

A study of different aspects of water pollution

Dr. Anupam Dubey

Department of Zoology

D.B.S. Collage, Kanpur

email : dr.anupamdubey@rediffmail.com

Abstract

The survival of the human being is mainly dependent upon three resource which are quite basic in nature i.e. water, soil and air. These have been considered very valuable gift for mankind. Among these resources, water can be considered to a very important component as it could form basic medium for origin of human life. It is not only required by the human beings, rather it is important for the other living beings like animals, birds, insects and different other forms of living beings. Majority water which is said to be fresh water is not good for use and is considered to be unfit for any kind of consumption. This is a major being faced in our country today and a similar situation is being faced by people in different countries. This situation is explained by the use of references. There are different sources that could cause pollution such as industrial effluents, sewage discharge and agricultural runoff and they have mentioned in various studies. There are many categories about inland water. This paper has mentioned about potential and extent of various components which could pollute water. Water shortage that occurred in an alarming and this depends on the water balance at regional level that is controlled mainly by climate, precipitation, soil composition, altitude, vegetation cover and percolation. Different industries generating quantity of waste water which is significantly quite large which ultimately enters into streams or rivers. Industrial discharge would contain toxic and hazardous substances that contributed toward different kind of pollution in the aquatic systems. Industrial development resulted in producing different chemicals that would result towards generating toxic and hazardous substances which has been increasing in a continuous manner since last few decades.

Keywords: wastewater, industrial development, chemicals, water pollution

1.1 Introduction

Survival of human beings depend upon three basic resources like soil, air and water. These resources are considered to be very valuable gift to the mankind. Among them water is considered to be most important component among the others as it mainly forms basic medium being origin in life. There is huge demand of water and it has risen many folds during 1990 and 1995, more than doubling of rate of population growth. There are environmental issues and this came to notice at a conference which was held in U. N. at Stockholm during June 1972. There is environmental pollution and this could be projected towards the environment which is around the human beings. Concepts such as carrying capacity, sustainability and environment in earth have now been considered as a central theme based on policy making in the entire globe. There are different water resources at the global level which are studied and also explained. In the study Falkenmark (1993) have pointed out how important is pure water during the current times and also for future. Multidimensional aspect in water and has been studied in previous studies. Biological and chemical aspects as well as their interactions in the polluted water are discussed in previous work. Urban civilization require more water in comparison to rural and quality of the discharged water of urban area which is chemically quite more toxic (Bandy, 1984). A study based on chemical composition of wastewater in the city, Amritsar has been conducted by researchers wherein there is also a mention about how suitable is water for different uses. Pollution in the Chambal River at Kota has been studied by previous researchers and water has been reported to be polluted moderately at many study sites. Comparative study based on chemical characters of the surface water which exist in Tungbhadra, Krishna and Godavari has been conducted by Mitra (1982). Similarly, comparative study has been conducted among different rivers i.e. Kali, Yamuna and Ganga. Chemistry of the river Godavari has been studied in Rajamundhary by Ganpati and Chacko (1951). In a study which was carried out by Mishra (1993) have studied about management of pond having fresh water in Varanasi. Pollution in the Gandakriver at Samastipurhas been studied. In many studies, there is parallel reporting about quality of water which has been deteriorating each day. Academicians have received a warning sign about pollution and this indicates that there should be proper check of pollutions, so that water could remain usable.

1.2 Status of Groundwater

As per current scenario, there is an annual water requirement which is around 6000 to 7000 km. Groundwater reserves are globally around 70,00,000km. The amount of water which is surplus has been brought to ground annually by process of percolation and precipitation. Since last few years, based on limited rainfall and withdrawal of rainfall. Lower replenishment would led to lowering of water table. Concretization of cities is considered to be a very important factor. Hence, water shortage could occur at an alarming rate on which would depend on balancing of regional water balance, controlled largely by climate, altitude, soil composition, vegetation cover, precipitation and percolation. A conjunctive use of surface and groundwater in a judicious manner after due consideration of factors influencing water must be planned. Thus, it becomes very important to use water in a planned manner and also water should be recycled so that it does not gets wasted. It becomes very easy to explore surface water through remote sensing and aerial photography, but in case of ground water, there is a need to evaluate the ground surface. Role played by subsurface and surface geophysical and geological methods in the exploration and development of groundwater would now be globally accepted and established.

