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The Impact of Waste on Surface Water Quality of River Pavana and River Indrayani in Pune city, Maharashtra

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Abstract

The proliferation of waste dumps in Pune city has become a growing menace to humans and natural ecosystems. This study has investigated to the effect of waste dump on river Pavana and river Indrayani. River Pavana flows from the city area and river Indrayani is situated near Pimpri Chinchwad Municipal Corporation where heavy solid waste dumping occurs in the river side of Pune City, water samples were collected from the different study sites of rivers during the summer and rainy season and following established protocols for water quality analysis. This Pavana River has served as the main source of water supply to many rural communities downstream. Data collected were analyzed using multivariate statistical techniques. The results showed that the waste dump had significant effect on the river water quality, especially during the rainy season. Some water parameters such as electrical conductivity, total dissolved solids and biological oxygen demand, recorded increased concentration levels in all seasons. The concentration levels of coliform bacteria were exceptionally high most of other water parameters correlated with the season. Ultimately, after that proper management of the dumpsite is to reduce immediate its nuisance level on the environment

Keywords*: - Pavana River and Indrayani River parameters, pollution, season, waste dump, water quality.*

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INTRODUCTION

Solid Waste is a continually growing problem at global and regional as well as at local levels. Solid wastes arise from human and animal activities that are normally discarded as useless or unwanted. Solid waste is used to describe non-liquid waste material arising from domestic, trade, commercial & public services. It comprises of countless different materials such as dust, food wastes, packaging in form of paper, metal, plastics or glass, discarded clothing, garden wastes, pathological waste, hazardous waste & radioactive waste. The problem of solid waste management in Pune has become a complex issue as a result of high population growth, accelerated urbanization and industrialization (Aguwamba 2003). It is estimated that each people of pune citygenerates about 0.85kg of waste per day totaling about 119 million tons of municipal and industrial waste perannum (Ayatomuno 2004; Cookey 2008). The problem of how to manage these wastes is reaching critical proportion. In the recent past, the present democratic government has gone extra mile to invest in the services of waste management companies especially in urban areas, which has led to quantum improvements in the level of urban cleanliness. But unfortunately solid waste dumps keep on emerging and proliferating at different parts of the urban landscape. According to the report of Urban Development Series (2014) current global MSW generation levels are approximately 1.3 billion tons per year, and are expected to increase to approximately 2.2 billion tons per year by 2025. Since the water bodies are used for agriculture & aquaculture, in addition to bathing, washing clothes, vehicles and cattle and cleaning activities by nearby residents, there is a need to evaluate the water characteristics and suggest techno-economically viable mitigation measures. In recent decades, concern has grown regarding the increasing deterioration of water quality and the related social, economic and environmental impacts. South and Central Asian countries, for example, have witnessed serious impacts on the quality of life of their growing populations and on every productive sector due to the increasingly poor quality of their water resources. It is often claimed that the main constraint to controlling water pollution in developing countries is lack of investment funds. Tortajada and Joshi (2015) analyses the legal and regulatory instruments for water quality management that have been set in place in Singapore for control of water pollution. In recent decades, concern has grown regarding the increasing deterioration of water quality and the

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related social, economic and environmental impacts. South and Central Asian countries, for example, have witnessed serious impacts on the quality of life of their growing populations and on every productive sector due to the increasingly poor quality of their water resources. Paper discusses the legal and regulatory instruments for water quality management that have been developed in Singapore at different times in history; how they have been modified taking into account the urban, commercial and industrial growth; and the role ministries and agencies, as well as their inter-coordination, have played in the effective implementation of laws and regulations. It shows how related policies, laws and regulations have had a decisive role in the overall conservation of the water resources. Venkatesan and Swaminathan (2009) studied that ground water drawn for various purposes, such as irrigation, drinking and industrial, is constantly on the rise in areas where surface water are sources nowadays scarce due to erratic rainfall and climatic conditions. Chloride and Sulphate in ground water increase due to municipal and industrial waste dumped on the ground surface. Elevated concentration of chloride (Cl) and Sulphate (SO4) in surface and ground water are common in all countries, and can serve as indicators of ground water pollution. There is an urgent need for additional solid-waste management capacity sites in many parts of developing countries. Current design, operation, closure, and post-closure activities for sanitary landfills do not guarantee sufficient public health and environmental protection of the groundwater resources near a landfill. The impact of Leachate on groundwater and other water resources have attracted a lot of attention worldwide because of its awesome environmental significance. Leachate migration from waste sites or landfills and the release of pollutants from sediment (under certain conditions) pose a high risk to groundwater resource if not adequately managed.

