

AN APPRAISAL OF AQUATIC POLLUTION: A REVIEW

Sadauki, M.A.^{1*}, Auta, T.², and Umaru, J¹.

¹Department of Fisheries and Aquaculture, Federal University Dutsin-Ma, Katsina State, Nigeria

²Department of Biological Science, Federal University Dutsin-Ma, Katsina State, Nigeria

ABSTRACT

Aquatic ecosystems, comprising oceans, rivers, lakes, and wetlands, play a crucial role in supporting a diverse array of marine and freshwater life, providing essential ecological services. Despite their significance, these ecosystems are increasingly threatened by various forms of pollution, including chemical contaminants, nutrient loading, sedimentation, and plastic waste. This review aims to comprehensively analyse the impacts of aquatic pollution on these ecosystems, beginning with an exploration of pollutant sources and types, such as industrial discharges, agricultural runoff, untreated sewage, and atmospheric deposition. The analysis delves into the physical and chemical characteristics of pollutants and their interactions with aquatic organisms and habitats. Examining ecological consequences on different levels individual organisms, populations, communities, and entire ecosystems the review covers various aquatic organisms, detailing how pollution affects their physiological functions, reproduction, growth, and survival. Cascading effects on predator-prey interactions, food webs, and biodiversity are explored, along with impacts on water quality, temperature, oxygen levels, and nutrient cycling, leading to issues like eutrophication and algal blooms. Furthermore, the review discusses how aquatic organisms respond and adapt to pollution, including behavioural, physiological, and genetic responses. It explores the potential for pollutant accumulation and biomagnification in aquatic food chains, posing risks to human health. Lastly, existing regulatory frameworks and management strategies for mitigating aquatic pollution are evaluated, emphasizing the urgent need for continued research, enhanced monitoring programs, and informed policy decisions to preserve and restore the health and resilience of these invaluable ecosystems.

KEYWORD

Appraisal, aquatic pollution, water quality, pollution control, mitigation strategies.

1. INTRODUCTION

Aqua (water) is amongst the most significant donations of natural surroundings to mankind as well as it participate extremely important roles in existence in addition to meet every day desires of human being (Sadauki *et al.*, 2022). Aqua (water) is life as well as its properties have been most exploited natural systems since man strode the world (Sharma and Sharma, 2020). Consequently Aqua (water) is basically needed by entirely categories of natural life, as well as is most plentifully obtainable on this globe. It is amongst the greatest diluters and is unique in numerous physical and biochemical ways. It is the medium of life (Sharma and Sharma, 2020). It is a massive environmental resource of community as well as economic values. It has been over the years exploited for home water supply, industrial water requirements, electric power supply, fishing events, dry season farming amongst others (Sadauki *et al.*, 2022). The importance of water for supplies of existence cannot be over-elaborate. Whether it is in usage of streaming water in our households, fostering cows and cultivating crops in our farmhouses, or the augmented usages in manufacturing, continue considerable. It is vital consequently, to not that weakening of these goods (water) moreover via pollution, or uncaring usage outcomes in severe

penalties (Owa, 2013). Human being actions comprising industrial development as well as farming exercises contributed hugely in no lesser amount to the dreadful conditions and contamination of the environs which unfavourably has an influence on the aquatic bodies (dams as well as rivers) that is a requirement for lifespan (Owa, 2013). Human beings produce a massive volume of garbage substances as well as have numerous types of unfavourable ecological impacts. The extreme amount for development amongst countries throughout the world endangered man's own wellbeing. In farming as well as industry, development has culminated in the unrestricted usage of entirely resources. Unrestricted human being exploitation of natural surroundings has disturbed the delicate environmental equilibrium amongst alive and non-alive habitats of the environment (Sharma and Sharma, 2020). We contaminate, in addition in numerous styles, we disturb the weather, which finally injures us. Aqua (water) makes use of in home environment as well as manufacturing works contaminates the water bodies as well as destroys fish in addition to animals. Pollution is a contribution of industrialized civilization as well as touches the environment openly. Aqua (water) is makes use of to eliminate both biochemical wastes in addition to waste heat. 300000 gallons of water is contaminated in the manufacture of a ton of aluminium; over half a million gallons are make use of in the manufacture of a ton of artificial gum (Lavaroni, O'Donnell and Lindberg, 1971; Sharma and Sharma, 2020). We augment species, frequently disturbing environmental equilibriums, as well as we kill species. Tropical forest in addition to additional environment kinds are vanished, in that way endangering species whose role is not yet recognized in the steadiness of the world. Entirely the large spheres are contaminated by dangerous as well as detrimental substances. This clearly illustrates that everything is indeed related to everything else (Sharma and Sharma, 2020). In numerous streams, aquatic/water is harshly contaminated as an end result of agronomic, home, and industrialized releases (Chen, 2009). Ecological constituents such as water in addition to the sustainability of these constituents are extremely significant for entirely breathing creatures in addition to the future of the globe. Entirely creatures in the environment are associated to every one with a lifespan connection. Consequently, the deterioration that happens in a portion of the system disturbs the entire structure over period. Water is disconnected from other ecological constituents as it is the major source of lifetime as well as cannot be replaced. Extremely of the large difficulties that mankind is meeting in the recent years are related to aquatic quality and aquatic quantity (Unesco, 2009; Kılıç, 2021). Contamination is an adverse change in the chemical, physical or biochemical features of air, water as well as soil that could impact the existence of any breathing creature damagingly or else produce a potential wellbeing hazard. Even though air could be worldwide accounted for, water is domestic. The most valuable natural resource is water (Sharma and Sharma, 2020). Water represents the most important natural resource. A wide-ranging of physicals, microorganisms, in addition to chemical variations such as raised temperature and bloom are the particular contaminants backing to water pollution. Even though numerous of the measured substances and elements could happen naturally, such as calcium, sodium, iron, manganese, etc. In dissimilarity to urban, rural development wants additional water, as well as the excellence of released water in metropolitan regions is frequently poisonous-chemically other hazardous (Bandy, 1984; Sharma and Sharma, 2020). Whichever alteration in water produced by human being and considered by humans to be adverse to individuals as well as for additional forms of existence may be labelled as water effluence. It may possibly be labelled as increasing or changing the chemical and physical features of whichever substance to water in any way that inhibits with its usage for legitimate reasons. The chemical and physical of water change contains acidity, electrical conductivity, temperature, as well as eutrophication (Sharma and Sharma, 2020). Aqua (water) should be conserved as well as sheltered from all kind of pollutant. Aqua (water) is amongst the crucial ingredient in the centre of the life. Without Aqua (water), existence is not possible. On the other hand Aqua (water) resources polluted by several poisonous, manufacturing pollutants that causes in certain difficulties such as dangerous for ingesting for individuals and irrigation activities; consequently this lead to Aqua (water)