1.3 River pollution in India

In India, water pollution has reached critical point. In almost each river system in our country, there is lot of water pollution currently. Based on assessment conducted by scientists of National Environmental Engineering Research Institute (NEERI) at Nagpur, around 70% water in our country is said to be polluted (Martin, 1998). Pollution in Ganga river has been studied by many scientists. Physical and chemical characterization of same has been studied based on Mirzapur by previous researchers. Previous works culminate into common conclusion about physico-chemical property of the water in Ganga and there has been degradation in it continuously and currently it is still following same suit. There has been other studies based on bacteriological pollution which exists in Ganga River and some based on Varunariver. It was found that these reports favour presence of large amount of pathogenic as well as non-pathogenic microorganism in such a quantity which can said to be even above the excess limit. Quality of the sewage water which enters Yamuna river has been studied by few studies. There is a mention about the quality of water in the Ganga river, Yamuna River and others that the quality of water is very bad. The water in Yamuna River is even more poor as compared to river Ganga based on the biological properties.

1.4 International studies in river pollution

In India, there have been many studies which are based on cleaning of water and water quality. Comparison has been made by different researches based on the quality of water which exists in different rivers. Similar studies have been conducted in rivers which exist at the international level. A study conducted by Watelet and Johnson (1999) have indicated river quality in Raisin in Canada and study by previous researchers is based on Glatt river which exists in Switzerland. Studies have been conducted based on different rivers like river Nile (based on macrophytes), river Amazon (based on microbiological aspect), and river Rhone (based on Nutritional character). Different studies have been conducted by different researchers based on other rivers like Missouri river, Costal River and many others. Some studies of similar kind have been conducted. A study based on heavy metal analysis has been studied by previous researchers. Sometimes there is growth of macrophytes in Florida. In a similar study, in Detroit river based on Michigan has been studied by Manny et al. (1988), pollution of heavy metals have been studied in same river. Their impact has been on the biotic component which exists in river and this has been conducted by Manny and Kenaga (1991). The previous literature indicated that problem based on water pollution happens in India and even different other literature shows that this problem is not restricted only to India, but rather in different parts of the world.

1.5 Sources of pollution

There are different sources of water pollution and from these sources pollutants enter water. Out of these sources, following are considered to be quite prominent sources:

- (i) Sewage which gets discharged into river
- (ii) Industrial effluents which get discharged into river without any kind of pre-treatment
- (iii) Surface run off from the agricultural land through which pesticides, manures, insecticides and chemical fertilizers enter water

This would make river water quite unsafe for bathing and drinking. There are around 1500 substances which are listed in the form of pollutants which effect the freshwater ecosystems and some of the pollutants mentioned in this list include: alkalies and acids, anions (e.g. cyanide, sulphite, sulphide), detergents, farm manure, domestic sewage, water used for food processing, ammonia, gases chlorine, metals (lead, calcium, zinc), nutrients (nitrates, phosphates), oil and other oil dispersants, organic toxic waste (phenols,

formaldehydes), pesticides, pathogens, radionuclides and polychlorinated biphenyls, oxidizable materials etc. Domestic sewage would contain metals, detergents, pathogens, nutrients and different other forms of compound. In the current scenario, there are many factors which are used for studying about pollution. Modification in the biology based on polluted water has been explained. There are different studies which have been conducted based on the presence of nitrate and silicon in fresh water, biological character related to physico-chemical properties in various ponds. Effluents of small and large scale industries, run off the agricultural fields, city sewage, all of them are marked as a source of pollution based on the previous researches being conducted. The effect that sewage has on water quality of the Ganga River in Kanpur has been mentioned in previous studies. This same study had been repeated by some other researchers. Heavy metal in the sewage sludge was found by previous studies. There are different studies based on understanding about sewage in Ahmedabad, effect that sewage disposal have in chemistry of different water bodies. Biology about sewage has been studied by previous researchers. Pollution aspect about sewage overflow, changes in chemistry of the Chambal River which was mainly due to sewage. Chemistry about run-off water which contains animal and bird's waste have been studied.

Crude agricultural practice is considered as an important source of water pollution. Pesticides in river water have been detected. Herbicides used in agriculture were also detected in river water (Galiulin et al., 2001). The above has shown positive test for the presence of large number of pesticides and heavy metals in grains, fruits, vegetables and milk. Industries generate significant amount of wastewater that would find their way towards rivers or streams. The industrial discharge would contain hazardous and toxic substance which contribute towards severe kind of pollution in aquatic systems. The industries are being developed since chemicals are being produced and they would result in generating toxic as well as hazardous substance which would continuously increase during few decades (Table 1).

