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Finding the Causes of Water Pollution in Ghats of Varanasi City

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Abstract - *Water quality deterioration has serious implications for the supply of water for drinking, irrigation, industrial use, and is important determinant of public health. One of the most important and holiest rivers in the world, the Ganga has now become highly polluted because of increasing number of anthropogenic activities. Nearly all kinds of wastes coming out of Varanasi, from sewage inflow, industrial waste, animal carcasses, unclaimed human dead bodies, and nearly all other kind of biodegradable as well as non-biodegradable wastes is being dumped in the Ganga river. This paper observes the negative effects of liquid waste disposal, untreated sewer water and cremation ground (Manikarkna Ghat) of Varanasi city. According to numerous studies that has been done on environmental degradation issues, cremation activity is recorded to have one of the biggest impacts on the environment in Varanasi. It affects environment, human health and economy of the country. The river Ganga, along whose bank the city rose has been constantly at a risk of endangering level of pollution from sewage or as a result of cremation. Thus it emerges as a great concern to save and clean the river Ganga along with the Ghats in its vicinity.*

Index Terms- **Environmental degradation, Contamination of water bodies, Sewage water, Ganga river pollution, Cremation activities, and Religious traditions**

1 INTRODUCTION

The WHO's database of more than 4,300 cities showed Indian cities such as New Delhi, Varanasi and Patna were among the most polluted, based on the amount of particulate matter under 2.5 micrograms found in every cubic meter of air.

Varanasi is one of the most prestigious pilgrimagse for Hindus. Varanasi's "Old City," the quarter near the banks of Ganga, has crowded narrow winding lanes that are flanked by roadside shops and scores of Hindu temples. Varanasi's labyrinthine Old City is rich with culture, and can deservedly be called the heritage city with its 84 ghats along the river Ganga.

Varanasi grew as an important industrial center, famous for its muslin and silk fabrics, perfumes, ivory works, and sculpture.

2 NEED OF THE STUDY

S. No.	Particular	Details
1	Key Economic Drivers of Varanasi City	Tourism, cotton textile, woollen, silk, and artificial thread based clothes and engineering units
2	Total Population (2011)	1,201,198 persons
3	Floating population (if any, in case of tourist cities)	30,000 per day*
4	Total Slum Population	407,036 persons
5	Area of the Urban Local Body	82.10 sq km
6	Density	14,656 persons per sq km
**Varanasi as Heritage City (India) on the Scale the UNESCO World Heritage List: From Contestation to Conservation*		

The environmental degradation and water pollution near the Ghats of Varanasi are majorly caused by increasing number of anthropogenic activities, disposal of sewage water with higher organic load, Industrial contamination etc. which are directly related with increase in population density.

2.1 Water Supply System- Water supply system for Varanasi is as old as 100 years when it was introduced in year 1892, designed for a population of 2 lakhs. With increase in population and corresponding water demand of the city, capacities of different units were increased from time to time in stages along with reorganization and extension of distribution system to make equitable distribution of supply and to meet the demand in different zones.

2.2 Sewer System and Storm water Some of the problems identified regarding the existing sewerage system is that it is not adequate with 68% area of the city uncovered with sewer system with the existing sewer network catering primarily to the old city, comprising

mainly of the ghat area. Entire trans-Varuna and nearly 50% part of cis-Varuna area is un-sewered. This leads to discharge of untreated sewage in open drains polluting the Ganga and Varuna, resulting in frequent clogging of sewerage system facilitated by combined sewer and storm water drainage (The underground drainage network is only 117 km long. Another 72 km is being laid under JNNURM) and waste dumps, especially during monsoons.

2.3 Religious Tradition- 70 million people bathe in the Ganges to clean themselves from their presumed past sins. More than 40 thousand bodies are cremated."As per 2015 data from Central Pollution Control Board (CPCB), Varanasi did not record a single day of good air quality in the more than 220 days that measurements were taken"

3. STATE OF WATER POLLUTION IN VARANASI

The contamination of water bodies (lakes, rivers, oceans, aquifers and groundwater)occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds.

