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Water Resources in Relation to Industrial Development of Barrackpore Sub-Division, North 24 Parganas, West Bengal

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Abstract:

Industrialization contains the social and economic changes in Barrackpore Sub-division. It transforms the human group from an agrarian society into an industrial one. The demand for water increases rapidly with the growth of industries. Barrackpore Sub-division has plenty of surface water bodies but the industries depend their required water from the underground water sources. As a result the potentiality of underground water storage decreases rapidly. Besides, the surface water bodies are polluted by the industrial waste water. This study reveals the situation of industrial growth and its impact on water resources both surface and ground water sources.

Keywords: *Industrialization, surface water, underground water sources, industrial water demand, ground water potentiality*

1. Introduction

Water resources are used in various ways, including direct consumption, agricultural irrigation, fisheries, hydropower, industrial production, recreation, navigation, environmental protection, disposal and treatment of sewage, and industrial effluents (William *et al.*, 2010). Barrackpore Sub-division depends largely upon South west/ summer monsoon for its water resources. About 78% of total annual rainfall occurs during the period from June to September and the balance 22% in the remaining period (West Bengal Development Report, 2010). The groundwater reserve and surface runoff constitute the water resources of the Sub-division. Industrial water use includes water used for such purposes as fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or for sanitation needs within the manufacturing facility (Thomson, 1998).

2. 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 are 22°76N of latitude and 88°37E 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. Results and Discussion

3.1. Industrial Growth of the Study Area

Barrackpore Sub-division houses traditional, historical as well new blue chip industrial units. It also houses some of the most prestigious public sector undertakings of national importance like Ichapore Rifle Factory, Gun and Shell Factory, Kanchrapara Railway Workshop, Jessop & Co., Bengal Chemicals, Bengal Water Proof, Tractor India Ltd., Esab India Ltd., India Foils, Worthington Pumps, Electro Steel, Texmaco, Modern Engineering etc. Barrackpore Sub-division is the single largest producer of raw jute in West Bengal. Industrial development in this Sub-division started with the development of jute textile industry. It is not only one of the most important industries in this region; it is an export earning industry for the country. Industrial development in this region dates back to the latter part of the 19th century, when jute mills were set up along both sides of River Hugli. These were followed by the large scale industries such as: (i) Jute and textile, (ii) Iron & steel, (iii) Engineering, (iv) Chemicals, (v) Paper, and (vi) Cotton textile.

| NIC 04 Code | Name of the industry | Municipalities |
|-------------|-----------------------|----------------|
| 29 | Engineering | 73 |
| 31 | Electrical | 22 |
| 32 | Electronics | 52 |
| 17 | Textile | 25 |
| 25 | Plastic based | 17 |
| 24 | Chemical based | 80 |
| 20 | Agro based | 14 |
| 15 | Food/Horticulture | 68 |
| 36 | Forest based | 10 |
| 23 | Animal resource based | 22 |
| 15 | Water resource based | 15 |
| 26 | Mineral/Metallurgy | 74 |
| 25 | Rubber based | 32 |
| 26 | Ceramic/Brick field | 21 |
| 19 | Leather based | 25 |
| 23 | Petrochemicals | 20 |
| 22 | Printing | 100 |
| 19 | Jute | 56 |
| 93 | Others | 110 |

Table 1: Categories of industries in the municipalities of Barrackpore Sub-division
Data Source: Sub Divisional Office, Barrackpore, 2010

The maximum number of industries is printing industries (100) and the minimum number of industries is forest based (10) industries. Printing industries are small scale in status. Mainly Jute, Engineering, Textile, Rubber, Leather and Petro chemicals industries are medium and large scale industries (table-1).

