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## WATER SUPPLY AND SANITATION SYSTEM IN RAJSHAHI CITY, BANGLADESH

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**Abstract:** An assessment was carried out to understand the present situation of water supply and sanitation system in Rajshahi City area. Water is an essential resource for all life and a requirement for good health and sanitation. Water supply in the study area is that 70% of the population have access to pipe water and 30% by tube wells with hand pumps. Groundwater contaminated has been found to be a critical problem in Rajshahi City, especially high Fe (3.32-5.57ppm) and Mn content (0.5-2.0ppm), which exceed the national drinking water standards. TDS varies between 300 and 350mg/L which exceed the WHO drinking water standards. Water sealed pit latrines are used by about 70% of the households and simple pit latrines by 23% and remaining 7% of the households do not have any sanitation facilities and defecate in the open. The study suggested that the authority should be taken necessary action how to improve present water supply and sanitation system in Rajshahi city.

**Key Words:** Water supply, groundwater, water quality, sanitation, Rajshahi City.

### Introduction

Consumption of water per capita is one of the major indicators of life-standard in modern and civilized society. Bangladesh has achieved a remarkable success in drinking water supply. In rural areas, 97% of the populations have access to water points within 150 meters, and about 30% people use safe water for all domestic purposes. The coverage

under sanitation is about 85%, which is far behind the coverage under the water supply. This imbalance is a hindrance to achievement of the desired health benefits out of water supply. Moreover, sustainability of water supply and sanitation services has surfaced as a major issue globally. Even though the water supply and sanitation sector in Bangladesh is expanding its coverage, it is difficult to keep pace with the rapid population growth. The country used to rely mainly on groundwater. Most of the tube wells water contaminated with arsenic. About 27% of the shallow tube wells water exceeds the WHO drinking standards for arsenic. In Bangladesh arsenic in groundwater first detected in Barogaria in Chapinawabganj in 1993 which was a major setback in water supply. Since arsenic was discovered in Bangladeshi groundwater in 1993, the share of population with access to safe drinking water had to be adjusted downward. UNICEF and WHO estimate that in 2008 up to 70 million people (of 150 million) in the country are still exposed to drinking water which does not comply with WHO standards (WHO, 2008). On the other hand, surface water is usually polluted and requires treatment (Das Gupta et al. 2005). The rainwater harvesting options was rejected because of its uncertainty, troublesome collection and storage system, micro nutrients deficiency, acidic nature and strong possibility of microbial contamination. The WATSAN sector is far from reaching cost-recovery due to poor economic efficiency and low tariffs. Even though the water supply and sanitation (WATSAN) sector in Bangladesh is expanding its coverage, the unmet drinking water and safe sanitation needs to increase at faster pace than the sector's ability to respond.

In RCC area a water supply network system provides water to the households. The network consists of main supply line, secondary supply have their own water supply and distribution system (DDC, 2002). The percentage of the population without access to any form of sanitation facility was calculated in the 2001 census to be 22%. Access in urban areas is much higher than rural areas with just over 67% of urban households having sanitary facilities in 2001 compared to just 28% of rural households (BBS 2005a). UNICEF estimated that access to sanitation facilities in Rajshahi Division was lower than in any other division in Bangladesh at just 43%. National statistics suggest that this is even lower in Rajshahi district where approximately 30% of households had sanitary facilities at the time of the 2001 Census. The objective of this study is to assess the present source for water supply to the city in terms of water availability and quality and sanitation system.

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## Methodology

### Study Area

Rajshahi is situated in the North-East of the country, close to the Indian border and built along the banks of the River Ganges. RCC covers an area of approximately 96.37 km<sup>2</sup> being bounded on the east, north and west by Paba thana and on the south by the Padma River. Land use statistics in the 1994 Drainage Plan suggest that agriculture and horticulture is the largest land use category in the RCC area, accounting for 31.0% of the land but a study for the Rajshahi Structure Plan and Master Plan recorded a much smaller area of 18.7% of agricultural land within the RCC area but also recorded a further 48% in the extended urban area. RCC operate in 30 wards, with 30 Ward Councillors. Population figures in 2001 were 0.5 million and present population about 0.78 million. Rajshahi is in the western dry zone and has a mean annual rainfall of below 1524 mm. Rajshahi district covers five of the 30 agro-ecological zones, soil textures are loamy and clayey and soil pH varies from pH 4.5 to pH 7.9; organic matter content of the soils are low or medium. The minimum temperature varies from 10°C to 27°C and the maximum temperature from 24°C to 36°C. Rajshahi is one of the 4 towns that participate in the WHO supported Healthy Towns Programme. As the supply of good quality water and sanitation are possible components of healthy town's programmes.

