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Water pollution has different factors

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Abstract

Water is an essential element for the preservation of life on earth. Maintaining the food chains and humanizing the living standards are closely connected to fresh and clean water accessibility. Currently, there is an approximation that one-fifth of the world's population (nearly 1.2 billion people) lack access to clean water and furthermore, it is estimated by the United Nations Development Programme's Human Development Report that 2.6 billion people lack access to sufficient sanitation. Water pollution is one of the major and serious threats to public health as drinking water quality is poorly managed and monitored throughout the world. Human activities like improper disposal of municipal and industrial effluents and indiscriminate applications of agrochemicals in agriculture are the main factors contributing to the deterioration of water quality. Industrial and chemical pollutants affect soil pH, which is one of the most important factors affecting the growth and health of flora on earth. Microbial and chemical pollutants are the main factors responsible exclusively or in combination for various public health problems. Water pollution causes the majority of the diseases in humans. Hence pollution is the main factor in producing a self-perpetuating circle of disease and low productivity, increased poverty and more spread of diseases. Pollutants are of various types as bacteria, virii, worms, parasites, acids, metals, toxins, plastics, pesticides and fertilizers. The pollutants, ultimately through various channels, reach into water channels; pounds, rivers, and oceans. These also seep into the earth and reach the water table. Water pollution causes diseases in humans like dysentery, gastroenteritis, food poising, viral hepatitis of all kinds, helminthiasis, retarded growth in children, various types of kidney problems due to dehydration from simple weakness to renal failure. According to World Health Organization (WHO), waterborne diarrheal diseases are responsible for over 2 million deaths annually across the world, with the majority occurring in children under 5 years.

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Introduction

According to biologists, all life came from the sea means water. We are living on this planet due to the blessing of water. From the dawn of civilization till now, humans have been using water for various seminal purposes: drinking, bathing, watering animals, and irrigating lands. However, this limited resource means a source of life under threat from the population, chiefly generated by human factors. Almost 71% of the earth's total surface is covered with water; only 2.5% of this amount can be considered as freshwater (Shiklomanov, 1993).

Unfortunately, even this small proportion of freshwater is under immense stress due to rapid population growth, urbanization and unsustainable consumption of water in industry and agriculture. According to a UNO report, the world population is increasing exponentially while the availability of freshwater is declining. Many countries in Africa, the Middle East and South Asia will have serious threats of water shortage in the next two decades. In developing countries, the problem is further aggravated due to the lack of proper management, unavailability of professionals and financial constraints (PCRWR, 2005).

Like other developing countries of the world, Pakistan is also facing critical water shortages and pollution. The country has essentially exhausted its available water resources (PCRWR, 2005); it is considered as water-stressed and is likely to have water scarcity in the near future (Hashmi *et al.,* 2009). The water precipitation rate is lower than the evaporation rate in the country. This causes a continuous decrease in water quantity in its rivers, lakes and diminishes the groundwater as well. The problem is further aggravated by factors like long droughts and lack of construction of new water reservoirs (Ullah *et al.,* 2009).

In certain regions, like the drought-affected areas of Sindh Province, people already have no freshwater for drinking and are compelled to drink brackish water (Ullah *et al.,* 2009). In Baluchistan Province, the underground aquifers are dropping at a rate of 3.5 m annually and will be exhausted in the next 15 years (Sajjad *et al.*, 1998).

Drinking water in densely populated cities like Karachi, Lahore, Rawalpindi, Peshawar, Faisalabad, Qasur, Sialkot and Gujrat is polluted due to various anthropogenic activities and cannot be recommended for human consumption (Bhutta *et al.*, 2002). The situation is even worse in the capital Islamabad. Analysis of water samples from Islamabad and its twin city Rawalpindi revealed that 94% and 34% of water samples were contaminated with total coliforms and fecal coliforms, respectively (Jehangir, 2002).

Water contamination is one of the main causes of health problems in human beings. About 2.3 billion people are suffering from water-related diseases worldwide. In developing countries, more than 2.2 million people die every year due to the drinking of unclean water and inadequate sanitation. Water-related infectious and parasitic diseases account for 60% of infant mortality in the world (Ullah *et al.*, 2009).

Currently, 1.1 billion people lack access to safe water, and 2.6 billion people do not have proper sanitation, primarily in developing countries, and an imbalance exists between rural and urban areas in access to both improved sanitation and safe drinking water supply. On a global scale, the restricted access to safe water and to improved sanitation causes 1.6 million deaths per year. The easily preventable diarrheal diseases caused by unsafe water and lack of sanitation and hygiene contribute to 6.1% of all health-related deaths; one report estimates that unsafe water is responsible for 15% to 30% of gastrointestinal diseases. The main acute disease risk associated with drinking water in developing and transition countries is due to well-known viruses, bacteria, and protozoa, which spread via the fecal-oral route. According to WHO records of infectious disease outbreaks in 132 countries (from 1998 to 2001), outbreaks of waterborne diseases are at the top of the list, with cholera as the next most frequent disease, followed by

