

Comparative Analysis on Socio- Economic Impacts of CWS and IWS Systems in Urban Areas, Mysuru, Karnataka

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Abstract—Water is a crucial component; scarcity can have a significant effect on communities and economies. Urban service delivery can be divided into two categories: higher-quality, continuous, and dependable, or lower-quality, intermittent, and unreliable. In India, piped water systems mostly belong to the latter category, despite efforts in some areas for transition to continuous service. The socio-economic strata for Continuous Water Supply (CWS) and Intermittent Water Supply (IWS) systems were carried out. This research conducted a public survey, for 400 households of two DMAs in Mysuru Karnataka, for over 6 months. This is data triangulation, a crucial method for enhancing information and data dependability. The pressure of the water supplied to individual houses based on the terrain details were determined and the affordability of water access under continuous supply, the equality of their distribution, and the net advantages at the household level was assessed. The results obtained represented, the advantages were not evenly distributed across socio-economic strata that is, 94% of the household in CWS depicted higher satisfaction levels of water supply while residents in IWS reported a satisfaction level of 36% only.

Keywords— Continuous water supply; intermittent water supply; water availability; socio-economic strata.

I. INTRODUCTION

Water is considered as the most essential tool for the survival of every living being in the planet. Water shapes the climatic conditions according to the season too hot or too dry. At the same time saving water and supply of water plays a major role in daily life. Water supply to the households are supplied in two mediums, continuous water supply and intermittent water supply. Continuous water supply (CWS) is constantly supplied to the consumers, that is 24/7 unlike intermittent water supply (IWS) that is supplied once in 3-4 days. In India IWS systems refer to a water distribution system in which water is delivered to consumers on a regular basis often for a limited number of hours or on specific days (Buurman et al, 2017). There are difficulties in maintaining water quality in IWS systems. Contrary to CWS systems, IWS systems have trouble maintaining water quality in accordance with accepted standards, notably those set forth by the Bureau of Indian Standards (BIS). The drift from IWS to CWS is very essential to meet the demand of the public without any crises in water.

CWS systems offer several benefits over IWS systems. They significantly reduce the health hazards by keeping tainted groundwater out of the pipelines, even in the case of a system failure (CPHEEO, 1999). If there are intermittent breaks, the affected region may be promptly located and cleaned. Since pressurized water is required to detect leak noise, continuous supply conditions facilitate the detection of leaks, even unauthorized connections. Furthermore, when there is a steady supply, customer meters function reliably, allowing for accurate water use monitoring and effective demand management. Because there are less shocks and pressure changes to the infrastructure, distribution systems have a longer lifespan. Because of the constant supply, there is less need for booster pumps, household storage, and water purifying devices, which reduces energy and coping expenses (Assia et al., 2018). Many parts of the world have poor urban access to piped water: 33% in Sub-Saharan Africa, 51% in South-Eastern Asia, and 56% in Southern Asia (WHO/UNICEF, 2015). For a few hours every day, a few days a week, water flows via portions of the piped network. This is known as intermittent access to piped water. More than one-third of urban water systems in Africa and Latin America and more than half of those in Asia were estimated by the World Health Organization (WHO) to be intermittently operational in 2000 (WHO/UNICEF, 2000). According to the International Benchmarking Network (IBNET) (Loubser et al., 2020) database, at least 309 million people worldwide have access to IWS; however, the actual figure may be more than twice that (Kumpel and Nelson, 2016).

No significant metropolitan region in India has fully transitioned to CWS, and more than 150 million people are served by sporadic piped water systems. Many Indian cities only provide water once every five to ten days, while the majority report having water available for about four hours every day (Ray, 2018). Therefore, households have to spend time and money waiting for, gathering, storing, and possibly treating their water in between deliveries.