### Findings of the Study

The study was mainly concentrate to investigate the present water supply and sanitation facility in the study area. In order to carry out the study a detailed survey on the existing facilities water supply and sanitation component such as manpower resources and water supply system (distribution system, reservoir services etc.) of the concerned utilities have been considered. The authors are from Rajshahi and their personal observation, living, and discussion with the professionals are other sources of primary data. Secondary data have been collected from different sources like journals, books, published documents and the Internet. Processing and analysis of the survey results, interviews, collected data and gathered information reveals the following results and findings.

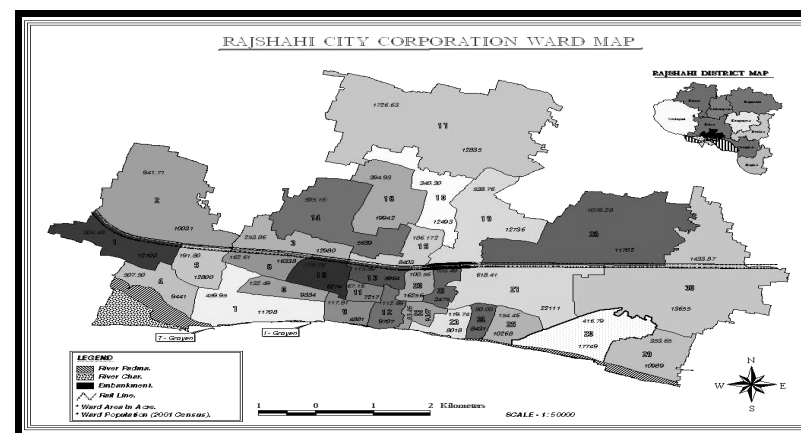


Fig. 1 Map of the Study Area

## Results and Discussion

### Conservancy Wings

Rajshahi City Corporation (RCC) is a statutory body with a water department that is responsible for providing water supply services to the city with a total population of 773,430 people. The city government provides oversight on the utility's service provision and tariff setting. Water supply system in RCC is operating under the conservancy wings by conservancy staffs under the direct supervision of Mayor of the city. Among them there is a suitable number of engineer, pump operator, tube well mechanics, sanitary operators, supervisor, electricians and labours (regular or master role). Table. 1 shows a list of the existing staffs of the conservancy wings of those who are engaged water supply system. Conservancy wings are responsible for establishing water treatment plants, sinking tube wells, water pumps establishing and expanding pipe lines for water supply etc.

**Table 1:** Manpower of conservancy wing of RCC

| Designation            | No. of employee<br>(Permanent) | No. of employee<br>(temporary) |
|------------------------|--------------------------------|--------------------------------|
| Executive Engineer     | 1                              | -                              |
| Assistant Engineer     | -                              | -                              |
| Sub Assistant Engineer | 2                              | -                              |

| Designation                               | No. of employee<br>(Permanent) | No. of employee<br>(temporary) |
|-------------------------------------------|--------------------------------|--------------------------------|
| Upper Clark                               | 1                              | -                              |
| Computer operator cum<br>office assistant | 1                              | -                              |
| Computer operator                         | -                              | 1                              |
| Vandar assistant                          | 1                              | 3                              |
| Office assistant                          | 4                              | -                              |
| Electricians                              | 1                              | -                              |
| Tube well mechanics                       | 1                              | -                              |
| Assistant Tube well mechanics             | 5                              | 26                             |
| Pump operator                             | 9                              | -                              |
| Assistant Pump operator                   | 20                             | 81                             |
| Pipe line mechanics                       | 2                              | -                              |
| Assistant Pipe line mechanics             | 10                             | 18                             |
| Sanitary Mechanics                        | -                              | 2                              |
| Plant Operator                            | -                              | 1                              |
| MLSS                                      | 4                              | 1                              |
| Total (197)                               | 62                             | 135                            |

(Source: www.rcc.gov.bd)

