

Assessment of Domestic Pollution Load from Urban Agglomeration in Ganga Basin: West Bengal

GRBMP: Ganga River Basin Management Plan

by

Consortium of 7 “Indian Institute of Technology”s (IITs)



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Preface

In exercise of the powers conferred by sub-sections (1) and (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government has constituted National Ganga River Basin Authority (NGRBA) as a planning, financing, monitoring and coordinating authority for strengthening the collective efforts of the Central and State Government for effective abatement of pollution and conservation of the river Ganga. One of the important functions of the NGRBA is to prepare and implement a Ganga River Basin Management Plan (GRBMP).

A Consortium of 7 Indian Institute of Technology (IIT) has been given the responsibility of preparing Ganga River Basin Management Plan (GRBMP) by the Ministry of Environment and Forests (MoEF), GOI, New Delhi. Memorandum of Agreement (MoA) has been signed between 7 IITs (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and MoEF for this purpose on July 6, 2010.

This report is one of the many reports prepared by IITs to describe the strategy, information, methodology, analysis and suggestions and recommendations in developing Ganga River Basin Management Plan (GRBMP). The overall Frame Work for documentation of GRBMP and Indexing of Reports is presented on the inside cover page.

There are two aspects to the development of GRBMP. Dedicated people spent hours discussing concerns, issues and potential solutions to problems. This dedication leads to the preparation of reports that hope to articulate the outcome of the dialog in a way that is useful. Many people contributed to the preparation of this report directly or indirectly. This report is therefore truly a collective effort that reflects the cooperation of many, particularly those who are members of the IIT Team. A list of persons who have contributed directly and names of those who have taken lead in preparing this report is given on the reverse side.

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Contents

	<i>Page</i>
1 Introduction	7
2 Major Obstruction and Abstraction Projects on the Tributaries of the River Ganga Executed in the State	10
3 Demographic Profile of Ganga Basin in the State	11
4 Religious Places and their Importance	21
5 Pollution Load	22
6 Conclusions	35
References	35
Appendix 1: Compilation of Data Sheets of Water Balance & Pollution Load (Domestic) of Class I Cities/Towns in West Bengal	
Appendix 2: Compilation of Data Sheets of Water Balance & Pollution Load (Domestic) of Class II Cities/Towns in West Bengal	
Appendix 3: Compilation of Data Sheets of Water Balance & Pollution Load (Domestic) of Class III Cities/Towns in West Bengal	

1. Introduction

West Bengal with the total area of 88,752 sq km, is the 14th largest state of India. The state population is 91,276,115 as per census 2011 provisional data. The total population growth in this decade was 13.84 percent (Census 2011). Only six of its 22 drainage basins fall completely within the political boundary of West Bengal. The major river basins of the state are the Ganga (81% of area), the Brahmaputra (12%), and the Subarnarekha (4%) and two small coastal basins constitute the reminder (3%) (Bandyopadhyay, 2014). West Bengal has a total of 23 districts with Kolkata as its capital. Kolkata is the largest city of the state and also the seventh largest city in India. The second largest city and urban agglomeration of the state is Howrah.

As per political geography the state is divided into 5 divisions i.e., Burdwan, Midnapur, Jalpaiguri, Malda and Presidency division. While on the basis of soil and climate it is divided into six divisions i.e., the hill region in the north, terai and teesta alluvial region of north, the laterectic, red and gravely undulating region in the west, the coastal alluvial region in the south, the gangetic alluvial region in the west and the Vindhya alluvial region in the centre.

The Ganga River Basin (GRB) has a total catchment area of 1,086,000 sq km across India, Tibet (China), Nepal and Bangladesh. The river basin in India, nearly covers 26% (861,404 sq km; about 80% of total catchment area of Ganga river basin) of the total geographical area. The sprawling Ganga basin, spread across 11 states, is the world's most populous river basin and home to more than 492 million Indians. West Bengal is one of the 11 states (Uttarakhand, Uttar Pradesh, Bihar, Chhattisgarh, Delhi, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, Jharkhand and West Bengal) of the GRB in India through which the Ganga River and her tributaries flows. The 81% of the geographical area of the state lies in GRB (Figures 1 and 2). A comparison of state-wise distribution of GRB area within the geographical areas of different states is presented in Table 1.

Table 1: State-wise Distribution of the Ganga River Basin Area

State/ Union Territory	*Total Geographical Area (sq km)	#Area contributing to Ganga Basin (sq km)	Percentage of the Basin Area (%)
Uttarakhand	53,483	53,436	6.2
Uttar Pradesh	240,928	240,928	28
Bihar	94,163	94,163	10.9
Jharkhand	79,716	49,798	5.8
Madhya Pradesh	308,252	198,962	23.1
Chhattisgarh	135,192		
Delhi	1,484	1,484	0.17
Haryana	44,212	34,341	4.0
Himachal Pradesh	55,673	4,317	0.5
Rajasthan	342,239	112,490	13.1
West Bengal	88,752	71,485	8.3

Source: *Census 2011

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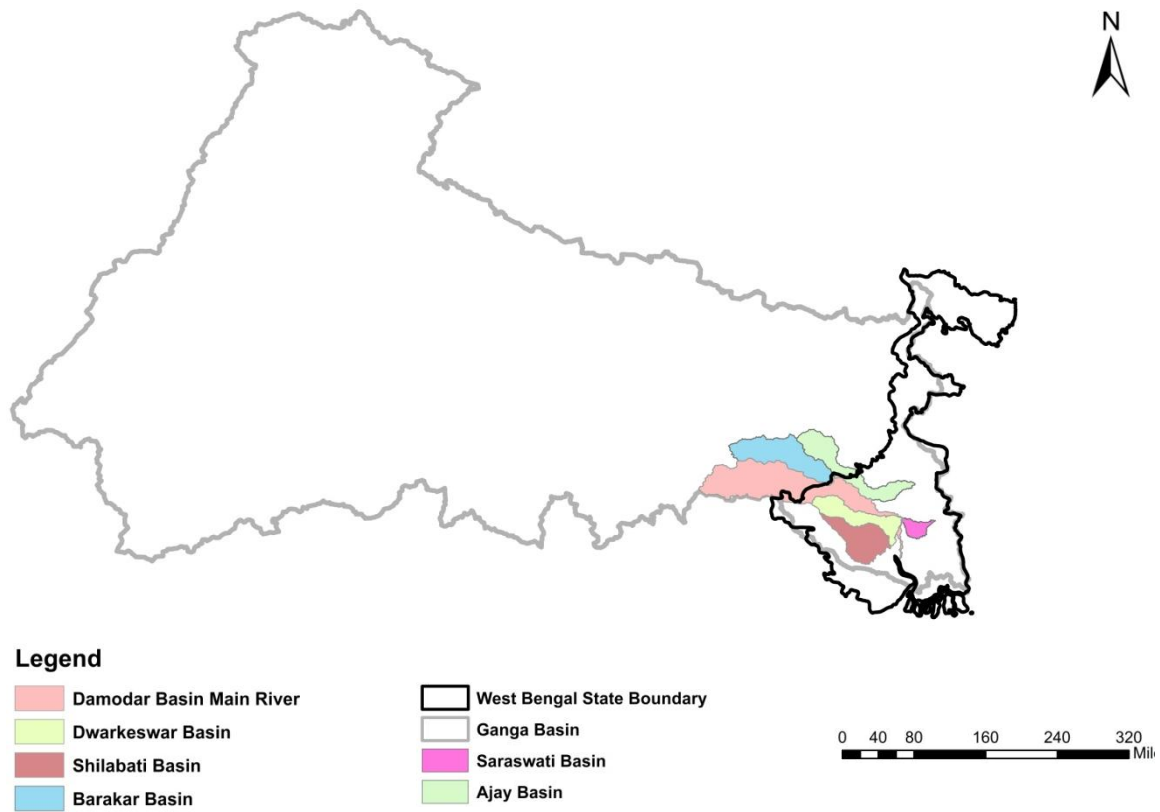


Figure 1: Ganga River Basin with its Major Sub-Basins in West Bengal

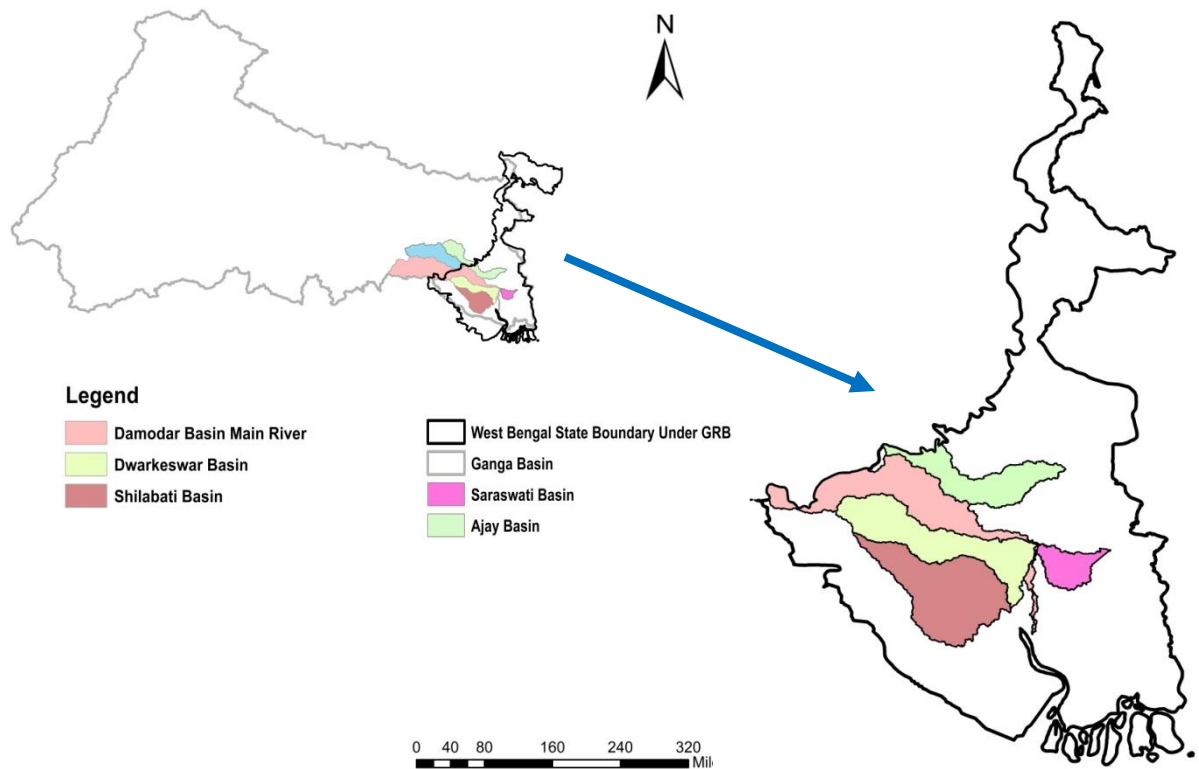


Figure 2: Part of Major Sub-Basins of Ganga River Basin in the State of West Bengal

River Ganga enters in West Bengal near Keserpur, and forms the major channel through which the Ganges entered the Bay of Bengal. River Ganga in the state after Farakka is known as the Bhagirathi–Hooghly River. In general, the Bhagirathi–Hooghly River is considered as the western limit of the Ganga delta. The major portion (in terms of volume) of the river Ganga enters into the Bangladesh territory known as Padma river. In the state after the Farakka barrage, the non-tidal part is known as Bhagirathi, whereas the tidal part from Nabadwip to the Bay is called the Hooghly (Garrett, 1910; Willcocks, 1930; Chatterjee, 2014). During her course many tributaries such as Damodar, Rupnarayan, Ajay and Mahananda merges into it. The salient features of some tributaries and sub-tributaries contributing directly or indirectly to the river Ganga in the state of West Bengal are presented in Table 2.