Approximately 37.7 million Indians are affected by waterborne infections each year, according to (Sarkar et al., 2019). These illnesses, which include diarrhea, cholera, and arsenic poisoning, are brought on by toxins found in the water, including bacteria, viruses, chemicals, and heavy metals. The Indian government has launched a number of programs and regulations in an effort to address these issues and provide access to a safe and dependable water supply. The Jal Jeevan Mission (JJM) is an illustration of a large endeavor. According to the Ministry of Jal Shakti, 2019 statement, the goal of this effort is to guarantee uninterrupted access to piped water for every rural family in India by 2024. The JJM prioritizes improving infrastructure, encouraging community involvement, and acquiring the knowledge and abilities needed to manage water resources sustainably, thereby alleviating the problems caused by erratic water supply. Another strategy that is gaining popularity as a sustainable way to increase water resources in locations with both continuous and intermittent supplies is rainwater gathering.

Additionally, the conversion improves infrastructure optimization and effective water management. Continuous supply makes it easier to identify and fix leaks, which lowers water losses and conserves valuable resources. It also enables efficient pressure management, which lessens strain on the distribution network and prolongs the life of infrastructure. A steady water supply also encourages equitable access to water, boosts economic growth, and aligns with sustainable development objectives. It encourages the efficient use of water resources and backs water-sensitive urban design techniques.

Wankhede et al., (2022) did a study on the methodologies, uses, and problems of sensitivity analysis, where sentiment analysis, often a method of natural language processing called opinion mining identifies the emotional undertone of a volume of text. It is a way to forecast what would happen if a circumstance turned out to be radically different from the main expectations. It also entails the process of compiling and examining consumer opinions, ideas, and impressions of diverse items. This is a common method used by corporations to identify and group customer opinions regarding a good or service. The plan incorporated data collection based on public perception, listing both the benefits and drawbacks.

The evaluation is based on, a technically constructed questionnaires form for survey for both CWS and IWS DMA's in Mysuru, Karnataka. Our methods include direct interaction with the public with substantial document analysis. A survey was conducted for ~400 houses, 200 each for CWS and IWS respectively. Addressing the concerns and losses of prospective losers is crucial for sustainable scaling up since different groups may feel benefits and losses in different ways. Second, it is essential to clearly express price and tariff structures in order to gain the public's support and consent. Public awareness of the financing sources and gradual scaling up can help overcome resource and financial limitations. Third, it also gets mandatory to conduct water pressure using a hand-held pressure gauge that depicted constant and higher-pressure heads in the CWS area, as determined by a portable pressure gauge.

Overall, the benefits of switching from intermittent to continuous water supply include better public health, increased customer satisfaction, effective water management, and sustainable growth.

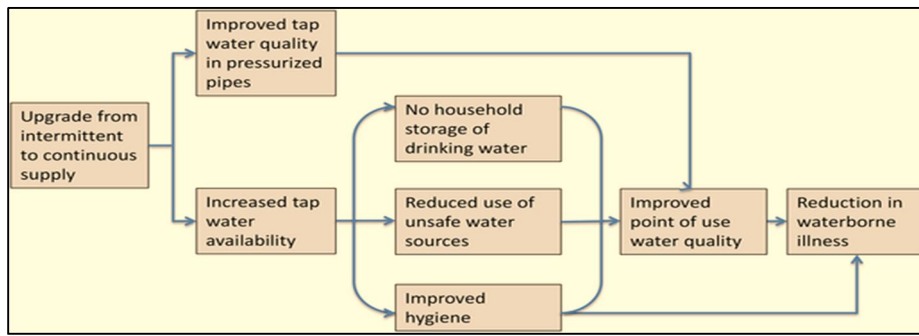


Fig 1. Upgrading from IWS system to CWS system

II. METHODOLOGY

A. Data collection and interpretation

A survey was conducted for both CWS and IWS areas to determine the efficiency of both intermittent and continuous water supply systems. From fig 2.1, the survey design was divided based on quality and quantity, that included the source of water, odour and colour, equity involving availability of water, maintenance of the pipe, frequency of water scarcity, health impacts, and tariffs which was determined by monthly payments. The survey was thoughtfully designed to address the technical components of the project through a series of research questions. The development of an intuitive Google Form survey that is simple for the general public to comprehend and complete is based on these key research topics.

