Research Article

ASSESSMENT OF SOLID WASTE MANAGEMENT IN GANGA BASIN-VARANASI: A CASE STUDY

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ABSTRACT

As far as river basin cities are concerned they have complete dependency over the river. In Varanasi, issues that require immediate attention to protect and conserve the Ganga River are (i) Garbage Dumping, (ii) Proper Sanitation, and (iii) Proper Sewage Treatment. River pollution means the presence of any foreign substance (organic, inorganic, radiological and biological) in the water of the river, which tends to degrade the quality of water. Though eight Indian states discharge their wastes into the river. In Varanasi also Nagar Nigam sewage constitutes 60 per cent by volume of the total waste that is dumped into the Ganges, and industries contribute about 15 percent of river pollution. The industrial wastes are smaller in volume but they have far more dangerous impacts than the sewage pollution in the river. Both, however, enters in the river largely untreated. Road sweeping waste (75%) and commercial waste comprises the maximum percentage of solid waste generated. Commercial waste is about 80 Million Tons per day Industrial waste is 15 Million Tons per day. As far as the relationship between the garbage and river is concerned there is direct relationship between the garbage and the river Ganga because Ganga is not only polluted by sewage disposal but poor solid waste disposal management is also responsible for the contamination of the river.

Key Words: *Ganga, Sanitation, Wastes*

Introduction

Varanasi owes its existence to the Ganga river (misspelled as Ganges in the West) considered to be the most holy river for the Hindu people and especially sacred in Varanasi where its course towards the Bay of Bengal suddenly turns north. Symbolically, the flow from south to north refers to the life cycle from death (south, the realm of death, Yama) to life (north, the realm of life, Shiva, i.e. Kailash). This unique directional change of the river course led to the development of the ancient city, Kashi, on the west banks of the river, facing the rising of the sun and making thus the Ghats of Varanasi sacred for all Hindu rituals.

The 7 km stretch through Varanasi is the only part of this journey where the river turns back towards her source.[1] Here Ganga is known as *Gangamaiyya, (*Mother Goddess) who nourishes the very soul of Kashi (Varanasi). Due to excessive load on infrastructure of the city and inefficient municipal services, solid waste management has been compromised severely. As a result the city becomes garbage bin from several years.

The development of cities in India is possible only when the prime development issues are addressed, including steps to protect the environment. As far as river basin cities are concerned they have complete dependency over the river.

So, there is dire need to protect the river from exploitation of the city dwellers. In Varanasi, issues that require immediate attention to protect and conserve the Ganga River are

(i) Garbage Dumping
(ii) Proper Sanitation
(iii) Proper Sewage Treatment

It is possible to address these concerns while protecting the river only within a favorable macro development model in which the role of government is very significant.

River Water Pollution

River pollution means the presence of any foreign substance (organic, inorganic radiological and biological) in the water of the river, which tends to degrade the quality of water. There are countless reasons for river pollution in Varanasi but three main factors of the water pollution are

given below which are not only creating pollution in the river but they are affecting the development of the city also:

[1] Sewage disposal
[2] Decrease in the Discharge of water into the river
[3] Dump of Industrial waste into the river

Contamination of Ganga due to Sewage disposal in Varanasi

The holy city Varanasi is among one of the oldest living cities of the world. This is a city that has grown around the Ganga, and is linked deeply with this river. Varanasi is the last major city for the river passes in Uttar Pradesh before moving on to the state of Bihar. Though eight Indian states discharge their wastes into the river, Uttar Pradesh contributes half of the river's total pollution (B. Sampat, 1996).[2]

Sewage system in every big city poses a great problem especially from past few decades. There are 101 Class I cities and 122 Class II towns in the Ganga basin.[3] The recent survey of Class I and Class II cities indicates that about 8,250 MLD. Wastewater is generated in the Ganga basin and treatment facility is available only for 3,500 MLD of wastewater.[4] Most of the cities have single sewage system. With increase in the urban population this single sewage system seems to be insufficient. As the Municipality of the concerned cities dispose there sewage into the river. In Varanasi also Nagar Nigam sewage constitutes 80 per cent by volume of the total waste that is dumped into the Ganges, and industries contribute about 15 percent of river pollution.[5] The industrial wastes are smaller in volume but they have far more dangerous impacts than the sewage pollution in the river. Both, however, enters in the river largely untreated. Out of all water polluting agents in Varanasi, Ganga carries all kind of pollutant load but sewage contribution is more as compared to other agents. Today In Varanasi 250-350 MLD sewage discharging per day, it is estimated that up to 2017 this amount will increase up to 5000 Mld.[3]

The sewer system of Varanasi was built in 1917[3] this system was designed by the Britishers .The total capacity of the sewer system at that time was one-tenth of the population of the city today. This outdated system is not only creating pollution for the river but this is inadequate for the city also. In consequence of this British designed sewage system, nearly 132 drainages are disposing their waste directly or indirectly into the river; as a result dissolved oxygen needed for living organism is very less. Biochemical oxygen demand (BOD) is also very less at most of the Ghats of Varanasi.