Table 2: Salient Features of Tributaries/ Sub-Tributaries of River Ganga (Hooghly) in the State of West Bengal

Characteristics	Tributaries/ Sub-tributaries			
	Damodar	Rupnaryan	Ajay	Dwarakeswar
Position	Right bank	Right bank	Right bank	Right bank
Region of origin	Khamarpur Hills (1050 meters) of the Chotonagpur Plateau	Dhaleswari (Dhalkisor) in the Chhota Nagpur plateau foothills	Chotanagpur Plateau from Chakai hill, Munger district of Bihar	Tilaboni hill in Purulia district of Bihar
Mouth	Hooghly	Hooghly	Bhagirathi	Rupnarayan
Total length (km)	540	78	288	200.2
Total catchment area (sq km)	23,370.98	-	5813.8	4000.5
Catchment area in W.B. (%)	26.3	100	-	100
River bed/ Soil texture	Alluvial	-	Laterite & alluvial soil	-

-Ghosh and Guchhait (2014); Ghosh, (2014); Maity and Maiti, (2013)

2. Major Obstruction and Abstraction Projects on the Tributaries of the River Ganga Executed in the State

West Bengal counts 30 dams on the major rivers for irrigation, hydroelectricity and flood control. The most recent (Teesta Low Dam IV) is on the Teesta river for hydroelectricity purpose. In West Bengal, the transformation of rivers has a long history (the Massanjore dam on Mayurakshi river 1955). The two largest dams in the state are the Massanjore dam on the Mayurakshi river, with a height of 47 m (height above lowest foundation) and the Teesta Low Dam IV on the Teesta river, with a height of 45 m. Apart of the above mentioned benefits, these dams also allow for the regulation of natural flows. Another important barrage on river Ganga in the state is Farakka barrage in Murshidabad district. The feeder canal from the barrage is about 40 km long. Diversion of Ganga water through Farakka barrage affects the ecology and economics of the cities/states/ countries located not only upstream but also downstream of the barrage. The ecological impact of pre and post-Farakka period on the fisheries is well documented in the reports published by CIFRI (Central Inland Fisheries Research Institute). The list of the dams on river Ganga and its tributaries in West Bengal are mentioned underneath (Table 3).

Table 3: Details of the Major Dams on the River Ganga and Her Tributaries in the State of West Bengal

Projects	River	Year of Completion	Remark
Bandhu Extension	Bandhu	2004	Irrigation
Bara Mandira	Baramandira	1977	Irrigation
Barabhum	Barabhum	1991	Irrigation
Beko	Beko	1990	Irrigation
Dangra	Dungrajhore	1982	Irrigation
Dimu	Dimu	1989	Irrigation
Futiary	Futiary	2004	Irrigation
Golamarjore	Golamarajore	1984	Irrigation
Hanumata	Hanumata	2004	Irrigation
Hinglow	Hinglow	1976	Irrigation
Kangsabati Kumari	Kangsabati Kumari	1965	Irrigation / Flood Control
Karrior	Karrior	1988	Irrigation
Khairabera	Khairabera	1989	Irrigation
Kumari	Kumari	1984	Irrigation
Lipania	Lipania	1985	Irrigation
Maliarajore	Maliarajore	1978	Irrigation
Massanjore	Mayurakshi	1955	Irrigation / Hydroelectricity / Flood Control
Moutorejore	Moutorejore	1990	Irrigation
Nachan	NachanKandar	1977	Irrigation
Parga	Parga	1982	Irrigation

Projects	River	Year of Completion	Remark
Patloi	Patloi	2004	Irrigation
Ramchandrapur	Machkandajore	1991	Irrigation
Rupai	Rupai	1982	Irrigation
Saharajore	Saharajore	1982	Irrigation
Sali	Sali	1985	Irrigation
Taragonia	Taragonia	1987	Irrigation
Tatko	Tatko	1985	Irrigation
Teesta Low Dam III Barrage	Teesta Basin	2013	Hydroelectricity
Teesta Low Dam IV	Teesta Basin	U/C	Hydroelectricity
Turga	Turga	1990	Irrigation

(Source: National Register of Large Dams)

3. Demographic Profile of Ganga Basin in the State

West Bengal in total has 58 Class I cities, 33 Class II towns and 71 Class III towns in catchment of Ganga River as per estimate based on Census-2011. The total population of the state according to the Census 2011 is approximately 91 million. The population density of the state is 1,028 per km². Some of the class I cities in the state are Asansol, Bardhaman, Barrackpore, Durgapur, Haldia, Dumdum, Howrah, Kharagpur, Kolkata, Medinipur, North Dumdum and South Dumdum. The maximum town population in the state resides in Kolkata followed by Howrah. In the state, nearly 70% of the population live in Class I Cities under Ganga river basin (devoid by the population reside under Ajay, Dwarkeshwar, Damodar, Saraswati and Shilbati basin) (designated as “others under GRB” in Figure 3). The Class II and III covered by nearly 9% and 8% population, respectively under the same basin area (others under GRB). The total population of Class I, II and III towns under the entire GRB in the state are 17.6, 2.2 and 2.0 million, respectively. The population resides under major sub-basins lying in the state has also been estimated for Class I, II and III cities/ towns. Within the sub-basins, Damodar basin having the maximum numbers of Class I cities (Asansol, Bardhaman, Durgapur, Jamuria and Raniganj). The total population of Class I cities in Damodar basin is nearly 8% of the total population of the state. The least population of Class I town belong to Ajay and Shilbati basin (0%). The major share of Class II town's population under the selected sub-basins in the state is in Ajay and Dwarkeshwar basin (nearly 1% each). The Ajay and Damodar sub-basins also having the maximum number of Class III towns. Kolkata, Dhulia and Gobardanga are the cities having maximum population of Class I, Class II and Class III cities, respectively. Map in the Figure 4, 5 and 6 showing the distribution of Class I cities, Class II and Class III towns in the state under Ganga River Basin. The details of the area, population and the major river systems of all the Class I, II and III cities are presented in Table 4-6, respectively.

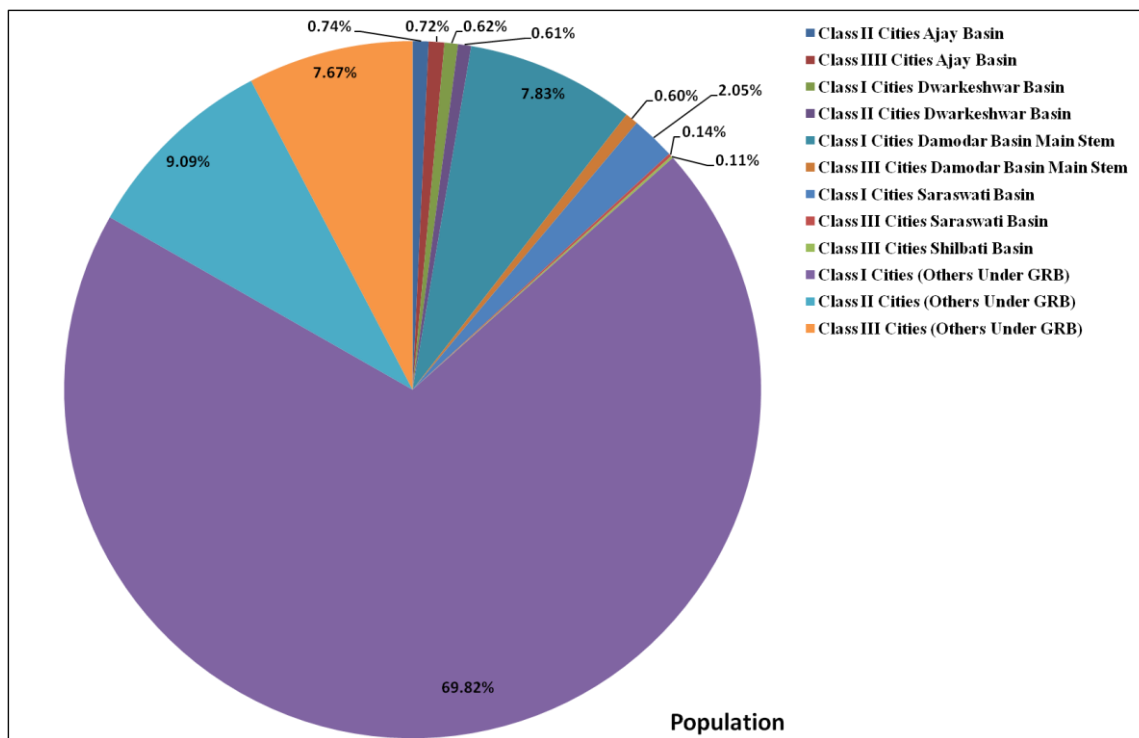


Figure 3: Population Distribution of Class I Cities and Class II, Class III Towns in the Major Sub-Basins and Along the Main Stem of River Ganga in West Bengal.

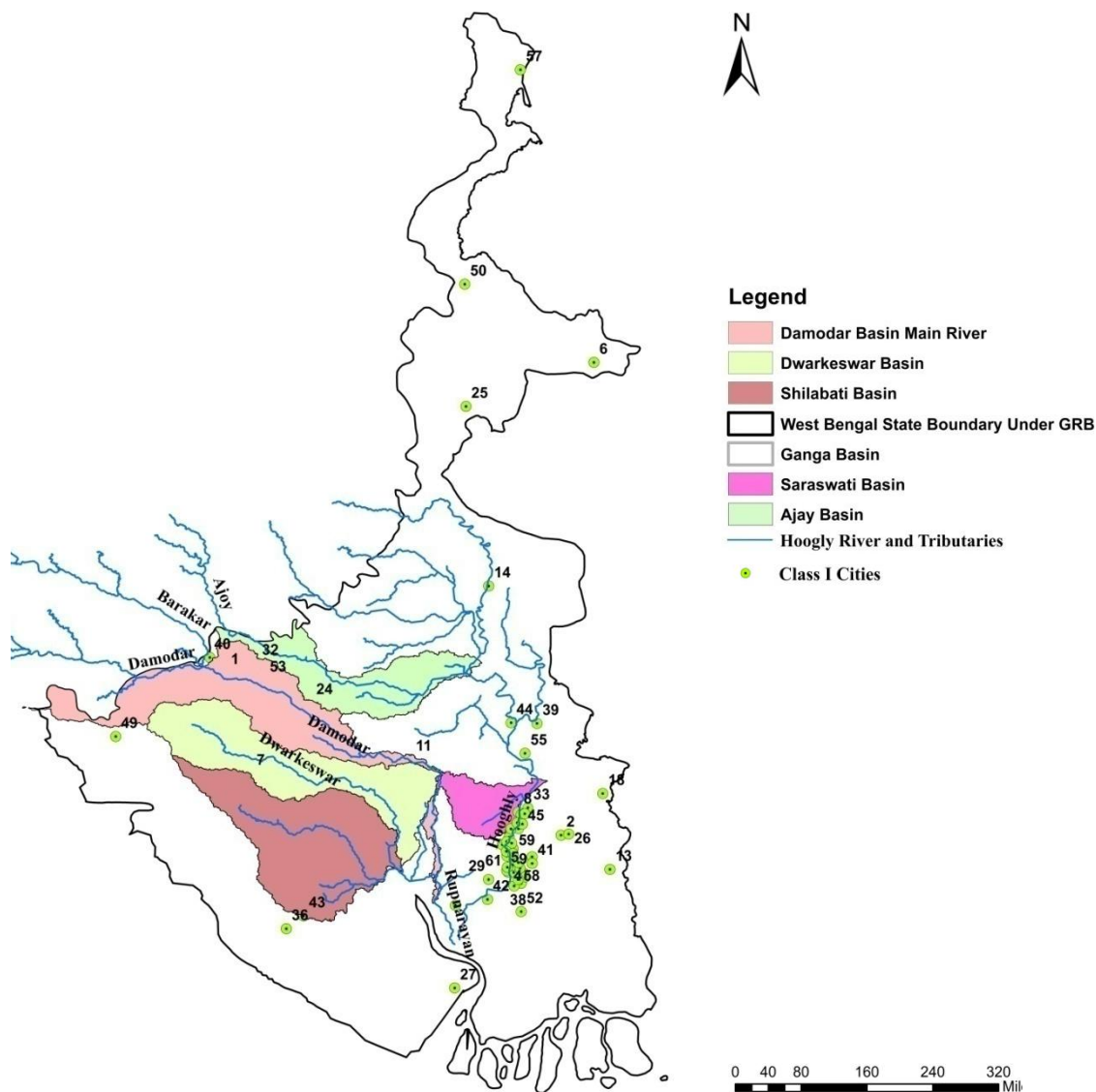
**The sub-basins having 0% contributions in any Class have been excluded from the figure*