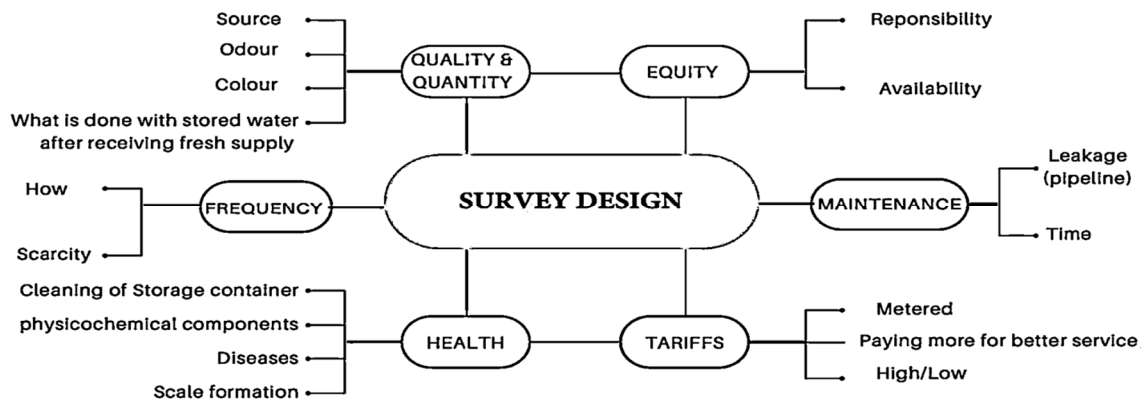


Fig. 2. Survey design flow chart

The questionnaire was translated into Kannada, the local language, and was created for both CWS and IWS areas. All survey participants provided spoken responses, which were gathered using a Google form as shown in Appendix-01.

The selection of survey houses was determined using a random sampling method. The number of houses surveyed are 400 in total. 200 for CWS and 200 for IWS areas, respectively. To capture the latitude and longitude coordinates of each household, a geo location camera was utilized (Fig. 2.2). The recorded coordinates were then entered into an Excel sheet to create the map, highlighting the surveyed areas. The detailed questionnaire is presented in Appendix-01.

The survey responses were separated into three categories in order to create a thorough and in-depth understanding of the various facets of the water distribution system in the CWS and IWS areas and meticulously recorded in an Excel sheet for a comprehensive analysis of the same. Environmental characteristics, including odour, scale presence, and water treatment quality, were the focus of the first category. In this area, special attention was paid to evaluating the possible health impacts associated with the reported water quality indicators. This recognition stems from the well-established positive correlation between water quality and human health outcomes. Social equity problems were the subject of the second type of analysis, which examined factors such as resident's satisfaction with the current water delivery system and the accessibility of water supplies. The

prices and aspects pertaining to convenience of the water delivery system were the subject of the third category. This entails assessing variables such as the incidence of pipe leaks, the reaction of repair services to issues that have been reported, and water bills.

The pressure was measured using a pressure gauge, a common method in water distribution systems to ascertain the pressure levels at specific points within the network. The pressure measurements were conducted for 20 houses in CWS area and 20 houses in the IWS area.

CWS- IWS Response sheet
Community survey form for IWS

karishmaoberoy123@gmail.com Switch accounts
Not shared

* Indicates required question

Name: *

Your answer

Latitude: *

Your answer

Longitude: *

Your answer

Address (Door no, Street /main, Area) *

Your answer

Remark: *

Your answer

Gender: *

☐ Male
☐ Female
☐ Others

Age group (based on health impact) *

☐ 0 - 6
☐ 7 - 18
☐ 19 - 60
☐ above 60

1) What is the source of water ? *

☐ Municipal /Corporation
☐ Borewell
☐ Bottled water
☐ Lorry /Tanker
☐ Other: _____

2) When do you receive the water ?

☐ Forenoon (6-8 am)
☐ Afternoon (12-3 pm)
☐ Evening (4-6pm)
☐ Night (8-10pm)
☐ Other: _____

3) How frequently you will receive the water ?

☐ Once in a day
☐ Once in 2 day
☐ Once in 3 day
☐ Once in a week
☐ Other: _____

4) How many liters of water will you store every time?

Choose: _____

5) What do you do with the stored water once you get fresh water ?

