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RESEARCH ARTICLE

Urban Water Supply Network Analysis: A Case Study on Pabna Municipality, Bangladesh

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Abstract

The study examines the spatial dimension of Public Water Supply in Pabna Municipality of Bangladesh to provide effective planning, development and operation of water supply and distribution networks. An attempt is made to understand the present water demand and supply status of the study area. With its limited water supply facility, which is only 42% of the total demand, the Municipality is in a backbreaking situation. The study suggests various site specific and cost effective strategies like demand management, conservation practices which can be implemented with available infrastructural development to achieve a sustainable water supply in Pabna Municipality of Bangladesh.

1. Introduction

At the beginning of the 21st century, many people have faced formidable challenges to meet the increasing demand of water. There are significant pressures that make it difficult to meet these demands including expanding urban areas, water pollution, and international conflicts. Unequal distribution of water supply has been characterized as one of the key development challenges for Bangladesh because of its high population growth. Supply of adequate safe water in the urban areas is a challenging task for the urban development authorities. It is one of the prime requirement and consideration to improve the public health and to decrease the transmission of infectious diseases related to water in urban areas (Nelson, 2001) and also for the sustainable urban development. Over the last half of 20th century, there has been a growing trend of population settlement in urban areas especially in developing countries. The United Nations has predicted that the year 2030, 56% of the people in developing countries will be resided in urban areas (UNEP, 2002). Urban population in Bangladesh is also rapidly increasing as a result of natural urban growth and migration from rural areas. The current urban population is about 38 million and it will be about 74 million by the year 2035(Ahmed, 2005). Such increase in urban population will certainly add a significant burden on urban water and sanitation facilities causes a large number of people to live without access to clean water supply and adequate sanitation in urban areas which is considered as one of the most important environmental issues in several developing countries. In major cities of Bangladesh, necessary infrastructural developments are done by the local governments and the Department of Public Health Engineering which have failed to supply adequate water to many urban areas due to a lot of reasons including poor operation and maintenance. Moreover, many existing systems are operating intermittently and at a fraction of their capacity (WHO, 2003). Lack of access to safe drinking water increases the risk of contracting water borne diseases and in developing countries, the costs of diseases and productivity losses linked to inadequate clean water and sanitation are equivalent to 2% of gross domestic product (Norstrom, 2007). Pabna was declared as a District in 1828 during the British reign. According to Cunnigham, a renowned archeologist, the name Pabna might have been derived from the old kingdom ***Pundra***. The popular belief is that the name of the Zila might have originated from the name of a stream ***Pabnaee*** which was flowing by the southern side of this land towards the Ganges. Pabna Municipality is one of the oldest Municipalities in Bangaldesh and it was established in 1876. In 1868 Pabna Town Committee was established before the Pabna Municipality. This municipality was upgraded to 'A' Category in 1989. It is located at 161 km North-West of Dhaka and 110 km East of Rajshahi. The area of the municipality is about 27 square kilometers and its population is 133403(BBS, 2005).

Ground water is the main source of drinking water for the local people. The location of study area has been shown in **Map 01** below.

Map 01: Location of study area

2. Methodology

Both primary and secondary data are used in this study. Field investigation and the key informers are the main sources of primary data. Secondary data and necessary information have been collected from different sources like Statistical Year Book of Bangladesh (BBS) and Community Series Report on Pabna District published by BBS. ArcGIS software is used to explore existing water supply networks and to produce the proposed water supply network map.

3. Result and Discussion

3.1 Present Water Supply System

The Municipal underground water supply treatment plant was established in 1951. There are 157 community water stand posts and 456 hand tube wells for drinking water supply. A handful of households have wells too. Water is also procured from a large number of ponds. The town has 9 overhead tanks with a holding capacity of 2.5 million liters among them 4 are established by Pabna Municipality and others are by the Public Works Department (PWD). The municipality facilitates 7,600 households with supplied water with its 100 kilometers of pipelines having diameters of 250mm, 200mm, 150mm, 100mm, 75mm and 38mm (Water Works Department of Pabna Municipality, 2012). Ground water in Pabna contains manganese and iron. Recently arsenic has been added to this list. Arsenic is found in Arifpur, Purbapara, Doharpara, Mathpara, Dakshin Ramchandrapur, Lokshikol and west part of Pailanpur. Supply of adequate safe water for all residents in the municipal area is now a challenging task. The water supply in Pabna Municipality is operated and maintained by Water Works Department of Pabna Municipality.