scarcity for human being and environment. There are two dissimilar water sources on our world. The first is the water we see in seas, streams, ponds as well as pools named surface water. Shallow water is home to numerous species of flora and faunas that be governed by not only on the amount but similarly on the excellence of the water to survive. Additional is groundwater, stored below the surface in earth's aquifers. This source of water feeds our streams and seas as well as makes up most of the world's consumption water supply. Both of these water resources are significant to existence on World, both could get unclean in dissimilar ways. The term effluence can define as pollution; damage, discoloration, soiling, spoiling, destruction. Amongst the kinds of pollution, water pollution is major significant for the health of all living organisms; particularly mankind. Inappropriately, water sources are used unconsciously and contaminated by humans and they cause threaten their future generations. When water is contaminated, it becomes dangerous for human being consumption because the water contains dangerous or toxic substances and disease-causing bacteria as well as creatures (Friedl, 2003; Kılıç, 2021). Aquatic/water is measured contaminated if certain affluences or situation is present to such a grade that the aquatic/water couldn't be use up for a particular reason (Owa, 2013). Whereas the economic activities that happening with the industrial development process provided the growing in addition to expansion of nations, they similarly triggered ecological difficulties and particularly negative influences on water resources. While an important part of the earth is sheltered with water, the amount of water available is very low. Moreover natural causes, the injuries caused by human being actions have caused stress on limited water resources as well as international water difficulties. Numerous researches as well as findings are carried out on the global water problem. Reports display that, in addition to climatic phenomena such as drought, global warming and weather change, numerous reasons such as the escalation in the world inhabitants, multiplication in urbanization rate and contamination of water resources will cause a global water crisis. "As the human being inhabitants and development in modern technology increases, the risk for water contamination likewise rises" (Ahmed, 2010; Galadima *et al.*, 2011; Kılıç, 2021). The most important cause behind water disaster in the Globe is, water effluence. Worldwide water quality is susceptible by manufacturing, farming actions, metropolises, excavating areas as well as other causes. This contamination is then transported to surface and groundwater (Dwivedi, 2017). Once surface water contaminated it can cause fitness and environs hazards. Moreover, waterways have important roles for wash and cleaning, for fishing and fish farming, and for recreation. In addition, toxic chemicals could be dissolved from the soil or rock layers into groundwater (U.S. EPA, 1999; Kılıç, 2021). Water environments are sensitive and at great threat generally due to the majority of contaminants resulting from home, municipal as well as industrialized sources i.e. numerous agronomic applies effect in the discharge of impurities into the river structure (Byrne *et al.*, 2015). Largely in water environment, the extremely frequent pollutants are in the forms of heavyweight metals as well as insecticides (Khoshnood, 2016). Eutrophication is an multiplication in the concentration in the environment of biochemical nutrients to a grade that augments the environment's main productivity. Later detrimental environmental impacts, such as anoxia (dissolved oxygen depletion) in addition to harsh weakening water superiority could occur, dependent on the degree of eutrophication, touching fish and other animal inhabitants. Once contaminants are introduced into the natural environs, water pollution results in water pollution. The discharge of inadequately treated discarded water into natural bodies of water, for example, may lead to the destruction of aquatic habitats. In fact, for individuals living downstream, this may lead to public health concerns. For drinking or bathing or irrigation, they may use the same polluted river water. The world's leading cause of death and disease is water pollution, e.g. due to water-borne diseases such as cholera, dysentery, typhoid, hepatitis etc. Contaminated waters are unclear, unpleasant, bad smelling, unhealthy for consumption, bath and washing or other purposes. When it is polluted by anthropogenic impurities, water is habitually mentioned to as polluted (Sharma and Sharma, 2020). Eutrophication has been the subject of global worry in industrialized and developing countries because of impairment of water for use in recreation,

industry, agriculture, and drinking, while loss of biodiversity and aquatic ecosystem function is often reflected in fish kills through de-oxygenation (Mcdowell and Hamilton, 2013). It is indisputable that there is a wide-ranging diversity of contaminants in the numerous water bodies around the planet, comprising inorganic and organic compounds, pathogenic bacteria, as well as micro plastics. The continuation of these water contaminants has a straight influence on the existence as well as health of all species that are present in these environments as well as poses, indirectly or directly, a risk to human being wellbeing. Fishes die due to pollution/eutrophication of water from pesticides adjoining the cultivation fields. Insecticides flow off into the aquatic showing lethal for the water life (Kivi, 2010; Ganguly, 2013). Fish are largely disturbed from the human being troubles. Consequently, it is the want of time to pay adequate attention to this issue as well as apply compulsory corrective actions (Cruickilton and Duchrow, 1990; Ganguly, 2013). Basically we have 3 major forms of pollution are: Air Pollution, Land Pollution and Aquatic Pollution.

