ISSN 2250-3153

Water Pollution and Public Health Issues in Kolhapur City in Maharashtra

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Abstract- Present paper is a micro level case study of Kolhapur city in Maharashtra. This study is based on secondary sources of data from different government reports, research articles from journals and books and internet sources. In this paper, an attempt has been made to understand the problem of water pollution of *panchaganga* river due to urbanization and industrialization and its impact on public health in Kolhapur city and measures to be taken to deal with this problem effectively. Researches have proved that, water pollution is one of the most leading causes of public health issues and mortality. Water pollution is the outcome of urbanization and overpopulation. Water pollution is caused due to over utilization of fertilizers by farmers, sewage from hotels, hospitals and homes and industries in the city. The polluted water of *Panchganga* has led to spread some dangerous infectious diseases like Diarrhea, jaundice, gastro and fever etc. in Kolhapur city. Therefore; there is a need of government intervention with the help of active peoples' participation.

Index Terms- Water pollution, Public Health, Case study and Government Intervention.

I. INTRODUCTION

India has been undergoing industrial revolution in a big way during the last three decades. With the recent liberalization of industrial policy, it has got a further boost. Economic conditions of the common man will improve, prosperity will prevail. This is all provability 'one side of the coin.' The other side of coin is not very bright. The industries spend solid, liquid and gaseous substances in to the environment. Unless such substances are effectively managed, our environment may get damaged irreparably. The scientific and technological advancements and mismanagement of natural resources have given rise to numerous environmental problems such as pollution of water, soil, air radiation and noise, with consequent adverse effects flora, fauna, human health and well-being (Shastri S.C. 2002, P.137).

The environment is under more sustained threat from human activity in the 21st century than at any other time in the history with extensive potential social and health consequences. Human health broadly defined, encompassing physical, mental and spiritual dimensions, is highly dependent on the context in which we live. Any threat to our environmental certainties, therefore, has a significant impact on human well-being.

In this present era of globalization has put before us some chronic public health issues due to the industrialization and urbanization. Multinational corporations (MNCs) have been spread all over the world. The environmental issues are more affecting to the urban areas than rural. Studies show that, today, the quality of health is decreasing due to global warming, climate change and pollution. The industrialization has produced the challenge of water pollution and it is affecting the public health at large.

II. REVIEW OF RELEVANT LITERATURE

Water sustains life. An adequate supply of fresh water is needed for domestic as well as industrial processes. Water bodies have become both resources for fresh water and receptacles for domestic and industrial wastes leading to "water pollution". According to Chapman (1996:6), "Pollution of the aquatic environment refers to the introduction by man, directly or indirectly, of substances or energy which results in such deleterious effects as harm to living resources, hazards to human health, hindrance to aquatic activities including fishing, impairment of water quality with respect to its use in agricultural, industrial and often economic activities, and reduction of amenities.

Water pollution affects water quality. Water quality refers to the overall quality of the aquatic environment (Chapman, 1996). The description of the quality of the aquatic environment can be carried out through a variety of ways. It can be achieved through quantitative measurements such as physico-chemical determinations (in the water, particulate material, or biological tissues) and biochemical/biological tests (BOD 16 measurement, toxicity tests) or through semi-quantitative and qualitative descriptions such as biotic indices, visual aspects, species inventories, odor, etc. These determinants are carried out in the field and in the laboratory and produce various types of data which lend themselves to different techniques (Chapman, 1996:7). The quality of freshwater at any point on a landscape reflects the combined effects of many processes along water pathways and both quantity and quality of water are affected by human activity on all spatial scales (Peters and Meybeck, 2000).
The Yamuna River in New Delhi had 7,500 coliform bacteria per 100 ml (thirty-seven times the level considered safe for swimming in the United States) before entering the city. The coliform count increased to 24 million cells per 100 ml as the river picked 20 million liters of industrial effluents every day from New Delhi. Mortality rates were thus high and life expectancy low in those areas (Cunningham and Saigo, 1999).
Man's health to a large extent is dependent on access to clean potable water. Unfortunately, not everyone on the planet has access to this precious resource. Some persons have access to water but such water is polluted. Polluted water could be a carrier of many diseases and when it is ingested into the human system, it could have negative implications for human health. Persons

who use polluted water are in danger of contracting water-borne, water-hygiene, and water-contact or water-habitat vector diseases. Water borne infectious diseases are those in which the pathogen is present in water and ingested when the water is consumed.