Administration has shown artificial concern towards the sewer discharge into the river. They have planned to make a proper sewage plan for the city but there are many loop holes in the plan.

Varanasi is an ancient city and also known for “Moksha and Mrityu”. This is the place where people come to die. As a result 32 thousand cementation are done every year.[3] 250 ton unburnt dead bodies are directly thrown into the river. Every year three thousand human and 6000 animal dead bodies are floated and decay in river. Dead bodies are mostly thrown from Rajghat Bridge or from Vishwa Sundari Bridge. These dead bodies thrown into the river of generate large amount of Nitrogen, Phosphorus and Potassium that is ultimately dissolved in the water of river. Situation becomes dangerous when dead body of the persons or animals who suffered from HIV, Hepatitis, or brain disease thrown into the water. The following table shows the quality of Ganga water at four bathing points.

Table - 1: Quality of Ganga water along the religious bathing area of Ganga in Varanasi[4]

Locations	Tulsi Ghat	R.P. Ghat	Panch Ganga Ghat	Ganga Varuna Confluence
Dissolved Oxygen (DO) mg/lit	6.6	6.4	7.0	1.0
Biochemical Oxygen Demand (BOD) mg/ lit	8.2	8.6	5.4	34
Faceal Coliform Count (FCC) count/ 100ml	62000	72000	34000	2700000

Note: The Permissible limits of River Water for Direct Human Touch in respect of **BOD is less than 3.0 mg/l and FCC is less than 500/100 ml.**

From the above table it is clear that BOD, DO and FCC is very high from the permissible limit of the river water for direct human touch. So, we can say that the river water is not fit for the bathing purpose. People living at the bank of the river are depends upon the river for number of daily meets. The fisherman depends on the river for earning the livelihood, the religious minded people use the water either for drinking or for bathing, the tourist enjoy the pleasure of boating, washer man cleans the cloth in the river.

The pollution of water directly affects the life style of the people living at the bank of the river. Other people who live far from the bank of the river are also affected by the pollution of the river.

Table–2(a): Point sources discharging directly into Ganga from the left bank[3]

Sl. No	Location	Latitude	Longitude
1.	Gyan Prawah Drain	25° 16' 05.1"	83° 01' 03.8"
2.	Samne Ghat Drain	25° 16' 20.5"	83° 00' 55.4"
3.	Mahadev Ghat Drain	25° 16' 29.8"	83° 00' 50.0"
4.	Aghoreshwar Ashram Ghat Drain	25° 16' 33.4"	83° 00' 48.6"
5.	Ram Ghat Drain	25° 16' 42.0"	83° 00' 44.0"
6.	Nagwa Drain (River Asi)	25° 17' 00.5"	83° 00' 34.9"
7.	Drain at north of Ravidas Park	25° 17' 04.7"	83° 00' 32.4"
8.	Ganga Mahal Ghat Drain	25° 17' 22.4"	83° 00' 24.9"
9.	Niranjani Ghat Drain	25° 17' 44.1"	83° 00' 27.1"
10.	Shiwala Ghat Drain	25° 17' 46.8"	83° 00' 27.1"
11.	Dandi Ghat Drain	25° 17' 50.1"	83° 00' 28.0"
12.	Harishchandra Ghat Drain	25° 17' 53.4"	83° 00' 27.7"
13.	Vijayanagram Ghat Drain	25° 17' 55.9"	83° 00' 28.1"
14.	Chauki Ghat Drain	25° 18' 01.6"	83° 00' 28.4"
15.	Kshemeshwar Ghat Drain	25° 18' 03.1"	83° 00' 28.7"
16.	Pandey Ghat Drain	25° 18' 13.8"	83° 00' 30.8"
17.	Ahilyabai Ghat Drain	25° 18' 20.3"	83° 00' 37.4"
18.	Rajendra Prasad Ghat Drain	25° 18' 24.9"	83° 00' 40.3"
19.	Man Mandir Ghat Drain	25° 18' 27.4"	83° 00' 41.8"
20.	Meer Ghat Drain	25° 18' 32.5"	83° 00' 45.7"
21.	Lalita Ghat Drain	25° 18' 35.4"	83° 00' 48.6"
22.	Jalasen Ghat Drain	25° 18' 37.3"	83° 00' 50.4"
23.	Manikarnika Ghat Drain	25° 18' 37.4"	83° 00' 50.4"
24.	Sankatha Ghat Drain	25° 18' 43.6"	83° 00' 57.9"
25.	Bhonsle Ghat Drain	25° 18' 44.4"	83° 00' 59.0"
26.	Mehta Ghat Drain	25° 18' 49.9"	83° 01' 01.0"
27.	Panch Ganga Ghat Drain	25° 18' 51.4"	83° 01' 03.5"

