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Conceptual Dimensions of Water Pollution: Special Reference to Rajasthan, India

Akshey Bhargava[1], Sabina Aysha[2], Prachi Golhar[3], Pallavi M Vishwanath[4], Preety Pandey[5] and Prablin Kaur[6]

[1]Professor, CEPT University, India

[2]Senior Environmental chemist at Qatar Geotechnical and Environment Company (QGEC) inDoha, Qatar [3]Human Health & Ecosystems, Brunel University, UK

[4]Masters in urban, Assistant Professor at Sir M V School of Architecture Bengaluru, CEPT University, India

[5]Environmental Engineering, Subharti University, India

[6]Environmental engineering, Assistant Professor at P. P. Savani University, India

*Corresponding author: Akshey Bhargava, Professor, CEPT University, India

Abstract

With the rapid growth of urbanization and industrialization coupled with social and economic needs, the pollution of water has reached a level of no return. Problem of water pollution is not limited to one area but being witnessed globally and has posed serious threat to limited water resources, human health, land, vegetation, fauna and flora, and our environment as a whole. Such a problem of water pollution becomes more critical in a region where availability of water is critically scarce like states of Rajasthan, Maharashtra and others in India and elsewhere in the world. An attempt has therefore been made by the authors of the present paper to explain briefly the sources, classification, conceptual treatment methods, disposal of waste water and a case study of highly scarce state Rajasthan, India. Such an effort would possibly educate, make aware, and make younger generation responsible to address such an alarming issue.

Keywords: Water pollution; sources; characteristics; treatment; disposal; case study; Rajasthan

Introduction

Water pollution can be defined in many ways. In simple terms it can be defined as presence of any objectionable substances in water in such objectionable quantities that it proves harmful for human, animals and other components of the environment. The widespread problem of water pollution is jeopardizing environment including human & animal health. With increasing industrialization; the sources and cause of water pollution; especially in areas of water scarcity; have also increased many folds thereby making it necessary to study the causes first in order to find the feasible solutions to rectify it. An effort has been made in this paper to throw light on various dimensions of water pollution in order to find the causes and solutions to minimize the problem and create awareness about the severity of the issue.

Sources of Water Pollutants

The major sources of water pollutants are as below:

1. Point Sources: Pollutants belonging to single source fall under this category. Point sources of water pollution are from industries, sewage works, treatment plants, hotels, hospitals, sewage from domestic households etc. These point source discharges are channelized which can be captured in a treatment system.

2. Non point sources: Water Pollution discharges from non channelized area sources come under this category. Such discharges are from agriculture fields , mining areas, waste disposal areas and predominantly occur during rainy seasons as runoff.

Various Causes Of Water Pollution

Industrial Waste

Industries produce a huge amount of waste that contains toxic chemicals and pollutants Many industries do not even have or follow a proper waste management system and release the wastes in the fresh water sources which goes into rivers, canals and later into the sea. The toxic chemicals have the capacity to change the color of water, increase the

number of minerals, also known as eutrophication, alter the temperature of water and pose a serious hazard to the water organisms.

Sewage and Wastewater

The sewage and wastewater produced by each household is chemically treated and released into the sea with fresh water. The sewage water carries harmful bacteria and chemicals that can cause serious health problems. The sewers of cities house several pathogens capable of producing harmful diseases.

Mining Activities

Mining activities emit a large amount of metal wastes and sulphides from the rocks .These elements when extracted in the raw form contain harmful chemicals and can increase the number of toxic elements when mixed up with water resulting in health problems especially to the residents in the surrounding areas.

Marine Dumping

The waste produced by each household consisting of paper, aluminum, rubber, glass, plastic, food is collected and disposed off into the natural water bodies in some countries. These items may take from two weeks to two hundred years to decompose. When such items enter the sea, they not only cause water pollution but pose a serious threat to the aquatic flora -fauna.