☐ Into drain
☐ Washing vehicle
☐ Gardening
☐ Reuse again

6) Are you facing any scarcity in the water supply? *

☐ To some extent
☐ Extremely
☐ No

7) Are you satisfied with the pressure of water supply? *

Your answer

8) How often do you clean the stored water container? *

☐ Daily
☐ Once in 3 days
☐ Weekly
☐ Once in 3 - 6 months (UG Pump)

9) Have you sensed any smell in the supplied water? if yes what kind of smell? *

Your answer

10) Do you observe any color in the water? if yes describe. *

Your answer

11) Have you observed any white scales formed in the stored container/tiles? *

☐ No
☐ To some extent
☐ Severely

12) Are you satisfied with the quality of your water supplied? *

☐ Yes, I am satisfied
☐ No, I am not satisfied
☐ I am not sure

13) Do you provide treatment to drinking water ? *

☐ No
☐ Boiling
☐ RO
☐ UV Filters
☐ Candle filter
☐ Other: _____

14) Is water supply system metered ? *

☐ YES
☐ No

15) Do you pay water bill, if yes how much rupees/month? *

☐ 0 to 100
☐ 100 to 500
☐ 500 to 1000
☐ <1000
☐ Not metered

Figure 3. Appendix 01



Fig 4. Researchers filling the public response in google form

III. RESULTS AND DISCUSSION

This recognition kind of analysis examined social equity problems, such as the ease of access to water supplies and the degree of satisfaction that residents have with the current water delivery system. The prices and convenience-related aspects of the water supply system were the main emphasis of the third category. This

entails assessing variables such as water costs, the frequency of pipe leaks, and the reaction of repair services to issues that have been reported.

A. Costs/ Tariff

The effective cost in CWS and IWS area is between 100 to 500 rupees per month, that involved the residents of CWS area being completely satisfied with the amount of water supplied (Fig 3.1). Although, maximum residents in IWS area also paid between 100 to 500 rupees per month and were also willing to pay more tariffs for the betterment of the water supply (Fig 3.2).

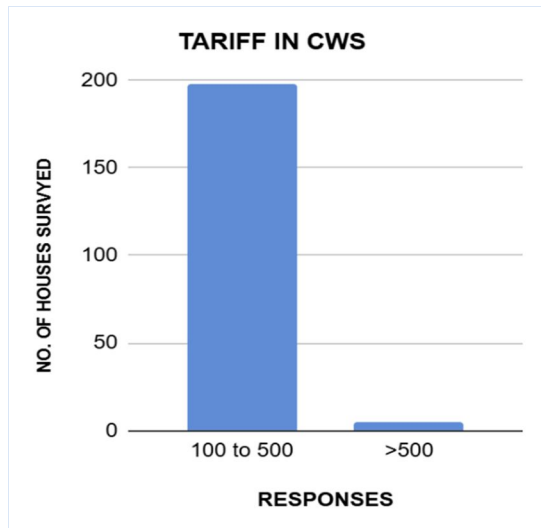


Fig 5. The bills regularly paid by the residents residing in CWS area

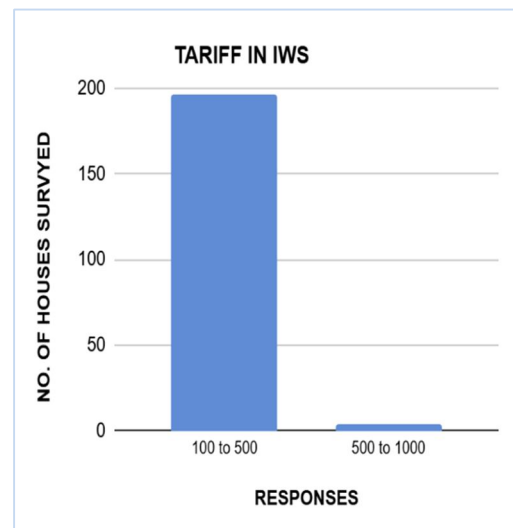


Fig 6. The bills regularly paid by the residents residing in IWS area

B. Health Impacts

The health impacts of the residents in CWS areas, depicted least category of health effects covering 98.5% (Fig 3.3).

While the residents in IWS areas depicted all kinds of levels, covering 91.3% of least health impact, 7.1% of moderate health effect and 1.6% of the residents showed severe health effects (Fig 3.4). 24/7 water supply systems significantly improve inhabitant's health and well-being.