Water-habitat vector diseases are transmitted by insect vectors that spend all or part of their lives in or near water. Examples include malaria and filariasis as well as onchocerciasis which has the aquatic fly as its vector (Bartram and Balance, 1996). According to UNDP estimates, more than 1 billion people are denied the right to clean water and 2.6 billion people lack access to adequate sanitation (UNDP, 2006: v). In Sub-Saharan Africa, it is estimated that 42 per cent of the population is without improved 27 water (WHO, 2004:2). The absence of improved water sources puts people's health at risk and may force them to extract water from alternative, unsafe sources, exposing them to diseases such as diarrhea, dysentery, cholera, typhoid and schistosomiasis (WHO, 2001). The WHO estimates that as many as 80 percent of all infectious diseases in the world are associated with insufficient and unsafe water (Smet and Van Wijk, 2002: 16). Furthermore in less developed countries (LDCs), it is estimated that 25 million people per year die from contaminated water; three-fifth of whom are children and worldwide, every hour 1,000 children die from diarrhea related diseases (Kaufman and Franz, 1996).

According to Wolff (1999), when significant improvements in the quality and quantity of water are made in less developed countries, there would be about 2 million fewer deaths from diarrhea among children. In addition, research showed that access to safe water reduced child death rates by more than 20 percent in Cameroon and Uganda whilst in Egypt and Peru, the presence of flush toilets in the house reduced the risk of infant death by more the 30 percent (UNDP, 2006).

It has been estimated that 50,000 people die daily world-wide as a result of water-related diseases (Nevondo and Cloete 1999). A large number of people in developing countries lack access to adequate water supply. In South Africa, it has been estimated that more than 12 million people do not have access to an adequate supply of potable water (Nevondo and Cloete 1999). Polluted water also contains viruses, bacteria, intestinal parasites and other harmful microorganisms, which can cause waterbornediseases such as diarrhea, dysentery, and typhoid. Due to water pollution, the entire ecosystem gets disturbed. Unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated 4 billion cases of diarrhoeal disease annually, causing more than 1.5 million deaths, mostly among children under 5 years of age (WHO 2005). Contaminated drinking water is also a major source of hepatitis, typhoid and opportunistic infections that attack the immuno-compromised, especially persons living with HIV/AIDS (UNICEF 2011). Almost 1 billion people lack access to safe and improved water supply. More than 50 countries still report cholera to WHO (World Health Organization). Millions are exposed to unsafe levels of naturally occurring arsenic and fluoride in drinking water which leads to cancer and tooth/skeletal damage. An estimated 260 million people are infected with schistosomiasis (WHO 2004).

III. Objectives of the Study

1. To understand the connection between water pollution and public health.
2. To discuss how polluted water of *Panchaganga* is affecting the public health in Kolhapur city.

IV. Methodology

This study is a case study of Kolhapur city. It is a micro level study. Kolhapur city is located at 16° 42' N and 74° 14' E, having mean sea level of 570 m, stands on rising ground on the south bank of the river Panchaganga. The river Bhogawati is renamed as Panchaganga from Prayag Chikhali, after the confluence with 5 rivers namely Kumbhi, Kasari, Tulshi, Dhamani and Bhogawati. The river flows towards south-north side and meets river Krishna at Narsinhwadi, Tal: Shirol, Dist: Kolhapur. The entire catchment area of Panchaganga river lies in Kolhapur district *(Study Report on Panchaganga River)*.