Table 1: Toxic chemical production in India (During 1960 to 1987)

Industries	Pollutants Released (Thousand tonnes)			
	1986-87	1980	1970	1960
Dykes & Pigments	-	30.85	13.55	1.15
Fertilizers	7000	3005	1059	153
Pesticides	56.20	40.68	3.00	1.46
Steel (Ingots)	9000	8000	3400	1500
Organic Chemicals Petrochemicals	42,500	24,100	17,100	580
Caustic soda	764	457	304	101
Non-ferrous metals	123.4	82.9	34.6	8.5
Pharmaceuticals		5.07	1.79	1.23

Source : GOI Publication, India, 1988-89.

Mushrooming of small and large scale industries generated larger amount of effluents. Industrial effluents can cause quite serious menace for the aquatic environment since it enters food chain. Dairy effluents are rich based on microbial population (Mohanta, 1984). Plant distribution has been affected by paper mill effluents which have been studied. There are different studies which were conducted for understanding the chemistry of Kali River which is affected by chemical and sugarcane. Industrial effluents would affect COD and BOD and this has been mentioned in the study of Gajghate and Reddy (1989). Chemistry of sugar mill effluent was studied by previous studies. Industrial waste of the pharmaceutical sector affects microbial population in the water. There are different studies which indicate sources which pollute water. There are efforts being put in for cleaning of water and the pollution would be reduced only when remedial measures are adopted and even followed later. There are many projects which are being run by the government and a lot of amount is being spent on these projects. There is a need of lot of man power, money and even precious times for finding some kind of solution to such a big problem. There are many such instances which indicate that great brains are being ignored by power.

1.6 Water quality standards

Standard of different categories of water which have been prescribed by various health agencies (Lester, 1969). Some agencies based at U.S. Public Health Service Drinking Water Standards (USPHS) (1962), World Health Organisation (1992) etc. The Standards

which are set are very essential since water quality affects health of human beings directly. Water quality standards are prescribed for the inland water by various agencies which are mentioned in table below:

Table 2: Water Quality Standards for Inland Waters Parameter	ICMR	BIS	USPHS	WHO
EC Sm-1	-	0.075	0.03	-
pH	6.5-9.2	6.5-8.5	6.0-8.5	7.0-8.5
COD mg L-1	-	<20.0	-	-
Temperature 0C	-	40.0	-	-
DO mg L-1	-	>5.0	>4.0	-
Chloride mg L-1	250	250	250	200
Sodium mg L-1	-	-	-	50
Alkalinity mg L-1 CaCo ₃	81-120	-	-	-
Sulphate mg L-1	200	150	250	200
BOD mg L-1	-	<3.0	-	-
Phosphate mg L-1	-	-	0.1	-
Total solids mg L-1	-	-	500	500
Potassium mg L-1	20	-	-	-
Nitrate mg L-1	20.0	50.0	10.0	45.0
Magnesium mg L-1	50	30	-	-
Total hardness mg L-1 CaCo ₃	300	300	500	100
Calcium mg L-1	75	75	100	75

- Not available

There are few researchers who have studied about the biological indicators to knowing more about water quality of Ganga River. Similarly there are many studies have been conducted at NagarjunSagar Reservoir, some have studied about bacterial parameters which are considered for evaluating quality of swimming pools. Beckett and Brown (1984) advocated usage of biological indicators for knowing about water quality. Qualities of various effluents which are discharged from different units would vary and standards would also vary based on nation (Ragas and Lenven, 1999). Allocating most polluted point in the river where different sources would meet transversely has been done by Li and

Morioka (1999). Development in various method of analyzing wastewater were indicated by Bansho and Miyazaki (1983).