Accidental Oil Leakage

Oil Spills pose a huge concern for the environment as a large amount of oil when gets spilled; it keeps floating on the water surface and thereby cuts the oxygen supply resulting in life threatening conditions for the marine life as also the nearby wildlife.

The Burning of Fossil Fuels

Burning of fossil fuels like coal, oil etc. Produce a substantial amount of ash in the atmosphere. The particles containing toxic chemicals when mixed with water vapor result in acid rains. Also, carbon dioxide released from the burning of fossil fuels result in climatic changes and global warming.

Chemical Fertilizers and Pesticides

Chemical fertilizers and pesticides are used in farming activities to protect crops from insects and pests. They are useful for the overall growth of plants. However, when these chemicals get mixed up with water bodies, can pose great danger to animals and plants. Also, when the chemicals get mixed up with rain water and flow down into rivers and canals they poseserious hazard for aquatic animals.

Leakage from Sewer Lines

A small leakage from the sewer lines can contaminate the underground water and make it unfit for drinking. Also, with no timely repair on time, the leaking water can come to the surface and become a breeding ground for insects and mosquitoes.

Global Warming

An increase in earth's temperature due to greenhouse effect results in global warming. It increases the water temperature and results in the death of aquatic animals and marine species which later results in water pollution.

Radioactive Waste

Nuclear energy results from nuclear fission of fusion of radioactive elements. The element mainly used in the production of nuclear energy - Uranium is highly toxic in nature. The nuclear waste produced by radioactive material needs to be disposed of carefully to prevent any nuclear accident and environmental hazards. Few major accidents have already taken place in Russia and Japan.

Urban Development

With increasing population, the demand for housing, food, and clothing also increases. Development of cities & towns results in increasing use of fertilizers to produce more food; soil erosion due to deforestation; increase in construction activities; inadequate sewer collection and treatment, more landfills as more garbage is produced, increase in chemicals from industries result in water pollution.

Leakage from the Landfills

Landfills are nothing but a large dumping grounds consisting of piles of garbage that produce awful smell. During rains, the landfills may leak and pollute the underground water with a large variety of contaminants.

Animal Waste

The waste produced by animals can get washed away into the rivers during rains. It can get mixed up with other harmful chemicals and causes various water-borne diseases like cholera, diarrhea, jaundice, dysentery and typhoid.

Underground Storage Leakage

Transportation of coal and other petroleum products

through underground pipes is not a new phenomenon. Accidental leakage may happen anytime causing damage to the environment and result in soil erosion.Water pollutants also include both organic and inorganic factors. Organic factors include volatile organic compounds, fuels, waste from trees, plants etc. Inorganic factors include ammonia, chemical waste from factories, discarded cosmetics etc. The water that travels via fields is usually contaminated with all forms of waste including of fertilizers that get swept along the way. This infected water makes its way to natural water bodies and sometimes to the seas endangering the flora, fauna and human life that consume it along its path [1,2].

Treatment Technologies

Wastewater treatment technologies can also be designed to provide low cost with additional benefits from the reuse of water. These systems may be classified into three basic systems as shown under:

1. Mechanical treatment systems
2. Aquatic systems
3. Terrestrial systems

Mechanical treatment systems use natural processes within a constructed environment. Such systems are usually applicable where suitable lands are unavailable for the implementation of natural system technologies. However, aquatic systems are in the form of lagoons; facultative, aerated, and hydrograph controlled release (HCR) lagoons. These lagoon-based treatment systems can be provided with additional pre or post-treatments using constructed wetlands, aqua cultural production systems, and sand filtration where ever required. Terrestrial systems use the nutrients available in wastewaters which facilitates plant growth, soil adsorption, and converting biologically available nutrients into less-available forms of biomass. Such a system is used methane gas production, alcohol production, cattle feed supplements etc.

