both point and non-point sources of human activity. Water

contamination poses many threats, and shielding freshwater habitats from this is the greatest challenge. The natural world makes human life possible, and the cultural climate helps to determine who we are. It is therefore necessary for our population and economic development to be environmentally sustainable. The most optimistic outlook for our future is one in which we have the right balance between:

- Continue to support and implement effective policies, programs, and resources (e.g. community engagement and volunteering programs, IMOS, India's Biodiversity Conservation Strategy 2010-2030, the Great Barrier Reef Science Strategy, the Reef 2050 Sustainability Plan, NESP, the Terrestrial Ecosystem Research Network, the Australian Heritage Strategy, the National Reserve System, the National Representative System of Marine Protected Areas, Indigenous Protected Area programs)
- Further development, testing and, where appropriate, implementation of innovative approaches and initiatives currently under development (e.g. policies, technology and management that decouple the economy from environmental harm, environmental-economic accounting and valuation, initiatives to reduce plastic pollution in coastal and marine environments, initiatives to reduce air pollutants in urban areas).
- Develop and incorporate new policies, processes, frameworks, and tools in the medium to longer-term, including greater integration of policies and management strategies across jurisdictions and sectors; (e.g. green or blue economy approaches, development of a sophisticated investment impact market, regulatory reform to provide a rapid response to new incursions of potentially harmful invasive species and diseases).

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