Information Systems In Urban Water Supply In Bhandara City, Maharashtra

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Abstract

Urban supply management is essential to sustain water supply. Bhandara, a small city in Maharashtra, is undergoing immense difficulties and challenges in water supply for uninterrupted and efficient utilization by the residents of this medium-sized urbanization. In this context, this paper discusses the enhancement of water supply management in Bhandara City (2016-17) using modern information systems. Further, it enlightens readers concerning the implementation and usability of diversified information technologies during the course, including Geographic Information Systems (GIS), Supervisory Control And Data Acquisition (SCADA), and the smart water systems. This paper analyzes how Information Systems can support the water supply system of Bhandara by evaluating existing infrastructure, challenges, and potential improvements toward efficiency and losses. The paper adopts a mixed method approach to achieve results that are supported by both primary data as well as existing data and literature.

Keywords: Urban water supply, Information Systems, Bhandara, Maharashtra, GIS, SCADA, Smart Water Systems, infrastructure, water management

1. Introduction

Urban water supply systems form the very basis of daily functioning of cities, thereby ensuring the provision of clean, safe, and sufficient water supply to all sectors, including residential, industrial, and commercial needs. In India, cities like Bhandara in Maharashtra are faced with problems that are mainly based on outdated infrastructure, increasing demand because of urbanization, and the inefficient management of resources. In this context, the application of IS (Information Systems) can be a critical factor for improving the water supply system in terms of providing real-time data, better decision-making, and sustainability. (BMC, 2016)

This paper, focusing on the Bhandara city's urban water supply status from the year 2016 till June 2017, has reviewed the integration of Information Systems that are likely to bring efficiency, reduced loss, improvement in service delivery, and also resolve the issues concerning water management in the city. Through an examination of the situation at hand and further looking at the possibilities technology could bring about to change things around, this paper intends to illustrate possibilities for change in urban water supply systems in Bhandara. (BMC, 2016)

2. Background of Study Area: Bhandara City and Water Supply System

Geographic and Demographic Overview

Bhandara is a small but significant city located in the Vidarbha region of Maharashtra. The city had a population of around 1.0 lakh people. The city's water supply mainly depends on surface water resources such as rivers (prominently the Wainganga) and reservoirs, while groundwater sources are supplementary. However, the population was growing increasingly due to the urbanization process, which had been challenging the city's water supply infrastructure to keep pace with the rising need. (BMC, 2016)

Challenges in Water Supply

Bhandara's urban water supply system experienced severe challenges during the study period (January 2016- June 2017) which included outdated infrastructure, lack of uniform water supply, water availability, water quality and inefficient building systems. Bhandara city's water distribution infrastructure was old with leaky pipes and lack of regular maintenance, while it would get ruptured time and again leading to water waste. Lack of uniform supply was observed in the city

wherein some of the city's neighbourhoods received water only for a few hours during the day. The water requirements changed with the season; because of scarcity during summer, the commodity of water remained in short supply. Sometimes due to very old pipes, the water was found to be contaminated, and whereas sometimes it was so because the treatment processes were inadequate. The water billing system lacked accuracy and transparency, leading to customer dissatisfaction and delayed payments. These challenges underscored the need for a more efficient and technologically advanced approach to managing the urban water supply system. (BMC, 2016)

3. Role of Information Systems in Urban Water Supply Management

Information Systems Overview

Information Systems in the management of urban water supply utilize the use of technology in the collection, storage, analysis, and visualization of data that would be related to water supply operations. These systems have the primary goals of enhancing decision-making, optimizing resource allocation, and enhancing service delivery. Information Systems embrace several technologies such as: GIS, SCADA, smart water meters, decision support systems etc. (Patnaik, 2016) (Bharat, et al., 2017) (Sapota, et al., 2015)

Geographic Information Systems (GIS): GIS technology helps map and manage water distribution networks, identify areas of problems, and optimize the flow of water. It also locates pipeline leaks, determines low-pressure areas, and plans future infrastructure. (Gupta, et al., 2016)

SCADA: SCADA systems offer real-time monitoring and control of water treatment plants, reservoirs, and distribution systems. They allow operators to monitor water flow, pressure, and water quality remotely, improving response times to issues such as leaks or contamination. (Bharat, et al., 2017)

Smart Water Meters: Smart meters offer real-time data on water consumption, enabling more accurate billing and helping detect issues such as leakage or excessive consumption. This is yet to start in India although discussions to incorporate it in India has begun. (Gupta, et al., 2016)

Decision Support Systems (DSS): DSS uses data analytics to support decision-making by predicting water demand, identifying trends, and suggesting optimal resource distribution.

