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Performance Assessment of Shirpur Water Supply Project

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Abstract: The basic level water supply coverage of Shirpur is 87.22% and among the water supply projects providing service to the people only 28.13% of the projects are fully functional. The reason behind this state of higher percentage of non-functionality and ill performance of developed projects is a matter of study. Thus, the main aim of this study is to access the overall performance; technical performance, financial performance and institutional performance with implementation status of water safety plan of Shirpur Water Supply Project; a water service provider supplying water to population of rapidly growing urban area of Shirpur City. Generating primary and secondary data from questionnaire survey, field visits, laboratory tests, focal group discussion, key informant interviews, journals, articles and annual reports, the performance indicators suggested by different national and international organizations for performance assessment of water service providers were analyzed. From data analysis, results regarding technical performance showed that water supply coverage of the project was 46.29%. Though the production population was 106 lpcd, per capita consumption was only 66.69 lpcd. The project supplied water for 24 hours a day through fully metered connections. The condition of physical structure was good giving a physical structure index of 78.89%. The distribution mains density was found to be 4.82 Km/Km^2 and quality of water supplied was within Drinking Water Quality Standards, representing good performance in overall technical aspect. The unit production cost was found to be Rs. 12.05 per cubic meter of water but the average tariff was Rs. 12.59 per 5 cubic meters. The operating ratio was 0.97 and a non-revenue water of 37.99% lower in comparison to previous years indicating efficient system management and generating additional revenue for satisfactory financial performance.

1. INTRODUCTION

Fresh water and energy are vital for life. Indeed, supply and distribution of energy and water form the foundation of present life. Many critical functions are served by water supply and distribution systems. It plays a huge part in bring off human and lucrative health. Even with this, until crucial disruption or working failure occurs, the performance of these systems often goes unnoticed. The everyday inadequate performance of a WDS necessitate great remunerative, social and sustainable implications.

Crucial matter in the etiquette and control of any Distribution System is measurement of Performance. Large amount of population have access to water that is clean and sufficient sanitation due to notable evolution of urban areas. The construction of large number of small and large water distribution systems and supply in recent decades is also one of the for that.

Water supply systems are critical strategic systems. It has somatic complications in their construction, installation, working. It also has huge lucrative concerns and environmental intimations. It also contribute notably to public health. Even with this, professionals and engineers are underrating the challenges for design and operation and their direct or indirect effects.

As the many of the WDS across the world were built decades ago, majority are approaching or have exceeded their design lives. Thus it is crucial to analyse the safe and secure operation of the old systems, particularly since performance has gradually declined and they require extensive upgrading. Many systems face the challenges that come with the task of keeping their systems efficient and aging problems over the long-term operation. However, these need resources in large quantity.

Even though awareness about the design and performance assessment of a WDS has been done, there are some important areas which have not been yet investigated fully. Under explored factors include: 1) Different criteria in social and environmental costs resulting from the performance of WDS; 2)The awareness of the quality of service requested by all customers; and 3) Developing new approaches for improving performance of current operating systems which includes more comprehensive public and economic issues.

2. OBJECTIVES:

The main purpose of the current research is to undertake a critical review of the principal concepts relating to the evaluation of a WDS, Which includes the importance of construction of such complex systems in all communities, the influence of system operation on public health and private issues, and the interactions of WDS with other public facilities. It starts by considering some basic questions: What is the true nature of a WDS? How does it operate and how should its performance be evaluated? Who are the major customers and what are their main expectations of such systems? And finally, how can various decision makers contribute to the evaluation of a multi-objective WDS?

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3. STUDY AREA OF THE PROJECT:

Shirpur model gets its name from the place Shirpur, a tehsil in Dhule district of North-east Maharashtra. It is in Tapi basin. In two watersheds – TE-63 and TE 75 – Suresh Khanapurkar, a retired officer with the Groundwater Survey and Development Agency (GSDA), Pune, implemented certain water conservation measures since 2004. It consists of three measures: one, well recharging using canal water; two, cement structures (bandhs) on streams; and three, widening and deepening of streams. The structures are without gates and waste weirs. The financial support came from Priyadarshini Cooperative Cotton Mill and the local MLA fund.

