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A Review: Effects of water pollution on aquatic life

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Abstract
Water is the most significant resource of nature for the life of living organisms. Water pollution triggered by industries, urban sewage and agriculture have become a vital stress on aquatic life. Water pollution have enough impacts on biodiversity that the composition of species changes from natural to tolerant. Waste products from industries hazardous chemicals from factories, dumping of medical and other dangerous materials leads to enter directly in water bodies. Through water pollution many harmful chemicals like heavy metals enter into water and adsorb by aquatic animals, which is ultimately becoming the part of food web and even the death of aquatic life. This review paper tries to describe the term water pollution, causes and different sources of water pollution and the main effects of water pollution on aquatic life.

Keywords: nature, ecology, chemicals, hazardous, biodiversity

Introduction

Water is said to be polluted if some undesired substances or condition is added to such a point that the water cannot be used to perform some specific purpose. It is said to be water pollution when an excessive amount of pollutants (hazard materials) will present in it, as a result it will be not suitable for cooking, bathing, drinking or other uses. Pollution is the exposure of any contamination into the Environment, it can be the result of agricultural pesticides, commercial and industrial wastewater, anthropogenic activities and notably from transportation (Webster.com, 2010).

Human activities like huge population expansion, extensive urbanization, industrialization and agricultural practices have led to decline the water quality in all over the world (Wang *et al.*, 2010) [2]. The most important natural resource is water second only to air. Even though food is on third number but for food production water is necessary. All the biochemical reaction which are taking place inside bodies of living organism, water is the main thing to perform these reactions. In addition to it the most important life's processes happening in the four dimensional world from which three dimensions are covered by water the fourth one is also interacts with water in some significant ways. On the other hand signs can also be seen many life processes are happening in water even in the terrestrial systems. Water is the most important component of all the origin of life from birth to maintenance of life as a nonstop and self-describing algorithm. In others word for biological terms water is so important to generate and develop living organisms which by simple extrapolation means that water is necessary for whole life processes, our domestic needs, our development and for our all living processes (Bibi *et al.* 2016) [3].

There are so many bases of water pollution, but most of them which are considered major players in this matter are loose domestic waste, industrial waste, marine dumping of the waste created by human activities, deforestation resulted soil erosion, usage of pesticides and dangerous chemicals in agricultural fields, air pollution, and untreated wastes etc. Heavy metals and their by-products created by industrial activities and disposed of without proper treatment and processing finally settle down in different water bodies like oceans and fresh water bodies (pounds, lakes and rivers) so exposing animals and humans to hazardous constituents. Exposure of animals to the polluted water ultimately results in accumulation of these risky materials in human bodies because human use this livestock and the products made by these livestock. These materials are so toxic and can be created a variety faults in human body and resulted ill health. The main diseases resulted in this way are inflammation, reproductive malfunction including infertility, immune compromise (which exposes to a gamut of many other pathogen based disease and pose life threating conditions), respiratory and gastrointestinal disorder (a prominent concern being hepatotoxicity), cancer and even death. And other many infectious diseases such as typhoid and cholera and even many cancers are resulted by water pollution (Juneja and Chauhdary 2013) [5]. The lists of diseases do not stay here, it can also spread up to dermatitis, renal disease, diarrhea, dementia etc. primarily because of contaminated or polluted water (Khan and Ghouri 2011) [4]. According to the statement of WHO the one sixth of the world population, about 1.1 billion people do not have access to harmless water and there is no proper sanitation for 2.4 billion people (European Public Health Alliance, 2009) [7]. Polluted water mainly contains sewage water, contaminated rain water, industrial effluent discharge (Ashraf *et al*, 2010) [10] and contaminated by household or agriculture cause damage to human health and the environment (European Public Health Alliance, 2009) [7].