At present, municipality can extract about **8,845** m^3/day of ground water through 11 production wells. The ground water extraction scenario in the study area is given in **Table 01**:

Table 01: Ground Water Extraction for Water Supply in Pabna Municipality

Sl no	Location of pumps	Capacity (m^3/hour)		Operating hour	Total production per day (m^3/hour)
		During install	At present		
01	Kutipara	100	100	09	900
02	Staff Quarter	100	100	09	900
03	Sadupara	100	80	09	800
04	Narikel Bagan	100	85	09	765
05	VTI	100	85	09	765
06	By Pass	100	85	09	765
07	Radanagar (Old)	100	85	09	765
08	Radanagar (New)	100	80	09	720
09	Shibrampur	100	85	09	765
10	Arifpur	100	100	09	900
11	Zillapara	100	80	09	800
Total					**8,845**

Source: Water Works Department of Pabna Municipality, 2012

Municipal water is supplied by 109 km pipelines that made of GI and PVC pipes. The statistics of water supply around the study area are given below:

Table 02: Water Supply Connection in Pabna Municipality

Year	No. of Households connected	Distance(km)
1995	2100	39
2000	2800	94
2005	4000	98
2010	6500	105
2012	7600	109

Source: Water Works Department, Pabna Municipality, 2012

According to Pabna Municipality there are 518 commercial units, 125 Government or administrative offices and 6926 residential households are connected with water supply network.
To estimate the demand of water, it is assumed that

- Per Day Per Capita Water Consumption in Zila (District) Towns in Bangladesh: 120 lpcd (Ahmed and Rahman, 2005)
- Technical Loss: 20%

Table 03: Water Supply Deficiency in the Project Area

Water Supply by the municipality in 2012 (m^3/day), A	Water demand in 2012 (m^3/day), B	Deficiency in 2012 (m^3/day), C=B-A
8,845	$\frac{(\boldsymbol{District\ towns\ per\ day\ per\ capita\ water\ consumption} + \mathbf{20\%}\ \boldsymbol{of\ technical\ loss}) \times (\boldsymbol{total\ population})}{\mathbf{1000}}$ $= \frac{(120 + 20\%\ of\ 120) \times 1{,}46{,}356}{1000}$ = 21,075	12, 230

The water supply system cannot meet the present demand of 21,075 m^3 of water per day. The capacity is not adequate and there is a deficiency of 12,230 m^3/day (Table 03).

3.2 Population growth:

Geometric progression is the most widely used method which is also known as empirical method suggested by Hardenberg (Ahmed, 2005). The projected population can be estimated by this method by using the following equation:

$$P_t = P_o (1+ r)^n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

P_t = Projected year population

P_o = Present/Base year population

r = Rate of yearly population growth and

The rate of population growth can be estimated from population data of two years of n year's interval in the recent past using the expression:

$$R= \sqrt[n]{\frac{P_2}{P_1}} -1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,

$P_{1 \text{ and }} P_2$ are the population data of two dates of n number of years

Table 04: Projected Water Requirement in the Study Area

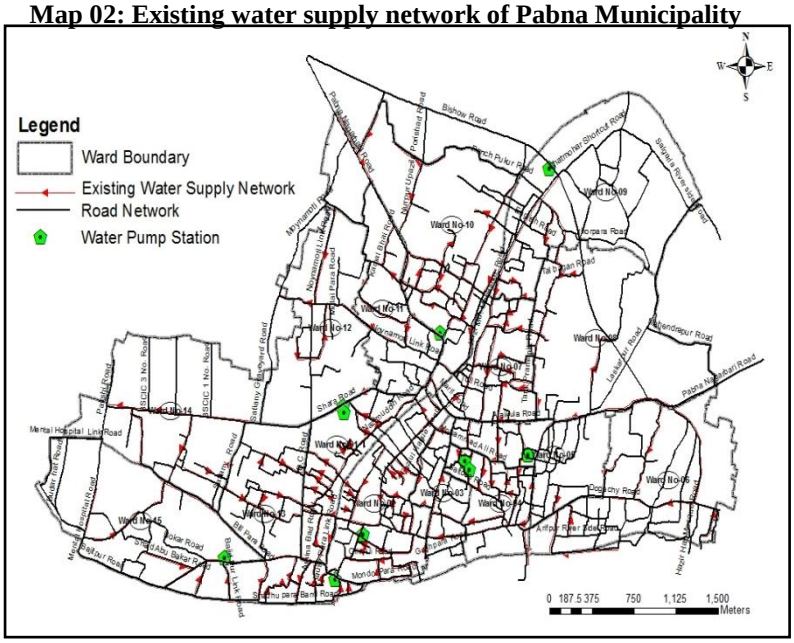
Year	Projected Population	Water demand in the study area (m^3/day)
2012	1,46,356	21,075
2017	1,60, 568	23,122
2022	1,76, 159	25,367
2027	1,93,264	27,830