2. OBJECTIVES

The objectives of this review is to identify the sources and causes of water pollution, identify the sound effects and impacts of water pollution on aquatic organisms with respect to fish review on the appropriate control and management practices

3. WATER POLLUTION

Water pollution/contamination is the pollution of water bodies' e.g ponds, stream, oceans and ground water. This form of environmental degradation occurs when pollutants are directly or indirectly discharged into the water bodies without adequate treatment to remove harmful compounds (Wotton, 1992). Effluence/pollution is the introduction of an impurity into the environs (Webster.com, 2010). It is produced by industrialized and marketable waster, agronomic applies; everyday human being actions then best remarkably, patterns of conveyance. Water pollution has well-defined as 'the occurrence in water/aquatic of strange matters which can be inorganic, organic, radiochemical or biological in quantity higher enough to lesser the aquatic excellence in addition to create a wellbeing threat; since of the occurrence of bacteriological causes, chemical causes, oxygen reducing materials, nutrient materials in addition to floating substance (Lwahas *et al*, 2010). Tripathy and Panda (1999), similarly understand aquatic pollution as biological, chemical and physical alteration in river, sea and dam that could badly influence breathing creatures. The USA Public Health Services well-defined aquatic pollution as the occurrence of whichever poisonous material in water that damages the excellence to create a threat or damage its valuableness. This entails every extraneous enrichment of chemicals which change the water quality parameters of water surroundings, altering the population structure as well as forcing certain classes to vanish from the natural environment with bad penalties on individuals could be regard as aquatic contamination.

3.1 Classification of Water Pollutants

Ecologically, pollutants are classified into biodegradable pollutants and non-biodegradable pollutants:

- Biodegradable pollutants. Examples are domestic sewage, animal waste and some industrial effluent.
- Non-biodegradable pollutants. Examples are DDT, Acids, Aluminium can and mercurial salts (Atiribom and Nnaji, 2013).

Table 1: Classification of Water Pollution Parameters

TYPE OF POLLUTANTS	PARAMETER OF THE POLLUTANT
Physical	Temperature, turbidity, Colour, Suspended solids e.t.c.
Chemical	pH, DO, NH ₃ , Nitrate, Nitrite, Phosphorus, Chlorides, Sulphate, Sulphide, detergents, Organic solvents, pesticides, oil and grease.
Biological	Bacterial, Virus, nematode, trematode, worms, algae e.t.c

Atiribom and Nnaji (2013)

3.2 Sources of Water Pollutant in Aquatic Environment

In addition, natural events such as volcanoes, algae blooms, hurricanes, earthquakes bring about substantial alterations in water quality and ecological conditions. In the coming years, the influence of weather change is expected to exacerbate these challenges, resulting in elevated water levels, glacier melting, and an increased intensity of the water cycle, in that way causing more frequent incidences of floods and droughts. A shortage of clean drinking water affects over one-third of the global population (Sharma and Sharma, 2020). Contaminants noticeably arrive streams through the point source or the nonpoint source (Council of College and Military Educators, 2011). Water pollution arises from two primary sources: point sources and non-point sources. Non sources and point sources both donate to aquatic pollution.

3.2.1 Point sources (PS)

Point sources denote concentrated pollution emanating from a singular, identifiable origin. This type of pollution involves the release of effluent into both streams and the ground. Examples of point sources encompass wastewater treatment plants, industrial manufacturing, runoff from mining activities, incidents of sanitary sewer or septic tank overflows, and accidental spills (Carpenter, 1998). According to Olufunke (2022), point source pollution is characterized by its specific and identifiable origin, such as emissions from a sewage pipe or factory wastewater pipe.

3.2.2 Non-point sources (NPS)

Effluence from non-point sources implies to single effluence that does not come from a single isolated source. Non-point sources, comprising farming runoff are more diffuse. The leaching of nitrogen compounds from fertilised agricultural land is a popular example. Polluted storm water, which is carried off from parking lots, roads, and highways and termed urban runoff, falls under the non-point source classification. This type of effluence has the possible to influence both plants as well as animals living or coming into interaction with contaminated aquatic bodies (Sharma and Sharma, 2020).

3.3 Sources of Water Pollutant in Nigeria

According to Gbamanija (1998), various activities contribute to water pollution in Nigeria, including:

- Malfunctioning septic systems
- Household chemicals
- Animal wastes
- Disposal of industrial waste into water bodies
- Sewage leakages
- High population density
- Oil spillage
- Presence of Nipa palm and water hyacinth
- Eroded sediments
- Deforestation
- Mining
- Littering
- Pesticides
- Radioisotopes
- Heavy metals
- Combustion
- Disposal of toxic waste at sea
- Mineral processing plants (e.g., coal production)
- Herbicides and fertilizers
- Groundwater pollution through drilling activities
- Flooding during the rainy season, transporting waste deposits into water bodies
- Construction lavatories and visionaries overflowing into water or the sea, especially in certain riverine areas.

