Available online at www.elixirpublishers.com (Elixir International Journal)

Applied Botany

Elixir Appl. Botany 66 (2014) 21062-21068

ISSN: 2229-712X

Water pollution and human health

Brijendra Pratap Singh

Department of Botany, University of Lucknow, Lucknow – 226 007, (U.P.), India.

ARTICLE INFO

Article history:

Received: 13 November 2013;

Received in revised form:

17 January 2014;

Accepted: 27 January 2014;

Keywords

Environment sources,

Human health,

Pollution,

Water.

ABSTRACT

Water pollution is a major global problem that requires ongoing evaluation and revision of water resource policy at all levels (from international down to individual aquifers and wells). It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily. In addition to the acute problems of water pollution in developing countries, industrialized countries continue to struggle with pollution problems as well. Water quality issues are a major challenge that humanity is facing in the twenty-first century. Here, we review the main groups of aquatic contaminants, their effects on human health, and approaches to mitigate pollution of freshwater resources. Emphasis is placed on chemical pollution, particularly on inorganic and organic micro-pollutants including toxic metals and metalloids as well as a large variety of synthetic organic chemicals. Some aspects of waterborne diseases and the urgent need for improved sanitation in developing countries are also discussed. The review addresses current scientific advances to cope with the great diversity of pollutants. It is organized along the different temporal and spatial scales of global water pollution. Persistent organic pollutants (POPs) have affected water systems on a global scale for more than five decades; during that time geo-genic pollutants, mining operations, and hazardous waste sites have been the most relevant sources of long-term regional and local water pollution. Agricultural chemicals and waste-water sources exert shorter-term effects on regional to local scales.

Introduction

Environment is the sum of all social, economical, biological, physio-chemical factors which constitute the surroundings of man, who is both creator and modular of his environment. Environment varies from place to place and continent to continent depending upon physio-topography, climate and natural resources. Since the beginning of the culture, natural resources like land/soil, air, water, forests, petroleum, stones and minerals have been exploited in different ways. However, at any moment when these natural resources are over exploited the environment gets polluted, damaged and degraded. Pollution is the result of the action or presence of a pollutant in a part of the environment where it is considered to have deleterious effect. Pollution and pollutants increase with a rise in population, which results into smaller available space as well as into an increase in demand per individual. Environmental pollution has of late become one of the major threats to the very existence of human kind today. This environmental pollution, in the last few decades, is tightening its grip all over the world. Generally pollution is classified either according to the environment like air, water, soil etc in which it occurs or according to the pollutants by which pollution is caused. Pollution may be of following types: Air, Soil, Radiation, Noise and Water pollution. Water is essential for all forms of life and none can survive on this earth without water. Most of our water bodies as ponds, lakes, streams, rivers, sea and ocean, have become polluted due to industrial growth, urbanization and other man made problems. We depend on water for irrigation, industry, domestic needs, shipping and for sanitation and disposal of waste. Water for human consumption should be clean, colourless, odourless, well aerated, cool, soft, palatable, and free from dissolved toxic substances and suspended particles, . In recent years the pollution of water has become one of the most significant environmental problems in the world. There is a great concern for rapidly deteriorating quality of water. Water is one of the critical inputs for the sustenance of mankind. It is used both terrestrial and aquatic environment for various activities, balancing the ecological system of global environment. Water is the important natural source, which is abundant in nature. Urbanization has given rise to a number of environmental problems such as water supply, wastewater generation and its collection, treatment and disposal in urban areas. In most cases wastewater is let out untreated and it either percolates into the ground and in turn contaminates the groundwater or is discharged into the natural drainage system causing pollution in downstream areas. Sewage and the industrial pollution also accounts for surface water contamination in India. Toxic chemicals from sewage water transfer to plants and entire in the food chain and affect public health. Pathogens occurring in the sewage water directly affect the mammals causing severe diseases. Agrawala and Sharma (1982), reported that about seventy percent of the available water in India is polluted. Not only the surface water but ground water is also getting polluted due to leaching of the various type of toxic pollutants (Madhusudan et al. 2001; Murali et al. 2001; Ubala et al. 2001; Sharma et al. 2002).