Kolhapur city is subjected to recurring outbreaks of water borne diseases and epidemics like, hepatitis and gastrointestinal diseases. This is due to the fact that pollution of Panchaganga river is one of the most important and burning problem till date. Panchaganga river gets polluted by the discharge of the municipal and industrial wastewater through various nallahs viz. Jayanti nallah (49 MLD), Dudhali nallah (17 MLD), Bapat Camp nallah (10 MLD) and Line Bazaar nallah (6 MLD). There is no underground drainage in the city and drainage is mainly by surface drains. The drains are let into the Jayanti nallah and the Panchaganga river. Municipal water supply to Kolhapur city is through two sources viz, Balinga water works having a capacity of 41 MLD and Kasaba Bawada water works with a capacity of 36 MLD. This supply is augmented by 2

MLD from Kalamba water works as well as from ground water supply through private bore wells. Consequently residents of Kolhapur city are anguished by the constant threat of outbreaks of epidemics *(MPCB Report; 2005-06)*. Thus it is worthwhile to assess the quality of the Panchaganga river water to study its possible environmental impacts.

The present paper is entirely depending on secondary sources of data which have been collected from various reports of the government apart from that; books, journals and internet were also used. The researcher has used recent data from various studies on this issue.

V. Water Pollution and Public Health Issues

It is estimated that 75 to 80% of water pollution by volume is caused by domestic sewage. The remaining is industrial wastewater, which could be more toxic. The major industries causing water pollution include: distilleries, sugar, textile, electroplating, pesticides, pharmaceuticals, pulp & paper mills, tanneries, dyes and dye intermediates, petro-chemicals, steel plants etc. Nonpoint pollution sources such as fertilizer and pesticide run-offs in rural areas from the agricultural fields are also emerging as a major cause of concern. Only 60% of chemical fertilizers is utilized in soils and the balance is leached into soil polluting ground water. Excess phosphate run-off is leading to eutrophication in lakes and water bodies. Adverse

health outcomes are associated with ingestion of contaminated water, lack of access to sanitation, contact with unsafe water, and inadequate management of water resources and systems including in agriculture. Infectious diarrhea makes the largest single contribution to the burden of disease associated with unsafe water, sanitation and hygiene. Besides, the water borne diseases like cholera, jaundice and other gastrointestinal track infections are quite significant amongst the population. Certain diseases have also been encountered amongst the affected persons coming in contact with toxic effluent discharged in the water bodies by highly polluting industries.

'Water pollution is any chemicals, physical or biological that changes the quality of water and has harmful effects on any living organism that uses it.' It often has serious effects on public health.

The microorganism which is responsible for disease is known as a pathogen and the infected organism e.g. human being is called as host. Some pathogens like in the environment and are transmitted to humans directly. Pathogens are highly sensitive to their environment. There are two main reasons for this. First, their ability to survive and multiply depends on the availability of right climate and nutritional conditions; second, to cause new infections, local conditions must facilitate pathogen's spread to a susceptible host. Divert environmental factors, such as ambient climate and the presence or absence of overcrowding, clean water influence a pathogen's chances of flourishing and causing disease. Some pathogens thrive in warm and wet climates, while others only survive almost anywhere. Thus, some pathogens cause disease worldwide, while others are only found in well-defined areas where the local environment is favorable to their propagation. For example jaundice, gastro, malaria caused pathogens can thrive in polluted water. So, water pollution can affect public health.

Urbanization, Water Pollution and Public Health:

Urban population (285 million) constituted 27.8% of the total population in 2001in India. Even at this relatively low level of urbanization, India still has the second largest urban population in the world. The Census of India has estimated that by 2026, urban population would rise to around 535 million or 38.2 percent of the total population. This means an addition of 250 million persons or near doubling of urban population in about two decades from now with reference to 2001. Similarly, the Mckinsey Global Institute projects that that India's urban population will be 590 million by 2030 which would be about 40 percent of the total population of the country and further estimates that by 2030, the number of million plus cities will increase to 68 of which 13 cities will have more than 4 million and six cities will have more than 10 million persons. By 2050, it is estimated that urban population will constitute nearly half of the total population in India.