28.	Brahma Ghat Drain	25° 18' 56.7"	83° 01' 08.7"
29.	Lal Ghat Drain	25° 19' 02.3"	83° 01' 15.5"
30.	Trilochan Ghat Drain	25° 19' 08.2"	83° 01' 25.2"
31.	Gola Ghat (sewage pumping stat.	25° 19' 09.6"	83° 01' 27.9"
32.	Nandeshwar Ghat Drain	25° 19' 11.4"	83° 01' 30.7"
33.	Teliyanala Ghat Drain	25° 19' 15.2"	83° 01' 38.4"
34.	Bhaisasur Ghat Drain	25° 19' 23.7"	83° 01' 53.7"
35.	Raj Ghat Drain I (Beside bridge)	25° 19' 25.2"	83° 01' 56.9"
36.	Raj Ghat Drain II (Below bridge)	25° 19' 26.0"	83° 01' 59.7"
37.	Basanta College outfall (Trunk Sewer)	25° 19' 34.1"	83° 02' 18.0"
38.	Varuna-Ganga Confluence	25° 19' 45.6"	83° 02' 40.9"

Table – 2(b): Point sources discharging directly into Ganga from the right bank[3]

Sl No	Location	Latitude	Longitude
1.	Ghurha Drain	25° 14'59.8"	83° 01'49.2"
2.	Hanuman Ghat Drain (Beside Fort)	25° 16'04.5"	83° 01'28.2"
3.	Point I (Beside Pipa Pul)	25° 17'24.1"	83° 00'24.0"
4.	Point II (Beside Pipa Pul)	25° 16'21.7"	83° 01'22.5"
5.	Point III (Beside Pipa Pul)	25° 16'26.3"	83° 01'21.1"
6.	Sump Drain	25° 16'32.4"	83° 01'19.7"
7.	Shakti Ghat Drain	25° 19'25.1"	83° 02'51.1"

Table–2(c): Point sources discharging in river Varuna (from right side) flowing into Ganga

Sl. No.	Location	Latitude	Longitude
1.	Titadri Math Drain	25° 19' 45.7"	83° 02' 05.0"
2.	Konia Pumping Station	25° 19' 51.9"	83° 02' 03.5"
3.	Konia Ghat (Sewer Line)	25° 20' 06.5"	83° 02' 09.9"
4.	Vijayipur (Mata Barik Temple)	25° 20' 31.1"	83° 01' 58.4"
5.	Point opp to Sarang Talab drain	25° 20' 28.0"	83° 01' 51.9"
6.	Konia (Beside Railway Bridge)	25° 20' 26.1"	83° 01' 47.7"
7.	Sarraiya-Kohrana	25° 20' 26.3"	83° 01' 38.4"
8.	Sarraiya-Bharaoti	25° 20' 26.3"	83° 01' 38.4"
9.	Lat Bhairo (Sarraiya-Musalmani)	25° 20' 28.9"	83° 01' 31.2"
10.	Point I below old bridge	25° 20' 29.6"	83° 01' 19.7"
11.	Point II below old bridge	25° 20' 27.3"	83° 01' 14.3"
12.	Point III below old bridge	25° 20' 25.9"	83° 01' 11.6"
13.	Shailputri drain	25° 20' 25.3"	83° 01' 10.3"
14.	Shailputri II (Tin-pulia Drain)	25° 20' 25.4"	83° 01' 04.5"
15.	Point I at Nakkhi ghat bridge	25° 20' 28.8"	83° 00' 40.7"
16.	Point II Below Nakkhi ghat bridge	25° 20' 29.1"	83° 00' 33.6"
17.	Point at site -168	25° 20' 31.1"	83° 00' 21.3"
18.	Bhelwaria (Bichhuanath akhada)	25° 20' 26.9"	83° 00' 03.1"
19.	Point at site 173	25° 20' 09.3"	82° 59' 58.8"
20.	Chauka ghat Drain	25° 20' 06.3"	82° 59' 52.7"
21.	Raja Bazar Drain	25° 20' 09.4"	82° 59' 24.8"
22.	Point at Varuna bridge	25° 20' 26.5"	82° 58' 55.3"
23.	Drain at Surya Hotel	25° 20' 20.8"	82° 58' 48.3"
24.	Drain at Clark Hotel (D.M colony)	25° 20' 18.0"	82° 58' 31.9"
25.	Fulwaria (Cantonment) Drain	25° 20' 22.8"	82° 57' 46.9"
26.	Shivpur (Military Cantonment)	25° 20' 11.1"	82° 57' 27.4"