Madhusudan et al. (2001), reported the effect of the industrial effluents on the ground water pollution. Due to urbanization, civilization, population pressure and other developmental activities in the catchment area (Trivedi et al. 1990) majority of rivers in India are polluted. River provide water for different purposes to human beings, but same river are being polluted by indiscriminate disposal of sewage and industrial wastes. Several industries release

Tele:

E-mail addresses: p.brijendra@gmail.com

toxic chemicals and heavy metals which are being dumped into rivers and change their physico-chemical properties. In India river water pollution has been reported to be indiscriminate disposal of industrial effluents (Trivedi et al. 1990; Mishra et al. 2002). In Lucknow city, the Gomti river from Gaughat to Gomti barrage several drains discharge waste water into the river and most of the drains discharge their waste water directly into the river Gomti without any treatment. Thus, the water gets polluted right from Gaughat to Gomti barrage (Singh and Tandon 2010). Water pollution has always been a major problem to the environment. A lot of water pollution is caused by factories discharging waste illegally into nearby rivers and lakes. This hurts wildlife because the pollution will flow down the river thereby destroying plants and animals. In some cases it can be fatal (Fayomi and Popoola 2011). Thus, wastewater can be considered as both a resource and a problem. Wastewater and its nutrient content can be used extensively for irrigation and other ecosystem services. Its reuse can deliver positive benefits to the farming community, society, and municipalities. However, wastewater reuse also exerts negative externality effects on humans and ecological systems, which need to be identified and assessed.

India faces a turbulent water future. Unless water management practices are changed and changed soon India will face a severe water crisis within the next two decades and will have neither the cash to build new infrastructure nor the water needed by its growing economy and rising population. Though methods are available to improve the quality of recycled water to potable grade, the lack of social acceptance and prohibitive costs may prevent the adoption of these techniques.

Types of Water Pollution

Water pollution can be classified into four categories. These are:

i) Physical pollution of water.
ii) Chemical pollution of water.
iii) Biological pollution of water.
iv) Physiological pollution of water.

Physical pollution of water

The physical pollution of water brings about changes in water with regards to its colour, odour, density, taste, turbidity, and thermal properties etc. The discharge from industries is coloured and such discharge may import colour to water bodies such as rivers, streams ponds lakes etc. Some of the important chemicals producing taste and odour in waters are salts, iron, manganese, H_2S, C_{l2} , phenols , unsaturated hydrocarbons etc. In some, taste and odour in water are also developed because of odorous substances produced by algae. The pollution of water by taste and odour may be detrimental to fish life and may damage the value of fisheries. Such waters are unfit for drinking. If taste and odour in water are due to certain toxic chemical gases , the use of such water may seriously affect the public health. Turbidity in water mainly arises from colloidal matter, fine suspended particles and soil erosion. Generally greater the turbidity, stronger is the sewage and the industrial effluent concentrations and worst are the effects.

Chemical pollution of water

The chemical pollution of water is due to the presence of inorganic and organic chemicals such as acids, alkalies, toxic inorganic compounds, dissolved inorganic compounds, suspended inorganic compounds, suspended organic compounds and dissolved organic compounds. The industrial wastes of certain industries such as DDT factory, high explosive factory, battery factory etc. contain acids. The most common form of pollution of water due to organic chemicals is because of the presence of proteins, fats, carbohydrates etc. These organic chemicals get access to water bodies either through sewage or through industrial wastes. Important industries which contribute such chemicals are dyes, drugs, insecticides, pesticides, detergent and chemical industries.

Biological pollution of water

Biological pollution of water is due to the presence of pathogenic bacteria, certain fungi, pathogenic protozoa, viruses, parasitic worms etc. The important sources of biological pollution are domestic sewage and industrial wastes. Solid excreta from human bodies and decomposable organic matter of sewage are the best medium for the development of bacteria in water. Biological pollution in water is caused by the excretory products of warm blooded mammals including man, wild and domestic animals. Birds of various types also degrade water. Contaminated water supplies frequently create infections of the intestinal tract.

Physiological pollution of water

Physiological pollution of water is caused by several chemical agents such as chlorine, sulphur dioxide, hydrogen sulphide, ketones, phenols, amines, mercaptans and hydroxy benzene.Chlorination of water usually converts phenol to ortho or para chloro phenol which tastes like medicine and produces offensive odour.