| NIC 04 Code | Name of the industry | Barrackpore Block-I | Barrackpore Block-II |
|-------------|-----------------------|---------------------|----------------------|
| 29 | Engineering | 73 | 39 |
| 31 | Electrical | 22 | 10 |
| 32 | Electronics | 52 | 4 |
| 17 | Textile | 2 | 58 |
| 25 | Plastic based | 17 | 15 |
| 24 | Chemical based | 1 | 10 |
| 20 | Agro based | 147 | 56 |
| 15 | Food/Horticulture | 201 | 12 |
| 36 | Forest based | 0 | 10 |
| 23 | Animal resource based | 22 | 1 |
| 15 | Water resource based | 155 | 0 |
| 26 | Mineral/Metallurgy | 0 | 5 |
| 25 | Rubber based | 0 | 9 |
| 26 | Ceramic/Brick field | 21 | 13 |
| 19 | Leather based | 0 | 21 |
| 23 | Petrochemicals | 0 | 15 |
| 22 | Printing | 10 | 5 |
| 19 | Jute | 30 | |
| 93 | Others | 11 | 0 |
| | Total | 764 | 283 |

Table 2: Categories of Industries of Barrackpore CD Block-I and Block-II, 2010
Data Source: Block Development Office, Barrackpore –I and II, 2010

Table-2 represents the data of number of the different categories of industries at Block level (Barrackpore CD Block-I and Block-II). It is observed that, in CD Block –I, food and horticulture industries (201) are in a large number but in CD Block –II textile (58) industry is of the highest number. In the Block –I, the total number of water resource based industries are 155, where as in Block-II, there is no water resource based industries. The total number of all categories of industries in Block-I is 764 and in Block-II the number is 283. So, the industrial growth in Block –I is more than that of Block-II.

3.2. Surface Water Sources

Industry directly or indirectly plays an increasingly important role in the growing total demand for water. Patterns of regional growth and development significantly affect the aggregate demand. The impact of industry on demand for water arises primarily from the large and ever-increasing requirements of various primary and secondary industries for cooling, processing and steam generation (Downie, 1997).