Table 4: Demography of Class I Cities in Portion of the Ganga Basin Lying in the State of West Bengal

S No.	Town Name	River System	Area (sq km)	Town Population (Census, 2011)
1	Asansol	Damoder	125	563,917
2	Ashokenagar Kalyangarh (Ashoknagar)	Jamuna	20.5	121,592
3	Baidyabati	Hooghly	12.1	121,110
4	Bally	Hooghly	11.8	293,373
5	Bally	Hooghly	11.7	113,377
6	Balurghat	Atrai	10.8	153,279
7	Bankura	Dwarakeswar	19.1	137,386
8	Bansberia	Saraswati	9.07	103,920
9	Baranagar	Hooghly	7.12	245,213
10	Barasat	Hooghly	34.5	278,435
11	Barddhaman (Bardhaman)	Damoder	26.3	314,265
12	Barrackpore	Hooghly	10.6	152,783

S No.	Town Name	River System	Area (sq km)	Town Population (Census, 2011)
1	Asansol	Damoder	125	563,917
14	Berhampore (Baharampur)	Hooghly	31.4	195,223
15	Bhadreswar	Hooghly	8.28	101,477
16	Bhatpara	Hooghly	34.7	386,019
17	Bidhannagar	Hooghly	33.1	215,514
18	Bongaon (Bangaon)	Ichamati	14.3	108,864
19	Champdani	Hooghly	6.54	111,251
20	Chandannagar	Saraswati	22.1	166,867
21	Dumdum	Hooghly	9.23	114,786
22	Durgapur	Damoder	154	566,517
23	English Bazar	Mahananda	13.3	205,521
24	Habra	Jamuna	21.8	147,221
25	Haldia	Hooghly, Haldi	110	200,827
26	Halisahar	Hooghly	8.29	124,939
27	Haora (Howrah)	Hooghly	51.7	1,077,075
28	Hugli-Chinsurah	Saraswati	17.3	179,931
29	Jamuria	Ajay, Damoder	79.2	149,220
30	Kalyani	Hooghly	29.2	100,575
31	Kamarhati	Hooghly	11.0	330,211
32	Kanchrapara	Hooghly	9.06	129,576
33	Kharagpur	Kansabati	90.7	207,604
34	Khardah	Hooghly	6.87	108,496
35	Kolkata	Hooghly	185	4,496,694
36	Krishnanagar	Jalangi	16.0	153,062
37	Kulti	Barakar	96.0	313,809
38	Madhyamgram	Hooghly	21.5	196,127
39	Maheshtala	Hooghly	44.2	448,317
40	Medinipur (Midnapore)	kansabati	18.4	169,264
41	Nabadwip	Hooghly	11.7	125,543
42	Naihati	Hooghly	11.6	217,900
43	North Barrackpore	Hooghly	12.6	132,806
44	North Dumdum	Hooghly	26.4	249,142
45	Panihati	Hooghly	19.4	377,347
46	Puruliya (Purulia)	Kangsabati	14.0	121,067
47	Raiganj	Kulik River	10.8	183,612
48	Rajarhat Gopalpur	Hooghly	28.0	402,844
49	Rajpur Sonarpur	Hooghly	49.3	424,368
50	Raniganj	Damoder	25.0	129,441
51	Rishra	Hooghly	6.48	124,577
52	Santipur (Shantipur)	Hooghly	25.9	151,777

S No.	Town Name	River System	Area (sq km)	Town Population (Census, 2011)
53	Serampore	Hooghly	17.6	181,842
54	Siliguri	Mahananda	41.9	513,264
55	South Dumdum	Hooghly	18.0	403,316
56	Titagarh	Hooghly	3.24	116,541
57	Uluberia	Hooghly	33.3	235,345
58	Uttarpara Kotrung	Hooghly	12.6	159,147



Class I Cities	
1	Asansol
2	Ashokenagar Kalyangarh
3	Baidyabati
4	Bally
5	Bally
6	Balurghat
7	Bankura
8	Bansberia
9	Baranagar
10	Barasat
11	Bardhaman
12	Barrackpore
13	Basirhat
14	Berhampore
15	Bhadreswar
16	Bhatpara
17	Bidhannagar
18	Bongaon
19	Chamdpani
20	Chandannagar
23	Dum Dum
24	Durgapur
25	English Bazar
26	Habra
27	Haldia
28	Halisahar
29	Haora
30	Hugli-Chinsurah
32	Jamuria
33	Kalyani
34	Kamarhati
35	Kanchrapara
36	Kharagpur
37	Khardah
38	Kolkata
39	Krishnanagar
40	Kulti
41	Madhyamgram
42	Maheshtala
43	Medinipur
44	Nabadwip
45	Naihati
46	North Barrackpore
47	North Dumdum
48	Panihati
49	Puruliya
50	Raiganj
51	Rajarhat Gopalpur
52	Rajpur Sonarpur
53	Raniganj
54	Rishra
55	Santipur
56	Serampore
57	Siliguri
58	South Dumdum
59	Titagarh
60	Uluberia
61	Uttarpara Kotrung

Figure 4: Class I Cities in the State of West Bengal under Ganga River Basin

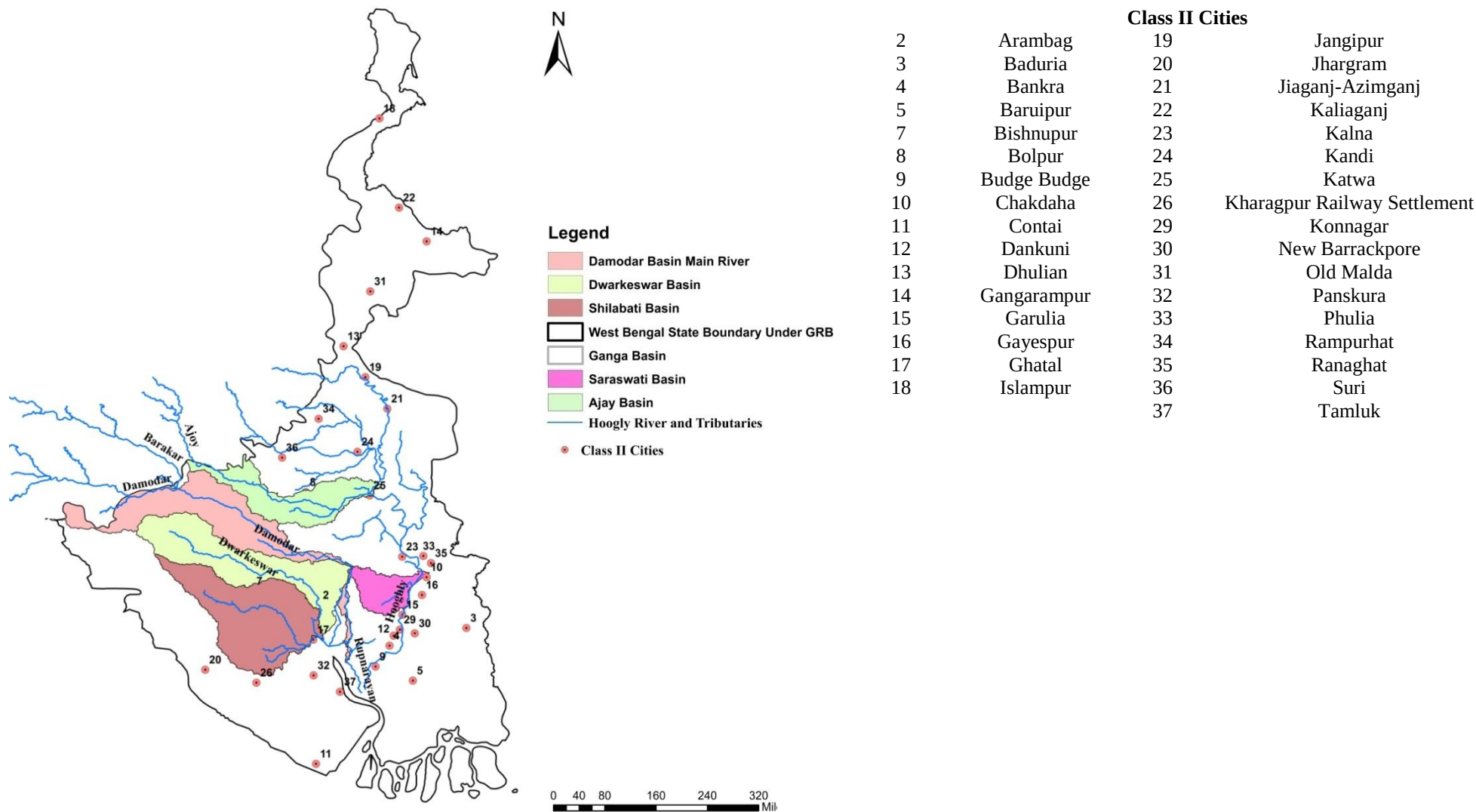


Figure 5: Class II Cities in the State of West Bengal under Ganga River Basin

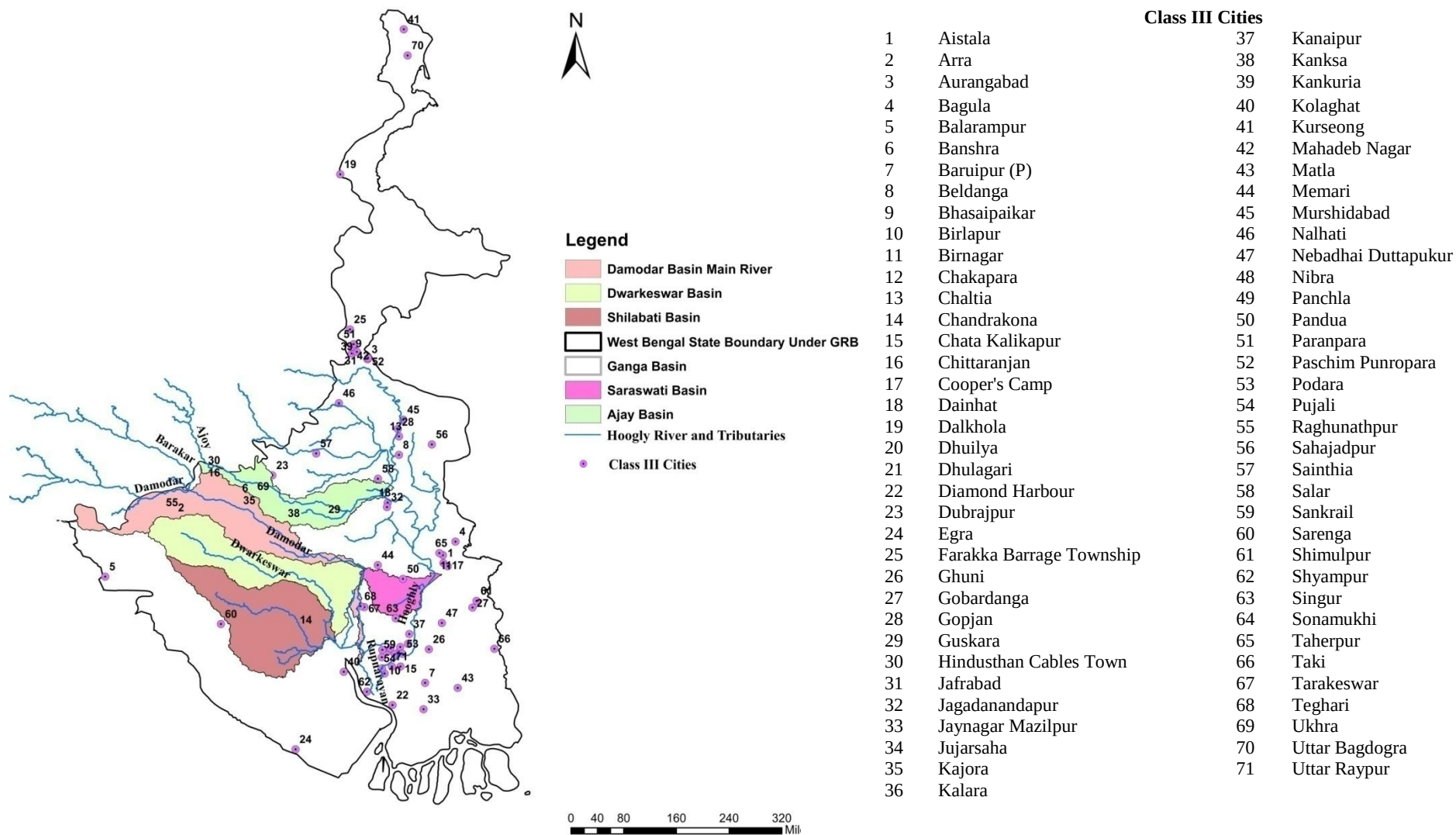


Figure 6: Class III Cities in the State of West Bengal under Ganga River Basin

Table 5: Demography of Class II Towns in Portion of the Ganga River Basin Lying in the State of West Bengal