Ground water of pollution

Ground water, is about 210 billion m^3 including recharge through infiltration, seepage and evapo-transpiration. Out of this nearly one third is extracted for irrigation, industrial and domestic use, while most of the water is regenerated into rivers. Over 98% of the fresh water on the earth lies below its surface. The remaining' 2% is found in lakes, rivers, streams and reservoirs. Of the fresh water below the surface, about 90% satisfies the description of ground water, that is, water which occurs in saturated materials below water table. About 2% water occurs as soil moisture in the unsaturated zone above the water and is essential for plant growth. It is the source of water for well and springs, that is, the recommended source of rural domestic use. It is replenished by precipitation through rain, snow, sleet and hail (Sharma 2007). Today human activities are constantly adding industrial, domestic and agricultural wastes to and water reservoirs at an alarming rate. Ground water contamination is generally irreversible i.e. once it is contaminated; it is difficult to restore the original water quality of the aquifer. Excessive mineralization of ground water degrades water quality producing an objectionable, odour and excessive hardness. Ground water is a principal source of drinking water, particularly in rural areas and also for irrigation, but it has earlier been polluted or overused, making it importable or resulting in its depletion. Underground sources of drinking water especially in outskirts of larger cities and villages are highly polluted. Ground water is threatened with pollution from the following sources.

i. Domestic wastes
ii. Industrial wastes
iii. Agricultural wastes
iv. Runoff from urban area
v. Soluble effluents

Sources of water pollution

Man-made situations are typically the causes of water pollution. Often, it's unintended and unknown that actions are contributing to water pollution. Many times it's the last thought on someone's mind that their actions could significantly impact the environment locally and beyond. Water pollution is a result of various things, but usually leads back to these sources:

Industry

There are three main ways that industries contribute to water pollution. They pollute by disposing of waste directly into waterways, emitting toxic gases that cause acid rain and changing the temperature of water with their disposals into waterways. Direct disposal of waste into natural waterways causes waste to build up within the water. A pungent odour is the result. Additionally, this waste decreases the amount of oxygen in water, causing the death of aquatic animals or other organisms. The emission of toxic fumes into the air causes acid rain. When the acid rain falls, it contaminates local natural waterways including streams, rivers and lakes. This causes the death of many aquatic animals. Other animals drinking the water may become ill and die, too. Thermal pollution occurs when water used to cool hot machinery is released into waterways and the temperature of the water is drastically increased. This temperature change may cause aquatic life to die and numbers to be reduced. Additionally, such a temperature increase decreases the amount of oxygen in water, causing more of a chance of death to organisms

Agriculture

It's common for farmers to use fertilizers and other chemicals on their crops to help them grow. However, these chemicals and nutrients added to the soil can soak into the underground water supplies. Additionally, when it rains, these chemicals join the run-off water and flow into streams, rivers and lakes, thus polluting them. Even just the sediments of dirt, without any chemicals, are pollutants in the fact that they cause the waterways to become cloudy and muddy.

Homes

Households are a leading cause of water pollution by the trash they create. Even if taken to landfills, often this trash finds its way to natural waterways. Human waste, disposed of typically by sewers, pollute water. Any time a septic system is not installed properly or bursts beneath the ground, the underground water supply may be polluted. Oils and anti-freeze leaked from vehicles pollute water.

Pollutants of aquatic habitat

There are many potential pollutants whose occurrence causes a reduction in quality of aquatic environment and about which a wealth of short term toxicity has been accumulated. Results are commonly reported as a median lethal concentration (LC50) or median tolerance limit (TL50). Both indicate the concentration that kills 50% of the test species with in specified time spans usually 96 hours. In account should LC50 or TL50 be viewed as safe levels. Safe levels must allow growth and other normal life process Such as reproduction to continue. Unfortunately, accurate data on safe levels are limited and in many cases dividing the LC50 concentration by a factor gained from experience empirically derives values.

a. ***Thermal Pollutant:*** Increased water temperatures may be beneficial for the fish culture in that faster growth is achieved as a result of year – round enhancement of the rate of metabolism, but only if the increase is to level below the thermal limit for the species. Tropical fish often live at environmental temperature closer to their upper thermal limits than living in temperature waters an important factor when assessing the significance of thermal pollution in the topics. Temperature modifies the impact of pollutants. Many are more toxic in warmer waters and while they are more soluble at higher temperatures may also reach higher concentrations.