The 65th round of the NSS reports that 11% of households had no latrines.

This implies that nearly three core people in urban areas defecate in open. 8% were using pit latrines and 77 percent of urban households were using either septic tanks or flush latrines. Further, according to 2001 Census, less than two-third of the urban households were connected to sewer system. The status in respect of treatment of sewage is worse. **As per CPCB report of 2009, treatment capacity installed was only 30%. The actual treatment was estimated at 72.2 % in 2008 which implies that only about 20% sewage generated was treated before disposal** in Class I cities and Class II towns (as per 2001 census). As per CPCB report brought out in 2005, about 1, 15,000 MT of Municipal Solid Waste is generated daily in the country. However, scientific disposal of the waste generated is almost non-existent.

Urbanization can affect infectious diseases positively or negatively. Overcrowding, poor housing, inadequate sanitation solid waste removal and unsafe drinking water are the causes of urban health problems. One quarter of the population living in urban area in developing world is vulnerable to diseases (WHO/UNICEF 2000).

***Panchaganga* River Pollution and Public Health Issues in Kolhapur City:**

Report on panchganga river pollution 2009:

1. *Panchaganga* is one of the most polluted rivers in the world.
2. Every day 90 million liters/day waste water produce in Kolhapur.
3. It's capacity is only 25 million liters/day
4. The present drainage system is 30 years old and should be modified.
5. Industrial waste water, *jayanti* and *dudhali* nails, domestic waste water are the main sources of the *panchaganga* river pollution.
6. Due to huge amount of waste water KMC got 131 time notices.
7. 165 metric ton/day solid waste produce.
8. These solid waste directly go to the river because there is no solid waste management facility properly working at present in the city.
9. Besides *panchaganga* river eight MIDCs, seven sugar factories and 174 gram panchayat villages produce waste water which goes to the river.
10. The causes of *panchganga* river pollution are industrial waste water, domestic waste water, solid waste, over utilization of fertilizers, hospitals and small businesses like hotels.

Kolhapur is blessed with the presence of *Panchaganga* river travelling along the city. However, water quality and quantity in the river is more cause of concern than pride.

The river is getting polluted due to:

i) Mixing of untreated domestic sewage
ii) Disposal of industrial effluent
iii) Biomedical Sewage
iv) Agrochemicals used in the field
v) Mixing of Crematorium ash
vi) Religious activities
vii) Other sources like Hotels, Restaurants, etc.

Discharge of large amount of untreated domestic sewage from the city :

The river is getting polluted due to discharge of large amount of sewage carried out by four major sewers in the city such as Jayanti nullah, Dudhali nullah, Line Bazaar nullah and

Bapat Camp nullah. Since most of the sewage is untreated, it increases the organic load of the river water. The river water becomes highly polluted due to toxicants, bacterial contamination, plastic litters, solid waste, etc.

Panchaganga River	Total Population of Kolhapur city (2001 Census)	Water Usage (per day)	Waste water without treatment (per day)
	4.93 lakhs	120 Million Liters	100 Million Liters

(Panchganga Basin Pollution study MPCB report, 2009)

Disposal of industrial effluent

Panchaganga River Basin	Total No. of Industries	Total waste water without treatment
	2953	18.59302 Million Liter per day

The industrial effluent coming from different small industrial units, foundries spray painting units in Udyamnagar and Tanneries from Jawahar Nagar alters the quality of river water. The ground water quality also changes due to the industrial effluent.

Sewage from different hospitals, pathological laboratories:

There are total 498 hospitals and dispensaries (governmental, semi-governmental and private) and 31 pathological laboratories in Kolhapur city. Only one hospital i.e. Chhtrapati. Pramilaraje Hospital is planning for STP whereas none of the hospitals in Kolhapur city treat its waste water. The untreated sewage about 1,00,000 liters per day mixes in to the river through nullahs which is highly dangerous to the riverine ecosystem.