Water polluted by chemicals or contaminated drinking water allowed waterborne diseases like, Hookworm, Giardiasis,

Amoebiasis, Typhoid, Ascariasis, Alzheimer's disease, non-Hodgkin's Lymphoma, Liver and kidney damage, that can harm reproductive and development processes, damage to the nervous system, Cancer, heart disease, Parkinson's disease, Damage to the DNA and even death, meanwhile, polluted beach water contaminated people like stomach aches, gastroenteritis, respiratory infections, Hepatitis, diarrhea, vomiting, ear ache, pink eye and rashes (Water Pollution Effects, 2006) [8]. Loss of wild have direct relation to pollution (Progressive Insurance, 2005) and rendering to Water Pollution Effects (2006) [8] on animals i) Fast and overgrowth of toxic algae due to nutrient polluted water, this toxic algae eaten by other animals living in water resulted in death; it can also explosion of fish diseases, ii) declines in tadpole and frog biodiversity mass can also due to chemical contamination iii) Pollution of Oil can enhance vulnerability to disease and can harmfully affect reproductive processes and badly affect progress of marine organism and it can be a reason of gastrointestinal irritation, harm to the liver, kidney damage and damage to the nervous system iv) Mercury present in water can be the reason of limitation in reproduction, reduce growth and development, abnormality and even death v) Death, deformities and declines of fish also caused by persistent organic pollutants, fish caught from polluted water or washed through contaminated water can make impact on animals and human health. Excessive amount of sodium chloride in water can damage plants and animals, plants can also be killed by mud generated by construction sites and plants can be killed by the presence of herbicides in water (Kopaska-Merkel, 2000) [9].

We ultimately have to think about this matter because; the aquatic life is so important for the beauty of nature as well as for eating purpose for human being and animals and it is also a part of food chain. The second thing is water pollution which is just like a poison for animals as well as human being.

Causes of water pollution

There are some most common and important effects and causes of water pollution

1. Intentionally or unintentionally discharge of hazardous materials and chemicals can lead to water pollution.
2. Through rainfall, polluted lands can disperse their toxic and poisonous materials into the water and polluted the surrounding water.
3. Water pollution can also be the result of some contributing factors or some specific points like oil refineries, chemical waste management, construction sites, dump sites and others large scale processes create or store a huge amount of hazardous or chemical waste.

Water pollution can generate by two sources first one is Point sources and second is Non-point sources (Table 1). The source which have directly recognizable point is known as point source of pollution. The examples of point sources are oil spilling from a tanker, discharge from industries and pipe attached to a factory etc. Point source of pollution comprise storm sewer discharge, wastewater effluent (both industrial and municipal) and mostly affect area around it. On the other hand the Non-point sources of pollution are the sources which come from many different ways and different basis, from which contamination arrive into surface water or ground water and come into contact with environment from different non recognizable points. Examples are urban waste, runoff from agricultural fields etc. There is another term which is known a transboundary pollution it can be defined as that if sometime pollution come in the environment at one place but has effects on thousands of miles away. The example of transboundary pollution is that radioactive waste that travels over the oceans from reprocessing plants to neighboring countries. Water pollutants can be organic or inorganic.

Table 1: Characteristics of point and nonpoint sources of chemical inputs to receiving water (Adapted from Nadushan *et al.,* 2011) [41].

Point sources	Non point sources
Wastewater effluent (municipal and industrial) - Runoff and infiltration from animals feedlots - A huge amount of sewer outfalls from cities having population >100,000 - Runoff and leakage from waste disposal sites - Overflows of combined tempest and sanitary sewers - Runoff from sites of construction >2 hac	Runoff from agriculture (including return flow from irrigated agriculture) - Runoff from failed septic system and septic tank leachate - Construction site's runoff - Urban runoff from sewered and unsewered areas having population <100,000 - Runoff by reckless mines - Atmospheric deposition over a water surface - Activities which can generate contaminants like construction and development of land or waterways, logging