b. ***Metals:*** The commonest causes of metal poisoning are the heavy metals copper, lead, mercury, zinc, chromium, cadmium, manganese and iron. Industrial discharges and seepage from Industrial and mining wastes are the commonest sources, although sometimes they occur naturally. Defining maximum safe levels of any particular metal is difficult, as much ancillary information is required, eg, pH, acidity or carbonate alkalinity, temperature, dissolved oxygen content, presence of metals (they often act synergistically, eg., cadmium in the presence of zinc or copper) (La Roche 1972), extend of exposure is not a reliable diagnostic feature unless historical and analytical evidence is available. Mercury poisoning (minamata disease) was caused due to consumption of fish captured from the Minamata bay in Japan. As elemental mercury is not soluble in water, it sinks into the bottom sediments and remain inert. However, bacteria living in the sediments were able to convert the elemental mercury into soluble methyl mercury was finally absorbed by tissue of aquatic organism. People ate this fish and there was an epidemic of nervous problem.

c. ***Non- metals:*** Many non-metals are toxic if present in sufficient quantity. Some of those encountered commonly are ammonia, fluorides, cyanides, phosphorus, sulphides, aluminium and beryllium salts, arsenates and halogens, particularly chloramines. Many organic compounds used in agriculture and industries are toxic for fish. Pesticides are chemicals designed to destroy plant and animal life. The major sources are run-off from treated farmlands, industrial and domestic sewage, spillage and direct application to water-ways, such as in herbicides treatments and aquatic crop treatments. The widespread use of pesticides in pest control of crops and forestry has threatened the fishery waters in various parts of the country (Jhingran 1970).

d. ***Sewage:*** Sewage discharges may reduce water quality, depending on the degree of dilution achieved, the degree of treatment of original material, its composition and response of the ecosystem. Oxygen depletion is the most common result of such discharges. It arises from insufficient dilution and microbial growth on its particulate and soluble organic content. Sewage-derived inorganic nutrients, such as phosphates ammonia and nitrates, may stimulate excessive blooms of algae or attached weed with attendant oxygen depletion and toxin production. Sewage is also a potential a source of heavy metals and toxic organic waste such as PCBs. Although its presence is likely to be short – lived, the highly toxic nitrite ion may also be present in sewage dischargers.

e. ***Particulate materials:*** All natural waters contain a certain amounts of naturally occurring suspended solids. During spates and flooding, suspended solids levels may rise considerably but fish usually survive these episodes reasonably well despite mechanical gill damage. Fish eggs, however, are very vulnerable to silt deposits that inhabit respiration through the membrane and encourage microbial growth. Wastes associated with certain industries, such as quarrying, sand gravel extraction, mining and paper and paint manufacture, and surface disturbance from civil engineering, can introduce large amount of particulate matter whose effects on fish health may be observed many miles downstream from its source. As well as its effects on the gills, it also reduces the penetration into water resulting in less energy in the food web leading to fish production (Sharma 2007).

f. ***Oil pollutants:*** Spills of crude oil can have highly toxic effects in river and other enclosed waters where dilutions of water–soluble components are not rapid. Crude oils are relatively less toxic, but use of oil dispersants and their solvent increase the toxicity for aquatic flora and fauna unless dilution is considerable. Oil spillage at sea or down streams of refineries may make conditions unfavorable for aquatic life. Even when oil levels are minimal and do no affect the fish, the resulting

taint in the flesh aquatic fauna, makes its totally unmarketable (Goodland 1996).

g. *Taints:* A wide variety of objectionable tastes, odours and colures have been noted in flesh of aquatic animals. Both natural and industrial causes are implicated muddy earthy tastes in flesh of aquatic animal in river - reared trout are caused by the activities of soil bacteria of Actinomycetaces and certain Cyanobacteria. Industrial wastes implicated in causing taints include oil products, phenolic disinfectants and domestic sewage. Some taints can be removed or reduce by holding fish in clean water for long periods but taints are more rapidly acquired than eliminated.

h. Algae: An algae affects aquatic fauna through the production of toxins or through mechanical damage. Under suitable environmental conditions they show considerable growth called algal bloom or tides and during this algal bloom toxins may be produce from aquatic animal. Biodegradable pollutants alone are not responsible for water pollution, though these indicate level of pollution (through BOD values). Besides these, a substantial pollution load is contributed by non-degradable or slow degrading pollutants, such as heavy metals, mineral oils, biocides, plastic materials etc. that are dumped into water. For biodegradable pollutants, pollution may be controlled at source by their treatment for reuse and recycling. The non-degradable toxic substances can be removed from water by suitable methods. In addition to these methods, some standard, conditions and requirements are to be legally enforced by the Government through Acts. The intensity of water pollution can be minimized to a great extent by treatment of sewage and industrial effluents and by the reutilization and recycling of wastes.