Advantages of Information Systems in Urban Water Supply

Information Systems integrated in urban water supply management bring with them a set of important advantages: (Sapota, et al., 2015)

Increased Efficiency: By automating data collection and providing real-time insights, IS can increase the overall efficiency of water distribution and management.

Water Loss Reduction: Leak detection and monitoring technologies such as SCADA can significantly reduce water loss caused by pipeline damage or inefficiencies.

Optimized Resource Allocation: GIS and DSS tools help accurately forecast water demand and optimize the allocation of available resources, so that high-demand areas get the required amount of water.

Better Customer Service: Smart water meters and automated billing systems lead to more accurate billing, which reduces discrepancies and improves customer satisfaction.

Real-Time Monitoring and Control: SCADA systems enable constant monitoring of water quality, flow, and pressure, providing the ability to respond to problems quickly.

4. Methodology

This study adopted a mixed-methods approach combining both qualitative and quantitative research in order to analyse the effect of Information Systems on water supply management in Bhandara city during January 2016 – June 2017.

Data Collection

Interviews: Key stakeholders were interviewed in semi-structured manner, including 2 officials from the Bhandara Municipal Council, water supply department, 70 local residents, and 5 engineers working in the water supply system.

Surveys: Survey questionnaires were distributed to 60 residents for assessing the satisfaction of public services regarding water supply, awareness about the ongoing technological improvements, and expectations from better water management. The survey forms had option of Hindi and Marathi language. The forms were purposively distributed

to 60 adult local residents who assured that they would completely participate in the study and completely attempt the survey form options. These forms were distributed in the first week of April 2017 and were collected in June 2017. Before the distribution of the forms, 5 willing participants were given the forms to be filled in in English language to test the forms. The initial feedback received by them, enabled us to simplify the forms by introducing the same questions and MCQ answer options in Hindi as well as Marathi language. Then the survey forms were distributed with the help of 6 Bhandara city's college student volunteers. In each form it was mentioned that the participants' information would be kept confidential and the responses would be utilized for non-commercial uses only. It was also made clear in the form itself that their anonymous participation and completion of the survey would indicate that they are agreeing to be a part of the study/ experiment. The forms were collected by the same volunteers in the last week of June 2017.

The details of the questionnaire can be found in Table 1.

Official Reports: Analysis of municipal records, reports from the water supply department, and previous surveys conducted by the local authorities was undertaken to gather secondary data on the state of water supply infrastructure and usage patterns.

Data Analysis

Descriptive Statistics: Statistical tools were used to analyse survey data, focusing on the extent of water shortages, customer satisfaction, and the reliability of the water supply.

Comparative Analysis: Information from Bhandara was compared with other comparable cities in Maharashtra that had adopted Information Systems to realize the potential gains that Information Systems might make in the water supply management system.

Table 1: Survey questionnaire items with responses Source: Authors

Total respondents n=60

Item		Response		n	%
1.	Do you use water supply from Bhandara Municipal Council (BMC) fully or partially for your residence?				
		a	Yes	44	(73.33)
		b	No	00	(00)
		c	Yes but I also use a well/ground water from tube well/ bore well etc.	16	(26.67)
2.	In the last one and half year (January 2016 to June 2017) did you face any inconsistency with the BMC water supply?				
		a	Yes, always	00	(00)
		b	No, I am satisfied	00	(00)
		c	Sometimes	16	(26.67)
		d	Mostly, more than half the time	44	(73.33)
3.	Was the water from BMC available to you 24 hours every day?				
		a	Yes	00	(00)
		b	No	00	(00)
		c	During some months	60	(100)
4.	During peak summer months, did you face less frequency of availability of BMC water than the other months?				

		a	Yes, most of the time	60 (100)
		b	No, not at all	00 (00)
		c	On rare occasions	00 (00)
5.	Whenever BMC water supply was cut off during some hours of the day did you have prior information (so that you could store water)?			
		a	Yes, every time with the time schedule of availability	00 (00)
		b	No, never. I would have to guess and be prepared any given time	00 (00)
		c	Sometimes, even if a general information was available it was not always accurate	60 (100)
6.	Are you satisfied with the quality of water from BMC?			
		a	Yes, absolutely	00 (00)
		b	No, not at all	00 (00)
		c	More than half of the time the water quality is unsatisfactory	60 (100)
		d	Occasionally	00 (00)
7.	Do you normally smell anything abnormal in the BMC water (strong chemical smell like that of bleaching powder or unpleasant organic/stagnant water smell?			
		a	Yes, always	00 (00)
		b	No, I have never faced this issue	00 (00)
		c	Mostly I smell something in the water supplied	51 (85)
		d	Sometimes I smell something abnormal	09 (15)
8.	Do you frequently see sediments in the BMC water or feel hardness in the supplied water			
		a	Yes always	10 (16.67)
		b	No never	00 (00)
		c	Mostly	47 (78.33)
		d	Sometimes	03 (05.00)
9.	Do you find the supplied water appropriate for kitchen use?			
		a	Yes	00 (00)
		b	No	52 (86.67)
		c	Depends	08 (13.33)
10.	Is the water bill compatible with the quality of water supply?			
		a	Yes, the bills seem justified	00 (00)

b	No, the bills are unreasonable and seem high	60 (100)