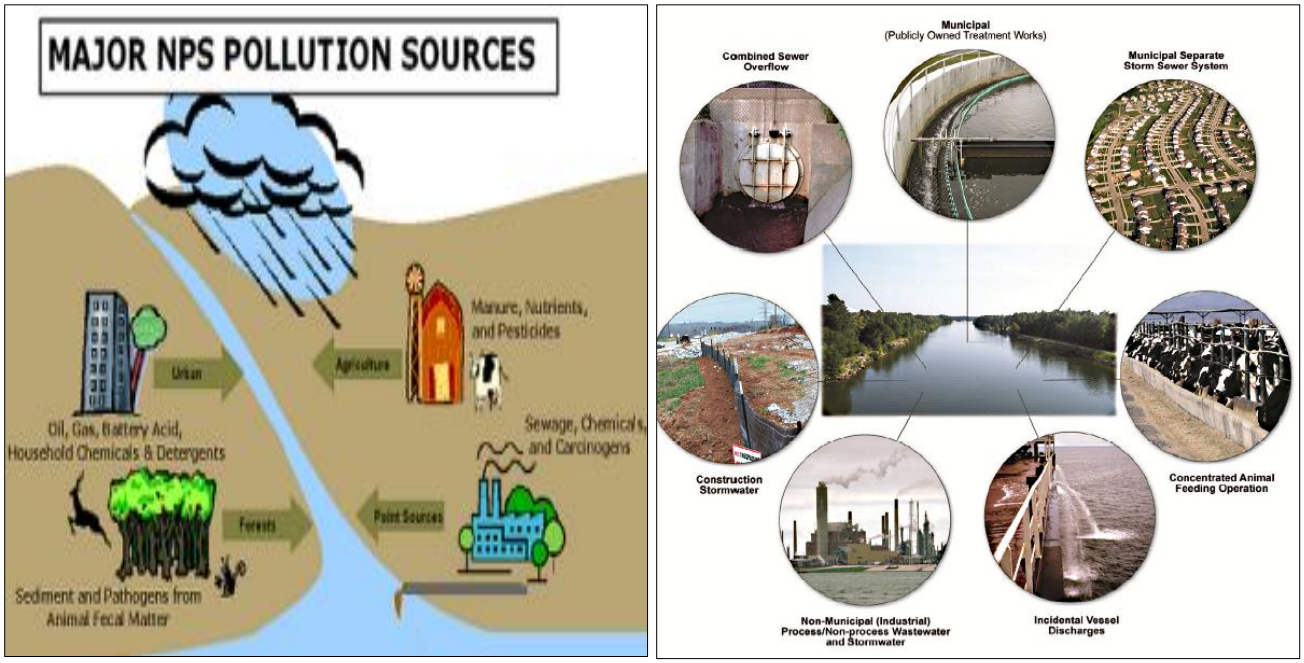

Fig 1: Pictorial representation of Point and Non point sources

There are many sources of water pollution as already mentioned but some detailed discussion is given bellow:

Domestic Sewage

Over all the world, pollution due to sewage water is main problem in the cities. Sewage water is carried into rivers without proper treatment. Disposal of sewage water without proper treatment resulted in creation of a lot of problems like dispersion of diseases, increasing of Biological Oxygen Demand (BOD) eutrophication (Dwivedi *et al.*, 2009) [10]. The basic reason of water pollution is the improper handling of waste water. Sewage is exhausted in a huge quantities to rivers. Sewage slows down the process of dilution of water constituents, it can spread a lot of diseases like typhoid and diarrhea (Baig *et al.*, 2009) [11].

Water which is used for industries and domestic purposes gets changed into waste water. It is known as sewage water (Bu *et al.*, 2010) [12]. Because sewage water carried out through pipes from cities so it can be recycled. Sewage consists of many chemical as well as organic wastes. It is observed that the sewage pollution is usually happening in developing countries. In developed centuries a proper sewage system are installed for sewage in cities, but in developing couturiers water is not disposed in proper ways (Ramakrishnaiah *et al.*, 2009) [14]. Treatment of the sewage can be minimized the pollution resulted from it. Still in some old cities may have leaky sewage system in developed countries (Steiner *et al.*, 2006) [15].

Industrialization

Due to the manufacturing of different products which having toxic byproducts and fumes which are ultimately discharge into the Environment (Dillinger, 2017; Ritchie and Roser, 2017) [36, 37], creating health problems. So fast growth of industries in China has increased the emission in recent decades up to 69.42 trillion m^3 between 2002 and 2014 (Xu *et al.*, 2014; Yang *et al.*, 2018) [38, 39]. Pollution created by any industrial activity is known as industrial pollution (Malik *et al.*, 2009) [17]. The most pollution on the earth can be drawn back to industries of some kind. The agencies which are trying to fight against the environmental degradation are giving grave impotence to industrial pollution (Sarkar *et al.*, 2008) [18]. Countries with such a huge development of industries finding it to be serious to bring it in control conditions urgently (Tariq *et al.*, 2007) [19].

Industrial pollution has contaminated main sources of safe drinking water, has released many undesired toxic materials into the air and decreased the quality of soil all around the world. Many and major environmental disaster which have yet to bring under control are the result of industrial disasters. Following are some main causes of industrial pollution that is the main reason of environmental degradation (Jan *et al.*, 2008) [20].