The above Table shows year wise projected water requirement in the study area. In the year 2027 about 27, 830 m^3/day of water would be required to serve almost 1, 93,264 people. Therefore, it is necessary to increase the capacity of water supply system for the designated year.

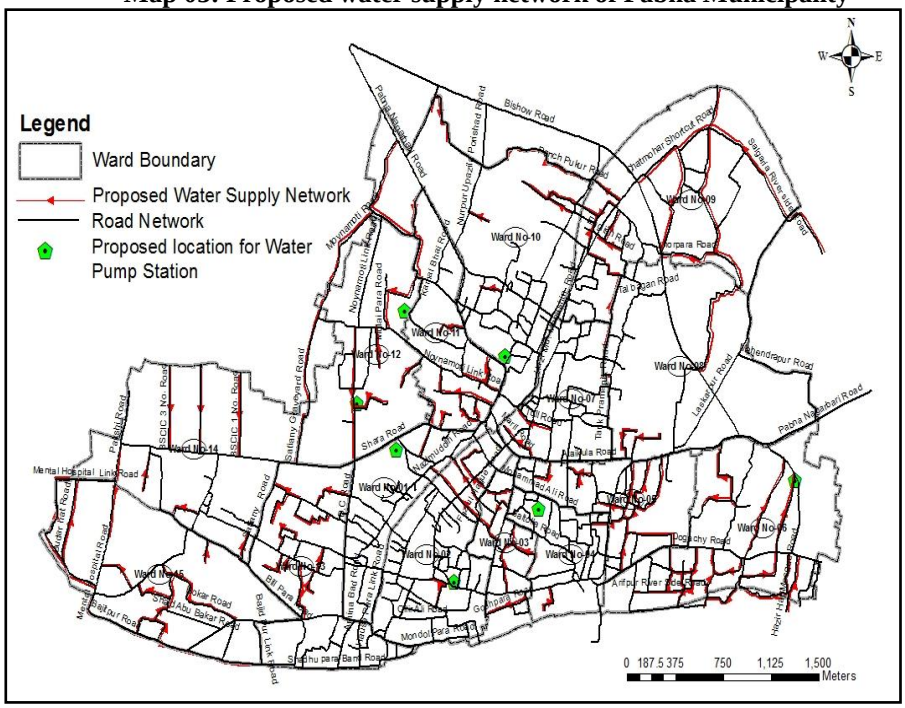
3.3 Location for the proposed water pump:

Availability of ground water level, electricity supply, roadway access for maintenance, security, and adverse impacts (if any) upon surrounding occupancies are the most important planning factors to be considered to set up new water pump stations for future requirements. Proposed locations of new pump stations and water supply networks are shown in map 03.

Map 02: Existing water supply network of Pabna Municipality



Map 03: Proposed water supply network of Pabna Municipality



4. Conclusion

Although the existing water supply network cannot meet the present demand, an efficient and effective water supply network for Pabna Municipality is needed to meet the present and future requirements. The water Works Department, a wing of Pabna Municipality is responsible for the operation, management and maintenance of water supply. However, this wing has lack of sufficient staffs, resources and facilities to assess and maintain water quality of the supplied water. To do so, it seems important to establish a technical surveillance unit for consistent monitoring and to prepare reports with recommendation for the necessary management actions. The inefficiency in the access to potable water by the residents of the town could be attributed to the following:

- With the incessant power outages, the water corporation is handicapped in meeting its daily pumping requirement.
- The lack of maintenance culture that pervades almost all sectors of the Municipality. This is responsible for the frequent breakdown of facilities of the waterworks resulting in water shortages affecting various locations within the town at almost frequent intervals.

To improve the quality of services rendered by the Municipality, the following aspects are recommended.

- An expansion of the water scheme to meet a more realistic demand for water as a result of population increase.
- Manpower development and training in modern relevant technology for water resources management should be facilitated.
- A more detailed database management strategy should be adopted by the municipality.

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