3.1 Major source of water pollution

About a wide range of wastes coming out of Varanasi, from sewage inflow, industrial waste, animal carcasses, unclaimed human dead bodies, Temple Waste dumped into river and nearly all other kind of biodegradable as well as non-biodegradable wastes is being dumped in the Ganga river. The river Ganga, along whose bank the city rose, is being constantly at a risk of endangering level of pollution from sewage or as a result of cremation.

Water quality parameters
The water quality parameters studied are temperature, pH, conductivity, dissolved oxygen (DO), biochemical oxygen demand (BOD), nitrate, nitrite, total coli forms (TC), and faecal coli forms (FC) (as per Varanasi CPCB).

3.2 Industrial areas: Currently, industrial areas such as Ramnagar and Chandpur have a drainage network. It was designed decades ago and is largely choked. The drainage condition in these industrial areas is poor; most of the drains are open and these areas often face flooding situation during monsoons. Tanneries, chemical plants, textile mills, distilleries and slaughterhouses discharge untreated liquid waste into the river through open drains and canals.

The industrial network does not have a CETP (common effluent treatment plant), therefore the effluents generated by the industries go into the sewerage network without treatment resulting in increased water pollution. Water users are exposed to this pollution and face a high risk of waterborne diseases.

3.3 Sewerage
Currently, the sewerage network covers only 32% of the city, which means that the remaining households are either connected through septic tanks, pits, or service latrines or do not have access to toilets. 18% of the total households do not have access to independent, shared, or community toilets.
In the slums, 52,457 dwelling units have toilets. In addition, there are 99 community toilets, which have 1,134 toilet seats. The city is estimated to generate 225 MLD (Million liters per day) sewerage and has capacity to treat only 101.8 MLD of sewerage.

3.4 Storm water drainage

Most of the drains have been connected to branch sewers, which leads to the mixing of sewage with storm water. This increases the load on the sewage pumps and the STPs, especially during the monsoons.

1. The existing drainage network is grossly inadequate.
2. Frequent clogging of drains due to dumping of solid waste in the drains reduces its rainwater carrying capacity.
3. Urbanization has reduced the natural drainage capacity of the various water bodies in the city.
4. As the drains are connected to branch sewer lines, it puts strain on the STPs during the monsoon season.
5. *Source: MoUD Rapid Baseline Assessment - Varanasi City – Draft Report*

3.5 Religious tradition

The Swachcha Ganga Research Laboratory in Varanasi, which conducts regular water quality tests, found that faecal coliform counts (FCC) range between 16,000 to 60,000 mpn per 100 ml of water from the bathing ghats, which far exceeds the permissible limit (limit for bathing is 500 mpn per 100 ml as stipulated by the CPCB). Similarly, biological oxygen demand (BOD) values are much higher (4.4 to 7.6 mg/l) than the water quality standard of less than 3 mg/l for bathing

4. GANGA WATER QUALITY DATA
Ganga Water Quality Along the Ghats of Varanasi

Ganga Water Quality on 19/06/2017

Parameters	**Nagwa**	**Narayan Ghat**	**Aghoreshwar Ghat**	**Samne Ghat**
Temp. Air	38	38	38	38
Temp. Water	31	31	31	31

D O (mg/l)	2.8	7.0	7.2	7.0
BOD (mg/l)	42.0	4.0	4.4	5.2
FCC/100 ml	4100000	26000	30000	41000