Water Pollution is the presence of harmful and objectionable material in water in sufficient concentrations to make it unfit for use. Water contamination weakens or destroys natural ecosystems that support human health, food production and biodiversity. Water-borne diseases kill millions people, world-wide every year. Livelihoods such as agriculture, fishing and animal husbandry are affected by poor water quality. Biodiversity, especially of freshwater ecosystems is under threat due to water pollution. There is a great need to explore the solid waste-surface water quality paradigm in environmental health

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studies with the view to developing new strategies for intervention and mitigating some easily preventable diseases. The objective of this study therefore was toinvestigate whether the closeness of a waste dump to a river in a humid tropical environment will significantly affect its water quality all through the two seasons of the year.

MATERIAL AND METHODS

Effect of solid waste dump on river water quality in Pune

In Pavana and Indrayani River result of poor waste collection system in this neighborhood with an estimated population found it most convenient to dump their waste. Due to available space along the river bank, the Pune Pimpri Chinchwad Municipal Corporation approved the site as the official dumpsite for most of solid waste collected from the municipality. Consequently, solid waste has been dumped in Moshi Dumping Yard surface area Nearly 750 tons of commingled wastes are dumped here daily. Waste components include metals (beverage cans,Ferrous materials), used papers, rags, plastics and organic materials (food remnants, dead leaves). A large quantity of decaying fruits and vegetables (oranges, tomatoes, cabbages, etc.) are dumped at the dumpsite. Other elements with toxic properties (dry lead batteries, spent oils, used carbides, paints and resins) are constantly dumped at the site and converted into Compost as these materials are dumped without any cover materials and are constantly exposed to weather and climatic conditions. During the rainy season, for example, most of these materials are washed into the river after torrential rains. Besides, the organic matter and other soluble contents in the waste dump produce leachate that easily treated and converted into water. The dump site has become a breeding ground for many birds (vultures), animals (wild pigs, antelopes), disease vectors (mosquitoes, flies, cockroaches) and rodents (rats, rabbits

Sampling, Sample Collection and Analysis:

The samples were collected and carried out during a period of Pre monsoon and post monsoon. The sample was collected from every 4 Km of distance in both water bodies The water samples were collected in high grade plastic bottles of one-liter capacity. Before collection, the plastic bottles were rinsed once with distilled water and then thrice with respective water sample. During collection, care was taken to avoid the trapping of air within the bottle by completely immersing the bottle within the respective water sample until the bottle

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is completely filled in with the water.

The sample was bought to the laboratory and the physicochemical parameters and bacteriological parameters were analyzed by following methods of WHO Standards. The Physicochemical parameters are pH, Connectivity, Dissolved Oxygen (DO), Biological Oxygen Demand (BoD), Chemical Oxygen Demand (CoD), Total Dissolved Solids (TDS), Sulphate, Nitrate, Chloride and Bacteriological parameters are Total coliform, Faecal coliform and free radical.

