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ROLE AND EFFECTS OF CONTAMINANTS IN NATURAL WATER BODIES CONVERTING INTO WASTWATER

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Abstract: World populations are expected to exceed nine billion by 2050. Urban populations may rise nearly twice as fast, projected to nearly double from current 3.4 billion to 6.4 billion by 2050, with numbers of people living in slums rising even faster, from one to 1.4 billion in just a decade. Over a fifth of the global total, 1.6 billion people are expected to live by the coast by 2015. Inadequate infrastructure and management systems for the increasing volume of wastewater that we produce are at the heart of the wastewater crisis Over half of the world's hospitals beds are occupied with people suffering from illnesses linked with contaminated water and more people die as a result of polluted water than are killed by all forms of violence including wars. The impact on the wider environment is no less striking. An estimated 90 per cent of all wastewater in developing countries is discharged untreated directly into rivers, lakes or the oceans. Such discharges are part of the reason why deoxygenated dead zones are growing rapidly in the seas and oceans. Currently an estimated 245000 km^2 of marine ecosystems are affected with impacts on fisheries, livelihoods and the food chain. Globally, two million tons of sewage, industrial and agricultural waste is discharged into the world's waterways and at least 1.8 million children under five years old die every year from water related disease, or one every 20 seconds.

Key Words: Wastewater, Inadequate infrastructure, contaminated water, untreated discharge,

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INTRODUCTION

Water is crucial for all aspects of life, the defining feature of our planet. Ninety seven and a half per cent of all water is found in the oceans; of the remaining freshwater only one per cent is accessible for extraction and use. Functioning and healthy aquatic ecosystems provide us with a dazzling array of benefits – food, medicines, recreational amenity, and shoreline protection, processing our waste, and sequestering carbon. At the beginning of the 21st century, the world faces a water crisis, both of quantity and quality, caused by continuous population growth, industrialization, food production practices, increased living standards and poor water use strategies. Wastewater management or the lack of, has a direct impact on the biological diversity of aquatic ecosystems, disrupting the fundamental integrity of our life support systems, on which a wide range of sectors from urban development to food production and industry depend. It is essential that wastewater management is considered as part of integrated, ecosystem-based management that operates across sectors and borders, freshwater and marine.

1.1 Wastewater and water quality issues Wastewater contains a number of pollutants and contaminants, including:

Table No 01:- Physical, chemical, and biological characteristics of wastewater and their sources

Characteristics	
Organic constituents:	Sources
Carbohydrates	Domestic, commercial, and industrial wastes
Fats, oils, and grease	
Pesticides	Agricultural wastes
Phenols	Industrial wastes
Proteins	Domestic, commercial, and industrial wastes
Priority pollutants	
Surfactants	
Volatile organic compounds	
Other	Natural decay of organic materials
Inorganic constituents:	Sources
Alkalinity	Domestic wastes, domestic water supply, groundwater infiltration
Chlorides	
Heavy metals	Industrial wastes
Nitrogen	Domestic and agricultural wastes
pH	Domestic, commercial, and industrial wastes

Phosphorus	Domestic, commercial, and industrial wastes, natural runoff
Priority pollutants	Domestic, commercial, and industrial wastes
Sulfur	Domestic water supply; domestic, commercial, and industrial wastes
Gaseous constituents:	**Sources**
Hydrogen sulfide	Decomposition of domestic wastes
Methane	
Oxygen	Domestic water supply, surface-water infiltration
Biological constituents:	**Sources**
Animals	Open watercourses and treatment plants
Plants	
Protists:	
Eubacteria	Domestic wastes, surface-water infiltration, treatment plants
Archaebacteria	
Viruses	Domestic wastes

- Plant nutrients (nitrogen, phosphorus, potassium)
- Pathogenic microorganisms (viruses, bacteria, protozoa and helminths)
- Heavy metals (e.g. cadmium, chromium, copper, mercury, nickel, lead and zinc)
- Organic pollutants (e.g. polychlorinated biphenyls, polyaromatic hydrocarbons, pesticides); and biodegradable organics (BOD, COD)
- Micropollutants (e.g. medicines, cosmetics, cleaning agents).

Table No 02:- Typical composition of untreated domestic wastewater

Contaminants in Water		
Solids, total (TS)	BOD_5 at 20? C	Phosphorus (total as P)
Dissolved, total (TDS)	Total organic carbon (TOC)	Organic
Fixed	Chemical oxygen demand (COD)	Inorganic
Volatile	Nitrogen (total as N)	Chlorides
Suspended solids (SS)	Organic	Sulfate
Fixed	Free ammonia	Alkalinity (as $CaCO_3$)
Volatile	Nitrites	Grease
Settleable solids	Nitrates	Total coliform
		Volatile organic compounds (VOCs)

All of these can cause health and environmental problems and can have economic/financial impacts (e.g. increased treatment costs to make water usable for certain purposes) when improperly or untreated wastewater is released into the environment; nutrient contamination and microbial water quality issues are considered further below.