#### Water Supply in RCC

The Rajshahi water supply system was installed in 1937 by the water supply section of the Ministry of Works, Calcutta, India. The system had more than 100 street water reservoirs (locally called *Dhokekal*), each with a capacity of 470 gallons. The *Dhokekals* were connected to a centrally built iron and hardness removal plant and an elevated service reservoir through reticulated distribution pipes of cast iron of diameter 3" to 6". The reticulation system covered an area of about 4 square kilometers and was designed to serve a population of about 20,000 people. The treatment plant, the Hatem Khan Water works, had a capacity of 700m<sup>3</sup> water per day but was abandoned in 1965. The elevated service reservoir is also not now used. However, many of the *Dhokekals* are still in use by the Water Supply Authority in the town. In Rajshahi City there are 1750 community water stand-posts, 85 on-street water stands, 47 communal reservoirs and 4 water treatment works. The RCC has provided around 20000 water supply connections from 45 pumps. In addition to this Rajshahi University, Rajshahi Medical College, RDA and some other organizations have their own water supplies (RDA vol-I 2004). Current water demand for the city is 103000 m<sup>3</sup>/day and supply is 71730 m<sup>3</sup>/day. Present

availability of water supply in the municipal area is that 70% of the population have access to pipe water and 30% by tube wells with hand pumps (Table. 2).

**Table 2:** Demand, supply and deficit of water in Rajshahi City

| Item                                                   | Position |
|--------------------------------------------------------|----------|
| Present water demand (m <sup>3</sup> /day)             | 103000   |
| Present piped water supply (m <sup>3</sup> /day)       | 71070    |
| Deficit after piped water supply (m <sup>3</sup> /day) | 31930    |
| Percentage of water supply                             | 69.00%   |
| Number of withdraw pumps                               | 51       |
| Pipe line length (km)                                  | 512      |
| Number of hand tube well (shallow & deep)              | 3789     |
| Number of communal reservoirs                          | 47       |
| Water treatment plans                                  | 4        |
| No. of Stand post                                      | 1750     |
| Number of house connections                            | 1200     |
| House connection per km. of pipe line                  | 34.45    |

(Source: www.rcc.gov.bd)

#### Collection of Water

Collection of water is the withdrawn of water from the water source. The RCC has provided around 20000 water supply connections from 51 pumps which meets 70% of the city water supply. Rest 30% of water supply done by the tube wells. There are 3789 tube wells in the city area of 30 administration area. Of them 1937 and 1852 numbers of shallow and semi deep tube wells, respectively. Table 3 shows Word based shallow and semi deep tube wells numbers of RCC. Highest number of shallow (229) and semi deep (123) tube wells are in the word No. 17 and 29, respectively (Table. 3).

**Table 3:** Word based shallow and semi deep tube wells numbers of RCC.

| Word No. | Shallow tube wells | Semi deep tube wells | Total tube wells |
|----------|--------------------|----------------------|------------------|
| 1        | 122                | 15                   | 137              |
| 2        | 137                | 62                   | 199              |
| 3        | 108                | 24                   | 132              |
| 4        | 7                  | 110                  | 117              |
| 5        | 38                 | 40                   | 76               |
| 6        | 60                 | 52                   | 112              |
| 7        | 21                 | 72                   | 93               |
| 8        | 7                  | 53                   | 60               |
| 9        | 1                  | 39                   | 40               |

| Word No. | Shallow tube wells | Semi deep tube wells | Total tube wells |
|----------|--------------------|----------------------|------------------|
| 10       | 10                 | 40                   | 50               |
| 11       | 3                  | 63                   | 66               |
| 12       | 1                  | 71                   | 72               |
| 13       | 16                 | 82                   | 98               |
| 14       | 127                | 60                   | 187              |
| 15       | 31                 | 60                   | 91               |
| 16       | 145                | 30                   | 175              |
| 17       | 229                | 23                   | 252              |
| 18       | 76                 | 94                   | 170              |
| 19       | 38                 | 101                  | 139              |
| 20       | 6                  | 65                   | 71               |
| 21       | 10                 | 65                   | 75               |
| 22       | 0                  | 58                   | 58               |
| 23       | 4                  | 57                   | 61               |
| 24       | 82                 | 40                   | 122              |
| 25       | 13                 | 70                   | 83               |
| 26       | 114                | 40                   | 194              |
| 27       | 50                 | 49                   | 99               |
| 28       | 138                | 92                   | 230              |
| 29       | 163                | 123                  | 286              |
| 30       | 220                | 62                   | 282              |
| Total    | 1937               | 1852                 | 3789             |

(Source: www.rcc.gov.bd)