Table 2: Sources of water pollution in Aquatic ecosystem

Point Sources	Non-point Sources	References
Wastewater effluent (municipal and industrial)	Runoff from agriculture (including return flow from irrigated agriculture) Runoff from pasture and range	Carpenter <i>et al.</i> (1998)
Runoff and leachate from waste disposal sites	Urban runoff from unsewered and sewer areas with a population <100,000	
Runoff and infiltration from animal feedlots	Septic tank leachate and runoff from failed septic systems	
Runoff from mines, oil fields, unsewered industrial sites	Runoff from construction sites	
Storm sewer outfalls from cities with a population >100,000	Runoff from abandoned mines	
Overflows of combined storm and sanitary sewers	Atmospheric deposition over a water surface	
Runoff from construction sites >2 ha	Activities on land that generate contaminants, such as logging, wetland conversion, construction, and development of land or waterways	

Uzomah, (1999) and Maton *et al* (2016) had related opinions concerning the main aquatic contaminants as well as sources, emphasised as follows:

- **Disease causing agents:** which comprise protozoans, viruses, bacteria, fungi and parasites
- **Oxygen demand litters:** utmost of which are bio-degradable similar home sewage, animal dung as well as other biological litters that do not stay in the surroundings
- **Aquatic Soluble Non-living/inorganic substances:** which comprise salts, acids as well as poisonous heavy metals
- **Deposits or floating substance:** it comprise impossible to solve elements of top soil, mud as well as other stuffs which could stay floating in water
- **Radio-active matters:** from nuclear-powered analysis/testing that are released into water bodies, in addition to
- **Heated water:** from nuclear-powered houseplant released back into aquatic bodies could increase the hotness beyond acceptable limits of extremely animals and plants.

Table 3: Organic and inorganic contaminants/pollutants from various industries.

Organic pollutants	Inorganic pollutants	Industries
-	Chlorides, ferrous sulphate, hydrogen sulphide, ferric hydroxide, suspended solids and heavy metals.	Mining industry
Oil, phenol and naphtha	Suspended solids, iron cyanide, sulphides, oxides, of copper, chromium, cadmium, and mercury.	Steel/iron industry
Aromatic compound solvents, organic acids, nitro compound dyes, etc.	Sulphates, nitrates, phosphorus, fluorine, silica, and suspended particles	Chemical industry
Proteins, carbohydrates, organic solvents, intermediate Products, drugs and antibiotics	-	Pharmaceutical industry
Fats and fatty acids, glycerol, polyphosphates sulphonated hydrocarbons	Tertiary ammonia compounds, alkalies	Detergent industry
Cellulose fibres, bark, wood, sugars and organic acids	Sulphides, bleaching liquors	Paper industry

Sources: Malik *et al.*, (2020)

3.4 Causes of Water Pollution

Water pollution is generally induced by humans. Its effects from activities of human being carried on to better self. These may possibly be treated under the numerous actions that man involves in, that lead to contamination. The development of human being inhabitants, industrial and farming practices is the major causes of pollution (Eguabori, 1998). Corresponding to Kılıç 2021 (1998), foremost causes of water pollution as follows: industrialization, plastics and polythene bags, pesticides and fertilizers, sewage in addition to other oxygen demanding wastes, home

sewage, population development, urbanization, eutrophication, mining, agro-chemical wastes, nutrient enrichment, thermal pollution, oil spillage, disruption of deposits, acid rain pollution, emitting radiation waste, weather change in addition to others.

There are many ways in which water get polluted in Nigeria. The causes are discussed as follows:

3.4.1 Dumping

Many water bodies are transformed into dumping sites by surrounding communities, posing a significant issue as these dumps contain a variety of materials such as plastic, aluminum, glass, and more. The degradation time of these wastes varies in water, and they have the potential to adversely affect aquatic life until they undergo decomposition (Olufunke, 2022).

3.4.2 Agriculture Wastes

Aquatic/water which is use up for irrigation and overflowing sometimes effects in the conveying of impurities into aquatic bodies. Highly developed agricultural expertise has caused in large-scale usage of agro-fertilizers, fungicides, herbicides, pesticides, insecticides and weedicides. Farming, being the major consumer of freshwater worldwide as well as an important donor to the worsening of surface in addition to groundwater resources due to erosion and chemical runoff, has a legitimate reason to be concerned about the worldwide implications of water quality. The associated agro-food processing industry is also a prominent contributor to organic contamination in numerous countries. In Nigeria, agriculture was a main source of revenue before the detection of oil in the 1950s, and it continues to be the primary income source for a majority of the population in the Northern part of the country, predominantly those who depend on streams, rivulets, and boreholes for their drinking water. These water sources are vulnerable to a variety of contaminants, which can enter through groundwater or drainage ditches. These contaminants include residues from artificial fertilizers, insecticides, herbicides, pesticides, and farmyard waste, all of which have the potential to be highly harmful. Seymour and Girardet (1987), debated that up and around half of the synthetic agro-fertilizers use up by nowadays agriculturalists is wash away out of the top soil into aquatic bodies yearly to initiate effluence which does not only influence water natural life forms nonetheless even human beings. Domestic animals husbandry similarly creates enormous sizes of fluid droppings concentrated in tiny spaces which simply move into aquatic bodies as well as contaminate the life-support structure.

3.4.3 Manufacturing waste or Release

Activities similar fabric, paper as well as pulp, biochemical, gum, plastic, skin in addition to pharmacological habitually discharge their poisonous emissions into aquatic bodies. Occasionally the hidden industrial metals as well as diluters could leak via the ground to move water bodies in addition to cause destruction to water areas. Moreover, these factories utilization massive amounts of water for processing of goods, cleaning as well as chilling and when released into the environs it could move aquatic bodies to cause destruction to natural life forms.