S No.	Town Name	River System	Area (sq km)	Town Population (Census, 2011)
1	Arambag	Dwarkeswar	34.8	66,175
2	Baduria	Ichamati	22.4	52,493
3	Bankra	Hooghly	3.59	63,957
4	Baruipur	Hooghly	9.50	53,128
5	Bishnupur	Dwarkeswar	22.0	67,783
6	Bolpur	Ajay	13.1	80,210
7	Budge Budge	Hooghly	9.06	76,837
8	Chakdaha	Hooghly	9.06	95,203
9	Contai	Hooghly	14.3	92,226
10	Dankuni	Hooghly	19.5	94,936
11	Dhulian	Ganges	6.25	95,706
12	Gangarampur	Tangan	10.3	56,217
13	Garulia	Hooghly	6.47	85,336
14	Gayespur	Hooghly	30.0	58,998
15	Ghatal	Shilabati, Dwarkeswar	10.4	54,591
16	Islampur	-	11.1	54,340
17	Jangipur	Hooghly, Padma	8.20	88,165
18	Jhargram	kansabati	21.4	61,712
19	Jiaganj-Azimganj	Hooghly	11.7	51,790
20	Kaliaganj	Tangan	11.7	53,530
21	Kalna	Hooghly	4.40	56,722
22	Kandi	Mayurakshi	13.0	55,632
23	Katwa	Ajay, Hooghly	8.43	81,615
24	Kharagpur Railway Settlement	Kansabati	32.4	82,735
25	Konnagar	Hooghly	4.32	76,172
26	New Barrackpore	Hooghly	6.89	76,846
27	Old Malda	Mahananda	9.68	84,012
28	Panskura	Kansabati	19.9	57,932
29	Phulia	Hooghly	15.0	55,653
30	Rampurhat	Mayurakshi	6.25	57,833
31	Ranaghat	Churni	7.72	75,365
32	Suri	Mayurakshi	9.47	67,864
33	Tamluk	Rupnarayan	17.9	65,306

Table 6: Demography of Class III Towns in Portion of the Ganga Basin Lying in the State of West Bengal

S No.	Town Name	River System	Area (sq km)	Town Population (Census, 2011)
1	Aistala	Churni	2.94	20,662
2	Arra	Damoder	8.64	21,272
3	Aurangabad	Padma	2.77	39,261
4	Bagula	Churni	3.60	22,649
5	Balarampur	Kangsabati	9.51	24,431
6	Banshra	Damoder	7.20	29,521
7	Baruipur (P)	Hooghly	10.0	22,430
8	Beldanga	Hooghly	3.98	29,205
9	Bhasaipaikar	Ganges	3.05	23,141
10	Birlapur	Hooghly	4.84	22,078
11	Birnagar	Churni	5.52	30,799
12	Chakapara	Hooghly	3.72	35,282
13	Chaltia	Hooghly	5.13	25,336
14	Chandrakona	Shilabati	16.6	23,629
15	Chata Kalikapur	Hooghly	5.66	24,985
16	Chittaranjan	Ajay	19.6	39,098
17	Cooper's Camp	Churni	1.50	23,119
18	Dainhat	Hooghly	10.4	24,397
19	Dalkhola	Fulahar	15.9	36,930
20	Dhuilya	Hooghly	2.43	20,962
21	Dhulagari	Hooghly	3.22	23,740
22	Diamond Harbour	Hooghly	10.4	41,802
23	Dubrajpur	Ajay	16.8	38,041
24	Egra	Champa	17.2	30,148
25	Farakka Barrage Township	Ganga	3.70	20,126
26	Ghuni	Hooghly	3.89	24,249
27	Gobardanga	Jamuna	13.5	45,377
28	Gopjan	Hooghly	9.62	23,415
29	Guskara	Kunur	17.2	35,388
30	Hindusthan Cables Town (Rupnarainpur)	Ajay	3.90	22,599
31	Jafrabad	Ganges	3.05	28,332
32	Jagadanandapur	Hooghly	3.93	23,822

S No.	Town Name	River System	Area (sq km)	Town Population (Census, 2011)
33	Jaynagar Mazilpur	Piyali, Hooghly	5.85	25,922
34	Jujarsaha	Hooghly	4.04	21,820
35	Kajora	Damoder	10.3	27,275
36	Kalara	Hooghly	4.64	27,210
37	Kanaipur	Hooghly	1.60	26,814
38	Kanksa	Damoder	8.66	23,789
39	Kankuria	Ganges	3.46	36,925
40	Kolaghat	Rupnarayan	6.07	25,191
41	Kurseong	Balason	7.85	42,446
42	Mahadeb Nagar	Ganga	3.43	21,737
43	Matla	Matla, Bidyadhari	10.2	31,920
44	Memari	Damoder River	8.84	41,451
45	Murshidabad	Hooghly	17.3	44,019
46	Nalhati	Hooghly	12.0	41,534
47	Nebadhai Duttapukur	Hooghly	3.29	25,557
48	Nibra	Hooghly	3.47	27,818
49	Panchla	Hooghly	4.51	26,432
50	Pandua	Hooghly	3.75	30,700
51	Paranpara	Ganges	5.66	22,297
52	Paschim Punropara	Padma	7.72	40,683
53	Podara	Hooghly	1.54	21,589
54	Pujali	Hooghly	8.32	37,047
55	Raghunathpur	Damoder	12.9	25,561
56	Sahajadpur	Jalangi	1.57	23,280
57	Sainthia	Mayurakshi	10.0	44,601
58	Salar	Hooghly	7.15	22,894
59	Sankrail	Hooghly	2.82	29,114
60	Sarenga	Kansabati	4.35	25,200
61	Shimulpur	Jamuna, Ichhamati	5.87	20,803
62	Shyampur	Old Damoder	7.45	22,024
63	Singur	Hooghly	6.40	21,382
64	Sonamukhi	Sali	18.0	29,085
65	Taherpur	Hooghly	2.01	38,039

S No.	Town Name	River System	Area (sq km)	Town Population (Census, 2011)
66	Taki	Ichamati	13.0	38,263
67	Tarakeswar	Damoder	3.88	30,947
68	Teghari	Damoder	3.54	25,058
69	Ukhra	Ajay, Damoder	7.33	24,104
70	Uttar Bagdogra	Balason	1.63	25,044
71	Uttar Raypur	Hooghly	5.32	23,084

4. Religious Places and Their Importance

The eastern bottleneck of the country is the state West Bengal covering Himalayan stretch in the north to the Bay of Bengal in the south. The state of West Bengal has significant importance in terms of religions and cultures live here. Many ancient and famous temples are found throughout the state. Belur Math, Kalighat Kali temple, Dakshineswar Kali temple, Tarapith temple, Rasmancha temple and many more temples are located near the rivers in the state. A significant number of devotees visited in these temples throughout the year and taking bath in holy river Ganga and its tributaries. The Kenduli fair and the Gangasagar fair or Gangasagar Yatra or Ganga Snan is the well known fairs congregate devotees around the river Ajay and river Hooghly. These fairs are also responsible for the dynamic change in the state economy. Some major religious events and their features have been illustrated in Table 7.

Table 7: Major Religious Events on River Banks in West Bengal

S No.	Religious Events	Place	Place/ River	Occasion
1	Ganga Sagar Mela	South 24 Pargana	Ganga Sagar	Makar Sankranti
2	Tusu Festival	Purulia, Bankura, Midnapur	Sessa river, Konsaboti river	Poush Sankranti
3	Dakshinray Utsav	South 24 Parganas	Hooghly river	-
4	Jaydev Kenduli Mela	Bolpur (Birbhum)	Ajay river	Makar Sankranti
5	Bera Utsav	Murshidabad	Bhagirathi river	-
6	Rath Yatra	Hooghly	Hooghly river	-
7	Mahalaya (Pitri Paksh)	All over West Bengal	-	Pitri Paksh
8	Durga Puja (Sharadotsav)	All over West Bengal	-	-
9	Rash Utsav	North 24 Paragana	Ganga river	-

S No.	Religious Events	Place	Place/ River	Occasion
10	Jagaddhatri Puja	Hooghly	Ganga river	
11	Kartikeya Puja	All over West Bengal	Ganga river	Karthik purnima
12	Chatth Puja	Kolkata, Siliguri	Ganga river	Chatth
13	Ganga Snan Mela	Nadia	Ganga river	Ramnavmi
14	Buddha Purnima	Siliguri	Ganga river	Buddha Purnima
15	Jalpesh Mela	Jalpaiguri	Teesta river	Shivratri

5. Pollution Load

The major pollution load in the area of basin under the state is due to point and nonpoint sources. Discharges of untreated/partially treated sewage from urban centres, discharge from open drain carrying sewage, discharges from the tributaries and discharge of untreated/partially treated wastewater from industrial units are the major point sources that contribute to the pollution load in the state. Damodar, Ajay, Dwarkeshwar, Saraswati and Shilbati are the major river basins under GRB in the state. All these basins are also contributing to the Hooghly basin. In the report published in 2009 by CPCB, the total water supply for Class I and Class II cities in the state was 3,723.53 and 225.56 MLD, respectively while sewage generation was 2345.2 and 180.4 MLD, respectively. The treatment capacity for Class I and Class II cities was only 21.6 and 34.3%, respectively of the total sewage generated (CPCB, 2009) (Figure 7).

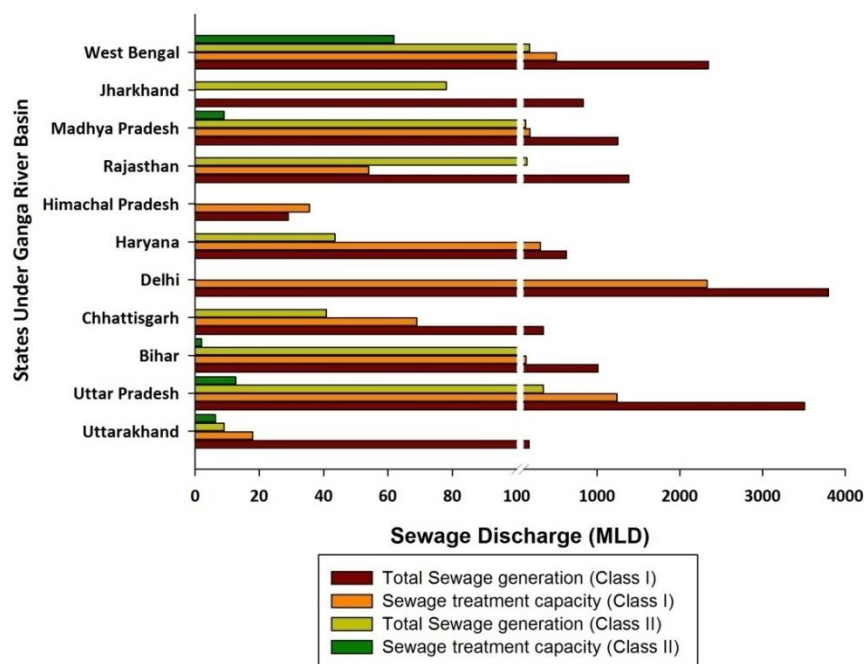


Figure 7: Assessment of Total Sewage Generation (MLD) and Sewage Treatment Capacity of Class I and II Cities in the States under Ganga River Basin

The pollution load for Class I cities, Class II and III towns have been estimated for the state (Figure 8). The maximum sewage generation is in the Class I cities (80%) followed by Class II (11%) and Class III towns (9%). The BOD and COD load for Class I cities, Class II and Class III towns are in the range of 76, 17 and 7%, respectively. The TKN load almost showing the same trend as BOD and COD load. The BOD, COD and TKN load of all the Class I cities, Class II and Class III towns are estimated on per capita basis by using standard values (Figure 8).