Pesticides and Fertilizers

A lot of water pollutants acts as poisonous chemicals. The pesticides are considered and established possession in view killing the insects-pests in general and thus they are not specific species. The methods of applying these pesticides are such as that these chemicals will not kill non target organisms these chemical will only contact with target pests. These target pests have many same characteristics of other animals and they are simple species of animals. One of these characteristics is a vulnerability to specific toxins. It can be said like that chemical which have harmful effects for one animal can also be have same effect of other animal life. Though it may take a high dose of pesticides to mischief humans than insects, a lot of pesticides are still harmful for human. The dose which is necessary for killing a pest can affect the human in different ways like reproducing performance and can make problem in function of sex hormones (Perry *et al.*, 2008) [21].

The thing which I used to kill undesired plants is known as herbicide. Specific herbicides used to kill targets and the non-targets crops will be unharmed. Some of herbicides affect the growth of undesired plants and usually make simulation of plant hormones. Herbicides usually used to clean some places like

industrial sites, waste ground and railway embankments and kill all plants material which face the herbicides. A little amount is used in pasture system, forestry and organized areas set aside as wildlife habitat. Many numbers of herbicides are specific for the specific target plants (Singh and Singh 2008) [22].

On the other hand many herbicides that are synthesized to harm an extensive variety of plants. A herbicides which is using for a specific species of plant have no guaranty that it will not enter into water system. Some special harmful things about these chemicals are still to be understood. So, there is need to use the cautions to ensure that these herbicides don't enter the water system (Mian *et al.,* 2010) [22].

For the safe and managed usage of things like pesticides, the risk to animals and human health should be minimum. If these chemicals come into contact with water system, they may come into contact with non-target animals and can create a serious hazard to the others animal's lives (including domestic animals and even human being) and non- target plants. Together with pesticides there are a lot of other thing which can cause the harmful effects to safe water and finally to humans (Kumar *et al.*, 2005).

Aquatic Life and water pollution. Crosstalk

There are contest effects of water pollution on nature. It has harmful effects on environment as well as human being. There are different effects of pollution on aquatic life and human beings. In developing countries there is approximately 14,000 deaths per day due to water pollution (contamination of drinking water through sewage) (Ebad *et al.,* 2013) [24].

Many sea organism which serve as food for human such as sea weeds, marine birds, mollusks, crustaceans and fishes are often killed by oil pollution from tankers of broken oil pipes. It is resulted in deficiency of calcium in our food. DDT concentration increases in our food chain when insecticides like DDT are allowed to enter in water bodies, and it is very dangerous. For example Oyster may collect DDT 70,000 times than it is present in sea water. Water pollution have enough effects on aquatic life in some area that it may create irreversible changing in aquatic ecosystem (Grema 2013) [25].

Water pollution has major impact on aquatic life, because their presence depends all in all on water so, any little trouble in ecosystem will lead to a high and maximum impact on aquatic organisms. Due to high growth of algae in water, the amount oxygen becomes lesser, which ultimately resulted in the death of fishes and others animals or plants. It is assessed that last twenty years, 40 per cent of aquatic life have been decreased (Ahada and Suthar 2018) [26].

The peculiar taste and smell from many water supplies is mainly due to high growth of algae in water it is also cause of gastroenteritis. According to the report of Wheler the algal poison commonly attack on the skin and central nervous system and it is also reported that it is able to produce liver's cirrhosis (Ahmad *et al.,* 2014) [28].

It is recorded in many cases that polluted water has destroyed marine life. The most dramatic and the earliest consequences of in discriminate pollution of water is the mass killing of fish. The killing through municipal sewage is another kind of fish killing. Many other threats are there for marine life like radioactive pollution, industrial and thermal pollution (Ahmed *et al.,* 2014).

By analyzing the fish of Oka river basin it has exposed that the metal distribution is irregular in fish. Except white-eyed bream (Abramis sapa), and bream in all species copper is inattentive in muscles, on the other hand its content is exceeded 1.3 times of allowable amount in the liver of silver bream (Blicca bjorkna) and this level has been exceeded 3.1, 5.5, 17.8, in the livers of bream, sabre fish and white eyed bream respectively. Spawn of white-eyed bream and silver bream confined a major amount of copper. Metal compounds hold their poisonousness nearly forever not like organic substances which are degradable, adsorb able or can be assimilated in the water body subsequently during their transformation the compound have basic components, for example the metal have no modification (Alrumman *et al.,* 2016) [30].