3.4.4 Waste water/Home Mess

In town communities, the home sewage is openly discharged into neighbouring aquatic bodies whereas certain home garbage dug in in landfill locations create solvable contaminants which could leak via leaky ground to go and contaminate native aquatic bodies also. Extremely litters as well as wastes frequently comprise higher amounts of carbon-based

substance which simply consume dissolved oxygen of water thus make water environment dilapidated to creatures.

3.4.5 Mineral Utilization

To get fossil fuel underneath aquatic surface, oil pits/wells have to be built in addition if safety measure is not taken for the duration of production, oil be capable of leak to adulterate aquatic bodies. Oil leaks similarly take place when transporters transport oil are spoiled, initiating their oil to leakage into the neighbouring water (Maton *et al*, 2016). Above and beyond, oil refineries located close the watercourse banks then marine coastline readily produce oil leaks by way of discharging certain numbers of oil. Removal of solid raw materials similarly discharge certain poisonous metals like lead into aquatic bodies that could kill delicate water natural life forms, particularly fishes.

3.4.6 Fishing with Deleterious Matters

In certain areas, kids as well as grown person unknowingly use up certain dangerous substances in addition to distribution it above surface aquatic environment to choke the fishes for trouble-free entrap. Sadly, such poisonous substances dilute with water, damage its excellence therefore, capable of damaging water villages. Individuals who drink water from such contaminated sources similarly threaten their healthiness.

3.4.7 Surface Flooded/ run-off

For the duration of heavy rainwaters, the surface flood assembles mineral deposits, soil as well as various other carbon-based contaminations as it relocates down in addition to connects bigger aquatic bodies to diluted. Henceforth, reduces such fresh water unacceptable for consumption in addition to for other commercial as well as community usages.

3.4.8 High temperature (heat)

Water released from particular industries similar steel plants and iron, petroleum refineries, nuclear reactors and electric power plants always carry a lot of heat. Once the thermal water is introduced into aquatic bodies, it affects thermal pollution, destroying important natural life forms.

3.4.9 Radio-active Wastes:

Once radio-active atrophies comprising dissimilar elements are released into water structure, they do not only damage the aquatic bodies nonetheless harmfully disturb water natural life and human being who eat both aquatic organism as well as water.

3.4.10 Human being Excreta

In multicultural metropolises of Nigeria, mainly shantytown parts where there is serious scarcity of toilet amenities, individuals just option to open excretion in so doing contributing increase to terrestrial, top soil and aquatic contamination straight, as detected in municipal zones that have rivulets passing via them. Nevertheless, there are other persons who choose to throw their excreta in the wilds, not be bothered exactly how close it is to their residence apartment. Nevertheless, when such excreta are placed of on terrestrial or watercourse, it finally moves to the bigger water bodies as well as contaminate the assets. This has harmful ecological concerns particularly to faunas and individuals.

Table 4: Association between the contaminants and activities/behaviors in fish classes.

Pollutant	Fish species	Behavioral traits	MS	S	V
Fluoxetine	Several fish Species	Ant predator behavior, boldness, aggression, associative learning	Yes	Yes	No
Oxazepam	<i>Salmo salar</i>	Migration	Yes	No	No
Carbaryl, chlordane, 2,4 DMA, DEF, Methyl parathion, pentachlorophenol	<i>Oncorhynchus mykiss</i>	Activity, Feeding	Yes	No	No
Mercury	<i>Danio rerio</i>	Activity, escape	Yes	No	No
Methylmercury MeHg	<i>Fundulus Heteroclitus</i>	Sociality	Sociality		

MS: multi-stress; S: syndrome; V: variability.
Sources: Malik *et al.*, (2020)

3.5 Effect of Water Pollution on Fish and Human

3.5.1 Diseases

In humans, the consumption of contaminated water in any form has numerous detrimental impacts on health. It leads to illnesses such as typhoid, cholera, hepatitis, and various other diseases (Olufunke, 2022).

3.5.2 Destruction of Ecosystems

Ecosystems are highly dynamic and can undergo significant changes in response to even minor environmental alterations. Unaddressed water pollution has the potential to lead to the collapse of an entire ecosystem (Olufunke, 2022).

3.5.3 Eutrophication

Chemicals present in a water body promote the proliferation of algae. These algae mount up as a layer on the shallow of fishponds or seas. Consequently, bacteria feed on these algae, leading to a decrease in the oxygen levels within the aquatic body, which has a negative influence on the water life in that environs (Olufunke, 2022).

3.5.4 Effects the food chain

The disturbance in food chains occurs when toxins and pollutants present in the water are ingested by aquatic organisms, including fish, shellfish, and other animals, which are subsequently consumed by humans (Olufunke, 2022).

3.5.5 Mortality of Marine Fish

Biological substance which comprises dead plants, individual as well as wide-animal excreta are largely from grounds, households and industrial unit. The occurrence of these contaminants in marine effects in decrease of dissolved oxygen, leading to an augment in the amount of oxygen required to break-down oxygen request. The resultant anaerobic condition creates foul odor due to the buildup of ammonia and hydrogen Sulphide. This could finally lead to the mortality of numerous water creatures not adjusted to low oxygen concentration.

3.5.6 Mortality of Water-birds

Water Creatures are momentarily disturbed, comprising birds of the air. As soon as aquatic bodies are contaminated with lubricant, fish-eating birds may possibly gulp lubricant or have their feather saturated with oil and would not be able to take wing; henceforth may perhaps be simply trapped by their predators. Since oil habitually prevents oxygen from water, water-dwelling creatures get choked as well as die also. The threats of oil on creatures are noticeable on oil-spoiled beaches where entirely classes of water life forms on rocks or in mud are regularly seen dead and washed onto land.