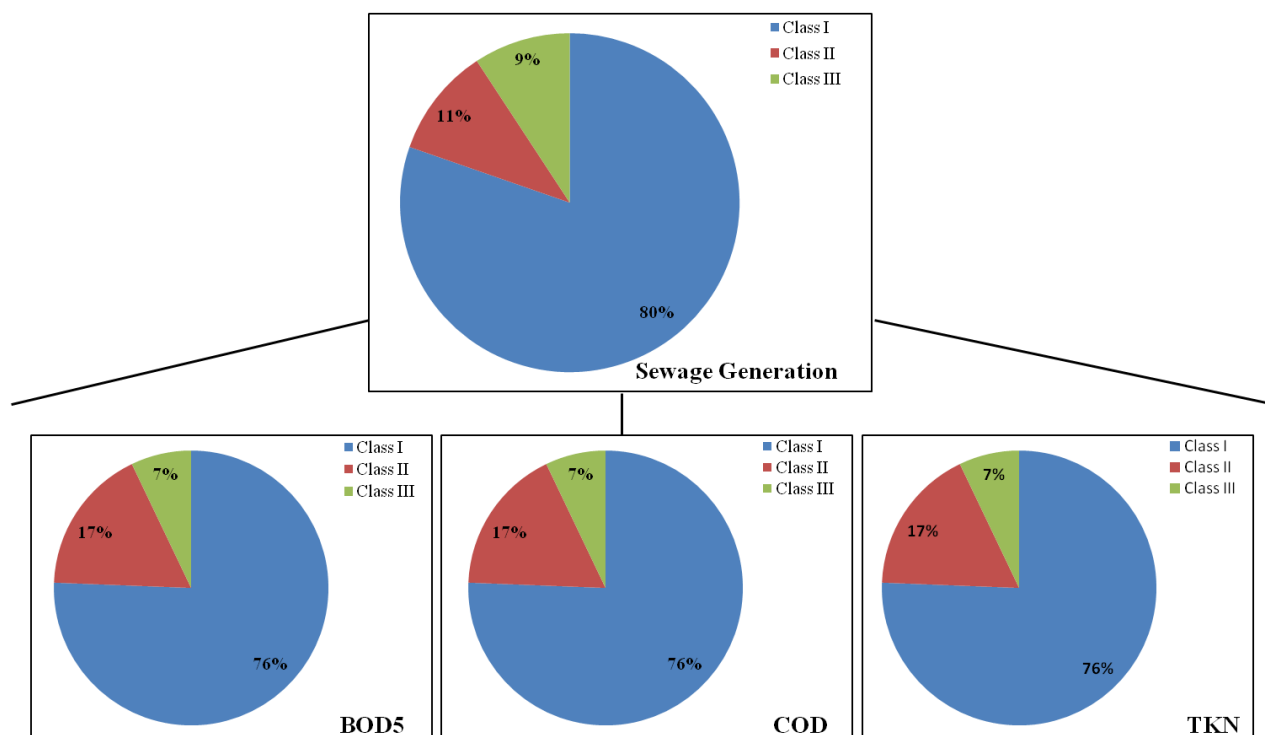


Figure 8: Distribution of Pollution Load of Class I Cities and Class II, Class III Towns in West Bengal

For Class I cities, the maximum sewage is generated in the city of Kolkata (485.6 MLD) followed by Howrah (116.3 MLD). The average sewage generation for Class I, II and III cities are 32.9, 10.3 and 3.1 MLD, respectively. As per the estimation, the total BOD and COD load in the state is nearly 477 and 811 tons/day, respectively from Class I cities. The load reduces for Class II cities and it is calculated as approximately 62 tons/day (BOD load) and 105 tons/day (COD load). The load due to Class III towns is even lesser (BOD: 54 tons /day and COD: 93 tons/ day). The average BOD and COD load from Class I towns is 8.2 and 13.9 tons/day, respectively whereas Class II towns contribute approximately 1.8 tons/day and 3.2 tons/day of BOD and COD, respectively. For Class III town the average values in the state are 0.8 tons/day for BOD and 1.3 tons/day for COD. In Class I towns, maximum BOD, COD and TKN load is from Kolkata,

whereas minimum is from Kalyani. The maximum and minimum BOD, COD and TKN contributing cities in Class II towns are Dhulian and Jiaganj-Azimganj, respectively. In class III towns, maximum and minimum BOD, COD and TKN load is from Gobardanga and Farakka Barrage Township, respectively. The estimates of total water supply, total sewage generated, BOD, COD and TKN loads are summarized and illustrated in Figures 9a-11c for class I cities, class II and class III towns. The comparative account of all the classes (I, II and III) for its population, sewage generation, water supply and BOD, COD and TKN loads are presented in Figure 12.

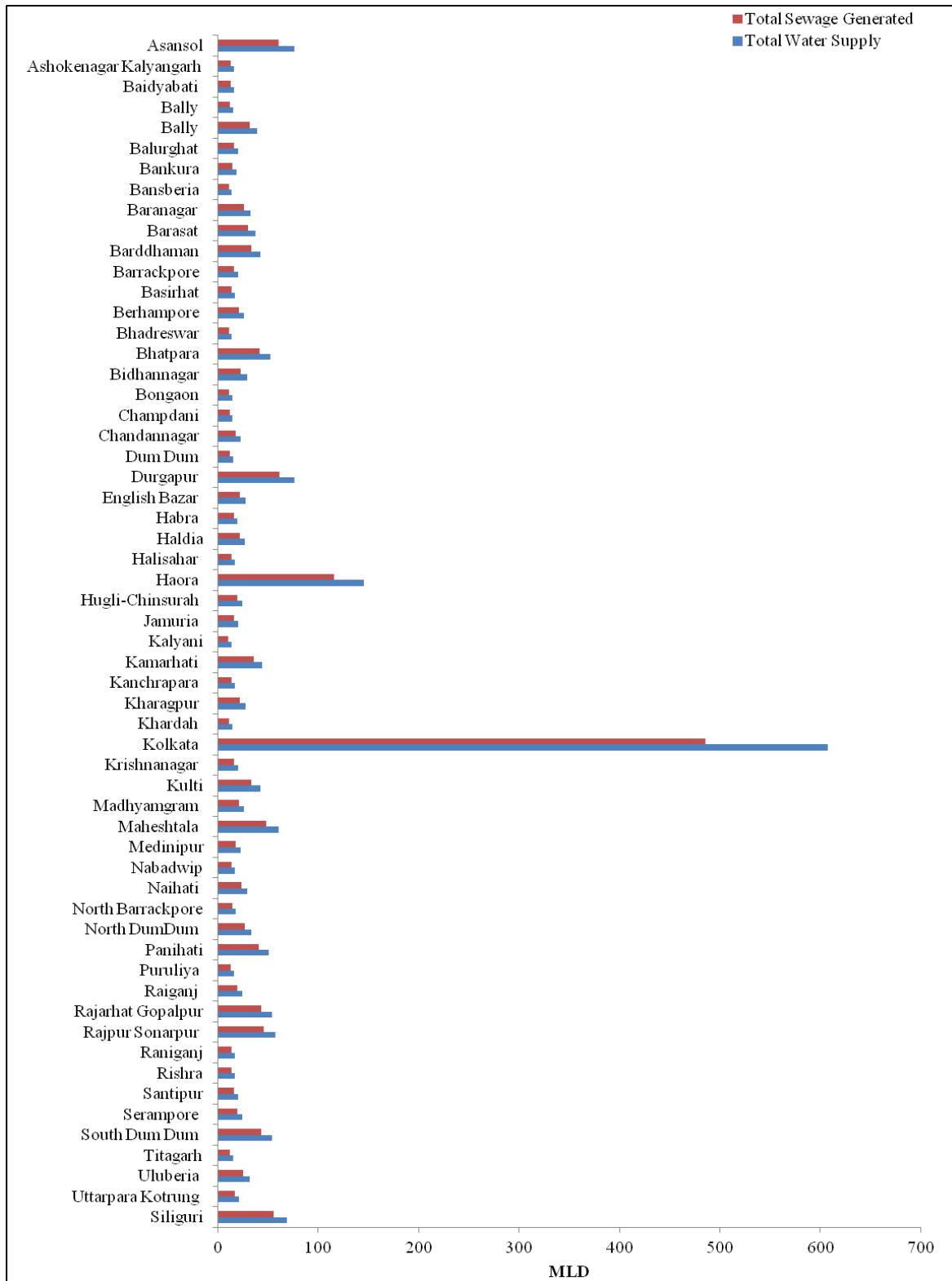


Figure 9a: Assessment of Water Supply and Sewage Generation (MLD) in Class I Cities in the Ganga River Basin Lying in the State of West Bengal

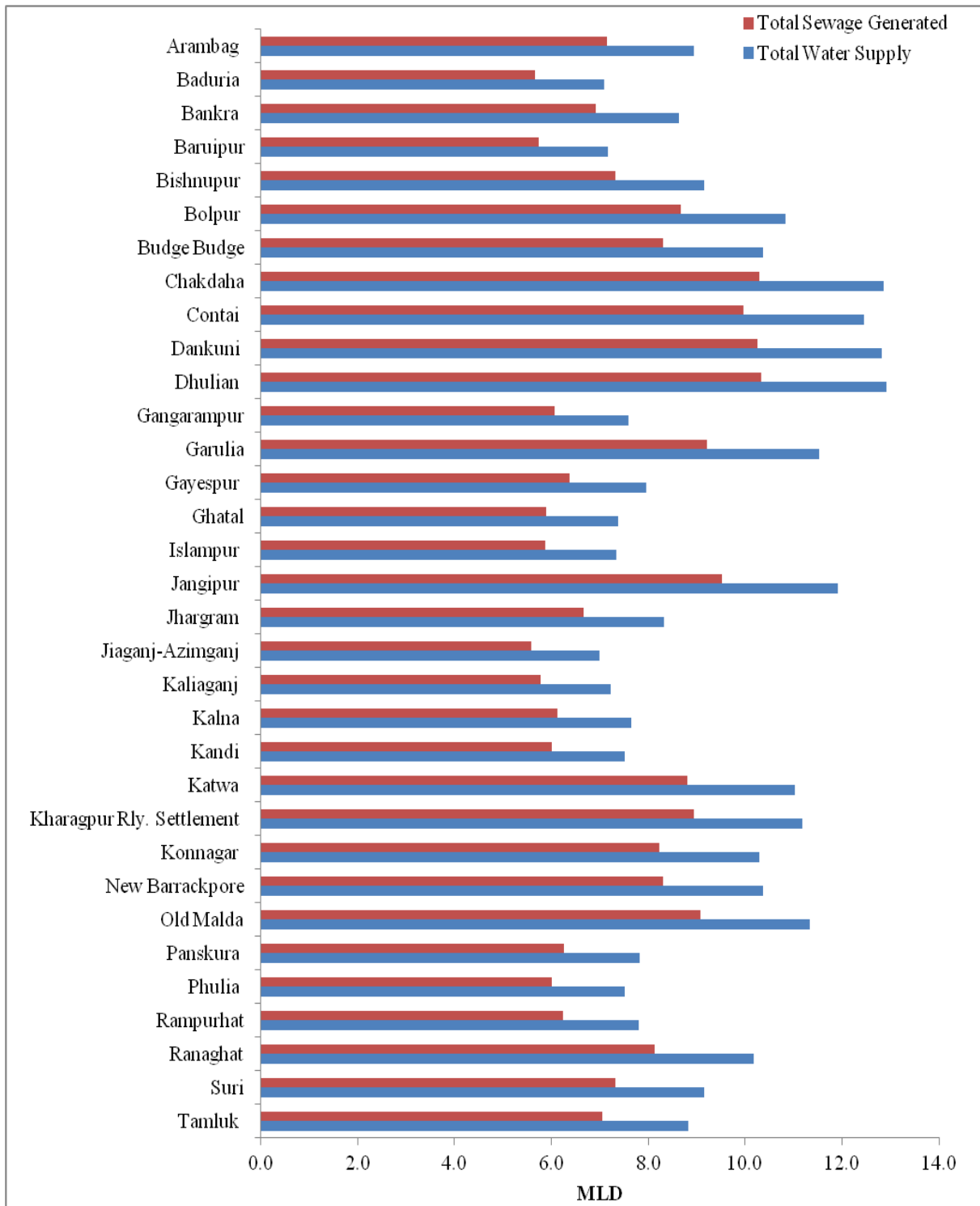


Figure 9b: Assessment of Water Supply and Sewage Generation (MLD) in Class II Towns in the Ganga River Basin Lying in the State of West Bengal

