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## Impact of Urbanisation on Water Resources in Municipal Urban Areas of Barrackpore Sub-Division, North 24 Parganas, West Bengal

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### **Abstract:**

*A considerable section of Barrackpore Sub-division's population is increasingly opting for the non-agricultural way of life resulting in rapid urbanisation in each of the 16 municipalities of the Sub-division. Since 2001, there has been a huge increase in urban centres across the Sub-division against a decline in the number of villages. A sharp rise of the number of 'census towns' since 2001 is a clear indication that people from rural backgrounds are increasingly discarding agriculture as a livelihood option and opting for more urban alternatives. Accelerated urbanization is the main processes responsible for increased pressure and deterioration of water resources. A large number of people depend for their drinking and domestic water on underground water sources. As population continue to climb, demand for limited water supplies has been steadily increasing in the urban sector, efficient water use is critical for water systems to support growth in their communities.*

**Keywords:** urbanisation, urban centres, census towns, underground water resources, water demand and supply.

### **1. Introduction**

Urbanisation refers to a process, in which an increasing proportion of an entire population lives in cities and the suburbs of cities. Urbanisation and population pressure are the two main challenges to water resources management. Urbanisation is commonly accepted to cause several detrimental effects to the water resources of a city. The volume of urban water use per capita is defined as 'the relationship between the water use for urban purposes and population'. It shows the trend of water use in that particular sector and its potential impact on water resources. In Barrackpore Sub-division, the water supply systems are introduced through overhead reservoirs and pipe line networks. Different municipalities have different rate of supplied water per day. As the population pressure increases rapidly, the per capita availability of water also becomes well below the desired norms. Water demand is the quantity of water that the treatment plant must produce in order to meet all water needs in the community. The purpose of water supply and Demand Strategies is to identify the best mix of measures to maintain a balance between the demand for water and available supply in urban supply systems now and into the future. Use of water resources that minimizes impacts on both ground water and surface water requires a comprehensive, long-term approach to water resources management that takes system interactions into account. System response to ground-water withdrawals is most obvious in lowered ground-water levels.

### **2. The Study Area**

Barrackpore Sub-division was founded in 1858 in North 24 Parganas district of West Bengal and the geographical co-ordinates of this Sub-division is 22° 76'N of latitude and 88° 37'E of longitude. The total area of this Sub-division is 334.51 sq km. The Sub-division consists of sixteen municipalities, one cantonment board (Barrackpore Cantonment), one census town (Ichhapur Defence Estate) and two Community Development (C D) Blocks: Barrackpore- I and Barrackpore- II. The municipalities are Kanchrapara, Halisahar, Naihati, Bhatpara, Garulia, Barrackpore, North Barrackpore, Titagarh, Khardah, Kamarhati, Baranagar, Dum Dum, North Dum Dum and South Dum Dum

### **3. Methods and Materials**

Due to the rapid growth of urbanisation, population increased rapidly in both the municipalities and villages. The decadal population data during 1971 and 2011 are collected from 'Census of India' and the growth rate of population of decades are calculated and represented through different cartograms.

Demographic features like total population growth and decadal growth rates have been taken as major indicators. Data have been collected from the 'District Census Hand Books'; Government of West Bengal, for the period 1971 and 2011. A large number of people of Barrackpore Sub-division depend for their drinking and domestic water on underground water sources. The data of seasonal ground water table are collected from the different municipalities, Central Ground Water Board (ER), Kolkata and also from primary sources.

The amount of supply of water per day, per capita is collected from different municipalities. On the basis of these data per capita water demand is calculated through the following formula (Seckler, 1998):

Per capita water demand=  $Q / (P \times 365)$  liters /day

Where Q= total quantity of water required, P= Population

Depending upon the computed values of average annual water demand, average daily water demand and average community daily water demand for the year 2001 and 2011 are calculated by “small system method” (Seckler, 1998) and represented through different cartograms.