The programme has been implemented in about 200 km2 covering about 35 villages. The work mainly include 91 cement bandhs, recharging of 59 wells along with 29 km recharge channels, and widening and deepening 36 kms stream length – widened by 10 to 15 meters and deepened by 10 to 13 meters. Rs. 15.55 cores were spent. Now he is planning to extend the work in the entire 149 villages of the tehsil.

Some of his claims include: in basalt area the water level came up from 500 feet to 15 feet in summer and in the alluvial areas of Tapi the water level has come up from 280 feet to 80 feet; a minimum of 5 crores liters (50,000 m3) and a maximum of 15 crores liters (150,000 m3) of water has been stored because of stream widening and deepening. As a result of this the water level in the bore wells on either bank of the stream up to two km distance went up by about 150 feet. He has gone to the extent of claiming that the Shirpur model would be useful not only for Maharashtra but for the entire country.

4. LITERATURE REVIEW:

4.1 Sustainable Development Goal for Water Supply and Sanitation

Engineering knowledge and by applying scientific approaches, practical solutions to human needs can be find out. In this light, the following general question is considered and progressively refined: How can engineering systems respond properly to all requested needs? The problem of comprehensive water demand evaluation, associated with the optimal design and operation are essential to system performance.

The advantages and drawbacks of current design approaches of WDS are discussed herein. It should be noted that there are important questions relating to the effectiveness of conventional approaches to WDS evaluation.

4.2 WASH Sector Development Plan (SDP) of Nepal

Residential customers often need safe water with high quality criteria for drinking and cooking while minor pressure deficits at their taps are usually ignored compared to poor water quality. Meanwhile for other residential purposes like toilet flushing, the same water quality criteria are not required as drinking and cooking. In some cases, the volume of supplied water is important. For example the volume of water for filling bath tubs is desired by some residential customers, while the possible deficit pressure is acceptable, as the user only needs a full bath tub with warm water in this case. But if a user wishes to take a shower, having warm water at an appropriate pressure during washing is obviously of greater importance. Therefore the satisfaction of the particular customer depends on the specific needs and preferences.

For industrial customers who require water as a component of their products, it is essential to apply the same high water quality criteria as for drinking water. But in some other industries that use water for other purposes, the quantity not quality of supplied water is the main expectation. It is not always necessary to provide the same high water quality for customers.

4.3 Performance Measurement of Water Distribution Systems (WDS) by Mahdi Moradi Jalal.

A system of distribution of water and supply is a complex that exists to satisfy different purposes to meet social health and sustainable constraints, following the continuous increasing demands for clean water and other important non-potable petition. It contains of various elements such as reservoir tanks, pumps, pipes and hydraulic parts that over all provide the essential amount of water with sufficient pressure from origins. It is normal preference that the water must be provide in an unbroken pattern. Nevertheless, this is a perfect condition, and infrequent disturbance by arbitrary defeat of their constituents and unforeseen difference of requests that may take place over the service life. Correspondingly, measuring and accessing a systems appraisal is a complicated problem.

4.4. Analysis of flow in water distribution networks by Pramod R. Bhave:

Of the total expenditure incurred on different facilities of a water supply system the expenditure incurred on the distribution network is quite large and may even exceed 70 percent. Therefore, it is essential to know the behaviour of a distribution network under different conditions such as variation in demand including fire flow requirements, variation in reservoir water levels, partial or full valve openings, closure of pipes during repairs or replacement. This knowledge is obtained by carrying out an analysis of the flow in the distribution networks.

4. METHODOLOGY

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Even though awareness about the design and performance assessment of a WDS has been done, there are some important areas which have not been yet investigated fully. Under explored factors include: 1) Different criteria in social and environmental costs resulting from the performance of WDS; 2)The awareness of the quality of service requested by all customers; and 3) Developing new approaches for improving performance of current operating systems which includes more comprehensive public and economic issues.