acute diarrhea, legionellosis, and typhoid fever. It is alarming that, after an absence of almost 100 years, cholera reappeared in Africa and accounted for 94% of the reported global cholera cases in this period. In addition to cholera, the most proliferate waterborne disease outbreaks were due to (para) typhoid fever (caused by *Salmonella typhi* and *S. paratyphi*, respectively). Also, hepatitis A and E viruses, rotaviruses, and the parasitic protozoa Giardia lamblia are often found associated with an inadequate water supply and hygiene (Rene *et al.*, 2010). Studies report various effects of heavy metals in drinking water. According to the International Agency for Research on Cancer (IARC), inorganic As and Cd are classified as human carcinogens. As is related to cancer risk and skin damage, Cd is linked to kidney damage and cancer. Other effects such as heart diseases and blood cholesterol from Sb, Anemia from Pb, kidney and liver damage from Hg, and gastrointestinal disorders from Cu are also reported (Albert *et al.,* 1999).

Among the many chemicals encountered in drinking water, pesticides occupy a unique position since they are deliberately used to control the growing problem of pests (Younes *et al.,* 2000).

Studies found that pesticide residues can cause nausea, vomiting, blurred vision, coma, difficulty in breathing, deficit hyperactivity disorder in the human body (Rauh *et al.,* 2006). Another study reported that many pesticide residues increase the possibility of some diseases like cancer and heart diseases. It also reported that pesticide residues could cause respiratory and neurological damages (Galloway and Handy, 2003). Another study reported that food products containing pesticide residues could cause cancer, teratogenesis and genetic damage (Chowdhury, 2011).

Domestic sewage effect on water pollution

Another factor of water pollution is human activities. The main sources of water pollution are domestic and industrial wastewaters (Kemp, 2004). Domestic wastewater comes from 'residential sources including toilets, sinks, bathing, and laundry and industrial wastewater is 'discharged by manufacturing processes and commercial enterprises' (Stapleton *et al.*, 2004).

Industrialization effect on water pollution

Hazardous material discharged from the industries is responsible for surface water and groundwater contamination. Contaminant depends upon the nature of industries. Toxic metals entered into the water and reduced the quality of water (Ho *et al.*, 2012). 25% of pollution is caused by industries and is more harmful (Desai, 2014). Waste from the industries like sugar, textile, electroplating, pesticides, pulp and paper are polluting the water (Kamble, 2014). The polluted river has an intolerable smell and contains less flora and fauna. 80% of the world's population is facing threats to water security (Owa, 2013).

Population growth effect on water pollution

The increasing population is creating many issues and it also plays a negative role in polluting the water (Ho *et al.*, 2012). Increasing population leads to an increase in solid waste generation (Jabeen, 2011). Solid and liquid waste is discharged into rivers. Water is also contaminated by human excreta. In contaminated water, a large number of bacteria are also found, which is harmful to human health (Desai, 2014).

Fertilizers effect on water pollution

In the modern world, most of the world's food production is achieved due to the application of fertilizers [nitrogen (N), phosphorus (P), and potassium (K) as it can be seen by the statistics of increasing fertilizers consumption level, which will be increased by 172%, 175%, and 150%, respectively, by the year of 2050 (Khan *et al.*, 2018).

Excess nutrient transportation takes place into the stagnant surface water reservoirs through rains causing eutrophication in them. The vast growth of algae and other aquatic plants occurs, and they consume most of the dissolved oxygen required by aquatic lives, and water becomes less usable for

fisheries, recreation, industry, etc. Percolation of fertilizer contaminated water can contaminate the groundwater as well because of the mixing of these chemicals and ultimately affects the health of living beings after intake (Khan *et al.*, 2018).

Pesticides affect water pollution

In the last four decades, the use of pesticides has increased substantially throughout the world. It aims at the protection of crops from insect infestation to achieve higher crop yields with better quality (Zia *et al.,* 2008). An estimated quantity of 2.5 million tons of pesticides is used in the world annually with continuous increases (Pimentel, 1995). An estimated amount of only 0.1% of pesticides applied to reach the target organisms and the remaining 99.9% disperse through air, soil and water, thus resulting in the pollution of natural ecosystems and affecting human health and other biotas (Pimentel, 1995).

Plastics and polythene bags effect on water pollution

Plastic wastes are accumulated in the aquatic ecosystems directly and indirectly by different kinds of sources. Land and ocean-based sources are critical sources of plastic pollution in coastal and marine ecosystems through in-situ and ex-situ pathways. Major land-based plastic pollution sources are freshwater input, residential & domestic activities, tourism, and other economic actions, including harbor operations (Andrady, 2011). Plastics not only harm terrestrial flora and fauna it has been known to have a disastrous effect on the aquatic environment as well (Browne *et al.,* 2011). Not only are oceans contaminated, but seabed near the coastal areas is also found to be rich in plastic bag contamination. The threat to the marine environment is caused by marine debris of plastics (Webb *et al.,* 2013). Due to debris, there has been a decrease in marine fauna population; either they entangled through their body, or they were ingested by fishes and birds mistaking debris to be prey (Derraik, 2002).