Hazardous pollutants of industrial waste water are characterized by the analysis of their physico-chemical properties. A majority of the workers analysed the physico-chemical properties of water and waste water by standard methods, APHA (Pandey and Pandey 1980; Pandey 2001; Mishra et al. 2002). Several physico-chemical parameters like temperature, odour, pH, alkalinity, conductivity, dissolved solids, dissolved oxygen, BOD and COD etc are important to assess the water quality. Sekar (2001), reported industrial pollutants have changed the electrical conductance of soil and water. Dissolved solids denote mainly the various kinds of minerals present in the water. High concentration of dissolved solids nearly 3000 mg/L may also produce distress in cattle and Livestock. Plants are also adversely affected by the higher content of solids in irrigation water, which increase the salinity of the soil. It has been observed that in natural water , dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron and manganese etc. In the polluted water, the concentration of other substances increases depending upon the type of pollution. The pH governs the distribution, transport and fate of heavy metals in aquatic systems. Metal hydroxides go in water causing metal enrichment in the overlying water column. Most natural water are generally alkaline due to presence of sufficient quantities of carbonates. The absorption of heavy metals by inorganic colloids increases with increase of pH causing enrichment of heavy metals in the sediment samples. Significant changes in pH occur due to disposal of industrial wastes, acid mine drainage, etc. High pH includes the formation of trihalomethanes, which are toxic. It has been reported that addition of waste water having acidity producing substances also increases the acidity of water. Acidity greatly controls heavy metal toxicity in plants. As dissolved oxygen is one of the important parameter in the assessment of water quality its presence is essential to maintain the higher forms of biological life in the water, and effects of the water discharge in the water body are largely determined by the oxygen balance of the system. Non polluted surface water are normally saturated with dissolved oxygen. Oxygen can be rapidly removed from the water by discharge of the oxygen demanding wastes. Low oxygen concentrations are generally associated with heavy contamination by organic matter. Dissolved oxygen is one of the most important parameters in water quality assessment and reflects the physical and biological processes prevailing in the water. Major Scientists in India, estimated Biological oxygen demand (BOD) as chief parameter for pollution studies of industrial waste water (Trivedi et al. 1990; Kudesia and Verma 1985). Trivedi et al. (1990), reported that the types of micro organisms, pH, presence of toxins, some reduced mineral matter and nitrification process are the important factors influencing the BOD test. BOD in general gives a qualitative index of the organic substances which are degraded quickly in a short period of time. BOD values should not be used as equivalent to the organic load regardless of the presence of non- degradable organic matter, presence of toxins and local changes in population of micro organisms. The BOD of any aquatic system is the foremost parameter needed for assessment of the water quality as well as development of management strategies for the protection of water resources (Banejad and Olyaie 2011). It causes low DO (dissolved oxygen) concentration and unsuitable life conditions for flora and fauna in the river (Dogan et al. 2009). The domestic wastes and the effluents from industries are the most important source of chloride in the water. Man and other animals excrete very high quantities of chlorides together with nitrogenous compounds. Even a moderate level of chlorides causes sufficient water pollution. The higher concentration of chlorides indicate pollution due to sewage as well as industrial wastes. Barman et al. (2001), reported the chemical oxygen demand (COD) values in effluents from different industries. COD is the oxygen required by the organic substances in water to oxidize them by a strong chemical oxidant. The determination of COD values are of great importance where BOD values cannot be determined accurately due to the presence of toxins and such unfavorable conditions for growth of micro organisms. In general, COD is more than BOD values for most of the industrial wastes. Trivedi and Goel (1984), observed that mainly sulphates and chlorides of the metals caused permanent hardness in water. Hardness is the property of water which prevent the lather formation with soap and increases the boiling point of water. Principle cations imparting hardness are calcium and magnesium. However, other cations such as strontium, iron, carbonate, bicarbonate, sulphate, chloride, nitrate and silicate etc also contribute to the hardness. If bicarbonate and carbonate salts of the cation causes the hardness then this hardness is called as temporary hardness since it can be removed simply by boiling the water.