3.5.7 Unemployment amongst Fishers

Fishing activities is a widespread action in Nigeria where numerous cultural classes in river regions involve in it for means of support. Contamination of water bodies indicates decrease in fish catch and may possibly place the native fishers out of occupational activities as it occurred one-time in 1980 at Akassa, Rivers State when Oil leak destroyed huge quantity of fishes in the region as well as bordering streams (Duru, 1999).

3.5.8 Decrease in Fish Supply

The occurrence of poisonous waste product in aquatic bodies habitually make softer the exoskeleton or outside of fish-like animals as well as subject them to numerous sickness conditions and a significant amount may possibly decrease. The demise of water creatures does not simply throw fishers as well as other water-related commercial actions out of trades but decreases fish supply largely. The nonappearance of these proteins nourishments from populaces' table has direct influence on their wellbeing by revealing them to protein-deficiency disease conditions.

3.5.9 Alteration in Species Structure

Certain activities such as thermal power plants and nuclear devices remove water from fresh water for cooling purposes but return same at higher temperature with harmful penalties. The heated water dissolves oxygen at the more rapidly rates than cool water in addition augment the rate of chemical reaction comprising breakdown, in that way leading to reduction of oxygen. In a thermal- contaminated water, oxygen is reduced but the growing of thermophilic species is boosted henceforth distresses species structure.

3.5.10 Floral Photosynthesis Decreased

The presence of insoluble elements floating in water bodies makes aquatic overcast and cloudy. These solid elements which are frequently resulting from farmed plots, overgrazing plots, degraded river banks, strip excavations as well as building places cause the water dusky henceforth decreases light penetration. As an effect of light decrease, the ordinary photosynthesis

of under-water plants would be weakened to the disadvantage of water faunas that be influenced by on such floras for maintenance. Decreased photosynthesis by water floras/plants decreases the concentration of dissolved oxygen in the aquatic water bodies. Under circumstances of low dissolved oxygen, anaerobic reactions for the dreadful conditions of contaminants begin to happen henceforth, may possibly lead to the decline of the water body beyond salvage.

3.5.11 Environmental Sequence

The attentiveness of nutrients in natural water from wash-down sources usually increases the growth and number of aquatic creatures. The occurrence of these contaminants, predominantly nitrogen compounds, sulphur, phosphorus and metal ions make a new environs henceforth the biological, physical and chemical properties alter; leading to new creatures getting into the system whereas others will depart. Subsequently there is thick growing in algae blossom then other water vegetation that currently shield the aquatic surface, photosynthesis is stopped as a consequence, the nourishing behaviors of water faunas may possibly adjustment from simple autotrophic to heterotrophic style recognized as eutrophication, which is a environmental method of environmental succession.

3.5.12 Damage of Visual and Entertaining Value of Water Fronts

In economically developed countries, there is ever-increasing pressure on the water resources as well as public concern about social uses of rivers, such as swimming, recreation which ought to be considered when surface water is being allocated (Eziashi, 1997) . Certainly, water sites like rivers, lakes, lagoons and reservoirs are very useful for recreation purpose where a lot of Nigerians and expatriates visit such areas on public holidays, weekends and other festive occasions. Many of them undertake swimming either for pleasure or as an exercise or both. Nevertheless, a contaminated water body that emits bad smell and is clogged with debris or covered with algae bloom can be offensive, hence unpleasant to visit. The stench can also arise from decaying organic matter and sewage which may replace the natural state of water. The implication is that such a body of water that emits foul odors to cause noxious smell will certainly lead to loss of the attractive locations for leisure and visiting the attractions growth.

The waste water from nuclear power plants is not as hot, but still has bad effects on water life. These are —

1. Hatching of eggs from fish.
2. Trout eggs fail to hatch.
3. Spawning failure of salmon.
4. Enhancement of BOD.
5. Changes in the organism's every day and seasonal behavior and metabolic responses.
6. Most important alteration to more heat-tolerant forms of algal forms and other organisms, leading to a deterioration of species diversity.
7. Changes in Macrophages.
8. Migration of such aquatic species (Sharma and Sharma, 2020).

Table 5: Pollutants of Aquatic Bodies, Their Sources and Impacts.

POLLUTANTS	PRODUCERS/SOURCES	EFFECTS
Metals (Cd, Cr, Cu, Pb, Ni, Zn, Fe, Mn, Hg, Al e.t.c.)	Tanneries, textile, metal/steel, mining, Petroleum, Surface run - off e.t.c.	Damages water life and results in diverse diseases if man consume water biota that are polluted.

Nutrients (Nitrogen and Phosphorus)	Sewage, abattoir, fertilizer, food processing industries, animal droppings etc.	Eutrophication of water bodies, algal blooms as well as oxygen reduction.
Organic matter	Manure, sewages from tanneries paper mills textile, food processing breweries etc.	Introduction of pathogens into aquatic bodies and oxygen reduction harmful to aquatic life.
Suspended matter (fibre, faeces, brewery residue, dirt, paper, saw dust etc.)	Food processing, edible oil, paper, pulp, textile industries, tanneries, sewage, breweries etc. Petroleum, textile, paper/pulp, steel and metal industries etc.	Increase turbidity, limits photosynthesis and acts as carrier for pathogens and other pollutants. Causes irreversible damage to aquatic life.
POPs (Pesticides, oil, grease, solvents etc.)	Industries producing salt water like mining industries	
Salinity	Almost all manufacturing processes	High salinity is unfavourable to some aquatic life and causes fish mortalities High acidity causes mortality of aquatic biota.
Acids (Acid rain, acid liquor from industry etc.)	Cooling water from electricity generation and industrial effluents at high temperature	Extreme temperature reduces DO level, augments bacteriological action, destroys creatures averse to it etc.
Thermal pollution	Natural erosion, agricultural run-off etc.	
Sediment		Deficiency of soil resources and reduction of water quality due to augmented deposit load

Source: Atiribom and Nnaji, (2013).