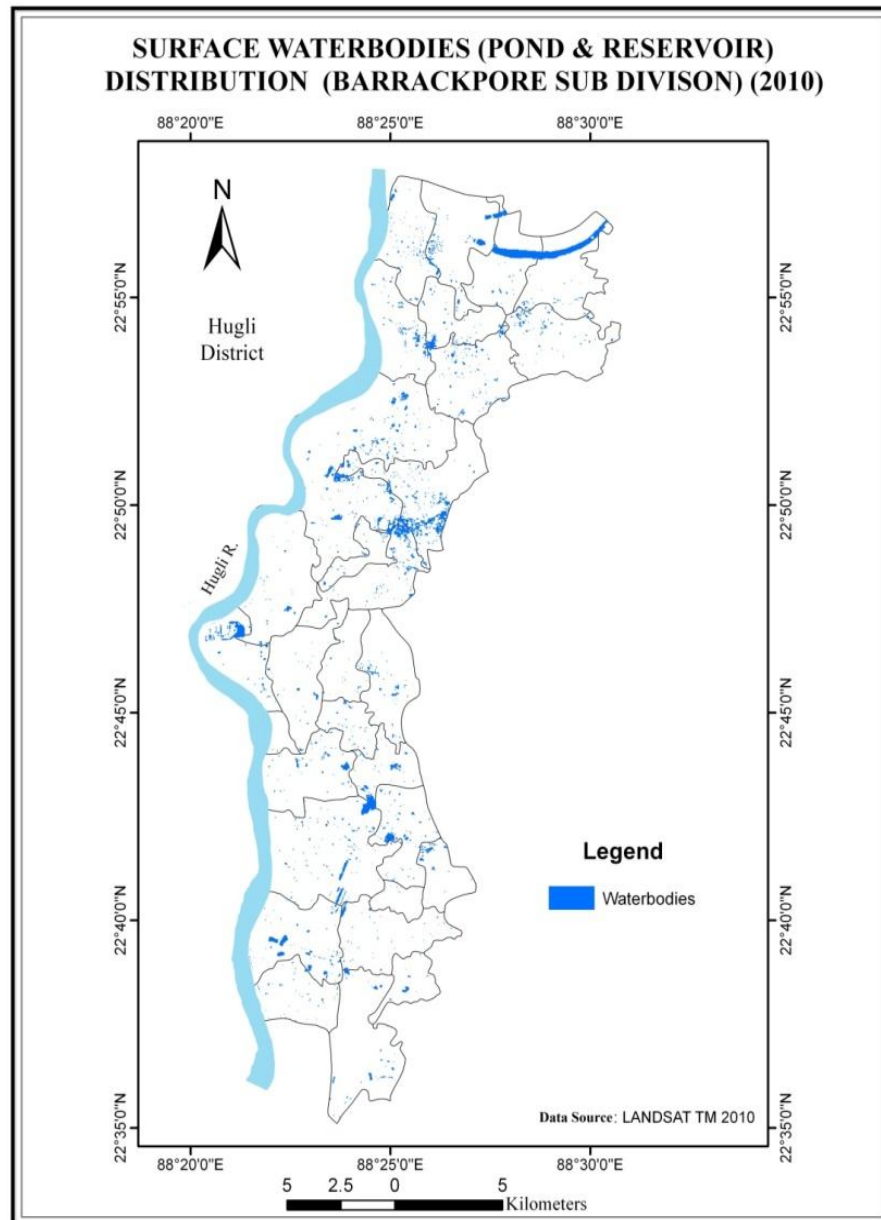


Figure 1: Source: Prepared by the researcher

Figure 1 represents the surface water sources mainly reservoirs and water bodies of the whole Sub-division. A long water channel is situated in the northern most part of the Sub Division (Kampa-Chakla and Majhipara-Palashi villages, Barrackpore CD Block-I). In Panpur-Keutia, Kowgachi-I and Kowgachi-II villages some water bodies are found. These are all man-made water bodies. In Barrackpore CD Block-II, there are also some marshy lands which are used for mainly fish cultivation. Ichhapore khal and Borti bills are situated in Block-I and Block-II and they contain the waste water. In municipal areas the urban reservoirs are found scattered all over the area of the Sub-division.

3.3. Ground Water Potentiality

In view of increasing demand of water for various purposes like agricultural, domestic, industrial etc., a greater emphasis is being laid for a planned and optimal utilization of water resources. Due to uneven distribution of rainfall both in time and space, the surface water resources are unevenly distributed (Tripathi, 1990).