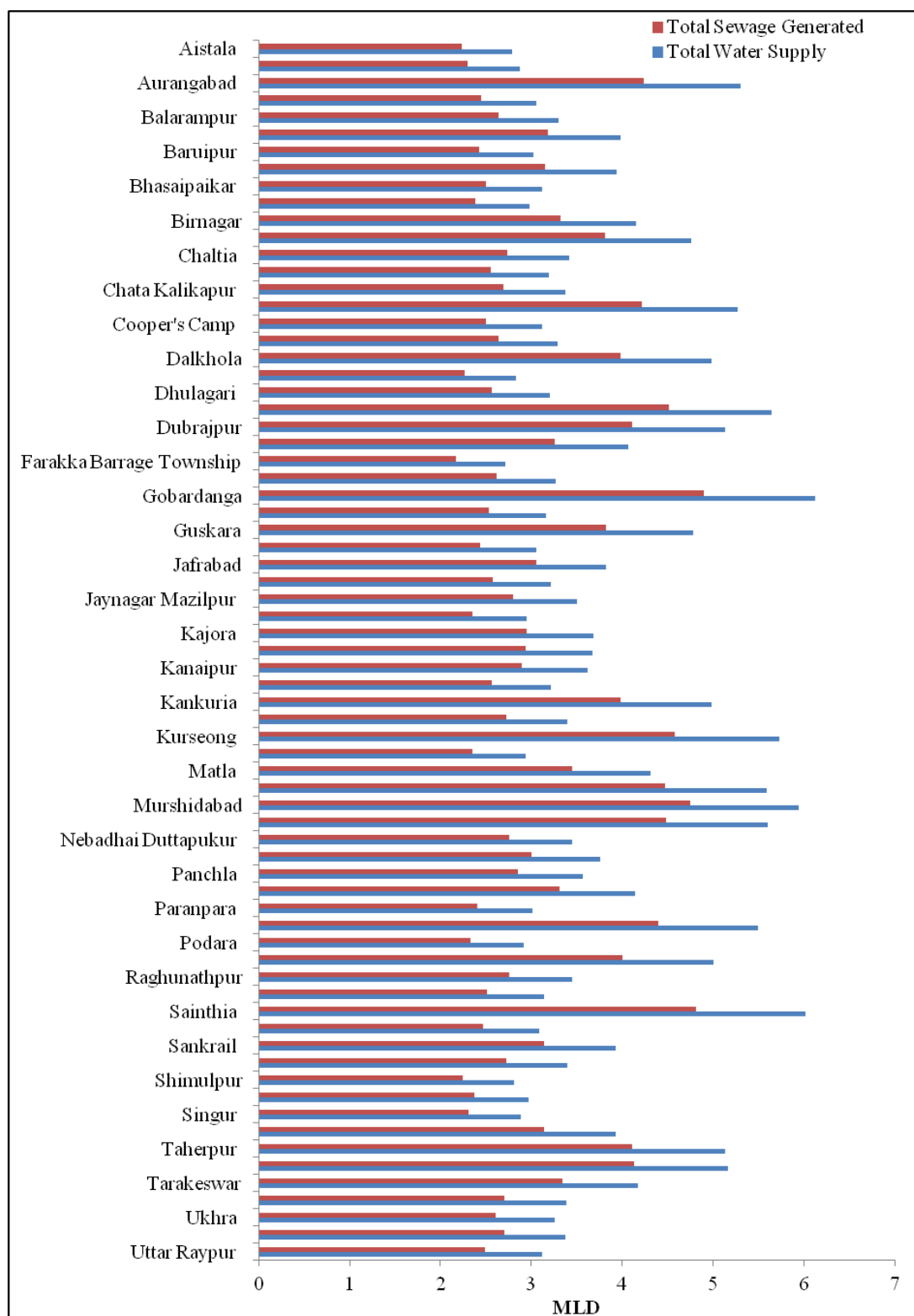


Figure 9c: Assessment of Water Supply and Sewage Generation (MLD) in Class III Towns in the Ganga River Basin Lying in the State of West Bengal

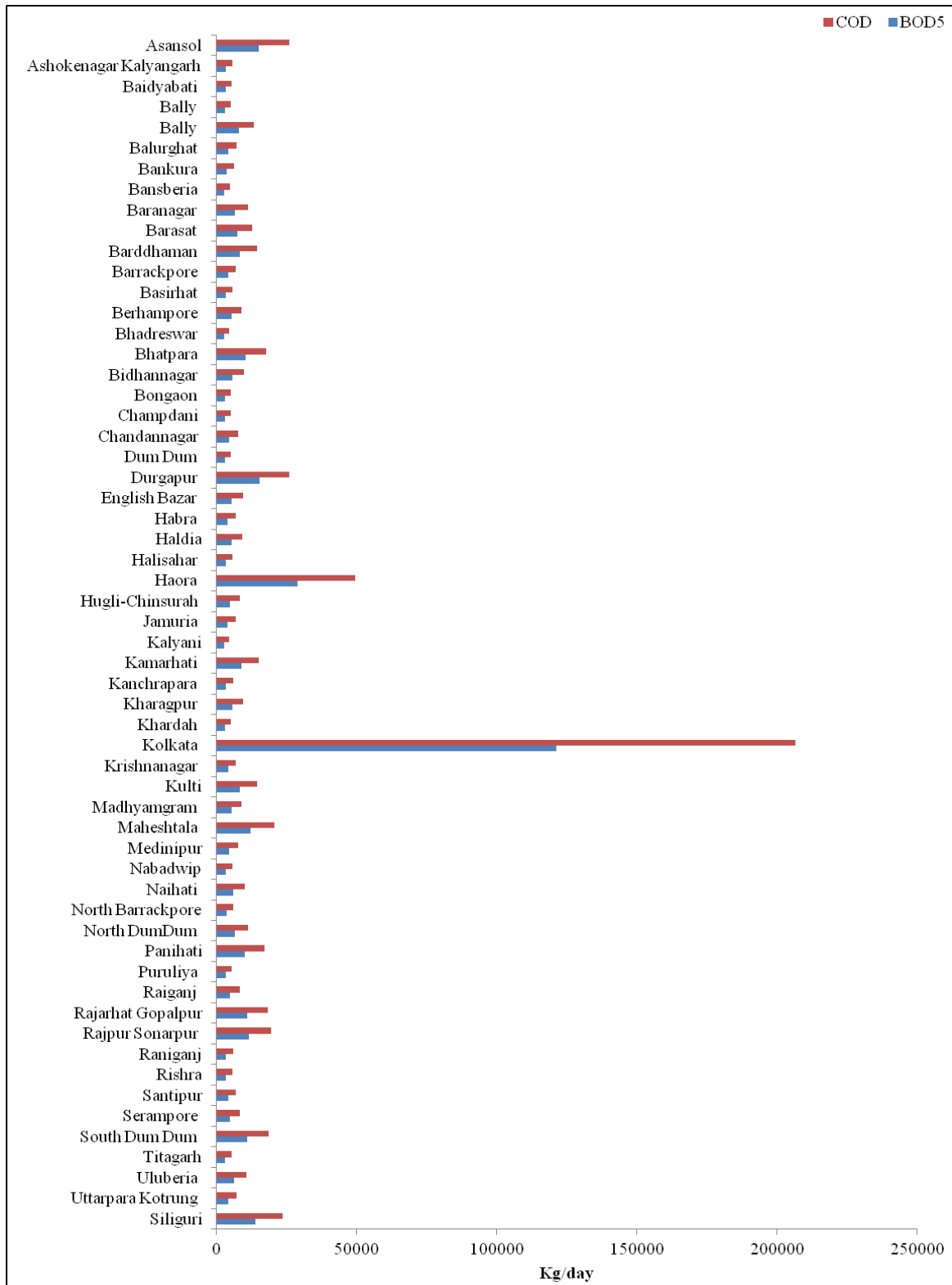


Figure 10a: Assessment of Organic Pollution Load (kg/day) from Class I Cities in the Ganga River Basin lying in West Bengal

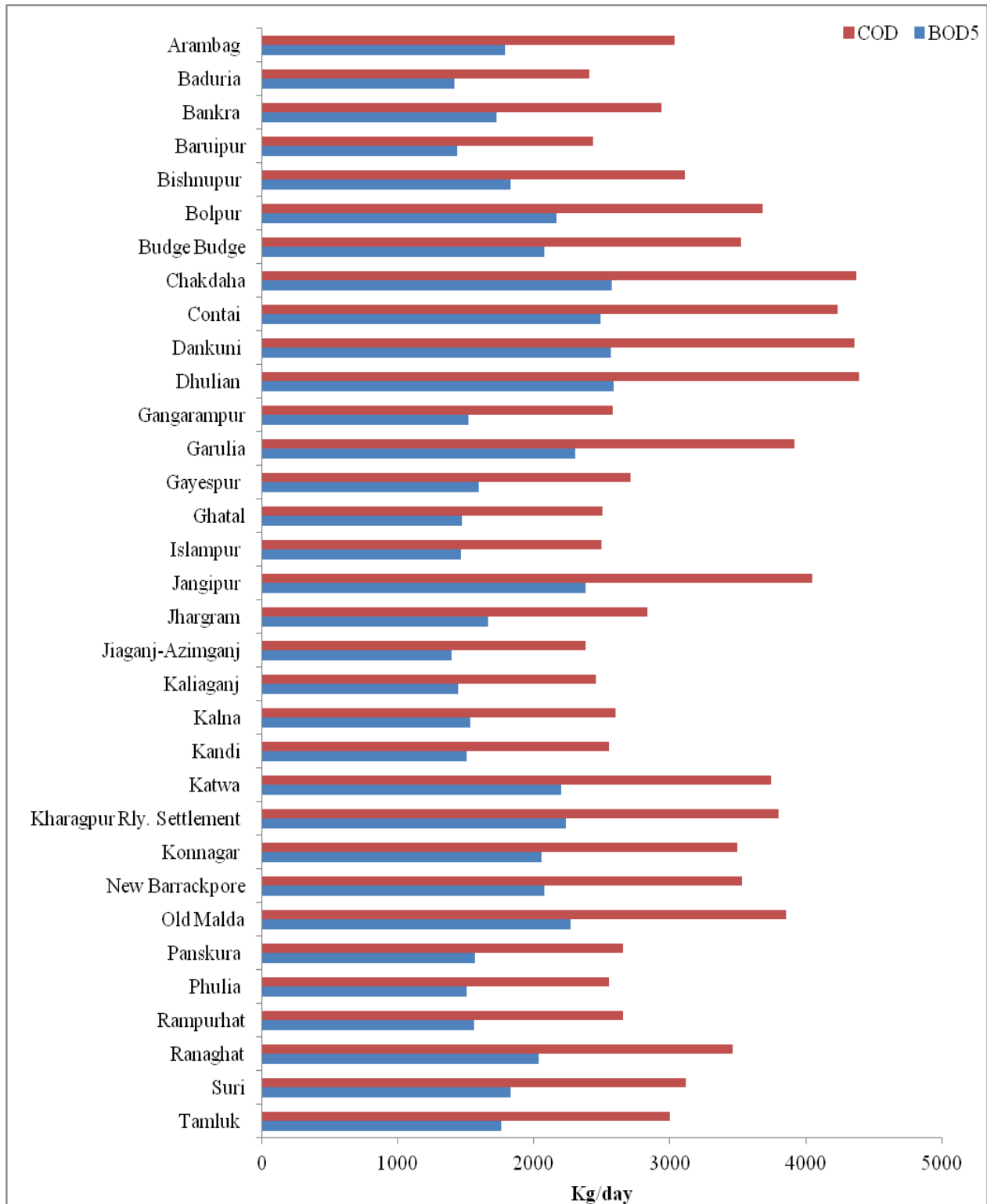


Figure 10b: Assessment of Organic Pollution Load (kg/day) from Class II Towns in the Ganga River Basin Lying in West Bengal