Table – 2(d): Point sources discharging in river Varuna (from left side) flowing into Ganga [3]

Sl. No.	Location	Latitude	Longitude
1.	Sarang Talab Drain	25° 20' 28.4"	83° 01' 53.4"
2.	Pul Kohna	25° 20' 28.9"	83° 01' 31.2"
3.	Point forward to Nakkhi ghat bridge	25° 20' 30.4"	83° 00' 32.0"
4.	Baghwa Drain	25° 20' 36.5"	83° 00' 05.3"
5.	Bhelwaria-Hukulgunj Drain	25° 20' 23.4"	83° 00' 01.4"
6.	Hukulganj Drain	25° 20' 13.7"	82° 59' 59.9"
7.	Chauka Ghat (Hanuman Temple)	25° 20' 05.8"	82° 59' 49.0"
8.	Point at site-177	25° 20' 24.4"	82° 59' 27.1"
9.	Gopaveer Raja colony	25° 20' 27.6"	82° 59' 23.3"
10.	Point beside Gopaveer Raja colony	25° 20' 29.6"	82° 59' 19.2"
11.	Point I at Cutchahry Kasai Bara	25° 20' 29.8"	82° 59' 06.0"
12.	Point II at Cutchahry Kasai Bara	25° 20' 28.7"	82° 59' 03.4"
13.	Imlia Ghat Drain	25° 20' 28.1"	82° 58' 20.7"
14.	Bhim Nagar Drain	25° 20' 29.7"	82° 58' 19.4"
15.	Balua Drain (Shivpur Chamrauti)	25° 20' 32.8"	82° 58' 02.3"
16.	Point at Chhota Jail	25° 20' 25.4"	82° 57' 47.3

Table – 2(e): Point sources discharging in river Asi (from right side) flowing into Ganga[3]

Sl. No.	Location	Latitude	Longitude
1.	Point at Gangotri Vihar colony (Nagwa)	25° 16' 57.6	83° 00' 27.6
2.	Point I at Nagwa Harijan Basti	25° 16' 57.9	83° 00' 23.2
3.	Point II at Nagwa Harijan Basti	25° 16' 58.4	83° 00' 17.1
4.	Drain from Petrol pump	25° 17' 07.4	83° 00' 08.0
5.	Point beside Sankatmochan-Durgakund bridge	25° 17' 06.3	83° 00' 02.5
6.	Saket Nagar Drain	25° 17' 02.6	82° 59' 50.9
7.	Point at Brahmanand Nagar Ext.	25° 17' 03.1	82° 59' 44.8
8.	Point I at Sunderpur	25° 16' 55.8	82° 59' 16.2
9.	Point at Batuapura Pul	25° 16' 56.4	82° 59' 12.7
10.	Point at Sunderpur Pulia	25° 16' 49.9	82° 59' 02.2
11.	Sunderpur –I	25° 16' 48.7	82° 58' 58.8
12.	Sunderpur -II	25° 16' 48.8	82° 58' 55.8
13.	Karamjeetpur (Sunderpur)	25° 16' 47.1	82° 58' 47.8
14.	Newada -I	25° 16' 47.9	82° 58' 42.4
15.	Newada -II (Ganesh Nagar colony)	25° 16' 46.0	82° 58' 38.5

Table– 2(f): Point sources discharging in river Asi (from left side) flowing into Ganga