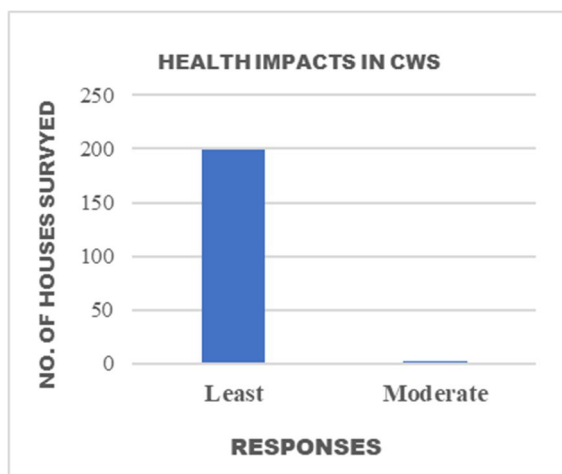


Fig 7. The health impacts of the residents residing in CWS area

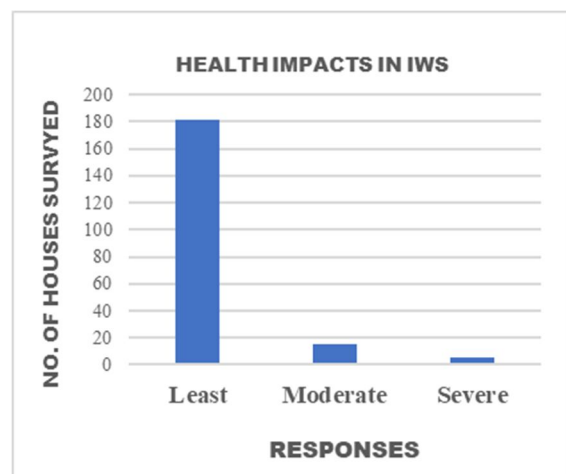


Fig 8. The health impacts of the residents residing in IWS area

C. Water Distribution

The distribution of water in CWS area, a system that provides water to consumers 24 hours a day, every day (Fig 3.5). It's considered the preferred system of water supply over IWS, which only provides water at specific times of the day (Fig 3.6).

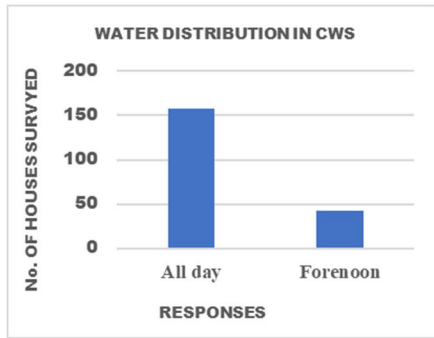


Fig. 9. Distribution of water in CWS area

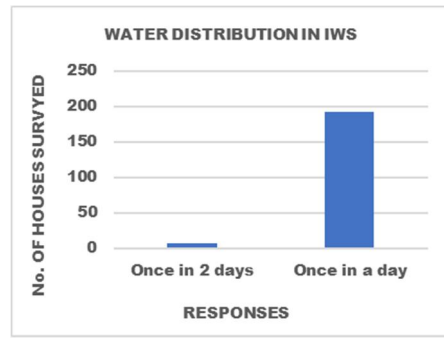


Fig. 10 Distribution of water in IWS area

D. Satisfaction Levels

The satisfaction levels of the residents were rated on a scale between 1 and 5 (Fig 3.7), where 1 indicated lowest satisfaction levels while 5 indicated highest satisfaction level. As observed, the satisfaction levels of the residents in CWS area were maximum of 94% due to continuous supply of water and availability of water to the residing residents. On the contrary, the satisfaction levels of the residents in IWS area depicted was well within grade 3 that is 36%, due to unavailability of continuous water supply to the residents.