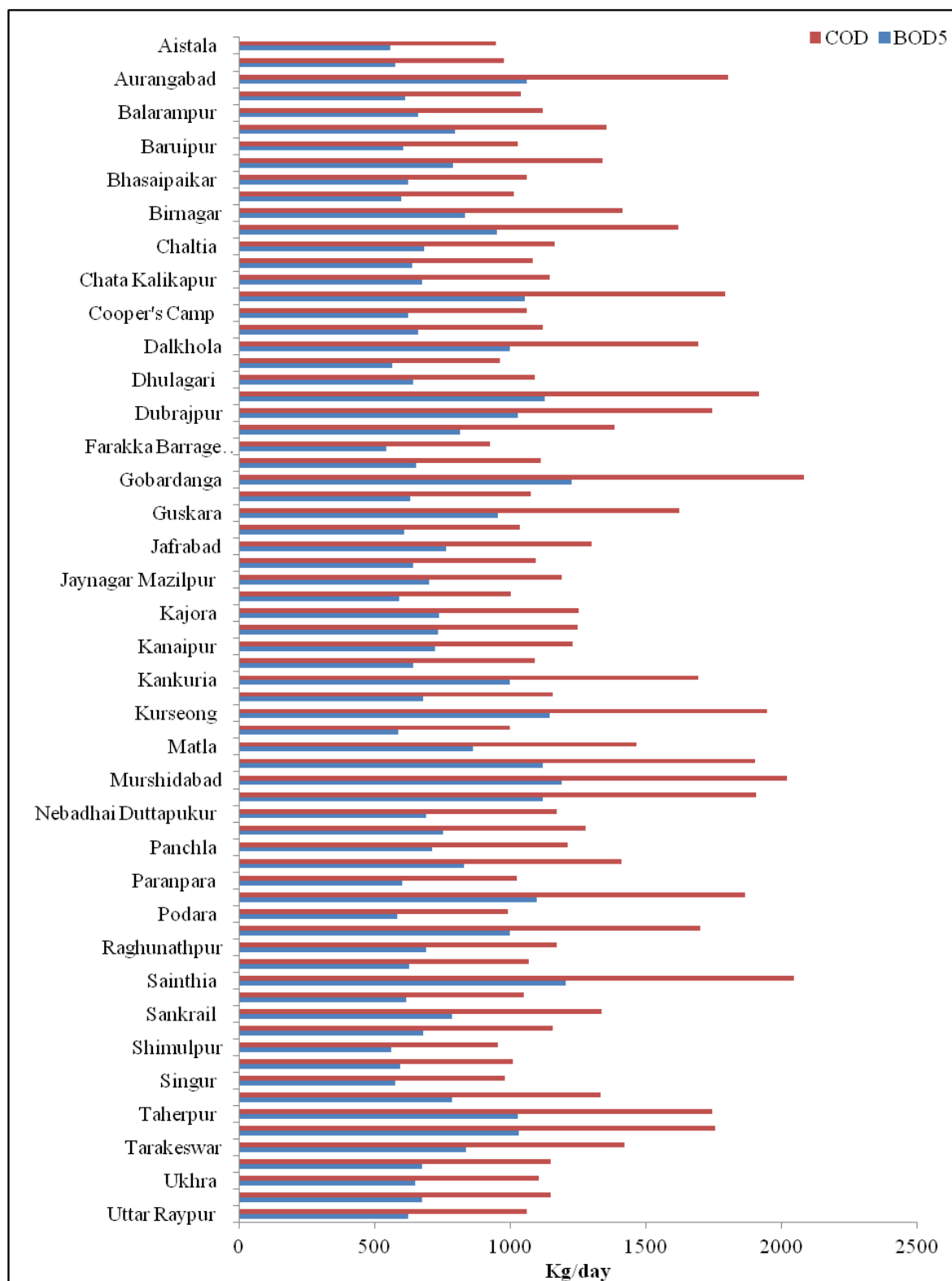


Figure 10c: Assessment of Organic Pollution Load (kg/day) from Class III Towns in the Ganga River Basin Lying in West Bengal

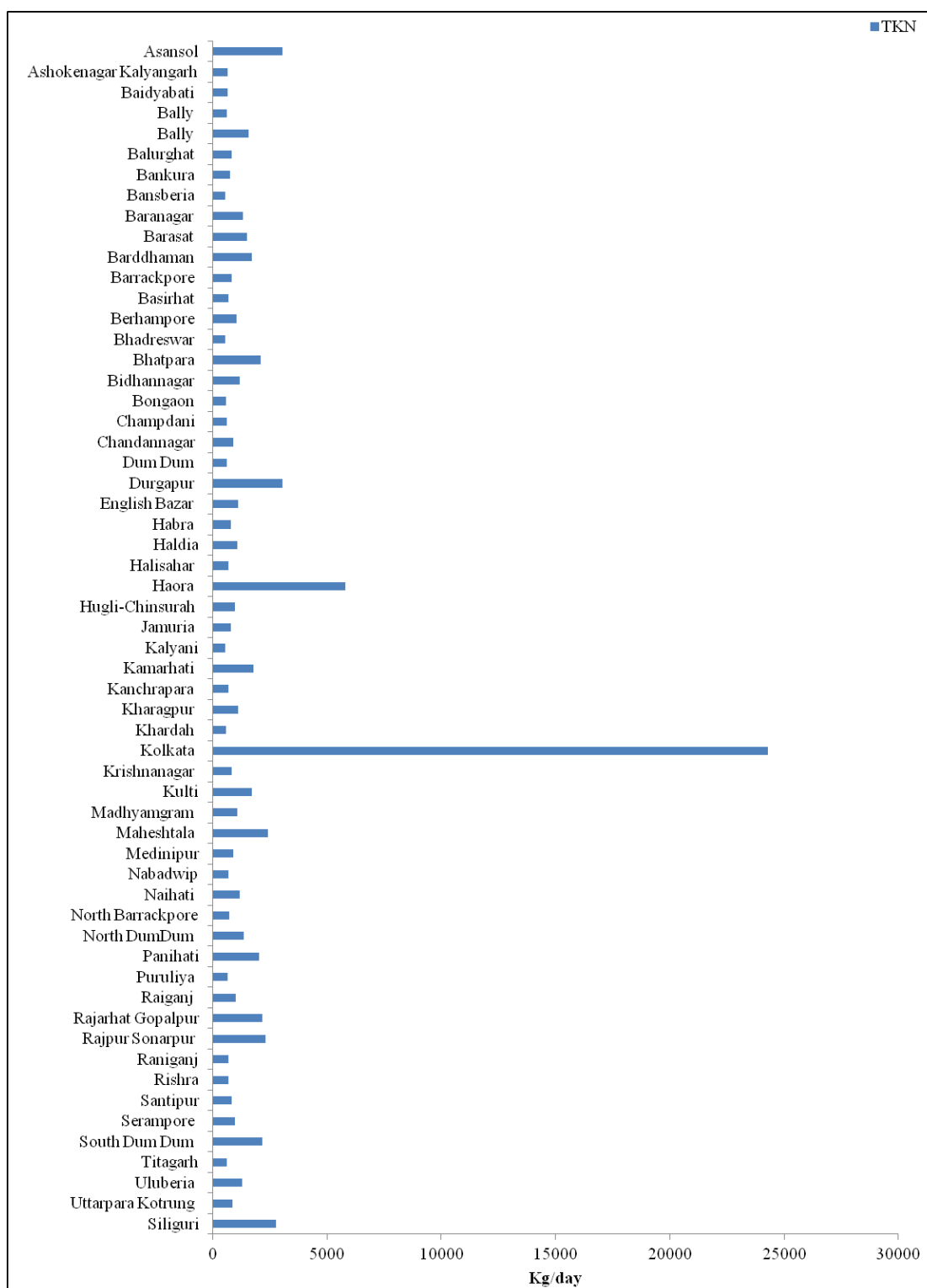


Figure 11a: Assessment of TKN Load (kg/day) from Class I Cities in the Ganga River Basin Lying in the State of West Bengal

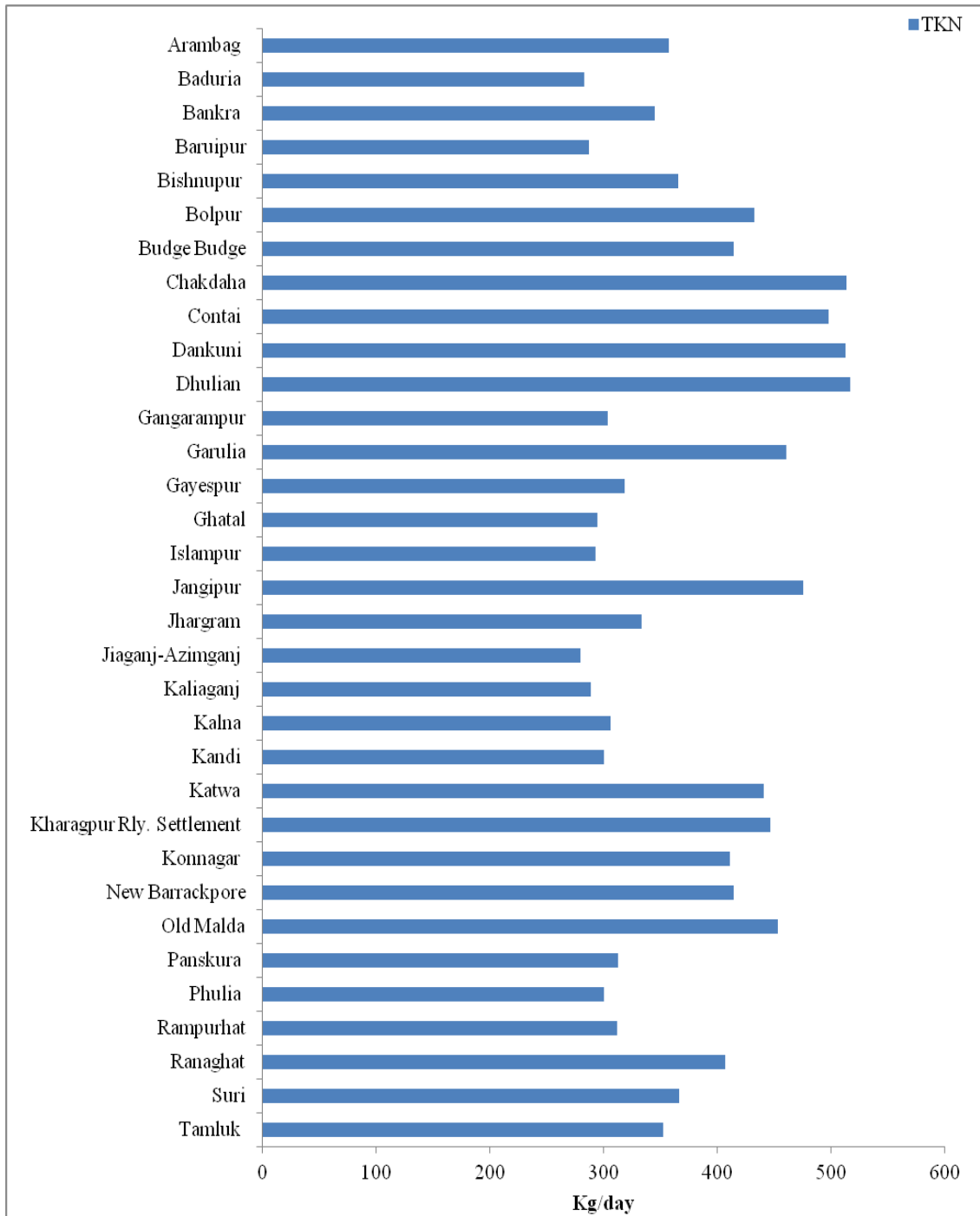


Figure11b: Assessment of TKN Load (kg/day) from Class II Towns in the Ganga River Basin Lying in the State of West Bengal