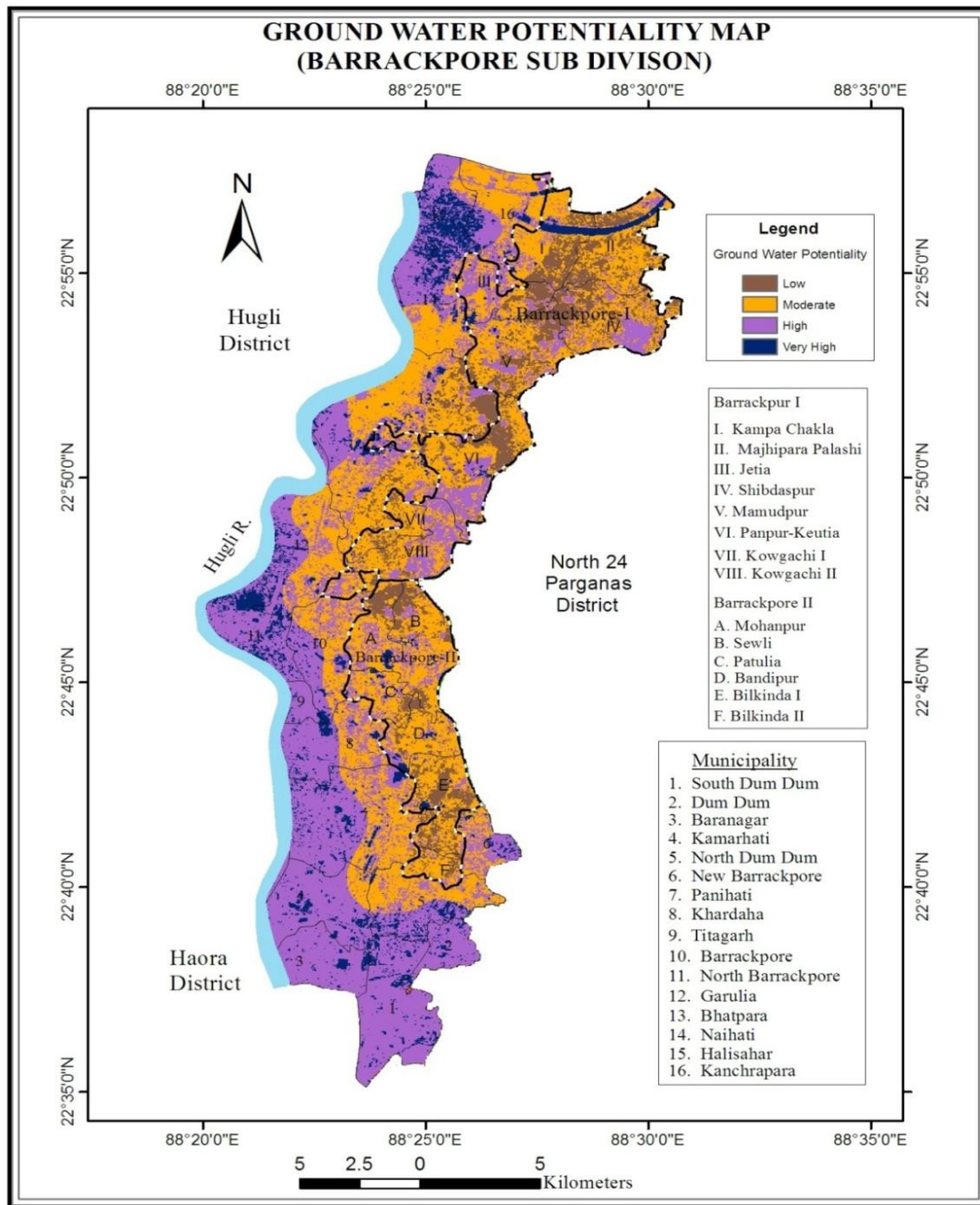


Figure 2: Source: Prepared by the researcher based on LULC, 2010

Barrackpore Sub-division is situated along the bank of the River Hugli and the ground water potentiality on the river side is naturally high. As the maximum number of large scale industries is concentrated here, a huge volume of water is withdrawn by the various industries of different volume. In spite of the presence of the River Hugli, the ground water potentiality decreases in some parts of the Sub-division. All the municipal urban areas are situated beside the River Hugli. Figure 2 represents the ground water potentiality zones of Barrackpore Sub-division and it is divided into four categories such as very low, low, moderate and high. It is observed that the maximum area is covered by low potentiality (49%) and the minimum area is covered by high potentiality (6%) in the study area. Very low and moderate potentiality is observed only 15% and 30% respectively.

3.4. Industrial Water Demand

Industry directly or indirectly plays an increasingly important role in the growing total demand for water. Patterns of regional growth and development significantly affect the aggregate demand. The impact of industry on demand for water arises primarily from the large and ever-increasing requirements of various primary and secondary industries for cooling, processing and steam generation (Downie, 1997).

| Name of the Industry | Demand of water (liter per day) |
|-----------------------|---------------------------------|
| Engineering | 200-500 |
| Electrical | 150-300 |
| Electronics | 150-250 |
| Textile | 3000-30,000 |
| Plastic Based | 300-400 |
| Chemical Based | 1000-1500 |
| Agro Based | 600-800 |
| Food/Horticulture | 400-800 |
| Forest Based | 300-400 |
| Animal Resource Based | 100-150 |
| Water Resource Based | 1000-4000 |
| Mineral/Metallurgy | 1000-4000 |
| Rubber Based | 300-600 |
| Ceramic/Brick Field | 400-1000 |
| Leather Based | 500-800 |
| Petrochemicals | 500-1000 |
| Printing | 500-800 |
| Jute | 2000-6000 |
| Others | 300-600 |

Table 3: Water Demand of different industries in Barrackpore Sub-division
Data Source: Primary Survey and Sub-divisional Office, Barrackpore, 2011

Steady industrial development produced a huge impact on water resources in Barrackpore Sub-division. Industries have grown rapidly along the eastern bank of the River Hugli. There are more or less nineteen categories of industries in this sub-division. Various categories of industries have different water demands (Table-3). The maximum water is used for textile industries (3,000 – 30,000 liter/day/ per plant), and about 97 percent of such industries use their required water from underground sources. A huge volume of water is withdrawn every day from the underground reserves.