Source: Sankat Mochan Foundaation website

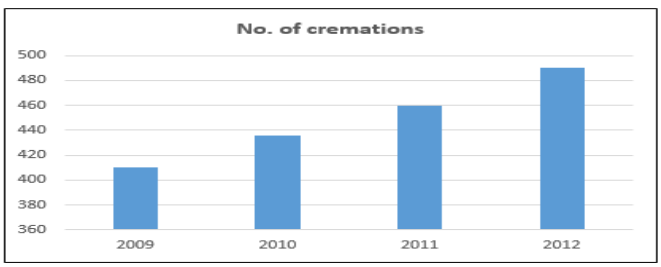
Pollutants in Ganga River

Categories	Nature	Examples
Physical	Temperature, Turbidity colour, suspended & floating matter	Waste, heat from industries, dyes & pigments. Silt, metal pieces, plastic, rubber, wood chips, paper, foam, sewage etc.
Chemical	Organic	Synthetic detergents, plastic, fertilizers, organic effluents from industries etc.
	Inorganic	Nitrates, Phosphates, Chlorides, Fluorides, trace elements etc.
Biological	Pathogenic	Bacteria, fungi, virus, worms etc.

5. MANIKARNIKA GHAT

The Manikarnika Ghat is the Mahasmasana (great cremation ground), which is followed by raised platforms that are used for death anniversary rituals. Myth- There is Tarakesvara Temple (Shiva temple at the Ghat), which says that Lord Shiva whispers the Taraka mantra (Prayer of the crossing) in the ear of the dead for which the dead gets moksha. Due to this reason dead bodies are used to burn here. According to the Hindu mythology, if cremated here provides an instant gateway to liberation from the cycle of births and rebirths.

Manikarnka Ghat is located in Varanasi city, in the Indian state of Uttar Pradesh along the bank of River Ganga. The environmental degradation and water pollution near Manikarnka Ghat is caused by increasing number of anthropogenic activities suchno proper arrangements for the disposal of solid wastes which even include garbage, unclaimed human dead bodies, half-burnt bodies, plastic bag andanimal carcasses.



Bar Diagrams Showing the Annual Variation in Number of Cremations at Manikarnika in 2012, 2011, 2010 and 2009 Year wise Data by Courtesy-Varanasi Nagar Nigam.

Comparison of water quality near Manikarnika Ghat with standards

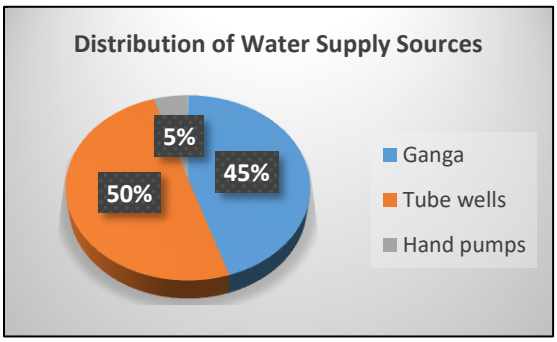
Manikarnika Ghat			
Percentage Violation	Existing scenario mg/l	Desirable Limit mg/l	Permissible limit mg/l
Chloride	1006	250	1000
T.D.S	1022	500	1000
Nitrate	100	45	100
Fluoride	2.3	1	1.5
Alkalinity	625	200	600
Dissolved Solids	2500	500	2000

Parameters	Standards	Existing Scenario
Ph Level	6.5-8.5	7.9
Total Dissolved Solids (TDS)	500	283 mg/l
Total Suspended Solids (TSS)	38mg/l	67 mg/l
Dissolved Oxygen (DO)	Less than 6	7.43 mg/l
Biochemical Oxygen Demand (BOD)	Greater than 2	5.86 mg/l
Chemical Oxygen Demand (COD)	10 mg/l	7.84 mg/l
Hardness		273 mg/l
Alkalinity	200 to 600 mg/l	194 mg/l
Turbidity	1 to 5 NTU	13.45 NTU
Chloride	250 to 1000 mg/l	142 mg/l

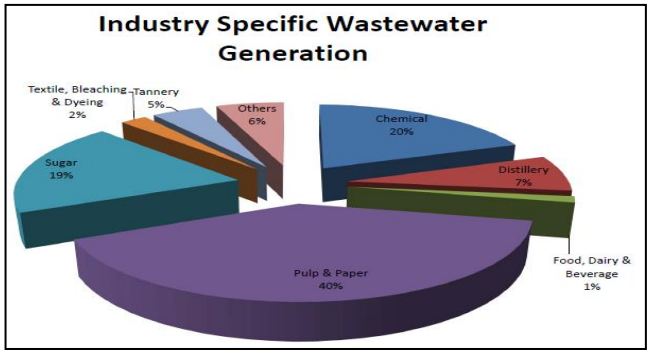
5.1 Causes of Water Pollution near Manikarnika Ghat