Average community daily water demand = Average daily water demand  $\times$  Number of people

#### 4. Results and Discursssion

##### 4.1. Urban growth of Barrackpore Sub-division

The growth rates in urban municipal areas of Barrackpore Sub-division are fluctuating in almost every decade.

Municipalities	1971-1981	1981-1991	1991-2001	2001-2011	2011-2021
Baranagar	24	32	11.5	-0.9	-7.39
Barrackpore	19	15.4	8.3	7	1.55
Bhatpara	30	14.9	45.1	-11.7	-4.02
Dum Dum	7	21.9	147.3	16.1	86.57
Garulia	29	41.8	-1.2	6.5	-8.57
Halisahar	44	14.8	9.2	1.9	-15.59
Kamarhati	39	13.6	17.8	7	-3.4
Khardah	40	95.3	31.8	-4.6	-8.72
Naihati	40	15.8	89.4	-11.8	13.11
New Barrackpore	43	37.1	30.4	-7.6	-13.94
North Barrackpore	7	23.1	22.9	9	16.93
North Dum Dum	51	55.5	46.7	15.3	13.15
Panihati	39	34.2	26.3	10.1	3.71
South Dum Dum	32	1.1	68.6	4.6	22.85
Titagarh	18	9.1	8.9	-4.7	-9.46
Kanchrapara	25	1.4	25.9	-3.2	-2.93

Table 1: Growth rate (%) and expected growth rate (%) of municipal population in Barrackpore Sub-division

Data Source: Computed by the researcher based on Census of India data, 1971-2011

In the decade 2001-2011, the negative growth rates of population are seen in seven municipalities. These are Baranagar (-0.9%), Bhatpara (-11.7%), Khardah (4.6%), Naihati (-11.8%), New Barrackpore (-7.6%), Titagarh (-4.7%) and Kanchrapara (2.9%) (Table-1). The expected growth rate of population is computed to show the negative growth rate of population in nine municipalities. These are Baranagar (-7.39%), Bhatpara (-4.02%), Garulia (-8.57%), Halisahar (-15.59%), Kamarhati (-3.4%), Khardah (-8.72%), New Barrackpore (13.94%), Titagarh (-9.46%) and Kanchrapara (-2.93%). The highest growth rate is seen in Dum Dum Municipality (86.57%).

Some rural areas are merged into the municipal administrative boundaries of some municipalities as the decadal growth rates become high in those municipalities. Besides, industrial development with technological up gradation and urban amenities are more accessible in these municipalities. These attract by the people and the growth rates are increased rapidly.

##### 4.2. Urban water demand and supply

In Barrackpore Sub-division, the water supply systems are introduced through overhead reservoirs and pipe line networks. Different municipalities have different rate of supplied water per day. As the population pressure increases rapidly the per capita availability of water also becomes well below the desired norms. Not all the households have individual water connections in some municipalities and not all localities and areas are covered by the water distribution network. In some municipalities, the supply is unreliable due to irregular supply, inadequacy, short duration as well as poor quality of water. Consumers have made additional investments on installing individual tube wells, hand pumps, booster pumps etc. as supply of water is not adequate in all regions. The deficiencies of water are acute in summer months due to the increase in demand and drying up of several sources.

Municipalities	Average daily water supply in million litre/day	
	2001	2011
Baranagar	18.00	20.00
Barrackpore	14.56	16.06
Bhatpara	27.12	27.50
Dum Dum	1.03	2.02
Garulia	9.00	10.00
Halisahar	208.01	300.01
Kamarhati	61.36	70.30
Khardah	14.92	15.06
Naihati	300.00	350.00
New Barrackpore	95.00	98.00
North Barrackpore	26.00	30.00
North Dum Dum	30.00	35.00
Panihati	30.36	40.00
South Dum Dum	30.00	45.40
Titagarh	160.00	200.00
Kaanchrapara	10.00	15.00