1.7 Components of polluted water

- **Nutrient Content** –Phosphate and nitrate often exist in runoff water based on urban and rural act in the form of nutrient which exist in water bodies. Concentration of it in water, sediment and also to understand about macrophytes, studies have been considered by various researchers. Denitrifying bacteria would play a very important role in concentration of nitrogen as a medium. Biological denitrification and nitrification has also been studied. A detailed investigation about nitrogen level which exist in the lotic ecosystem has been understood.
- **Temperature** –There are few industries which discharge hot water in water bodies which might disturb aquatic ecosystem resulting in thermal pollution. These industries which could lead to thermal pollution can be power generators, nuclear powers etc., and where water is being used in the form of coolant, generally all industries are contributing towards the thermal pollution, though the extent of it might vary. Modification in the surrounding temperature would affect biodiversity of an ecosystem. Temperature could affect electrical conductance related to water that might act as prominent factor about biodiversity modification.
- **COD, DO and BOD** –When oxygen gets dissolved in water it is said to be dissolved oxygen. BOD of water sample can be referred to oxygen amount spent for the biochemical process which lasts for 5 days. COD is referred to oxygen quantity which is required for completing oxidation of all substances which have inorganic or organic origin is present in water. Relationship between COD and BOD in the river Ganga, effect of BOD directly as well as indirectly has also affected by presence of some toxic metals. DO affects sewage treatment, DO of water gets affected by turbidity that restricts solar radiations.
- **Turbidity** - Turbidity of water gets affected by SPM (Suspended Particulate Matters) which is present in water. As per the study of Mitchell and Furnas (2001) has been designed as river Logger, it is considered to be an instrument for monitoring aquatic SPM. Trace elements have been reported in SPM of different rivers which includes Yarra River in Australia. SPM could affect biotic community as has been studied by few researchers. Turbidity not affects water chemically,

rather it would reduce photosynthetic activity of water body which retards DO that would cause suffocation to aquatic life.

- **pH** -pH is negative log of H⁺ concentration which is present in sample. Specific level of pH is very important for normal survival of organisms. pH would affect enzymatic activity, hence indirectly affect elemental mobilization. pH affects plant's distribution. Study about changing phytoplanktonic composition related to lowering pH has also been conducted previously.
- **Organic Matter** –Organic and inorganic carbon could affect eutrophication that would ultimately affect chemistry of a particular river. Pollution which is caused due to spillage has been studied. Organic contaminants which are toxic in nature having agricultural origin in the water stream, organic pesticides in river of Argentina and Buenos Aires, presence of a particular organic compound which is responsible for a specific odour. There are some hydrophytes which grow in the medium based on carbon rich having capacity for absorbing inorganic carbon which is used for photosynthesis.
- **Heavy Metals** - Heavy metals exist in different industrial effluents. They are then absorbed by the hydrophytes. Such metals precipitate in sediments. There is metal content in different strata which exist in rivers. Since nutrients have absorption property in some plants, hence they were treated as the biological filters. Accumulation of Pb and Cd by the rooted aquatic plants, Cd, Tl, Hg and Pb were reported being present in lake which is nutrient rich. There is bio-accumulation of Cr and Hg. Many such studies have been conducted by few of the previous researchers.
- **Microbial Pollution** –There are different types of Microorganisms which are present deeper in sediments of oceans. Some of such microorganisms are said to be helpful in removing of nutrients from water bodies. Underground water is reported to contain some bacteria. Relationship between level of organic pollution and coliform bacteria were studied in previous studies. Coliform number is studied in the Jordan River. Reaching of various microbes even to underground water can be said to be quite alarming as majority of surface water has already been spoiled it is important that the ground water remains protected.

1.8 Water pollution and its effects

Water's chemistry and control distribution of fishes in the waterbodies has been discussed in the previous researches. Multidimensional effect which exists in environmental pollution has been studied, also about impact which bathing has on the quality of water and would affect health of different living beings. Different pollutants have different impact on living beings like human beings, animals and other living creatures. Heavy metals and macrophytes have a unique effect and even acidification has a unique effect on aquatic fauna. There are different pollutants which concentrate in sediments are highlighted in previous researches. There are various reports which indicate mortality happens due to pollution of water. Heavy metals are present in vegetables, fruits, milk and grains have indicated that nothing is pure now in entire universe. There are very harmful effect of heavy metals and it is important that they are treated carefully.

1.9 Conclusion

Based on the above discussion, it can be concluded that water pollution level has reached an alarming stage. Water quality in many parts of the world have been degraded and the situation of water in India is quite more severe. The Indian philosophers are having a belief that the thinking of people depends upon the food type they have and water which they drink. These lines are very connective as if a person ingests food as well as water, normal physiology of people would get disturbed. In a human body, there are more than 10000 enzymes and hormones and they are quite specific in the requirement as well as kinetics. In case any undesired material enters a human body, it would directly affect mechanism of enzyme or hormone activities. Generally human beings are not aware about this fact that they are consuming Aldrin, BHC, DDT and other such pesticides in addition to different varieties of heavy metals in their diet. Entry of such xenobiotics needs to be avoided. Human beings should consume only seasonal fruits and vegetables and should avoid consumption of any non-seasonal vegetables and fruits, since they require more amount of pesticides and chemical fertilizers for being developed in a season which is not suitable for their growth. It is very important that a person should ensure to avoid any such food item for consumption which involves a lot of use of pesticides and are grown in non-season.

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