Pre monsoon water analysis report of River Pavana

Table 1: River Pavana pre monsoon analysis

S.No	Sampling sites	Ph	Conductivity	Do	BoD (3 days at 27 ^{0}C)	CoD	TDS	Sulphate	Nitrate	Chloride	Color	Odour
1	Site 1	7.0	1000 mhos/cm	3 mg/L	12 mg/L	10 mg/L	800 mg/L	70 mg/L	68 mg/L	220 mg/L	Little Mossy	Unobje-ctive
2	Site 2	7.1	1100 mhos/cm	5 mg/L	11 mg/L	6 mg/L	750 mg/L	65 mg/L	69 mg/L	200 mg/L	Little Mossy	Unobje-ctive
3	Site 3	7.9	850 mhos/cm	3.5 mg/L	12 mg/L	6 mg/L	800 mg/L	75 mg/L	66 mg/L	220 mg/L	Little Mossy	Unobje-ctive
4	Site 4	6.0	700 mhos/cm	3.7 mg/L	11.5 mg/L	5 mg/L	750 mg/L	70 mg/L	65 mg/L	230 mg/L	Little Mossy	Unobje-ctive
5	Site 5	7.6	1200 mhos/cm	3.9 mg/L	12.0 mg/L	7 mg/L	875 mg/L	73 mg/L	67 mg/L	180 mg/L	Little Mossy	Unobje-ctive
6	Site 6	7.8	1150 mhos/cm	4.2 mg/L	12.5 mg/L	7.5 mg/L	820 mg/L	69 mg/L	65.5 mg/L	200 mg/L	Little Mossy	Unobje-ctive

Bacteriological Analysis: In Bacteriological Analysis Total Coliform (TC), Faecal Coliform (FC), Free Radical was done.

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Table 2: River Pavana pre monsoon bacteriological analysis

S.No	Sampling Sites	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1.	Total Coliform	36	34	35	32	30	28
2.	Faecal Coliform	20	17	19	16	14	13
3.	Free Radical	Absent	Absent	Absent	Absent	Absent	Absent

Pre monsoon water analysis report of River Indrayani

Table 3: River Indrayani pre monsoon analysis

S.No	Sampling sites	Ph	Conductivity	Do	BoD (3 days at 27 ^{0}C)	CoD	TDS	Sulphate	Nitrate	Chloride	Color	Odour
1.	Site 1	6.0	850 mhos/cm	2.7 mg/L	11.6 mg/L	4.5 mg/L	670 mg/L	60 mg/L	63 mg/L	150 mg/L	Little Mossy	Smelly
2.	Site 2	6.2	750 mhos/cm	2.9 mg/L	11.3 mg/L	5.0 mg/L	680 mg/L	70 mg/L	59 mg/L	230 mg/L	Little Mossy	Smelly
3.	Site 3	6.2	670 mhos/cm	2.8 mg/L	11.1 mg/L	5.2 mg/L	680 mg/L	67 mg/L	57 mg/L	260 mg/L	Little Mossy	Smelly
4.	Site 4	6.7	700 mhos/cm	2.6 mg/L	10.5 mg/L	5.4 mg/L	700 mg/L	69 mg/L	67 mg/L	250 mg/L	Little Mossy	Smelly

Bacteriological Analysis: In Bacteriological Analysis Total Coliform (TC), Faecal Coliform (FC), Free Radical was done.

Table 4: River Pavana pre monsoon bacteriological analysis

S.No	Sampling Sites	Site 1	Site 2	Site 3	Site4
1.	Total Coliform	24	21	21	23
2.	Faecal Coliform	12	11	10	6
3.	Free Radical	Absent	Absent	Absent	Absent

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Post Monsoon Water Analysis Report or River Pavana

Table 5: River Pavana post monsoon analysis

S.No	Sampling Sites	Ph	Conductivity	Do	BoD (3 days at 27 ^{0}C)	CoD	TDS	Sulphate	Nitrate	Chloride	Color	Odour
1	Site 1	6.8	1000 mhos/cm	3.9 mg/L	11.5 mg/L	5.5 mg/L	750 mg/L	64 mg/L	75 mg/L	260 mg/L	Little Mossy	Unobje-ctive
2	Site 2	7.0	1100 mhos/cm	4.1 mg/L	12.0 mg/L	6.5 mg/L	800 mg/L	65 mg/L	73 mg/L	250 mg/L	Little Mossy	Unobje-ctive
3	Site 3	7.2	1050 mhos/cm	4.0 mg/L	12.2 mg/L	7.0 mg/L	700 mg/L	62 mg/L	68 mg/L	240 mg/L	Little Mossy	Unobje-ctive
4	Site 4	6.6	1000 mhos/cm	4.2 mg/L	12.1 mg/L	6.5 mg/L	750 mg/L	63 mg/L	65 mg/L	200 mg/L	Little Mossy	Unobje-ctive
5	Site 5	6.7	900 mhos/cm	4.0 mg/L	12.5 mg/L	6.0 mg/L	775 mg/L	65 mg/L	66 mg/L	250 mg/L	Little Mossy	Unobje-ctive
6	Site 6	6.8	850 mhos/cm	4.4 mg/L	11.5 mg/L	7.5 mg/L	800 mg/L	68 mg/L	65.0 mg/L	270 mg/L	Little Mossy	Unobje-ctive