The statistical analysis of heavy metals in water bodies' concentrations is given in table 2. Co have the highest mean values among the given values (3995 mg/L) and on second number there is As (3982 mg/L), and the heavy metal which have lowest concentration is Hg (1.01 mg/L). The coefficient of variation described that the minimum variation is investigated for Hg and the highest for Ni and on second umber is Cd (table 2).

Table 2: Heavy metals concentration (mg/L) statistics in water bodoies (Kumar *et al.,* 2017).

Heavy metals name	Minimum	Maximum	Mean	Standard deviation	Coefficient of Variation
Hg	0.007	8	1.01	0.54	168.34
Cd	0.003	13700	180.88	62.8	614.25
As	0.22	86100	3981.78	145.96	440.66
Zn	0.01	54000	723.11	213.10	579.3
Ni	0.001	38100	945.86	191.84	669.54
Co	0.06	42970	3994.82	135.24	392.32
Fe	0.001	63500	1654.05	541.75	322.94
Mn	0.015	77000	2562.15	747.74	432.87
Cr	0.001	21800	413.27	128.24	478.71
Cu	0.00067	27400	537.87	138.71	500.72

The metal's toxicity is estimated by several factors such as ambient temperature, pH, concentration and duration of action, O_2 content in water, hardness of the water the existence of compounds with which metal can be complex. Enhancement of water temperature, shortage of oxygen, low pH and hardness often increase the toxicity for hydrobionts. Immediately presence of metals and other organic compounds in water may have variety of effects on the toxicity. Coefficient of metal buildup by hydrobionts, derived with respect to their concentration in water, there is a lot of difference between organisms for various

taxonomic status, in addition to different metals and organs. Mostly, the values contrast a range from a few tens to tens thousands. The metals enter into the tissues of marine animals primarily through their food. Metals can also enter through mechanical detention of suspended elements of hydroxides in gills and mucus membrane can chemically adsorb ions in fishes. Metals are organized according to decreasing order of toxicity in hydrobionts as follows: Hg>Cd=Cu>Zn>Pb>Co>Cr>Mn=Fe>Sn (Currie *et al.*, 2013) [31].

The amount of mercury in huge predatory fishes in oceans like shark, tuna (Thunnus), and swordfish in addition to cetaceans is higher than in non-predatory marine fishes. Permanent settle down of mercury in predatory fishes results in becoming a part of food chain. The fishes' scale and skin is highly accumulated by cadmium and led (Desai and Vanitaben, 2014) [32].

When many hazardous chemicals stick to small particles they are up taken by plankton and benthos animals, many of them are filter feeders or deposit. In this manner the hazardous materials and many toxins are become the part of ocean food chain. Among these particle many of them chemically combined and cause depletion of oxygen at high rate as a result estuaries become anoxic (Faiq *et al.*, 2018) [38].

When pesticides and insecticides are combined into aquatic ecosystem, they rapidly absorbed into oceanic food chain. When these chemicals become the part of food web they can cause many diseases as well as mutation which may cause danger to food web as well as human being. These hazardous things (metals) can also be entered in marine food web (Kamble, 2014). These dangerous chemicals be the basic reason of changing biochemistry, tissue matter, reproduction, behavior and destroy growth of aquatic life. Because a lot of animals are nourished by fish hydro lysate content or fish meal, in this manner, toxins present in marine system easily can be moved to terrestrial animals and later will be present in dairy and meat products (Lu *et al.*, 2015) [35].

Conclusion

Water pollution is the major concern for us because it is an environmental problem all over the world. Macroinvertebrate taxa composition and richness of functional feeding groups are highly effected by organic pollutants. Aquatic life is decreasing day by day due to the water pollution. The main contribution towards water pollution is from anthropogenic activities because human being is contributing through dumping, industrial waste washing clothes and also by using a lot pesticides etc. into water. Aquatic life have its own importance in the environment if it will destroy ultimately there will be have numerous effect on human life. So, to avoid all these losses of environment and human being the environmental education should be compulsory at school level, it should have proper place in curriculum. In this way we can control environmental pollution and ultimately there will be low impact on aquatic life.

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