#### Distribution System

The distribution subsystem is that part of the water supply system which receives the water from the pumping station or from treatment plant and delivers it throughout the desired area to be served. It includes, reservoirs for purposes of storage, equalizing pressures and subsequent distribution, together with pipes, valves, hydrants and other appurtenance for carrying water, service pipe and meters etc. In Rajshahi city area, the method of distribution system is system with pumping and storage or direct-indirect or dual system. In this system, when the demand rate exceeds the rate of pumping, the flow rate into the distribution system is both from the pumping station as as the elevated reservoir. When, however, the reserve conditions exists i.e., pumping is more than the demand, the excess of water is stored in the reservoir. This system obviously, is more economical and reliable. It provides for a uniform rate of pumping. The pumps can be operated at their rated capacities, resulting in higher efficient and

economy of operation. Also, the water stored serves as a reserve to take care of fire demands and pump breakdowns. Table. 4 shows the distribution of water for various sector in RCC.

**Table 4:** Demand, supply and deficit of water in Rajshahi City

| Items                    | Amount                    |
|--------------------------|---------------------------|
| Average daily production | 86,082 m <sup>3</sup> /d  |
| Distribution pipes       | 430.0 km                  |
| Annual consumption:      |                           |
| Residential—direct       | 21,050,000 m <sup>3</sup> |
| Commercial/industrial    | 1,340,000 m <sup>3</sup>  |
| Institutional            | 1,020,000 m <sup>3</sup>  |

(Source: www.rcc.gov.bd)

#### Service Reservoir

The service or distribution reservoirs are generally provided in the distribution system to store the clean treated water before it is dispatched to the consumers. These reservoirs was constructed brick masonr , reinforced or pre-stressed steel. There are three types of reservoirs are used for water service reservoir i.e. elevated reservoirs, stand pipes, and Dhopekal. In the RCC, water supply system is intermittent. In this system of supply, the water is supplied during certain fixed hours of day only. The usual period is about 1 to 6 hours in the morning and about the some period in the afternoon. Table 5. shows the water availability per day is 12 hours only and water coverage 85%. This system is provided due to (a) the available pressure is poor and (b). the quantity of water available is not sufficient to meet with various demands for water. The working of the system is very simple. The distribution area is divided into several zones and timings of each zone are so adjusted that good working pressure are minimized in each zones. The necessary combinations of dead end, grid iron and circular methods are usually made to suit the local conditions of the RCC area. Table 6 shows the number of new connection per year from 2001-2010 (upto January).

**Table 5:** Water Service in Rajshahi City

| Direct/shared taps  | Amount |
|---------------------|--------|
| Population served   | 520400 |
| Public water points | 133230 |
| Total               | 653630 |
| Pipe breaks         | 1436   |
| Complaints          | 2785   |

| Direct/shared taps     | Amount                  |
|------------------------|-------------------------|
| Population served      | 520400                  |
| Public water points    | 133230                  |
| Total                  | 653630                  |
| Pipe breaks            | 1436                    |
| Water coverage         | 85.00%                  |
| Water availability     | 12 hours/day            |
| Per capita consumption | 88 l/c/d                |
| Average tariff         | 2.11 Tk./m <sup>3</sup> |
| Sewerage coverage      | Nil                     |

(Source: www.rcc.gov.bd)

**Table 6:** Number of new connection per year from 2001-2010 (unto January).

| Year                       | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010(Jan) |
|----------------------------|------|------|------|------|------|------|------|------|------|-----------|
| No. of Connection per year | 715  | 885  | 1150 | 1711 | 2615 | 1879 | 767  | 1550 | 1348 | 113       |

(Source: www.rcc.gov.bd)

#### Quality of Supply Water Source

In Rajshani city area the majority of households relying on tube wells for drinking water. Groundwater plays a vital role of safe drinking and domestic supply water in the study area. Groundwater continues to play an important role in the socioeconomic development of the Rajshahi city. Groundwater quality deterioration has been found to be a critical problem in Rajshahi City and its surrounding areas. Table 7. shows the groundwater quality in the Rajshahi City. Groundwater pollution has been found to be a critical problem in Rajshahi City and the surrounding areas, especially high iron (range: 3.32-5.57ppm) and manganese content (range: 0.5-2.0 ppm), which exceed the national drinking water standards (Table. 7). Few researches have been done to assess the arsenic contamination and some physico-chemical analysis of groundwater in this area. A survey conducted by BAMWSP (2003) that 4 out of 25 pumps were found to be contaminated with arsenic above 0.05 ppm. About 20% of the groundwater contaminated with arsenic (range:0-0.06 ppm) where WHO standard is 0.01ppm. Another report showed that the hardness levels of the groundwater were above the WHO standard (RDA vol-I 2004). Hardness is an important criterion for determining the usability of water for domestic, drinking, and many industrial supplies (Karanth 1987). Total hardness varies between 300 and 350mg/L which exceed the WHO drinking water standards indicating hard to very hard types of waters (Sawyer and Mc Carthy 1967). Hard water is mainly an