Ashes of dead bodies consist of bone, enamel and cartilage and traces of dentine. Scanning these components at elemental level provides an insight that it is dominantly composed of carbon dioxide, calcium phosphate, magnesium phosphate, sulphur dioxide and traces of nitrogen dioxide, nitrate oxide and nitrogen mono oxide.
Due to pouring of ash of cremation ground Manikarnka Ghat into the river increases the BOD and COD, Nitrate level, Fluoride level etc., which adversely affect the aquatic ecosystem.

Manikarnika Ghat involves in major proportion of contamination of surface water (River Ganga) from which 45% of water supplies to city.



5.2 Impact of industrial waste on water quality near Manikarnika Ghat



5.3 Problem Statement

The tradition practiced by Hindus to cremate dead bodies at the river banks, by the method of burning wood leads to air pollution and also effects natural water resources.

According to tradition, a dead body is washed by family members in the river water before being put on wood pyre with feet facing south. According to Hindus beliefs that soul of a dead person must be completely detached from the body to attain 'moksha'. And for this, an open cremation is needed so that the soul can be released easily as soon as the body is set on fire. The ashes are later immersed in the river completing the rite.

The problem, thus arises, of the Ghats of Varanasi increasingly becoming a disposal center of industrial effluents, domestic sewage and also due to human cremation as per Hindu rituals. As a consequence water pollution in the River Ganga has increased manifold. This is a great concern because the river serves as a source of living for the people. Alternatively, the Ghats which are a site of cultural heritage are also simultaneously being polluted.

5.4 Visual Survey

Air Pollution Water Pollution

Soil Pollution Water Pollution

Bad Practice of Dispose of fire place ash land Management

Selling of wood setting of wood pray to cremate body

Body during cremating preparing body to cremate

6. CONCLUSION

Water quality of Ganga River in Varanasi is unacceptable for potable or for farming purposes and it is getting worse.

Discharge of nearly all liquid and solid wastes n the river by various point sources is contaminating the river to a very high extent and soon a condition may arise from where return or repair may not be possible. Hence, the following suggestion maybe incorporated to check any further deterioration:

- Unwanted cremated wastes must be either:
  - Disposed of by a licensed waste removalist
  - Buried on-site if written Council approval has been granted.

- To avoid potential pollution hazards when disposing of unwanted cremated remains on-site:
  - construct a soil bund to divert stormwater runoff from burial pits
  - Never excavate burial pits below the water table.

Methods to reduce the impact of cremation on water bodies at Manikarnika Ghat

1. Promoted the use of electric systems as an alternate way of cremation
2. Bioremediation
3. Aquamation

The water supply and sanitation system of the city requires major changes, before the situation becomes even worse. Continuously worsening quality of water of the Ganga river shows that the various government plans to cleanse the river has failed. Until the objective of cleaning the Ganga is achieved, people should be educated and informed about the situation of the river quality so that the use of its water for daily purposes is stopped. Alternate clean water resources for people living in the slums are to be provided. Methods to reduce the impact of cremation at Manikarnika ghat that should be provided are promoting the use of electric systems as an alternate way of cremation, Bioremediation, Aquamation, measures which can invariably reduce the water pollutant level in river Ganga near Manikarnika Ghat, Varanasi.

Note: The NGRBP will be the first basin-level initiative in India to manage an inter-state river for water quality and environmental protection. However, despite passage of about four years no progress is visible on waterfronts of Varanasi. ULBs could also search for alternative technologies that are low cost and more context-appropriate to replace capital and energy intensive technology that requires a high level of expertise for operation and maintenance.

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BIOGRAPHIES

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