Effluent from other sources:

There are about 49 servicing stations in the city which generates 49,000 liters of waste water. The quality of water alters due to oil and grease content, various petrochemicals colors, etc. The waste water coming from slaughter houses and fish markets are having high organic load which is directly discharged into the nearby sewer which finally ends into the river through nullahs. The sources like hotels, restaurants, hawkers, etc. also contribute for water pollution.

Other sources of river pollution:

Sources	**Total No.**	**Total amount of waste generated**
Servicing Stations	41	2,00,000 liters/ day
Hotels, restaurants and hawkers	1044	1,49,400 liters / day
Slaughter houses waste	02	800 Kg / day
Meat shops and fish markets waste	76	1000 Kg / day

Agrochemicals used in the field:

Large quantities of agrochemicals are used in the agricultural sector in the upstream as well as in surrounding areas of the river. The residues of these chemicals mix in to the river due to excess use, flooding, heavy rainfall, excess irrigation, etc. Many pesticides and chemicals when dissolved in the river water enter in the food chain. Studies have shown that many vegetables and fruits contain harmful residue of agrochemicals.

Sr. No.	**Type of agrochemical**	**Solid state (per year)**	**Liquid State (per year)**
1	Chemical fertilizers	78,244 Tones	------
2	Pesticides	1,41,764 Tones	22,068 liters
3	Weedicides	34,995 Tones	21,664 liters
4	Fungicides	6771 Tones	1828 liters

Crematorium ash:

Crematorium ash is becoming one of the reasons of water pollution. There are about four crematorium sites present in the city. Each year approximately 130 tones of crematorium ash pollutes the river water. The crematorium which is most affecting the quality of river water is Vaishvadham Crematorium located near Prince Shivaji Bridge and Bapat Camp crematorium. After burning of the dead bodies, as a ritual, the ash is disposed in the river water, which forms a layer on water surface. It traps the sunlight and prevents mixing of oxygen into the water. There is change in the physicochemical parameters of the water body. The amount of total solids, total dissolved solids, toxic heavy metals, phosphate and nitrate level increases. At the same time, amount of dissolved oxygen decreases. The aquatic ecosystem gets harmed as well as water becomes unsuitable for drinking purpose. The downstream areas of the river also get affected as well as the aesthetic beauty of the site decreases.

Religious activities:

Various religious activities during festivals produce solid waste in the form of nirmalya and idols. The idols made up of Plaster of Paris changes the physicochemical composition of water body. There are 12 sites in the city where the Nirmanlya and idols are disposed.

Sr. No.	**Components Amount per year**	**Amount per90 Tones**
1	Nirmalya	90 Tones
2	Idols (domestic)	27000
3	Idols (Sarvajanik)	600

The idols are made up of Plaster of Paris or Shadoo and coloured with chemicals. When these idols immersed in water the chemicals dissolve in water body altering water quality. The

paints are having heavy metals such as copper, zinc, lead, chromium and iron. The other constituents of the idol like bamboo, flowers, cotton, clothes and other pollutants such as eatables like prasad, coir, plastic, etc increase the nutrients in the lake and lead to eutrophication. The water column is disturbed completely during idol immersion.

Discharge of nullahs in the river basin:

There are four nullahs in the city viz. Jayanti Nullah, Dudhali Nullah, Line Bazaar nullah and Bapat Camp Nullah. Jayanti nullah starts flowing from eastern part of the city. During its course through the heart of the city, it receives waste water from tanneries from Jawahar Nagar, domestic waste from the city, effluent from fabrication units, spray painting units and foundries from Udyamnagar. Jayanti nullah basin covers 2357 ha of the city.