Waste water treatment methods may also be classified under following

a. Primary treatment
b. Secondary treatment
c. Tertiary treatment

Waste water treatments are categorized under Primary, Secondary and Tertiary treatments with following unit operations and processes: The schematic diagram is shown in (Figure 1) below. Waste water treatment consists of Physical, Chemical and biological methods basically

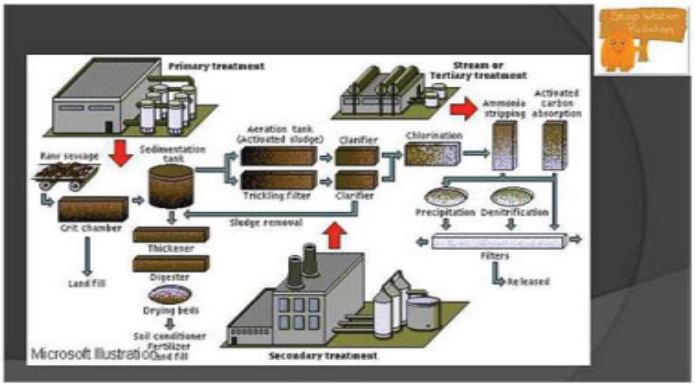

Figure 1: Showing schematic diagram of treatment systems.

used to remove the contaminants from waste water. In individual waste water treatment, procedures/ techniques are combined into variety of systems in order to achieve different levels of contaminant removal. These treatments are classified as Primary, Secondary and Tertiary waste water treatment

Primary Treatments

Primary treatment systems are used to remove suspended solids, oil and grease, floating materials, mixing of coagulants and coagulant aids, and removal of pollutants through well designed settling systems. These primary systems are usually in the form of physico- chemical treatment where inorganic impurities are removed which helps in reducing the pollution load in secondary treatment. The unit processes and operations are listed as under:

a. Screening
b. Grit chamber
c. Oil and grease trap
d. Equalization and neutralization
e. Coagulation and flocculation
f. Sedimentation tank (settling tanks or clarifier)
g. Flash mixture

Secondary Treatments

Secondary treatment is employed after primary treatment to remove organic pollutants present in the waste water. Such a system has different residence time for differ rent unit processes. The unit processes and operations used in secondary treatment are listed below

a. Activated sludge process
b. Trickling filters

c. Lagoons

d. Oxidation ponds

e. Anaerobic digestion

Tertiary Treatments

Tertiary treatment is employed as an advance treatment system to remove remaining left over organic and inorganic impurities in the waste water after primary and secondary treatment. The unit operation and processes used in tertiary treatment are listed as under

a. Chlorine (or other disinfecting compounds, or occasionally ozone or ultraviolet light)

b. RO (Reverse Osmosis)

c. Filtration

d. Desalination

e. Colloidal removal

Indian Scenario

India with a geographical area of nearly 3.3 million sq. km. experiences extremes of climate with annual rainfall varying from 100mm (in Western Rajasthan.) to over 11,000 mm (in Cherrapunji, Meghalaya). Out of total precipitation, a part goes towards ground water storage, a part is in evaporation Transpiration and remaining appears as surface water, viz., rivers, lakes, impoundments, and other inland water bodies - this surface/ground water needs resource management particularly in the light of increasing water pollution. The government of India, in the light of above, enacted following legislations and regulations to address the problem of water pollution.

a. Government of India has passed The Water (Prevention and Control of Pollution) Act, 1974 to safeguard water resources.

b. The Ganga Action Plan to save Ganga rive as launched in 1985.

c. CPCB has developed a concept of 'designated best use' in field of water quality management.

d. CPCB along with SPCB, has classified water bodies all over India according to the 'designated best uses'. This classification helps the quality managers and planners to set water quality targets

e. Setting up ' Riparian buffers' i.e. a vegetated area near a water body, usually forested, that helps to protect the water body from the impact of land uses

f. Emphasis on organic farming and use of animal residues as natural fertilizers instead of chemical fertilizers.