3.5. Industrial Water Quality

The quality of the water supply is determined by the combined chemical, physical and biological characteristics of the water. Water from underground sources is normally preferred to surface water supplies, which usually are inferior because they contain more suspended matter, dissolved oxygen and microorganisms and are in general more subject to contamination. But the demand for a large volume of water by some industries or their location frequently precludes exclusive use of ground water (Thomson, 1998).

The WBPCB monitors the river water quality for physico-chemical and bacteriological parameters like pH, Total Suspended Solids (TSS), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonia nitrate, Total Coliform (TC) bacteria, Fecal Coliform (FC) Bacteria, etc. Heavy metal concentrations (Copper, Zinc, Lead, Cadmium, Mercury, etc.) are also monitored from time to time. The river water quality monitoring of River Hugli started in 1979 through a national network. The Board currently monitors water quality of River Hugli at two locations in Barrackpore Sub-division. This also includes stations on the river at raw water intake point. Water quality of River Hugli at two stations (Palta and Dakshineswar) was monitored every month in the year 2010-2011.

| Stations | Aprl | May | June | July | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
|-------------|------|-----|------|------|-----|-----|-----|-----|-----|-----|-----|------|
| Palta | 7.1 | 7.2 | 5.9 | 6 | 5.9 | 5.2 | 5.2 | 6.7 | 7.5 | 8.8 | 6.9 | 0.13 |
| Dakhineswar | 6.6 | 6.6 | 4.5 | 5.9 | 4.4 | 4.8 | 4.7 | 6 | 7.7 | 8.2 | 8 | 6.6 |

Table 4: Dissolved Oxygen (DO) concentration (in mg/l) in the River Hugli during 2010-2011 (standard: DO= 4mg/l)
Data Source: West Bengal Pollution Control Board, 2010-2011

| Stations | Aprl | May | June | July | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
|-------------|------|------|------|------|------|-----|-----|-----|------|------|-----|------|
| Palta | 4.2 | 3.4 | 1.5 | 2.5 | 2.9 | 1.5 | 1 | 1.8 | 0.85 | 1.8 | 0.6 | 1.6 |
| Dakhineswar | 2.95 | 2.75 | 4.05 | 3.5 | 3.35 | 2.3 | 5.3 | 4 | 6.2 | 1.45 | 5.9 | 6.05 |

Table 5: Biological Oxygen Demand (BOD) concentration (in mg/l) in the River Hugli during 2010-2011 (Standard: BOD=3mg/l)
Data Source: West Bengal Pollution Control Board, 2010-2011

| Stations | Aprl | May | June | July | Aug | Sep | Oct | Nov | Dec | Jan | Feb | March |
|-------------|------|-----|------|------|------|-----|-----|-----|-----|-----|------|-------|
| Palta | 170 | 110 | 170 | 170 | 80 | 220 | 80 | 110 | 70 | 110 | 170 | 220 |
| Dakhineswar | 1200 | 115 | 1400 | 650 | 1100 | 110 | 250 | 400 | 170 | 55 | 1100 | 165 |

Table 6: Total Coliform (TC) Bacteria concentration (in 1000 MPN/100ml) in the River Hugli during 2010-2011 (Standard: TC=5000 MPN/100ml)
Data Source: West Bengal Pollution Control Board, 2010-2011

| Stations | Aprl | May | June | July | Aug | Sep | Oct | Nov | Dec | Jan | Feb | March |
|-------------|------|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-------|
| Palta | 80 | 70 | 110 | 70 | 50 | 110 | 50 | 70 | 50 | 50 | 70 | 110 |
| Dakhineswar | 650 | 40 | 700 | 400 | 400 | 55 | 85 | 250 | 20 | 35 | 700 | 110 |

Table 7: Fecal Coliform (FC) Bacteria concentration (in 1000MPN/100ml) in the River Hugli during 2010-2011 (Standard: FC=500MPN/100ml)
Data Source: West Bengal Pollution Control Board, 2010-2011

3.6. Industrial Water Budget in Barrackpore Sub Division

Ground water is the major source of water for the industries. The use of municipal water is limited to industries located in urban areas. A vast majority of industries use surface and groundwater in conjunction with groundwater being relied as a source when surface water availability is on a decline or is impacted by water pollution bound to have an impact on the industrial process.