Table 2: Average daily water supply of the different municipalities in Barrackpore Sub-division  
Data Source: Office of the municipalities of Barrackpore Sub-division, 2011

Table-2 represents the average daily water supply in the different municipalities in the last decades (2001-11). The maximum supply of water is recorded in the Naihati Municipality in both the year 2001 and 2011 as Naihati Municipality is included under the JNNURM scheme for water supply, and the minimum water supply is found in Dum Dum Municipality in both the years. The average daily water demand is the total volume of water delivered to the system over a year divided by 365 days. The average use in a single day expressed in million litres per day. This values are multiplies by the population of the present year to get the average community daily water demand.

Average community daily water demand = Average daily water demand × Number of people

Municipality	Average community daily water demand (million litre/day)	
	2001	2011
Baranagar	18.81	24.85
Barrackpore	14.44	23.17
Bhatpara	36.72	39.05
Dum Dum	12.16	14.12
Garulia	9.56	10.21
Halisahar	15.07	16.50
Kamarhati	26.73	33.66
Khardah	19.23	18.34
Naihati	33.93	37.09
New Barrackpore	9.15	9.99
North Barrackpore	15.46	18.88
North Dum Dum	28.61	32.97
Panihati	31.36	46.02
South Dum Dum	39.24	61.58
Titagarh	10.56	15.40
Kaanchrapara	12.62	14.66

Table 3: Average community daily water demand of the different municipalities  
Data Source: Computed by the researcher and Office of the municipalities of Barrackpore Sub-division, 2011

Table-3 represents the average community daily water demand in municipal urban areas of Barrackpore Sub-division for the years 2001 and 2011. The maximum average community daily water demand is found in South Dum Dum Municipality in both the years 2001 and 2011 because this municipality contains a huge number of populations. The minimum average community daily water demand is recorded in New Barrackpore Municipality in both the years of 2001 and 2011.

Municipalities	Water Balance (Million litre/ day)	
	2001	2011
Baranagar	-0.80	-4.84
Barrackpore	0.12	-8.11
Bhatpara	-9.59	-11.53
Dum Dum	-1.89	-12.09
Garulia	-0.59	-0.21
Halisahar	5.73	283.51
Kamarhati	34.62	36.64
Khardah	-4.31	-3.27
Naihati	-39.25	-2.09
New Barrackpore	8.20	88.00
North Barrackpore	10.54	11.12
North Dum Dum	1.39	317.02
Panihati	-0.99	-6.02
South Dum Dum	9.24	392.42
Titagarh	14.94	184.60
Kaanchrapara	-2.61	0.33

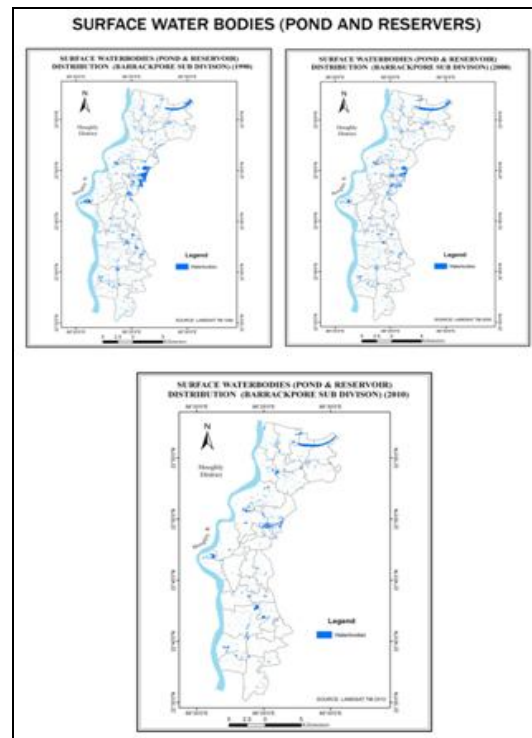
*Table 4: Balance between water demand and supply in Municipalities, 2001 and 2011*