5. DATA COLLECTION:

The street plan, topography and location of service reservoirs etc. govern the type of distribution network. Proper layout of the pipelines, correct locations of various types of valves and specials are necessary for proper and efficient operation and maintenance of the system. Sufficient residual pressure at peak demand period is the prime hydraulic consideration of the distribution system.

Old Water treatment Plant near Police line ESR is proposed to be discarded as it is too old (1984) and has nearly outlived. Present capacity of the WTP is 12 MLD in 20 hours. The required capacity in 2027 is 17.472 MLD in 20 hours. Hence, for 16 hours of pumping, capacity of WTP required will be 17.462x (20/16), ie., 20.96 MLD. Hence, additional WTP of 9 MLD is required. 10.5 Pure Water Pumping Machinery.

Raw Water: The invert level at jack well and lip of aerator are given to the model. Demand of (17.472x1.5), i.e., 26.004 MLD or 301 LPS is given to the node at WTP. With this data, maximum velocity of the existing rising mains is 1.742 m/s which is less than 1.8 m/s (as per MJP Circular). Hence, existing raw water rising mains shall be enough to deliver the flow for the year 2027.

Pure Water: The invert level at pure water sump (PWS) and the maximum FSL in ESR are given to the model. Flow of (17.336x1.5), i.c., 26.004 MLD or 301 LPS is given to the pump at the PWS. Value of 5751 m which is a total length of the pure water transmission main and a maximum head of 46 m are given to the model. With this data, maximum velocity of the existing transmission mains is 2.6 m/s which are more than 1.8 m/s (as per MJP Circular).

On probing, excess velocity in pipe is found only in section (between junction of police line and Khandesh). A parallel pipe of size 300 mm and a length of 88 m are inserted and the computed maximum velocity of the rising mains is now found as 1.63 m/s which are less than 1.8 m/s. Hence, the existing raw water rising mains, with addition of 500 mm pipe in the suction as mentioned above, shall be enough to deliver the flow for the year 2027.

There are four existing ESRS. Their diameters and levels are fixed. Capacity and serviceability of all the existing four ESRs at Bhaskar Bapu, Khandesh Package, Police line and APMC have been checked. It is found that these ESRS are vital for providing the 24/7 water supply. But on analysis, it is found that they remain empty during the peak hours, in spite of the fact that their capacities are enough. Their capacity to serve demand is 12 MLD (Figure B). However, total demand of the city is 12.457 in the year 2012 for which the operational zones are not prepared with respect to ESR's capacity. Moreover, the tanks are designed for the next 15 years, the demand in the 2027 will be 17.387 MLD. Hence, two new ESRS are added in the design and the operational zones are also designed for the demand in 2027 year and with respect to the ESR's capacity

6 RESULT AND DISCUSSION:

With a sole objective of assessing the technical, institutional and financial performance of the project, the data obtained from primary and secondary sources are analyzed and results are presented for the selected indicators.

Outcome of the work is as follows:

1. Computer GIS based hydraulic model of the entire Shirpur city is prepared,
2. An assessment of the scheme has been carried out as to how it would perform under different external conditions, especially, present water supply scenario, at mid design life and at the end of the life,
3. Measures for sustainability of the water utility,
4. Recommendations and modifications or adjustments to the system to improve performance,
5. Checking ESR capacity and serviceability from the point of view of demand of zone,
6. Analysis of the Distribution system with the base scenario for the entire city and the three child scenarios for population of the year 2012, 2027 and 2042.
7. A detailed project report (DPR) for 'Nagrothhan" program.

The basic level water supply coverage of Shirpur is 87.22% and among the water supply projects providing service to the people only 28.13% of the projects are fully functional.