Effects of water pollution

Kudesia and Verma (1985), reported that the river water subjected to industrial pollution as unfit for drinking purposes for cattle and human being, fish catching and

irrigation purposes. The river water pollution caused by industrial effluents also affect its flora and fauna (Kaushik et al. 2001; Pandey 2001). These polluted water adversely affect the aquatic life, animals and human beings using the river water for drinking. The nutrient enrichment of water leads to the consequent loss of species diversity (Eutrophication). Sharma and Dubey (2011), worked on the physico-chemical characteristics of water bodies of Indore (India),these water bodies having highly nutritionally rich status plays an important role in the eu-trophication in rivers and ponds. Chemical characteristics of water bodies in investigation indicated high nutrient level, with reference to nitrates, chlorides, phosphates and total dissolved solid. Higher values of chemical oxygen demand is indicative of the presence of oxidisable, organic matter. The total hardness of water bodies was mainly due to the calcium as observed in their investigation. Although, the sewage water contain heavy metals Fe, Pb, Zn, Cr and Cu an appropriate dilution can make them worth for use in agricultural fields to minimize its hazardous effect. Long-term applications of these effluents may increase concentration of heavy metals to considerable levels that will ultimately enter in the vegetation grown on such soils. Agricultural fields also show deterioration of physico-chemical properties irrigated by these polluted river water and become sink for metals and chemicals. In India a large number of industries with different capacities are discharging their effluents, having hazardous pollution properties. These effluents are toxic in nature, even after the treatment, even large number of small and medium sized industries have no capability economically to install their own treatment plant, and discharging their effluents without the treatment. These toxic effluents pollute the agricultural fields in the adjacent area of the drains and ultimately pollute the major fresh water bodies like river, affect the flora and fauna. Major studies reported the phytotoxic effect of industrial effluents on cereals and vegetables growing in the industrially polluted fields. In India everyday tons of chemicals and effluents from various industries are released into the environment. Environmental pollution due to the discharge of toxic industrial effluents today has not become only a national but an international problem. The use of industrial waste water for irrigation is the most common practice in agricultural fields adjoining the drains of the industries in all the industrialized urban areas in India. These industrial effluents which are used for irrigation of crop plants have hazardous pollution properties. Higher accumulation of heavy metals have been reported in the crop plants irrigated with industrial effluents. The toxic industrial effluents which are discharged continuously from the industries find their final way into the river. Rivers are the most important water resource in the world in general and in particular in India. The quality of river water is constantly being deteriorated on receipt of sewage water and industrial effluents containing toxic substances. Industrial and domestic waste water coming from different sources in the river contain high levels of metals beside other pollutants (Kudesia and Verma 1985; Kaushik et al. 2001; Pandey and Srivastava 2002). It was observed that due to some important phenomenon such as adsorption, hydrolysis and coprecipitation only a small portion of free metal ions remain dissolved in water while a large quantity of them are deposited as sediments. The micro-organisms present in the riverine system transform these heavy metals into biologically active or toxic compounds, which enter into the biological cycles. Since these heavy metals accumulate in the sediments these are said to be good indicators of pollution in the river (Gaur et al. 2002). Several health hazards have been reported the users of the polluted river water. These are diseases like typhoid, fever, dysentery, diarrhoea beside various respiratory diseases . Gupta et al. (2000), reported the methemoglobinaemia disease in areas with high nitrate concentration in polluted water. Gupta et al. (2002), reported bioaccumulation of heavy metals in fresh water molluscs of the river Gomti. In many parts of the world, human activities still have negative impact on the environment. Some of the consequences of manmade pollution are transmission of disease by water-borne pathogens, eu-trophication of natural water bodies, accumulation of topic or recalcitrant chemicals in the soil, destabilization of the ecological balance (Ajuzie and Osaghae 2011).

There are various effects of water pollution.

Spread of disease: Drinking polluted water can cause cholera or typhoid infections, along with diarrhea.

Affects body organs: The consumption of highly contaminated water can cause injury to the heart and kidneys.

Harms the food chain: Toxins within water can harm aquatic organisms, thus breaking a link in the food chain.

Causes algae in water: Urea, animal manure and vegetable peelings are food for algae. Algae grow according to how much waste is in a water source. Bacteria feed off the algae, decreasing the amount of oxygen in the water. The decreased oxygen causes harm to other organisms living in the water.

Flooding: The erosion of soil into waterways causes flooding, especially with heavy rainfall.