aesthetic concern because of the unpleasant taste. It also reduces the ability of soap to produce lather and causes scale formation in pipes and on plumbing fixtures. Long-term consumption of very high hard water might lead to an increased incidence of urolithiasis, anencephaly, parental mortality, some types of cancer, and cardiovascular disorders (Agrawal and Jagetia 1997). On the other hand, surface water quality is similarly poor because untreated sewage is discharged through various drains and ultimately to the Padma River, some ponds etc. Above the results reveal that groundwater was unfit for the human consumption without treatment.

**Table 7:** Water Service in Rajshahi City

| Parameters | Value (mg/L) | Bangladesh standard (mg/L) | WHO standard (mg/L) |
|------------|--------------|----------------------------|---------------------|
| Fe         | 3.32-5.57    | 1                          | 0.3                 |
| Mn         | 0.5-2.0      | 0.1                        |                     |
| Hardness   | 300-350      | 250                        |                     |
| As         | 0-0.06       | 0.05                       | 0.01                |

(Source: www.rcc.gov.bd)

#### Sanitation Facilities

Access in urban areas is much higher than rural areas with just over 67% of urban households having sanitary facilities in 2001 compared to just 28% of rural households (BBS 2005a). UNICEF estimated that access to sanitation facilities in Rajshahi Division was lower than in any other division in Bangladesh at just 43%. National statistics suggest that this is even lower in Rajshahi Zila where approximately 30% of households had sanitary facilities at the time of the 2001 Census. The deterioration of the infrastructure due to poor maintenance leads to open-air defecation and water supplies being inundated with contaminated water. In the city area the RCC reported in 2004 that about 50% of households have sanitary facilities: 30% have latrines with soak-away pits and 20% have latrines without soak away pits. Based on the BBS (2005c) data this amounts to 22954 and 15303 households, respectively. Water sealed pit latrines are used by 30% of the households and simple pit latrines by 10% (7651). The remaining 10% of the households do not have any sanitation facilities and defecate in the open (RDA vol-I 2004).

**Table 8: Percentage of households with access to sanitation facilities**

| Water Seal | Pit  | Hanging | Open defecation | Water | Water+Soil | Water + ash | Water + soap |
|------------|------|---------|-----------------|-------|------------|-------------|--------------|
| 68.4       | 23.2 | 7.3     | 1.1             | 6.1   | 24.2       | 11          | 58.7         |

(Source: UNICEF 2004)

In addition to these private facilities there are 43 public toilets in locations such as markets (RDA market, New market, Ranibazar, Uposhahor market etc.) and bus stations (Central bus terminal, BRTC bus station etc.) (RDA Vol-I 2004) and several sites specifically for men to urinate, from which the urine flows directly into the storm water drains (personal observation).

### Conclusions

Consumption of water per capita is one of the major indicators of life-standard in modern and civilized society. The study showed that the present situation of water and sanitation system in Rajshahi City. Rajshahi City Corporation (RCC) is a statutory body with a water department that is responsible for providing water supply services with a total population of 773,430. In RCC area a water supply network system provides water to the households. The City authority can meet 70% of the water demand. The only source of supply water is groundwater and its coverage is 85%. The city dwellers water uses for drinking purpose mainly rely on tube well water. Both shallow and deep tube wells water contains excessive amount of Fe, Mn and Ca. The supply water quality is not fit for drinking purpose due to contaminated various toxic metals. Sanitation facility depends on water. In the city, 70% household use sanitary latrine and remaining 30% household use Pit latrine. In slum area (near the bank of Padma river) open defecation are found which indicate the city is till now fail to achieve 100% sanitation. As a result various diseases are break out in the lack of sanitation area. To meet the present water demand other source of water supply should be search. It might be Padma River water and rainwater harvesting system will be the sustainable option for mitigating the water quantity and quality problem in Rajshahi City along with present water supply source. So, the authority should be take necessary action how to improve present water supply and sanitation system in Rajshahi city, and the city dwellers have to more awareness about sanitation.

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