Patients suffering from waterborne diseases:

Year	Jaundice	Diarrhea	Dysentery	Gastro	other
2005-06	146	221	48	223	15
2006-07	85	298	84	132	23
2007-08	103	320	94	51	10
2008-09	139	241	79	79	7
Total	473	1090	305	485	55

[Source- Isolation Hospi., Kop., Apr-2006 to Apr-2009]

Water Treatment Plants:

At present water is supplied to Kolhapur city through water treatment plants:-

Kolhapur Municipal Corporation has provided four water treatment plants for serving potable and safe drinking water to the citizens. These are namely; Kalamba water treatment plant, Puikhadi water treatment plant, Bawda water treatment plant and Balinga water treatment plant.

• **Kalamba water treatment plant: -** It is the oldest water treatment plant and started in pre independence days. An earthen dam about 4300 ft. long and 27 ft. high was constructed during 1881- 83 on the southern side of the city. The treatment plant is of 8 MLD capacity. The water of the Kalamba tank is pure and wholesome and is filtered and chlorinated. Kalamba water is available only to a portion of the city i.e to B ward .

• **Puikhadi water treatment plant: -** This treatment plant is located at Puikhadi, 14 km. away from the Shingnapur pumping station. This plant is recent plant established by KMC and started functioning in the year 2001. The capacity of this plant is 50 MLD.

• **Bawada water treatment plant: -** This water works is commissioned in the year 1978. It is located 5 km away from Bawada pumping station. Initially the treated water from this plant was served to E ward and to 6 villages of eastern outskirts of city. The capacity of this plant is 36 MLD and presently this supplies water to E ward only.

• **Balinga water treatment plant:-** This water works commissioned in the year 1949 with the capacity of 10.90 MLD which was increased by providing augmentation schemes. Now the total capacity of this plant is 41 MLD and the source of the water from Bhogawati river.

Analysis report of Water Treatment Plants (WTP) of Kolhapur city

Parameter	Kalamba WTP		Puikhadi WTP		Bawada WTP		Balinga WTP		WHO standards
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
pH	7.78	7.74	7.31	7.36	7.2	7.08	7.02	7.10	6.5-8.5
Turbidity (NTU)	20.3	4.4	21.6	4.6	26.6	4.3	24.31	4.9	5-25
Hardness	154	124	76	60	68	52	84	60	100-500
Chloride	25.7	17.04	25.56	20.1	51.12	30.1	48.2	19.22	20-500
TDS	200	110	245	135	505	100	400	100	500-1000
MPN	1600>	nil	1600>	nil	1600>	nil	1600>	nil	0/100 ml

(Dept. of Environmental Science, SUK) (All the parameters except pH, MPN and turbidity are expressed in mg/l)

The results of the treated drinking water in the WTP are within the standard limits but further analysis of piped water shows presence of coli form bacteria due to leakages in the system.

VI. Conclusion

Increased developmental activities due to urbanization and industrialization are greatly responsible for water pollution in Kolhapur city. There are many causes of water pollution such as sewage disposal, excess use of agrochemicals in the field,

discharge of industrial effluents without treatment, disposal of urban solid waste, agricultural runoffs etc. The polluted water of *panchaganga* is creating some serious public health issues in the city. Kolhapur city is one of the developed cities in the state Maharashtra. Thousands of people are coming to Kolhapur for seeking employment from across the India. The industrial sector is growing very rapidly. This city is also characterized as a famous religious place; therefore plenty of pilgrims visit it every year. The population of this city is increasing so fast due to educational facilities, employment and service. Today and probably in the future; due to the rapid growth in population, urbanization and industrialization; public health issues will be a great challenge before the planners, administrators and politicians. The river as a drinking source is becoming polluted and the capacity of treatment plants is not enough to stop the pollution and reduce the damage on public health. The capacity of these plants needs to be increased. Therefore; there is a need to wake up as early as possible to be prepared to tackle the growing issue of water pollution to promote public health. There is a need of government intervention with active peoples' participation.

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