Harms animals: Birds that get into oil-contaminated water die from exposure to cold water and air due to feather damage. Other animals are affected when they eat dead fish in contaminated streams.

The effects of water pollution are not always immediate. They are not always seen at the point of contamination. They are sometimes never known by the person responsible for the pollution. However, water pollution has a huge impact on our lives. With knowledge, consideration and preparation, water pollution can be decreased.

Control measures

The best solution for water pollution is prevention. While pollution that has already occurred is a current threat to all life on Earth, attempts to clean it up may cause even more harm. Chemicals used to treat or clean up oil spills may further contaminate water supplies. Adjustments in temperature to counteract heat or cooling pollution may not achieve proper balance, leading to more loss of aquatic life. Preventing water pollution does more for the environment by halting the level of pollutants where they are. This gives the environment needed time to begin to correct itself, and time for scientists to determine the best way to combat existing problems. Treatment of the sewage is required before it can be safely buried, used or released back into local water systems (Nikolades et al. 2009). There are several steps that can be taken to help prevent water pollution from getting worse.

Conserve soil

Erosion is one of the biggest causes of water pollution today. While taking steps to conserve soil, there is also the conservation of water and water life. Planting vegetative covers, strict erosion management and implementing beneficial farming methods are just a few of the many possible approaches to soil conservation.

Dispose of toxic chemicals properly

It's always a good idea to use lower VOC (Volatile Organic Compounds) products in home whenever possible. When using toxic chemicals, such as paints, stains or cleaning supplies, dispose them properly. Paints can be recycled and oils can be reused after treatment. Proper disposal keeps these substances out of storm drains, water ways and septic tanks.

Keep machinery in good working order

Oil is one of the largest polluters of water in the world. It's estimated that just the transportation of oil is responsible for .0001 percent of oil contamination in water. Take steps to ensure you aren't adding to this problem by repairing oil leaks in cars and machinery as soon as they are spotted. Clean up the residue and dispose of the used oils properly.

Clean up beaches and waterways

Just picking up waste and litter wherever it is spotted can go a long way to keeping debris and pollutants out of the water and dispose it to a nearby disposal facility.

Avoid plastics when possible

Plastic bags in the ocean is a well documented water pollutant. Keep this problem from getting worse by changing to reusable grocery bags whenever possible.

Get active and get involved

Get involved. Contact the EPA, local authorities or write letters to the heads of companies. Spreading an awareness of problems is a big first step toward combating them.

The pollution ends up hurting nature and poisoning fish that are good for food. On a more direct approach it can even pollute drinking water. With so many bad side effects of water pollution, more research needs to be done (Fayomi and Popoola 2011). While water pollution solutions may seem like too little, too late when viewed in the light of major oil spills and floating plastic bag islands they are necessary to prevent these problems from growing worse. Simply slowing down the rate of pollution can give the environment and scientists time to find long-term solutions to the very real problems of water pollution.

References

Agarwal, A., and R. Sharma. 1982. State of India's environment: A citizen's report. Center for Science and Environment, New Delhi.

Ajuzie, C.U. and B.A. Osaghae. 2011. The bacterial and physico-chemical properties of hair salon wastewater and contaminated soil in Benin metropolis. African Journal of Biotechnology 10(11):2066-2069.

Banejad, H., and E. Olyaie. 2011. Application of an Artificial Neural Network Model to Rivers Water Quality Indexes Prediction – A Case .Study Journal of American Science 7(1).

Dogan, E.,B. Sengorur, and R. Koklu. 2009. Modeling biological oxygen demand of the Melen River in Turkey using an artificial neural network technique. Journal of Environmental Management 90:1229–1235.

Fayomi, O.S.I., and A.P.I. Popoola. 2011. Analysis of waste water with the use of activated carbon from local raw material. International Journal of the Physical Sciences 6(8):1915-1919.

Gaur, V.K., S.K. Gupta., S.D. Pandey., K. Gopal., and V. Mishra. 2002. Assessment of pollution load in sendiment/water of river Gomti with reference to heavy metals. The Academy of Environment Biology. 22nd annual session, NBFGR, Lucknow 150.

Goodland, J. 1996. Effects of Brayer oil spill on the Shetland seafood industry. Science of Total Environment 186:127-133.

Gupta, S.K., V.K. Gaur., S.D. Pandey., V. Misra., and K. Gopal. 2002. Bio- accumulation of heavy metls in fresh water molluscs *(Yiviparous bengalensis)* of river Gomti. 22nd annual session. The Academy of Environment Boilogy 189.