3.6 Matters That Could Rise Due To Water Contamination

3.6.1 Environs

All the categories in an environmental unit be influenced by each other in order to stay living. External materials, such as contaminants discovered in water waste, could disturb the complex associations among species that an environment wants in order to stay alive.

3.6.2 Healthiness

Agreeing to the United Nations, each time, there are additional mortalities make happen by contaminated water than entirely kinds of aggression joined, comprising war. Discarded from human being in addition to faunas that pollutes water transmits microorganisms and diseases that produce the increase of infections such as typhoid, cholera as well as giardia

3.6.3 Economy

Contaminated water could have numerous deleterious results on the financial system. It openly influences areas such as money-making fishing, entertaining trades, sightseeing and even stuff morals, all of which depend on seriously on uncontaminated water. Contaminated water

could similarly cause treatment prices to increase, which in turn makes the cost of consumption water increase as well. (Olufunke, 2022).

Table 6: A common group of fresh water organism that are tolerant to aquatic effluence/pollution

Pollution tolerance	Group	Scientific name	References
Tolerant	Leeches	<i>Hirudinea</i>	
	Midges	<i>Nematocera</i>	
	Worms	<i>Oligochaeta</i>	
Intolerant	Stoneflies	<i>Plecoptera</i>	
	Caddisflies	<i>Trichoptera</i>	
	Mayflies	<i>Ephemeroptera</i>	(Malik <i>et al.</i> , 2020b)
Slightly tolerant	Dragonflies		(Malik <i>et al.</i> , 2020a)
	Damselflies		
	Freshwater shrimp		
	Beetles (True bugs)		
	Black flies		
	Flatworms		
	Alderflies		

3.7 Water Contamination/Pollution Management and Control

There are many strategies that could be taking on in water pollution controlling as well as monitoring. It can be via prevention exercise efforts or joint scheme/program; Law in addition to inspection or participating in management measures by decreasing or reducing garbage. Approaches for safeguard of water bodies from eutrophication include improved agricultural land management, conservation farming methods, recycling or retention of drainage and runoff water, and use of buffer strips and riparian vegetation for filtration. Decrease in pesticide use has been achieved by improved application technologies, accuracy farming, acceptance of organic farming, as well as usage of biological control techniques. Without water pollution control, the waste produces from eating, heating system, cultivation, extracting, industrial, transport as well as other human being doings, run-off, whether they mount up or break up, will damage the surroundings. Contamination/pollution prevention and waste decreasing are more necessary than contamination/pollution control. Nevertheless, effluence can be reducing by embracing these exercises (i) by reusing (ii) by recycling (iii) litter/waste reduction (Owo, 2013).

Preventing of aquatic pollution in accord to Wikipedia, 2019 comprises the following methods:

- Wash-down car distant from any rainstorm aquatic gutters.
- Do not send out garbage, substances or cleaners into drain gutters
- Inspection of septic structure each 3 – 5 years
- Shun use up insecticides as well as enrichers that could run off into aquatic structures
- Remove driveway instead of washing it down
- Use of non-toxic washing tools
- Clean up oil and additional watery leaks
- Do not wash-down paints brushes in the basin.

3.8 Management Measures

- Fisheries management, policy making and fisheries law enforcement agency should take appropriate measures
- Non-degradable and slowly degradable substances should be carefully handle
- Products containing chemicals should not be used in an aquatic environment or their usage should be reduced.
- Through recycling (Atiribom and Nnaji, 2013).

Tripathy and Panda (1998) recommended the following methods that must done in orderliness to prevent additional deterioration.

3.8.1 Contamination Curb/control at Starting place (sources)

The best familiar as well as simplest tactic to reinstating contaminated aquatic (water) is to decrease or halt more input of water contaminants in addition to delay or wait for natural activities to eliminate or else end those at present in the system.

3.8.2 Dig up/dredges

Numerous water contaminants such as contaminated carbon-based (organic), phosphates in addition to heavy metals could connect themselves to good deposits then mount up at the bed of aquatic bodies for a prolonged period. These could be eliminated through dig up which removes the whole contaminants away of the water body. On the other hand, work or attempt could be done throughout dig up to lessen the amount of good floating deposits persistent in return into aquatic water as they might comprise difficult concentrations of contaminants.

3.8.3 Biochemical Remedies/ therapies

The adding of aluminium, iron, salts, calcium and salts could setup phosphorus in deposits. This decreases eutrophication, therefore decreasing algal blossom that possibly will contaminate fresh water. It is added inexpensive to usage these elements than use up artificial algaecides to end algae blossom. Management with these non-toxic substances might be repetitive each three or four years in orderliness to retain the water resource functional.

3.8.4 Community Education

Teaching or enlightens agriculturalists correctly possibly will aid to pressurise them change from the usage of chemical enrichers to compost manure or dropping that is fewer harmful contaminants than chemicals fertilizers (agro-chemical). Measures would similarly be put in place to controlling earth loss (soil erosion) that habitually conveying agro-chemicals fertilizers in addition to additional solid material into river, dam and reservoir bodies to contaminate them.