Bacteriological Analysis- In Bacteriological Analysis Total Coliform (TC), Faecal Coliform (FC) and Free Radical are done.

Table 6: River Pavana post monsoon bacteriological analysis

S. No	Sampling Sites	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1.	Total Coliform	50	48	45	45	42	43
2.	Faecal Coliform	16	14	13	11	11	10
3.	Free Radical	Absent	Absent	Absent	Absent	Absent	Absent

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Post Monsoon Water Analysis report of River Indrayani

Table 7: River Indrayani post monsoon bacteriological analysis

S.No	Sampling sites	Ph	Conductivity	Do	BoD (3 days at 27 ^{0}C)	CoD	TDS	Sulphate	Nitrate	Chloride	Color	Odour
1	Site 1	6.0	800 mhos/cm	3.1 mg/L	11.9 mg/L	4.8 mg/L	690 mg/L	65 mg/L	58 mg/L	180 mg/L	Little Mossy	Smelly
2	Site 2	6.2	650 mhos/cm	2.8 mg/L	11.2 mg/L	5.1 mg/L	670 mg/L	67 mg/L	55 mg/L	200 mg/L	Little Mossy	Smelly
3	Site 3	6.5	690 mhos/cm	2.6 mg/L	11.0 mg/L	5.4 mg/L	660 mg/L	66 mg/L	59 mg/L	210 mg/L	Little Mossy	Smelly
4	Site 4	6.6	790 mhos/cm	2.9 mg/L	10.5 mg/L	5.6 mg/L	700 mg/L	68 mg/L	61 mg/L	220 mg/L	Little Mossy	Smelly

Bacteriological Analysis-In Bacteriological Analysis Total Coliform (TC), Faecal Coliform (FC) and Free Radical are done.

Table 8: River Indrayani post monsoon bacteriological analysis

S.No	SamplingSites	Site 1	Site 2	Site 3	Site4
1.	Total Coliform	32	34	33	32
2.	Faecal Coliform	11	13	12	10
3.	Free Radical	Absent	Absent	Absent	Absent

RESULTS AND DISCUSSION

Results from our observation show that there was increased quantity of suspended particles such as dead Leaves, plastic materials, pieces of woods etc., seen floating at sampling points specially during the post monsoon period when the river regime was at its peak effect of solid waste dump on river water quality in both rivers. There were spatial variations in the mean

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concentration levels of water quality parameters. During the pre-monsoon and post monsoon periods, values obtained showed little variations among the parameters analyzed with the exception of total hardness, calcium, chloride, Sulphate and BOD that recorded considerable increases.

CONCLUSION

This study has tried to investigate the effect of waste dump on the nearby Pavana and Indrayani River. Results show that the waste dump has significant effects on the river water quality, although the mean values of most parameters analyzed fell below WHO standards for drinking water. The most important finding was the high concentration of Coliform bacteria in the river water making it most unfit for domestic consumption. The effect of climatic factors, especially high temperature and rainfall, also contributed significantly in explaining the seasonal variations of water Quality parameters. There were more pollution loads from the waste dump during the rainy season than during the Dry season mainly because of increased leaching and run off arising from the dump. The case in point demonstrates that proper sitting of waste disposal units is an important part of environmental hygiene and needs to be integrated into total environmental planning in the country. Moreover, unsanitary disposal of waste, not only provides harborage for disease vectors, causes emission of odor and environmental nuisance, but also defaces urban habitations and particularly pollutes nearby surface water. The problem of Pavana river water quality arising from its Proximity to the waste dump may be more widespread than this study was able to recognize due to certain limitations of the study.

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