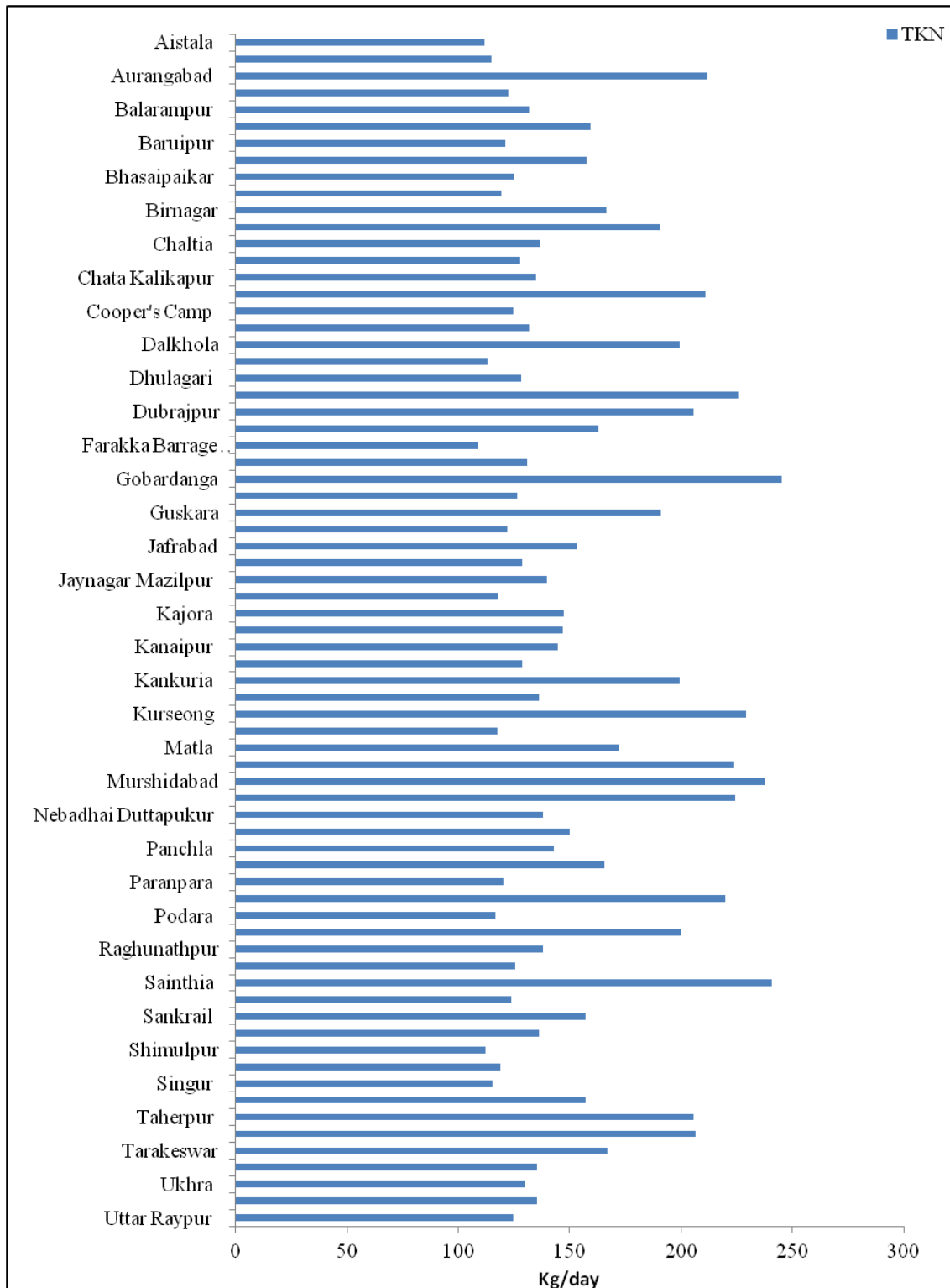


Figure11c: Assessment of TKN Load (kg/day) from Class III Towns in the Ganga River Basin Lying in the State of West Bengal

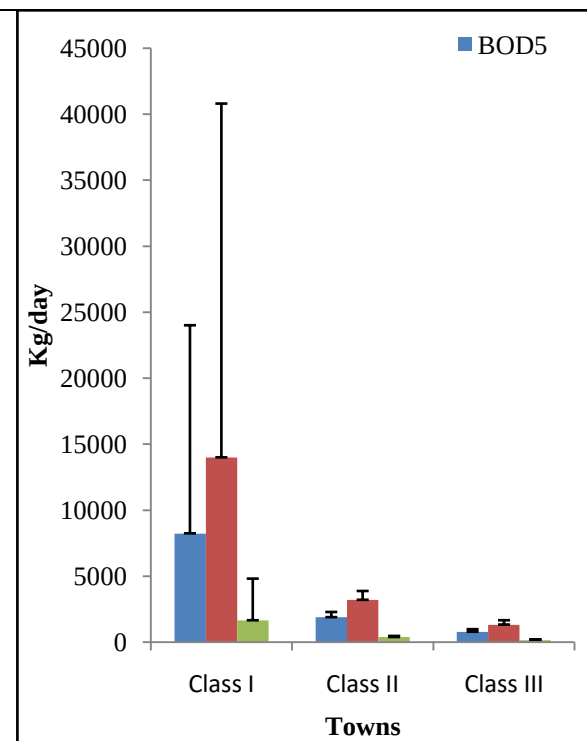
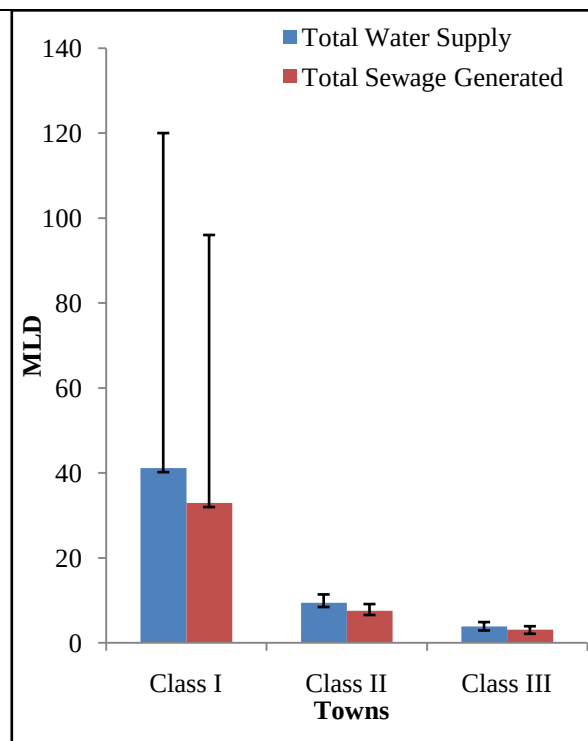
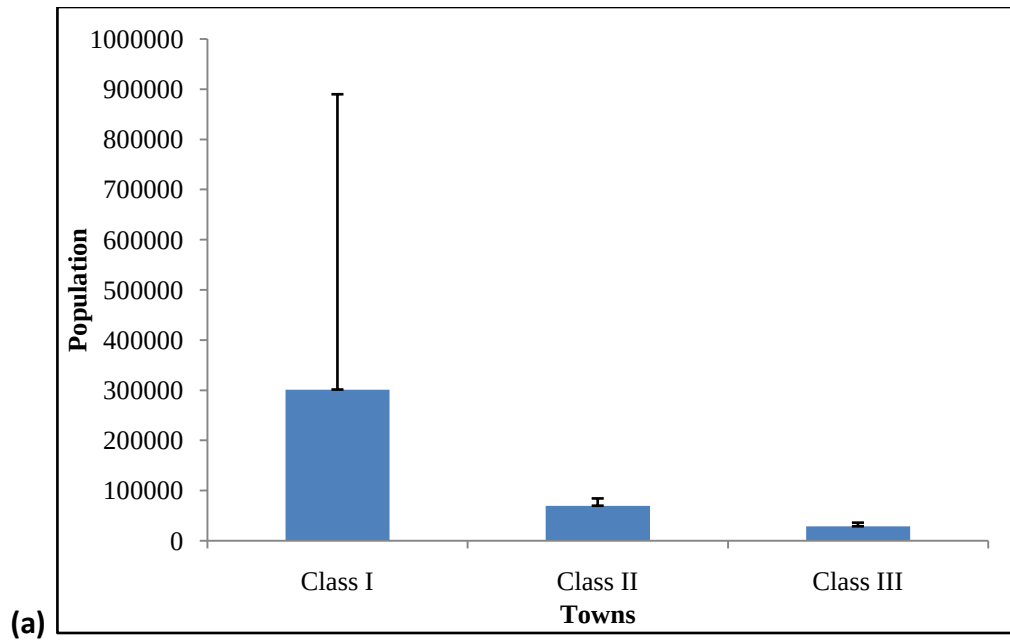


Figure 12: Comparative Analysis of Class I, Class II and Class III Cities/Towns Lying Under the State: (a) Population (b) Total Water Supply and Sewage Generation (c) Pollution Load

6. Conclusions

River Ganga in the state of West Bengal from Farakka barrage splits into Bhagirathi/ Hooghly stream on the right and Padma stream on the left. Construction of Farakka barrage in the state not only changes the hydrology of the river, it heavily impacted the riverine biodiversity. Water quality of river Bhagirathi-Hooghly was studied number of times by WBPCB in between 2004 and 2007 at the major centres like Berhampur, Garden Reach and Diamond Harbour (WBPCB, 2009 and Bandyopadhyay et. al., 2014). CPCB also tested some critical water quality parameters in Bhagirathi-Hooghly for certain sampling stations between 2006-2011 and reported in 2013 (CPCB, 2013).

The catchment of the river bears the load of 58 Class I cities, 33 Class II towns and 71 Class III towns, directly or indirectly. The main Class I cities of the state are Asansol, Bardhaman, Barrackpore, Durgapur, Haldia, Dumdum, Howrah, Kharagpur, Kolkata, Medinipur, North Dumdum and South Dumdum.

The multitudinous problems also arise during lean season due to the continuous discharge of untreated and/or partially treated sewage and industrial wastewater. The Ayay, Konsaboti, Rupnarayan, Saraswati, Mahananda and Damodar tributaries discharge their partially treated and untreated effluent into river Ganga/ Hooghly. As per our estimation the pollution load in terms of BOD and COD in the state is nearly 477 and 811 tons/day, respectively from Class I cities. For Class II and Class III towns, pollution load (BOD and COD) is approximately BOD: 62 tons/day and COD: 105 tons/day and BOD: 54 tons /day and COD: 93 tons/ day, respectively.

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