Nutrient contamination and eutrophication

When water bodies receive excess nutrients, especially nitrates and phosphates, these nutrients can stimulate excessive plant growth – eutrophication - including algal blooms (which may release toxins to the water), leading to oxygen depletion, decreased biodiversity, changes in species composition and dominance, and a severe reduction in water quality. Although there are natural causes, much of the eutrophication seen today is a result of inadequately treated wastewater and agricultural run-off. The deterioration in water quality resulting from eutrophication is estimated to have already reduced biodiversity in rivers, lakes and wetlands by about one-third globally, with the largest losses in China, Europe, Japan, South Asia and Southern Africa. The quality of surface water outside the OECD (Organization for Economic Co-operation and Development) is projected to deteriorate further in the coming decades as a result of nutrient flows from agriculture and poor/non-existent wastewater treatment, with the number of lakes at risk of harmful algal blooms expected to increase by 20% in the first half of the century (OECD, 2012).

Microbial water quality

Wastewater (domestic wastewater, in particular) can contain high concentrations of excreted pathogens, especially in countries where diarrhoeal diseases and intestinal parasites are particularly prevalent. Table 1 outlines the diseases caused by some of the pathogens that have been found in untreated domestic wastewater. It can be seen that many of the pathogens outlined in Table 1 cause gastroenteritis and it has been estimated that, globally,1.45 million people a year die as a result of diarrhoeal illness each year, 58% of which is caused by inadequate water, sanitation and hygiene. 43% of the deaths occur in children aged five and be- low. Infection can result from direct exposure to untreated wastewater but also exposure to wastewater-contaminated drinking-water, food and recreational water.

Domestic wastewater, storm water and urban runoff

Domestic wastewater consists of black water (excreta, urine and faecal sludge) and grey water (kitchen and bathing wastewater). The mix and composition will depend on the water supply and sanitation facilities available, water use practices and social norms. Currently, roughly half of the world’s population has no means of disposing of sanitary wastewater from toilets, and an even greater number lack adequate means of disposing of wastewater from kitchens and baths (Laugesen et al., 2010).

Industrial wastewater

Among the possible classifications of industrial waste- waters, one distinguishes between diffuse industrial pollutants, such as those from mining and agri-industries, and end-of-pipe point discharges and mostly illegal discharges from tankers. The former are frequently highly polluting and difficult to contain and treat, while the latter can be contained, controlled and treated in circumstances where there is sufficient political will, regulatory power and resources (economic and human capacity) to ensure compliance. Large end-of-pipe discharges are generally easy to identify and can be regulated, controlled and treated. However, some wastewaters arise from concentrations of small enterprises that discharge wastewaters wherever they can and not necessarily to any identifiable sewer. Many are highly polluting containing acids and toxic metals from, for example, small metal finishing (plating) enterprises which have developed in specific localities. Not only do such discharges inflict considerable environmental damage especially to sensitive ecosystems but they also often come into direct (as well as indirect) contact with humans and animals with consequent damage to health.

The discharge/disposal of industrial wastewaters can be classified as follows:

- Uncontrolled discharges to the environment.
- Controlled (licensed) discharges to the environment (watercourses) possibly after pre-treatment.
- Illegal, mostly clandestine, discharges to sewerage systems.
- Controlled discharges to sewerage systems under agreement or license, possibly with pre-treatment.
- Wastewaters collected by tanker for treatment/disposal elsewhere.

It is seen that, in many cases, large volumes of industrial wastewaters which are legally discharged to decaying and/or badly operated sewerage networks, both combined and separate, never actually reach a treatment plant. Much is lost en-route through broken pipes or ends up in surface water drains with consequential pollution of both groundwater and surface watercourses.

Agricultural wastewater Agriculture has long been recognized as an important source of non-point or diffuse water pollution. Key problems include:

- **Sediment runoff** – this can cause siltation problems and increase flood risk;
- **Nutrient runoff** – nitrogen and phosphorus are key pollutants found in agricultural runoff, they are applied to farmland in several ways, including as fertilizer, animal manure and municipal wastewater, and can result in eutrophication in receiving waters

- **Microbial runoff** – from livestock or use of excreta as fertilizer (domestic animals, such as poultry, cattle, sheep and pigs, generate 85% of the world's animal faecal waste – Dufour et al., 2012)
- **Chemical runoff** from pesticides, herbicides and other agrichemicals can result in contamination of surface and groundwater; in addition residues of veterinary drugs may also cause water pollution

RESULT AND DISCUSSION

Effects of sewage in freshwater ecosystems

Dumping sewage into water bodies, such as rivers or lakes, creates a human health hazard but can also negatively disrupt the river and lake ecosystems. The sewage contaminates) untreated discharge) the water, spreads disease, and leads to environmental degradation (WQM 2004). Here is a list of effects of untreated sewage disposal into freshwater ecosystems:

1. Increased organic matter (from the sewage- untreated discharge) breaking down in the river reduces the amount of dissolved oxygen in the water body as the decomposition process uses up the available dissolved oxygen. Fish and other aquatic life need that dissolved oxygen in the water to live.
2. Sewage heightens the levels of nutrients, increasing the bioavailability of nutrients, which can increase productivity of plankton near the sewage outfall (Munawar *et al* 1993) and increase the chance of algal blooms.
3. Contaminants present in the sewage might be toxic for some already existing phytoplankton (Munawar *et al* 1993).
4. Sewage can increase the turbidity and amount of suspended sediments. This effect reduces light available for plant growth, can smother in-stream habitats, and damage fish gills and respiratory structures of other species (WQM 2004).
5. Sewage (and stormwater runoff) can introduce pesticides, other chemicals, and heavy metals into the water column. It may also introduce fine sediments, which have the potential to (bio)accumulate within animal tissues and have long-term toxic effects. Sewage and run off may increase acidity**,** such as from acid sulphate soils which kill fish and crustaceans, cause fish red-spot disease, damage or cause death of oysters, and interact with sediments to release heavy metals (WQM 2004).
6. Industrial effluents (often a complex mixture of chemicals) can negatively affect fish by impairing growth and reproduction and by reducing immune competence. These effects have the potential to impact fish populations (Environment Canada).
7. Microbial pathogens introduced by sewage into surface or groundwater can threaten public health, as well as affect ecosystem health and function (Environment Canada).

8. Sewage can release water that is either warmer or cooler than the receiving water body. Because aquatic life has optimal temperature ranges within which it lives, too warm or too cool water temperatures can harm the aquatic life. For example, cold waters reduce ecosystem productivity, eliminate temperature-sensitive biota, and decrease survival of eggs, larvae of fish and aquatic insects (WQM
2004).

9. Release of sewage can degrade vegetation and soil by depositing harmful chemicals in bottom sediment, for example.

10. With sewage comes water that has some degree of chlorine or similar agent. The chlorine or other disinfectant react with organic matter (such as what's in sewage) to create different end-products, such as chloroform or haloketons, which can be harmful in either the short or long term. These reactions happen faster in warmer water (LennTech 2007).

Release of untreated sewage into freshwater bodies is sometimes necessary. Yet, it not only creates a human health risk but damages the health of the receiving water bodies in over short or long time periods. Our responsibility to ecosystems means we should have the capacity to deal with our own waste rather than expecting the rest of the ecosystem to do it for us.

The bodies of freshwater, namely lakes, ponds and reservoirs, are known as lentic environments. Although standing or lentic in nature, there is movement of water within their basins that is determined by morphometry (depth, shape, etc.), solar heat input and wind. Plankton algae, or phytoplankton, are at the mercy of water movement and are usually the most important producers in lentic water bodies. The extent to which water moves (is mixed) vertically and horizontally determines the distribution of plankton and the amount of light available to mixed plankton cells, so water movement indirectly determines the productivity of lentic water bodies. The gradation among lakes, reservoirs, rivers and streams is large and the distinction is not always clear-cut physically. The principal factor separating these environments is water residence time. Algal abundance per unit phosphorus in the water was found to increase along a residence time gradient from rivers to impoundments to natural lakes (Soballe and Kimmel, 1987).

However, large, slow-moving rivers and the heads of reservoirs and estuaries may have significant plankton populations even though their residence times are relatively short. While the emphasis here is on the ecological principles and effects of nutrients in lakes, those principles and effects apply to reservoirs as well. However, reservoirs generally have higher flushing rates (shorter residence times) and consequently higher nutrient loading than lakes (Walker, 1981). Main stem reservoirs usually show a zonal transition from a riverine to a lacustrine type environment (Kimmel and Groeger, 1984). Estuaries show similar transitions from freshwater to marine, but the boundaries can change diurnally as a result of tidal effects.

Conclusion

This paper and the study conclude that the presence of contaminants in water bodies which will be responsible for variety of health problems that could be a direct or indirect result of the discharge and flow of waste water. For example Skin diseases, stomach problem, gastric ulcers and other similar gastric problems. The cultivated crops and fisheries by using contaminated water and these will consumed by people living around water bodies. The percolation and infiltration of contaminated water will leads the subsurface water pollution with accumulation of heavy metals will make the output in terms of diarrhea and dysentery.

The animal, household utensils, cloths, cars, washing at the sides of natural water bodies will integrate the concentration of contaminants. These contaminants will be the ideal carrier to spread diseases like Dengue, Malaria, Hepatitis and similar epidemic diseases. The rapid industrialization may contribute the apex role to create more contaminated and polluted water bodies. The continuous heavy demand of food and vegetables and other eatables will leads to produced more contaminates in water bodies due to agricultural activities.

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