g. Cleaning of oil spills with help of bregoli- a byproduct of paper industry resembling saw dust, oil zapper, micro organisms

h. Emphasis on plantation of Eucalyptus trees along sewage ponds. The Eucalyptus trees absorb additional waste water rapidly and release pure water vapors into the atmosphere.

i. Release of water hyacinth to purify water to some extent by absorbing toxic materials and number of heavy metals from water

j. Government has also emphasized on techniques to control water pollution such as

1. Upflow Anaerobic Sludge Blanket (UASB)

2. Common Effluent Treatment Plant (CETP)

3. Zero Liquid Discharge (ZLD) [3]

According to reports by CPCB, there are total 816 STP's of total 23277 MLD capacity (Table 1).

Table 1: Showing Status, Number and Capacity of STP's in India.

	Status	Number of STP's.	Capacity (MLD)
1	Operational	522	18883.2
2	Non operational	79	1237.16
3	Under Construction	145	2528.36
4	Proposed	70	628.64
	Total	816	23277.36

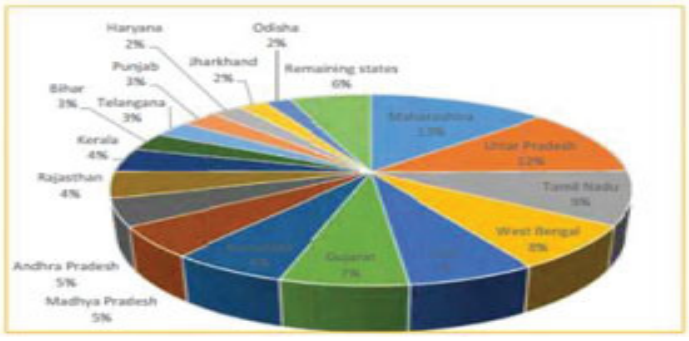

Figure 2: Percentage wise sewage generation in Indian States.

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Prefectural governments are playing very important roles in water quality management. Their responsibilities include establishing more stringent standards, inspection of specified factories &regulating effluents discharged from factories (Figure 2). They are also responsible for establishing and implementing environmental water quality monitoring programs within their jurisdictions. Besides from prefectural governments, city governments in71cities specified in the Water Pollution Control Law as "designated cities" are empowered to inspect and regulate effluent discharges of factories in their respective areas of jurisdiction [4].

a. Regulating factories based on laws and ordinances;

b. Maintaining and constructing additional sewerage lines and sewage treatment systems;

c. Purifying water in waterways;

d. Controlling pollution from new high-tech industries such as the electronic industries.

Brief Scenario of Rajasthan

The state of Rajasthan is highly water scarce. Its limited water resources coupled with extensive water pollution are being reflected here under to get an idea and visualize alarming problems [5].

Water Resources

Water is a predominant attribute for the survival of all the living organization - thus crucial to any human activity, be it social or economic. Very aptly said, water has always been a key element in any environment - hence no exaggeration that it is always a balancing factor in any ecology. Roughly 12 percent of India's geographical area falls under arid and semi-arid regions - out of which 61% is located in Rajasthan. Other states like Gujarat, Punjab/Haryana, have 20 and 9 % respectively whereas, Andhra Pradesh, Tamil Nadu and Karnataka accounted for 10% of arid regions [6].

India has a share of 16% of the world population but it was only 6% of the total annual run off of the world's rivers. Rajasthan in this context is most critical and the degree of water deficitness can be revealed by a comparative study of the following Figures: -

a. Geographical land ratio (Rajasthan/India) = 10.4%

b. Area under Cultivation (Rajasthan/India) =10.1%

c. 1991 census popular ratio (Rajasthan/India) = 5%

d. Availability of Water resources (Rajasthan/India) = 1.15%

It would thus be seen that scarcity of water resources has been proved to be the greatest constraint in the overall development of the state - thus needs resource management [7].