Sl. No.	Location	Latitude	Longitude
1.	Drain I from Ravidas park	25° 16' 57.4	83° 00' 34.3
2.	Drain II from Ravidas park	25° 16' 57.6	83° 00' 27.6
3.	Drain III from Ravidas park (Asi bridge)	25° 16' 57.8	83° 00' 25.6
4.	Nagwa Drain (Beside Rameshwar Math)	25° 16' 58.5	83° 00' 24.0
5.	Point Beside Rameshwar Math	25° 16' 58.3	83° 00' 23.5
6.	Point Behind Bhagwat Mahavidyalay)	25° 16' 58.8	83° 00' 16.7
7.	Ghasiyari Tola	25° 17' 05.7	83° 00' 17.0
8.	Site-206 near Asi bridge	25° 17' 05.3	83° 00' 13.3
9.	Ravindrapuri colony (sewer line)	25° 17' 07.4	83° 00' 08.0
10.	Point I beside Sankatmochan-Durgakund pul	25° 17' 06.3	83° 00' 02.5
11.	Point II beside Sankatmochan-Durgakund pul	25° 17' 06.1	83° 00' 01.9

12.	Rohit Nagar	25° 17' 00.0	82° 59' 29.1
13.	Gandhi Nagar	25° 16' 56.6	82° 59' 22.7
14.	Batuapura (DLW new sewer)	25° 16' 57.1	82° 59' 02.9
15.	DLW main sewer (Sunderpur Satti)	25° 16' 57.1	82° 59' 10.8
16.	Sarai Nandan Drain	25° 16' 57.1	82° 59' 10.8
17.	Sarai Nandan Khurd	25° 16' 54.5	82° 59' 03.2
18.	Sunderpur Pulia	25° 16' 49.9	82° 59' 02.2
19.	Ganesh Dham Colony (Newada)	25° 16' 46.3	82° 58' 33.0

Disposal of garbage and pollution into the river

Composition of Garbage: The composition of garbage in India indicates lower organic matter and high ash or dust contents. It has been estimated that recyclable content in solid wastes garbage varies from 13 to 20% and combustible material is about 80-85%. A typical composition of municipal solid waste is given below. [3]

Table-3 (a): Composition of municipal solid waste

Description	Percent by weight
Vegetable, leaves	40.15
Grass	3.80
Paper	0.81
Plastic	0.62
Glass, ceramics	0.44
Metal	0.64
Stones, ashes	41.81
Miscellaneous	11.73

Quantity:

It is estimated that solid waste generated in small, medium and large cities and towns is about 0.1 kg, 0.3-0.4 kg and 0.5 kg per capita per day respectively. Total quantity of waste generated in Varanasi is about 600 Million Tons per day, out of which approximately 450 million tons per day of waste is collected.[5] This constitutes to 75% of the total waste. Road sweeping waste (75%) and commercial waste comprises the maximum percentage of solid waste generated. Commercial waste is about 80 million tons per day industrial waste is 15 million tons per day. Waste generated by different activities is shown in the **Table (3b).**

Table-3 (b): Estimated waste generation (Total 600 ton)[5]

Category	Generation amount (ton/ day)	Percentage
Commercial waste	80	13.33
Industrial waste	15	2.50
Road sweeping waste	450	75.0
Clinical waste	20	3.33
Nala cleaning waste	10	1.66
Construction and others	25	4.16

As far as the relationship between the garbage and river is concerned there is direct relationship between the garbage and the river Ganga because Ganga is not only polluted by sewage disposal but poor solid waste disposal management is also responsible for the contamination of the river. Municipal Corporation of Varanasi has adopted only dumping as method of disposal of the waste as of today.[5] Waste is dumped at a site near Rajghat and in the absence of any preventive measures the

levee generated finds its way into the ground water and the drains leading to river Ganga. A high percentage of waste generated in the city comprises of non recyclable plastics and compostable religious and domestic waste, which at present is either dumped into the landfill or in the river.[5] On an average nearly 10 tones of waste per day is collected only from drains cleaning. Dumping of solid waste in the drains/sewer and rivers of the city leads to health hazards and hampers flow of drains.

Waste management is still a linear system of collection and disposal, this linear pattern is creating health and environmental hazards. Increasing urban migration and a high density of population makes waste management a difficult issue to handle. There is however, an inadequate understanding of the problem, both at level of infrastructure requirements as well as at its social dimensions. At the national policy level, the Municipal Solid Waste Management and Handling Rules 2000 legislated by the Government details the practices to be followed by the various municipalities for managing urban waste.[5] However, the response has been segmented and far from satisfactory. First, it does not address mechanisms that will be needed for promoting recycling, or waste minimization. Secondly, there is no provision for any public participation, despite the fact that the rules have been an outcome of public pressure and the immense work done by non-government organizations and community groups in this area.

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