From data analysis, results regarding technical performance showed that water supply coverage of the project was 46.29%. Though the production population was 106 lpcd, per capita consumption was only 66.69 lpcd. The project supplied water for 24 hours a day through fully metered connections. The condition of physical structure was good giving a physical structure index of 78.89%. The distribution mains density was found to be 4.82 Km/Km^2 and quality of water supplied was within Drinking Water Quality Standards, representing good performance in overall technical aspect.

The unit production cost was found to be Rs. 12.05 per cubic meter of water but the average tariff was Rs. 12.59 per 5 cubic meters. The operating ratio was 0.97 and a non-revenue water of 37.99% lower in comparison to previous years indicating efficient system management and generating additional revenue for satisfactory financial performance.

7. SUMMARY AND CONCLUSIONS:

With the sole objective to assess the performance of Shirpur Water Supply System, various indicators of technical, institutional and financial aspects were used. Aligning with the theme of the study, these internationally accepted performance evaluation indictors are used for assessing the performance of the project which has also been used for assessing performance of different small- and large-scale water service providers of India and similar developing countries.

Different literatures related to performance assessment of drinking water supply systems are reviewed to generate idea and develop methodology for assessing the performance of the water supply system in an easy and modern way. The study involved a descriptive research methodology to collect data from Water department members and staff with the use of questionnaires and personal interview as the survey instrument, and the collection and analysis of the past and present technical, institutional and financial data relevant to the study.

The analysis is done by direct field observation, interaction with users committee, staffs, consumers and the records available whereas secondary data are obtained from literature review.

The major findings of the study are as follow:

Key findings regarding to assessment of technical performance are:

1] The value of per capita consumption is 66.69 lpcd which is less than that for urban areas of 100 lpcd.
2] The production population is 0.106 m3 /person/day indicating inefficient use of water resource.
3] The connections are 100% metered which indicates proper water accounting.
4] The water supply is 24 hours a day.
5] There is no any major accidental water pollution, but due to current developmental work by municipality, pipes get broken and sometimes mud gets mixed in water in transmission lines.
6] Distribution mains density is found to be 4.82 Km/Km2 which needs to be increased in order to increase the coverage area and provide easy access of water supply to scattered residents.
7] Mains are replaced and rehabilitated every year which directly control the losses .
8] Whole valves are not replaced but damaged parts are repaired and replaced on damage and malfunctioning.
9] The water quality is within range of Water Quality Standards which needs to be maintained for better serviceability.

Key findings regarding to assessment of institutional performance are:

1] The current functionality index was found to be 90% indicating a well-managed institutional formation.
2] The complaints of the customer are addressed within 24 hours and within 2-7 days depending upon the complexity of the problem.
3] The water safety plan is fully implemented within the system and consumer satisfaction survey indicates that consumers are well aware about the 66 importance of quality of water.

Key findings regarding to assessment of financial performance are:

1] The personnel cost is 59.07% showing high payoffs to staffs even though the staff productivity index is low indicating less efficiency of staffs.
2] The unit production cost is Rs. 12.05 per m^3 in year 2018/19 showing more expenditure in O & M.
3] The operating ratio of 0.97 indicates the incomes are just efficient to cover the operating expenses.
4]There are no any accounts receivables indicating 100% efficiency in revenue collection within time

8. CONCLUSIONS

1] The overall technical performance of the system is good even though the system was designed for limited number of populations but is supplying water to three times more population at present. Regular repair and maintenance of the components of the system is helpful in decreasing NRW.

2] The institutional performance of water supply system is good with positive points such as timely meeting, general assembly and audit but despite of this the decreased staff productivity index indicates decreased performance of WSUC and efficiency of WSUC human resource. Since this project was supported by JICA in enhancing capabilities of WSUC in O&M activities, so the capable committee is able to supply water to its consumers even though the number of consumers is thrice time more than the initial design with the system constraints being same.

3]The financial performance of the system seems just satisfactory. Current income is just enough to sustain the

O&M expenses. This is due to increased personnel cost and higher expense on O&M of the components of the system.

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