Gupta, S.K., R.C. Gupta., A.K. Seth., A.B. Gupta., J.K. Bassin., and A. Gupta. 2000. Methaemoglobinaemia in areas with high nitrate concentration in drinking water. National Medicional Journal of India 13 (2):58-61.

Jhingran, V.G. 1970. The problem of aquatic pollution in India. POSP Symposium on Human Environment, Bhabha Atomic Research, Mumbai 304:3-12.

Kaushik, A., S. Jain., J. Dawra., R. Sahu., and C.P. Kaushik. 2001. Heavy metal pollution of river .yamuna in the industrially developing state of Haryana (India). Indian Journal of Environment Health 43(4):164-168.

Kudesia, V.P., and S.P. Verma. 1985. Physico-chemical studies on industrial pollution of Kali Nadi due to combined effluents of can sugar, chemical industry, distillery and rubber industries in Meerut, India. Second International Conference, New Delhi, India, 50.

La Roche, G. 1972. Biological effects of short-term exposure to hazardous materials. In: Control of Hazardous Material Spills. Houston, University of Houston and Environmental Protection Agency pp 199-206

Madhusudhana Reddy, P., and N. Subba Rao. 2001. Effects of industrial effluents on the ground water regime in visakhapatnam (India). Pollution Research. 20 (3):383-386.

Mishra, S., D.S. Remteke., S.R. Wate., C.A. Moghe., and R. Sarin. 2002. Assessment of water quality in Amlakhadi receiving various industrial waste water discharges. Proceeding of National. Conference. of Pollution. Prev Contl. Nagpur (March 2-3), India. 151-157.

Murali, M., and T. Satyanarayana. 2001. A study on source of water pollution at Machilipatnam, A.P.· (India). Pollution Research 20(3):471-473.

Nikolades, E.D., M. Nits., and A. Kastalsky. 2009. Water treatment for public and Industrial supply. Journal of Environmental Science 14-16.

Pandey, K.S. 2001. An integrated pollution study of surface water sediments and ground waters of river Ramganga at Muradabad. Pollution Research. 20(4):601-608.

Pandey, P.K., and G.N. Pandey. 1980. Physico-chemical characteristics of river Ganga at Kanpur, U.P., India. Journal of Jnst of Engrs. 61:28-30.

Pandey, S., I. Ahmad, S. Parvez, B. Hafeez., R. Haque., and S. Raisuddin. 2001. Effect of Endosulfan on Antioxidants of Freshwater Fish *Channa punctatus* Bloch: 1. Protection Against Lipid Peroxidation in Liver by Copper Preexposure. Arch. Environmental Contamination Toxicology 41:345–352.

Pandey, S., and V.S. Srivastava. 2002. Heavy metal accumulation in industrial solid waste amended soils. Nature Environmental Pollution Technology 1(1):73-75.

Sharma, B.K. ed. (2007): Environmental Chemistry. GOEL Publishing House.

Sharma, D., and A. Dubey. 2011. Seasonal Study of Nutritional Status for *Microcystis Aeruginosa* and Water

Hyacianth of Water bodies of Indore, India. Annals of Biological Research 2(3):461-468.

Sharma, S.K., A.N. Tiwari., and V.P. Nawale. 2002. Impact of industrial pollution on ground water quality in kalmeshwar area, Nagpur district, Maharashtra. Proceeding of National Commission: IAEM, 2-3 March. 183-188.

Singh, B.P., and P.K. Tandon. 2010. Assessment of water quality of river Suheli and Gomti. Research of Environment Life Science 3(2):93-103.

Trivedi, R.K., and P.K. Goel. 1984. Chemical and biological methods for water pollution studies. Environmental Publishing Karad.

Trivedi, R.K., S.D. Khatavkar., A.Y. Kulkarni., and A.C. Shrotri. 1990. Ecology and pollution in the river Krishna in Maharashtra. I. General features of the river and pollution inventory. Ecology and pollution of Indian rivers (ed. R.K. Trivedi). Ashish publishing House, New Delhi.

Ubala, M.B., M. Farooqui., M.D. Arif Pathan., A. Zaheer., and D.G. Dhule. 2001. Regression analysis of ground water quality data of chikalthana industrial area, Aurangabad (Maharashtra). Oriental Journal of Cbemi. 17(2):347-348.