*Data Source: Computed by the researcher, based data provided by the municipal office of Barrackpore Sub-division. 2011*

Table-4 represents the water balance between average daily water supply and average community daily water demand in the municipal urban areas for the year 2001 and 2011. In 2001 nine municipalities (Baranagr, Bhatpara, Dum Dum, Garulia, Khardah, Naihati, Panihati and Kachrapara) have the negative water balance, and in 2011 still five municipalities (Baranagar, Barrackpore, Bhatpara, Dum Dum, Garulia, Khardah and Panihati) have the negative water balance. This is because some municipalities supply water for 24 hours and the water deficit is reduced during the last ten years.

A huge population put pressure on the water demand and the municipalities are not able to fulfil the increasing water demand and a negative water balance is seen in those municipalities. Ground water is the main source of municipal water supply system and a huge volume of water is withdrawn everyday from underground water sources. As a result depletion of water table is a problem in this Sub-division.

4.3. Impact of urbanization on surface and ground water resources



Map 1

Map-1 represents the status of surface water sources (mainly ponds and water bodies) in Barrackpore Sub-division for the years 1990, 2000 and 2010. Due to the rapid growth of urbanization as well as industrialization the surface water sources are deteriorated simultaneously. In the southern part of this Sub-division, urban growth and settlement concentration is high and therefore small and medium sizes of water bodies are converted to residential areas. It is easily found that in the year 1990 the middle and eastern part of this Sub-division was occupied by a large number of water bodies and ponds, but in the year 2010 a few number of water bodies are found in this part of the Sub-division. Moreover, in rural areas (mainly in Barrackpore CD Block-I), the urban out growth and census towns are growing rapidly and as a result, surface water bodies are being converted into settlement and industrial areas.

Municipalities	Ground water table variation in %	
	Jan-June	July-Dec
Baranagar	3.26	14.28
Barrackpore	3.15	12
Bhatpara	2.04	12.5
Dum Dum	5.55	12.5
Garulia	12.5	6.66
Halisahar	13.33	20
Kamarhati	8.88	12.5
Khardah	5.88	21.42
Naihati	5.55	5.88
New Barrackpore	3.26	7.14
North Barrackpore	12.5	13.33
North Dum Dum	6.25	14.28
Panihati	12.28	15.38
South Dum Dum	12.5	6.66

Titagarh	8.1	15.38
Kanchrapara	5.55	5.88

*Table 5: Change in ground water table of the municipalities from 2001 and 2011  
Data Source: Computed by the researcher, based on municipal data of 2001 and 2011*

Table-5 represents the decreasing rate of ground water table in the different municipalities of Barrackpore Sub-division in the months of January to June and July to December. The maximum decreasing rate, in the months January to June is found in Halisahar Municipality (13.33%) while the minimum is noticed in Barrackpore Municipality (3.15%). In the months of July to December the maximum changing rate is observed in Khardah Municipality (21.42%) and the minimum rates are noticed in Naihati and Kanchrapara Municipalities.

The average rate of decrease of ground water in all municipalities is 6.75% during the last 10 years in the months January to June. But in the months July to December the average rate of decrease is 12.18% during the same period. So in every year the ground water table goes down fulfil the urban water needs.

## 5. Conclusion

The water supply system in urban municipal areas of Barrackpore Sub-division is based on piped lines, overhead reservoirs, deep tube wells and hand pumps; but in rural sectors, the water supply system is based on the deep tube wells, dug wells, hand pumps and small amount of piped lines. As the standard of living is high in urban areas with a huge population pressure, the average community daily water demand is also very high. But in rural sectors, the water demand is low compared to the urban areas. As the population growth is high in both the rural and urban areas, a huge volume of water is withdrawn everyday from the underground storage and a high rate of ground water depletion is found in this Sub-division, and therefore, some parts of the urban areas of the Sub-division experience water stress situation.

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