Water Pollution Scenario

The state of Rajasthan has significant industrialization in some areas and urbanization around all major towns contributing water pollution to a great extent. The state has textile industries in clusters at Pali, Balotra, Jasol, Jodhpur, Bhilwara, Jaipur Sanganer, Bagruetc where problem of water pollution is quite extensive and alarming, some of areas like Pali, Balotra, Jasoletc have CETP'S (Common Effluent Treatment Plants) to take care of combined effluents of these textile units. The waste water is being discharged into Luniriver which has become highly polluted [8].

Rajasthan has many big cement industries at Chittorgarh, Udaipur, Nimbaheda, Beawar, Lakheri, Abu Road, Gotanetc where lots of mining activities being carried out resulting into ground water pollution. Similarly fertilizer industries alongwith chemical, chlor-alkali industries are located mainly at Kota causing significant water pollution.

The corresponding author of the present paper had carried trend of water quality of Chambal river on the downstream side of Kota barrage in which important parameters like Dissolved Oxygen (DO), Bio-chemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were considered for a wide period ranging from 1990 onwards. The trend showed DO levels were on decreasing whereas BOD was on an increase. COD trend was found static-though reflecting marginally Increasing trend [9].

The study was also conducted in respect of waste water generation and its disposal into different river basins of the state, the details of which are reflected in (Figure 3) below.

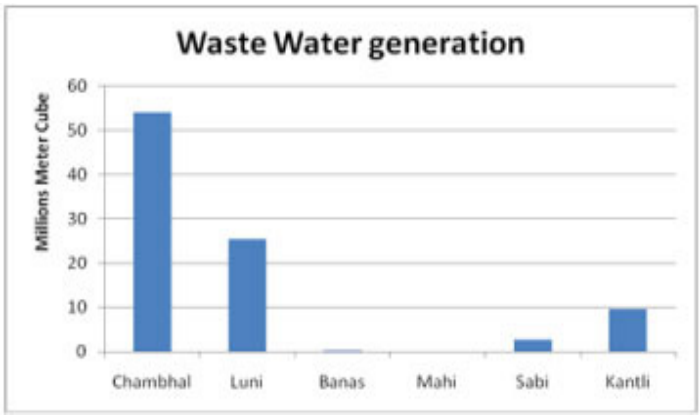

Figure 3: Waste water generation and disposal in different river basins.

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Conclusions

It is a known and emerging fact that problem of water pollution is increasing not only in India but also globally. The problem becomes more acute and critical in areas where water resources are scarce. An effort needs to be done in making aware the public about every aspects of water pollution. Continuous research needs to be taken up in regard to innovative technologies for the treatment of waste water including reuse and recycle of treated waste water. More research should be encouraged to transform waste water into usable products having focus on economic benefits. A strong data base needs to be developed to keep all such research studies at a place where new researchers can get access and make use of such studies for their extending research.

References

1. Roy Harrison (2001) Pollution: Causes, Effects, and Control. Royal Society of Chemistry, Comprehensive pp. 579-582.
2. Roy Harrison (2006) An Introduction to Pollution Science. Royal Society of Chemistry.
3. www.cpcbenvis.nic.in
4. Metcalf and Eddy, Inc., Wastewater Engineering, (3rd edn),.
5. Liu and Lipták, Wastewater Treatment, and Water Environment Federation (WEF) and American Society of Civil Engineers (ASCE)
6. Design of Municipal Wastewater Treatment plants, WEF Manual of Practice 1: 8.
7. ASCE Manual and Report on Engineering (1992) Practice No. 76 Book Press Inc, Vermont.
8. Water Environment Federation (WEF) and American Society of Civil Engineers (ASCE), Design of Municipal Wastewater Treatment Plants.
9. Liu and Lipták, Wastewater Treatment.

*Corresponding author: : Akshey Bhargava, Email: draksheyb@gmail.com

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