Urbanization effect on water pollution

Population growth brings environmental deterioration through development, such as large-scale farming, urbanization and industrialization (Chu, 2002). Population growth and the change of lifestyle and technology bring worse sewage because nature cannot keep up with the treatment of the pollution (Kemp, 2004). Population size is one human impact on the environment (Stapleton *et al.,* 2004). Another factor of water pollution is human activities. The main sources of water pollution are domestic and industrial wastewaters (Kemp, 2004). Domestic wastewater comes from 'residential sources including toilets, sinks, bathing, and laundry and industrial wastewater is 'discharged by manufacturing processes and commercial enterprises' (Stapleton *et al.,* 2004).

Temperature effect on water pollution

The temperature of the water should be 20–30 ℃ according to WHO standards. The temperature of water influences the aquatic life, solubility of solids, taste and odor, dissolved oxygen (DO), etc. (Zuane, 1996).

Modification in surrounding temperature affects the biodiversity of any ecosystem. Bacterial population reduction in response to thermal pollution was studied by (Zeikus and Brock, 1972). Temperature also affects the electrical conductance of water (Talbot *et al.*, 1990), which may be a prominent factor of biodiversity modification. Oxygen content in water is also affected by temperature (Steele, 1989); increasing temperature renders the oxygen to flee from the medium. The rate of biodegradation of organic compounds increases by an increase in temperature; this further adds to the reduction of DO and nutrient accumulation. The distribution pattern of plants with respect to temperature and light was studied by (Dale, 1986).

PH effect on water pollution

Although pH has no direct impact on the consumer, it is one of the most necessary operational water quality parameters (WHO, 2011). WHO recommended that the pH of the water be within 6.5–8.5. A specific pH is essential for the normal survival of any organism. pH affects the enzymatic activity, thus indirectly affecting

the elemental mobilization. pH also affects the distribution of plants (Findlay, 1984).

Organic matter effect on water pollution

Organic as well as inorganic carbon affects eutrophication (Goldman, 1972), which ultimately affects the chemistry of the river (Crowder, 1991).

The presence of particular organic compounds is responsible for specific odor (Ma *et al.,* 2001). Some hydrophytes growing in a carbon-rich medium have the capacity to absorb inorganic carbon for photosynthesis (Raven, 1970). Seasonal variation in organic content is found in the water bodies (Pocklington and Tan, 1987). Organic phosphates have been shown to be absorbed by some selected microorganisms (Longowaska, 1982).

Heavy metals affect water pollution

Natural water contains impurities of trace elements/heavy metals as it dissolves these substances while moving downward as a hydrological cycle (Ilyas and Sarwar, 2003). In addition, these metals are introduced to both surface and groundwater through several human activities like large-scale use of chemicals in agriculture and improper disposal of industrial and municipal wastes. Many of these metals are considered essential for human health (Midrar-Ul-Haq *et al.*, 2005).

Microbial pollution rate in water pollution

Contamination of drinking water with pathogenic microorganisms is one of the most serious threats posed to humans, causing serious diseases in many parts of the world. Consumption of water contaminated with pathogenic microorganisms causes several diseases like diarrhea, cholera, typhoid, paratyphoid, hepatitis A, dermatitis, enteric fever, etc., as well as several permanent health defects (Butt and Iqbal 2007). Microbial analysis of water is usually carried out to detect total fecal coliforms. Coliforms commonly occur in the environment and are generally not harmful to humans, but their presence is used as an indicator for water contamination with diseases causing germs and pathogens. The presence of fecal coliforms and E. coli is also an indicator for water contamination with human or animal wastes (Farooq *et al.,* 2008).

In rural areas, open dug wells and low water tables make it further vulnerable to bacterial contamination. It is generally considered that the water is free from bacteriological contamination at the sources and becomes contaminated in pipes due to unauthorized connection or leakage. But in reality, the situation is different in the country as the water was found to contain bacterial contamination even at the source or treatment plants (Hashmi *et al*., 2009).

Effects of polluted water on soil

It has well been documented that irrigation with sewage water increases soil electrical conductivity and organic C, decreases soil pH, and could result in the accumulation of heavy metals in the plow layer of agricultural soils (Aulakh and Singh 2008).

Conclusion

Many factors are involved in polluting water, among which industrial wastes, pesticides and domestic sewage are most important as they contaminate the water with a heavy load of pathogens and toxic materials, which are very hazardous for human, animal and plants life. Besides these, some other factors include population growth, urbanization, organic matters, etc. The whole ecosystem of water bodies is disturbing due to water pollution. The pollution of water can be controlled by the government and public levels. To treat industrial wastes government should force them to make special waste treatment plants with every industry. Pesticides should be replaced with biological control. The old and rusty pipelines of the water distribution network should be renovated properly. Active and operating sewage collecting and treatment plants in large cities for municipal wastewater treatment must be installed. Public awareness campaigns should be launched to educate the population about the importance of safe drinking water. The farmer community needs to be educated well about the safe handling and use of pesticides and proper application

of fertilizers to minimize the contribution of agricultural practices to water pollution.

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