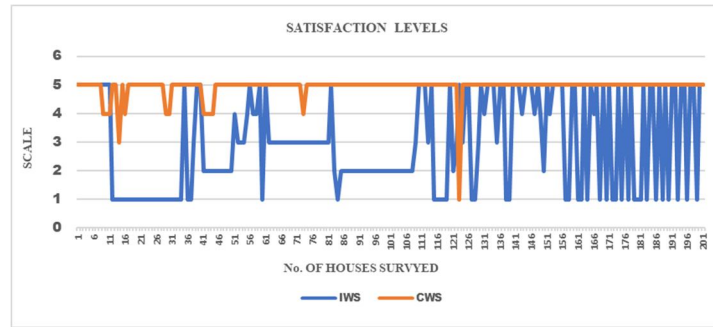


Fig 11. Satisfaction levels of the residents residing in CWS and IWS areas respectively

E. Pressure Head Measurement

The study's topography was taken into account when choosing the locations. For various time intervals, three samples were taken: one from the centre lane, one from the downstream location, and one from the upstream location. This method made sure that pressure readings were taken at various locations throughout the water distribution system.

The pressure measurements were conducted for 20 houses in CWS area and 20 houses in the IWS area. The measured pressure head values were ranging from 18m to 21m. The residents in CWS areas (Fig 3.8) received maximum supply of water with a pressure head of 21m while the residents in IWS areas received supply of water with a maximum pressure head of 19m, once or twice a day (Fig 3.9).

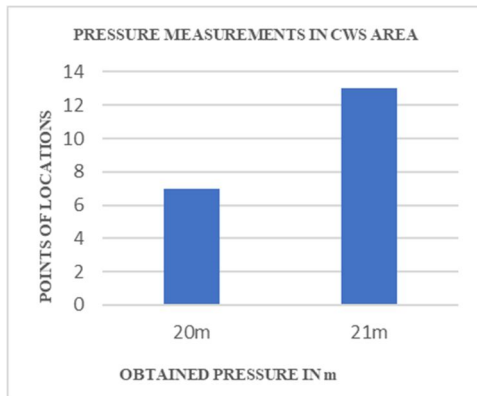


Fig 12. Pressure measured in CWS area

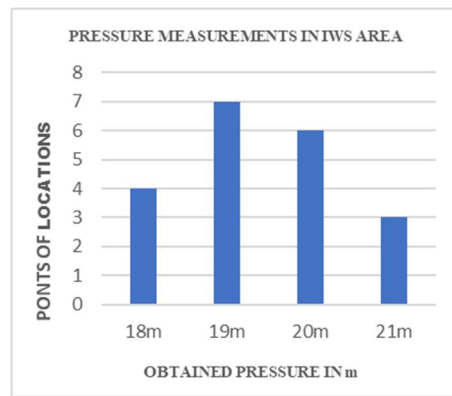


Fig 13. Pressure measured in IWS area

IV. CONCLUSION

A comparison of continuous water supply (CWS) and intermittent water supply (IWS) systems reveals glaring differences in socio-economic impact, satisfaction, and efficiency. The survey method adopted in the study involved the use of a carefully constructed questionnaire, to collect the responses from the general public. The questionnaire covered various dimensions such as quantity, quality, maintainance, health, equity, frequency and tariff. The results obtained, depicted residents in CWS regions report far higher levels of satisfaction (94%) than those in IWS areas (36%). CWS systems guarantee fair water distribution, improve infrastructure longevity, and lower health concerns.

The results show that although CWS necessitates upfront expenditures, the long-term advantages like precise billing, less maintenance, and improved quality of life far exceed the drawbacks. The results may not be generalizable to other areas due to the small sample size and narrow study location in Mysuru, Karnataka. Future studies should seek to broaden the study by including a broader and more varied sample population from various geographical regions in order to solve this issue. It is also important to note that the survey responses were gathered via a Google form, which may bring biases and restrictions typical of internet surveys. Furthermore, the small number of people who reported specific quality-related problems may have an impact on the strength and direction of correlations in this study. It is crucial to understand that other elements that were not considered in the investigation, such as pipe materials and maintenance procedures, may potentially affect the public's impression of the water quality. Future research should think about including these elements to get a fuller grasp of the problems at hand.

Stakeholders and governmental organizations can use the study's findings to better understand the benefits and challenges of moving from IWS system to CWS system. The results of the study can have an impact on policy decisions, proposals for additional infrastructure, and community engagement programs. This study concludes by emphasizing the need of a steady water supply for ensuring that everyone has access to trustworthy and safe water and for promoting sustainable development.

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