3.8.5 Fresh Aquatic Contamination Reduction/abatement

Management at Local, State and Federal levels should lay down limits for manure discharge into waterways, made on cleanliness morals for water quality. Administration/Governments, as a matter of hurry would present then pass rules banning industries as well as additional organizations from releasing detrimental contaminants into aquatic bodies excluding or without treatment to eliminate the contaminants. The implementation of the rule could aid in

monitoring the contamination of aquatic bodies mostly in addition to clean/fresh aquatic contamination in particular.

4. CONCLUSION

Diverse categories of contaminations in addition to poisons arrive into the water environment besides influence the aquatic excellence then disrupt the lifespan of water creatures. Certain contaminants are extremely working to injury the water creatures both metabolically as well as morphologically. On the other hand, there is only insufficient indication that water pollutions then pollutants are really responsible for the growth of infection or disease in water animals (animals). The disclosure of water faunas to contaminants for the long period produced the constant threat of healthiness. Consequently, indirectly and directly, water faunas are at greater threat due to numerous anthropogenic actions. Water pollution poses a important risk to the health and functioning of aquatic environments worldwide. By understanding the consequences of pollution and implementing comprehensive strategies, we can mitigate its impact and protect these fragile ecosystems. Strengthening regulatory frameworks, promoting sustainable agriculture, implementing effective waste management practices, investing in advanced treatment technologies, raising awareness, and encouraging research and innovation are key steps towards achieving cleaner and healthier aquatic ecosystems. It is our collective responsibility to act now and safeguard these invaluable resource for futures generations. In conclusion, aquatic pollution has a significant and detrimental effect on aquatic ecosystems. It disturbs the fragile equilibrium of these environments by introducing destructive constituents as well as altering the chemical and physical stuffs of the water. The pollution leads to the decline of biodiversity, the destruction of habitats, and the disruption of food chains. It also poses a threat to human health, as contaminated water can be a source of diseases and toxins. It is crucial that we take immediate action to reduce and prevent aquatic pollution through effective waste management, stricter regulations, and increased public awareness. By doing so, we can protect and preserve these valuable ecosystems for future generations.

5. RECOMMENDATION

Aquatic pollution is a global problem and world communal is meeting life-threatening outcomes of contaminated aquatic environment. Water environments, such as streams, lagoons, as well as oceans, are critical constituents of our globe's biodiversity in addition to offer many environment services. On the other hand, these environments are under frequent threat from numerous sources of contamination. Water pollution, make happen by human being activities, has arisen as a important alarm international, with unfavourable influences on the wellbeing as well as functioning of water environments. This comprehensive recommendation aims to highlight the penalties of water contamination and provide approaches to lessen its influence on these delicate environments.

1. Understanding the Consequences of Aquatic Pollution

Aquatic pollution encompasses a wide range of contaminants, including chemical pollutants, nutrient overload, plastics, and oil spills. These pollutants have severe implications for aquatic ecosystems:

- ✓ **Disruption of Aquatic Food Chains:** Poisonous affluences similar to heavy metals as well as pesticides accumulate in water creatures, show the way to bioaccumulation and biomagnification. This distracts the delicate equilibrium of nourishment chains as well as can result in the deterioration or death of susceptible species.

- ✓ **Oxygen Depletion:** Extreme nutrient inputs, predominantly from farming runoff as well as manure release, cause eutrophication. This leads to algal blooms, which lessen oxygen levels in the water, triggering hypoxia and negatively impacting fish as well as other water creatures.
- ✓ **Habitat Destruction:** Effluence, predominantly from industrialized actions, could effect in physical environment damage, such as the deprivation of coral reefs in addition to damage of swamplands. These environments assist as vital propagation surroundings and nurseries for many water species.
- ✓ **Biodiversity Loss:** Water contamination donates to the deterioration of numerous species, disturbing the complicated web of connections within environments. The loss of biodiversity has cascading effects on ecosystem stability, resilience, and overall functioning.

2. Strategies to Mitigate the Impact of Aquatic Pollution:

To address the challenges posed by aquatic pollution, it is crucial to implement comprehensive strategies that aim to prevent, control, and remediate pollution sources:

- ✓ **Strengthening Regulatory Frameworks:** Authorities must endorse as well as administer stringent rules and regulations to avert contamination from point sources, such as industrial discharges and sewage treatment plants. Regular checking as well as harsh punishments for non-compliance are vital to ensure compliance.
- ✓ **Promoting Sustainable Agriculture:** Boosting maintainable agricultural practices, such as precision agriculture, organic farming, and integrated pest management, can reduce the use of chemical fertilizers and pesticides, reducing nutrient runoff as well as water contamination.
- ✓ **Implementing Effective Waste Management:** Proper waste management systems, including recycling, waste segregation, and controlled landfill practices, can prevent the discharge of plastic waste and other pollutants into water bodies.
- ✓ **Investing in Advanced Treatment Technologies:** Increasing as well as applying highly developed water therapy skills, such as membrane purification, triggered carbon adsorption, and ultraviolet sterilization, could successfully eliminate contaminants from wastewater before its release into water environments.
- ✓ **Raising Awareness and Education:** Public awareness campaigns, educational programs, and community engagement initiatives can play a vital role in fostering responsible behavior towards water resources, promoting pollution prevention, and encouraging sustainable practices.
- ✓ **Encouraging Research and Innovation:** Authorities, academia, as well as companies should work together to encouragement study in addition to innovation in developing eco-friendly substitutes, green technologies, and supportable practices that lessen contamination dangers in water environments.

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