The amount of water that is taken (or withdrawn) from the source is called the water intake, and the amount that is returned is called the water discharge. The difference between the water intake and the water discharge is the amount consumed (Geol, 2006). Thus water budget has the following equation:

Water intake – Water discharge = Consumption

| Industrial Sector | Annual Waste Water Discharge (Million Cubic Meters) | Annual Consumption (Million Cubic Meters) | Proportion of Total Water Consumed in Industry (Percent) |
|---------------------|---|---|--|
| Thermal Power Plant | 27000.9 | 35157.4 | 87.87 |
| Engineering | 1551.3 | 2019.9 | 5.05 |
| Pulp And Paper | 695.7 | 905.8 | 2.26 |
| Textile | 637.3 | 829.8 | 2.07 |
| Iron And Steel | 696.8 | 516.6 | 1.29 |
| Sugar | 149.7 | 194.9 | 0.49 |
| Fertiliser | 56.4 | 73.5 | 0.18 |
| Others | 241.3 | 314.2 | 0.78 |
| Total | 30729.2 | 40012.0 | 100.00 |

Table 8: Waste Water discharge and Water consumption by different industries in Barrackpore Sub-division
Data source: Centre for Science and Environment (CSE), 2004

Table-8 represents the balance between the annual waste water and the annual water consumption of different industries in Barrackpore Sub-division. The maximum water discharge and consumption is recorded in the thermal power plant (87.87%). In Titagarh Municipality Thermal Power Generating Station is situated and it discharges the warm water to the River Hugli. The minimum water consumption and discharge is found in case of fertilizer industry which is 0.18%. The maximum fertilizer industries are concentrated in South Dum Dum Municipality and there is no recycling process in those industries.

3.7. Depletion of Ground Water for Industrial Development

Ground water is a vulnerable resource. It is the source of drinking water not only that it supplies to the industries for their required water. Ground water depletion, a term often defined as long term water level declines by sustainable ground water pumping, which is a key issue associated with ground water use. Many areas of Barrackpore Sub-division are experiencing ground water depletion.

It is estimated that 42% of the ground water is used in industries of Barrackpore Sub-division. Major industries users include Thermal Power Generating Station (Titagarh Municipality), Jute mills in Naihati and Bhatpara municipalities use water in chemical processes, and manufacturing plants, cooling etc. as a result, water level decreases rapidly. During the past two decades the water level has been falling rapidly due to an increase in extraction in the study area. During the pre-monsoon, of 2010 major part of this Sub Division shows depth to water level rising from 2-5m (33%) and 5-10m (45%) below the ground level (SWID, 2009).

In Barrackpore Sub-division the piezometric level lies between 2.0-5.0 mbgl and 5.0-15mbgl (SWID, 2009) due to heavy withdrawal from large number of heavy duty tube wells constructed by several organizers of different industries. As a whole, Barrackpore Sub-division has its water level above 260m in the part of Barrackpore CD Block-I and Barrackpore CD Block-II, Naihati, Bhatpara and Titagarh municipalities where the maximum number of industries are concentrated.

4. Conclusion

From the above discussion, it is concluded that the industries of Barrackpore Sub-division are mainly depended for their required water on underground water sources and the withdrawal of ground water is increasing rapidly in the past decade, large scale industries which are situated in the northern part of this Sub-division, use the underground water and recycled the waste water through their own treatment plants, but these industries are locked out at present. Now many of the large scale industries discharge the waste water into the River Hugli. In Barrackpore CD Block –I and Barrackpore CD Block-II, small scale and medium scale industries are concentrated and they also depended for their required water from underground sources and as they do not have any treatment plant and the waste water is discharged into Ichhapore *Khal*, Borti *Beel* and Sonai river and therefore there is no agricultural fields surrounding these water bodies. The level of ground water has been decreasing very rapidly. There is only one water treatment plant in Barrackpore Sub-

division Palta Water Works, but the treated water is not used for industrial sectors. The surface water bodies are filled up rapid for urbanization and industrialization.

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