5. Results and Discussion

A. Status of Information Systems in Bhandara (January 2016- June '17)

As of the study time frame (Jan 2016 - June '17), Bhandara city has been able to adopt limited Information Systems for advanced information technology in its water supply management system. The findings indicate the following:

Basic GIS and Manual Data Collection: There were a few basic GIS mappings in place to track water distribution pipelines, but there were no overall data management systems that kept track of water quality, consumption, or even distribution in real time.

No SCADA Implementation: There was no SCADA system in place yet for Bhandara city at this point in time, which meant there was no proper monitoring of the water supply infrastructure and no real-time controls.

Smart water meters: There are no smart water systems to accurately monitor the water consumption.

Data Management Challenges: Data management was largely done manually, with inconsistent reporting and limited integration between departments responsible for water supply and maintenance.

B. Benefits of Information Systems (Potential for Improvement)

The research indicates that the integration of Information Systems in the future may significantly improve the efficiency and reliability of the water supply system in Bhandara. The potential benefits include:

Reduced Water Loss: With the implementation of SCADA and smart water meters, real-time data could and would help detect leaks faster, reducing water wastage and loss due to pipeline failure.

Better Service Delivery: The implementation of GIS in planning and maintenance would ensure better water distribution efficiency, especially to the under-served areas.

Accurate Billing: Smart meters would enable measurement of water usage with accuracy and thus more accurate billing and better transparency for the customers.

Improved Decision Making: DSS along with real-time data from SCADA systems would help local authorities make better decisions on water distribution, usage pattern, and future infrastructure planning.

C. Barriers to Adoption

High Installation Costs: SCADA and GIS are complex Information Systems that call for a large amount of capital investment, which may be hard to raise by a small town like Bhandara.

Lack of Qualified Staff: There is a scarcity of technical staff who would be able to handle and operate complex Information Systems, which could prevent successful adoption.

Infrastructural Backlog: Old infrastructure in the city could challenge any attempt to include new technologies; this would need massive upgrades and investments.

Conclusion

Although Bhandara city's Urban Water Supply Systems in 2016-17 witnessed significant challenges in its water supplies, the scope of integrating GIS is vast when it comes to improving water supply management. Advanced technologies and SCADA system, GIS applications, and smart metering can potentially enhance the service efficiency, sustainability, and user satisfaction of such services. Implementation of these services will require strong collaboration, investment, and capacity building, both in public and private sector.

Recommendations and the Way Forward

The recommendations to enhance the water supply system in Bhandara are as listed below:

Investment in Technology: Technology investment in the municipal council should mainly focus on Information Systems,

SCADA, GIS, and smart water meters to modernize water management.

Training and Capacity Building: Local authorities and engineers should be trained to acquire skills in managing and maintaining advanced water management technologies.

Public Awareness Campaigns: Public education on water conservation and the advantages of new technologies may improve cooperation and ensure more sustainable use of water.

Stakeholder Incentivising: Encouragement to the stakeholders is necessary for the suggested systems to be successful by various steps such as subsidies in bills, felicitation, media coverage etc. Apart from the local residents, all the other stakeholders, such as concerned municipal officials, engineers, service teams should also be given due professional incentives.

Partnerships with Private Sector: Partnerships with technology companies may help overcome financial and technical barriers to implement modern water management systems.

References

1. Bharat, V. et al., 2017. *Smart water management system in cities.* s.l., IEEE International Conference on Big Data Analytics and Computational Intelligence (ICBDAC), pp. 267 - 271.

2. BMC, G., 2016. *Annual Water Supply Report. Bhandara, Maharashtra,* Bhandara: Bhandara Municipal Council, Govt. of Maharashtra.

3. Gupta, A., Mishra, S. & Bokde, N., 2016. Need of Smart Water Systems In India. *International Journal of Applied Engineering Research,* 11(4), pp. 2216-2223.

4. Patnaik, S., 2016. *Design of IoT Systems and Analytics in the context of Smart City.* Bhubaneswar, Odisha, India, Elsevier (2nd International Conference on Intelligent Computing, Communication & Convergence).

5. Sapota, M. et al., 2015. An Overview of Hybrid Water Supply Systems in the Context of Urban Water Management: Challenges and Opportunities. *Water,* 7(1), pp. 153-174.