Preference heterogeneity, public choice and willingness to pay have been looked collectively in this thesis through a study of water supply reform in a mega city. Households’ preference heterogeneity for different water supply scenarios differentiated by their quality has been examined. As there is no perfect market for water quality, either a contingent valuation method or household health production method has to be used to find the value households place on it for getting private health benefits. In this study, data is collected through a carefully designed contingent valuation survey among 1100 households spread over planned and unplanned residential units categorized by property-tax-class for estimating households’ willingness to pay for dual quality water (decentralized municipal water for drinking and local groundwater for other purposes), single potable quality water and the ‘business as usual’ scenario of water supply. Property-tax-class is taken for stratification to introduce first level of preference heterogeneity. Water supply with different quality and quantity attributes induce the second level of heterogeneity in preference behaviour. The dependent variable, households’ choice of water supply scenario is observed as a discrete variable and logit, probit, multinomial logit and nested logit models are used for estimating customers’ willingness to pay. Some case studies have been attempted for making estimates of cost of water supply under different water supply scenarios.

This chapter summarises results of data analysis and concludes with policy implication with regard to water service provision in heterogeneous settlements. Figure 6.1 outlines points of discussion relating to objectives of the study set in Chapter 3 and is summarized under four headings – (i) nature of the household demand, (ii) valuation of heterogeneous preference, (iii) cost of unreliable supply, and (iv) difficulties in implementing reform project in a heterogeneous planning environment.
Summary of results and conclusions

Figure 6.1 Flowchart to raise points of discussion relating to objectives of the study and their policy implications

- Nature of the household’s demand
  - Quantity of supply
  - Duration of supply
  - Demand-supply gap
  - Quality perception
  - Regional disparity within the blocks

- Valuation of preference heterogeneity for three scenarios
  - Dual
  - Single
  - BAU
  Variation across planned and unplanned blocks

- Cost of unreliable supply
  - Enhancement strategies
  - Accommodation strategies
  - Valuation of unreliability

- Policy outcome: implementing reform project in a heterogeneous environment
  - Differential ‘supply-preference’ regime – one size does not fit all
  - Political position in ‘planning the unplanned’
  - Limits to technology: planning under existing settings often under pressure with retrofitting

6.1 Nature of the household demand

6.1.1 Quantity of supply and consumption: The supply of water in the service area is not even. Large disparities exist in the availability of water between planned and unplanned areas. The average per capita supply varies from 60 lpcd in Mehrauli to 175 lpcd in Rohini although DJB uses a supply norm of 227 lpcd. Average per capita consumption varies characteristically with rising planning classes. The average consumption per household in the unplanned areas was found to be 420 liter or 67 lpcd and in the planned areas it was 165 lpcd. On an average, people need 36 lpcd for potable purposes and 125 lpcd for domestic purposes (Figure 5.2). The mean consumption in planned areas was found to be 19.8 kl/month and 12.6 kl/month in unplanned areas.

6.1.2 Duration of supply: On an average people in planned areas get 4.02 hours of daily supply whereas those living in unplanned areas get 4.73 hours of daily supply. Compared to unplanned areas, people in planned areas demand more hours of supply, which indicates wealthier customers are not too satisfied with the current level of supply duration. Extra hours of daily supply demanded in planned areas are 7.46 hours and 4.84 hours in unplanned areas (Figure 5.5). A few areas of the city have distribution systems that are connected directly to the transmission system and such areas enjoy a near-continuous supply of water.

6.1.3 Demand-supply gap: There are wide disparities among population groups within the zones, including the level of services available to them (Table 5.1). The demand supply gap in planned areas is nearly 20% less than the gap in unplanned areas. The reasons for this gap include inefficiency of the network, excessive leakages, bulk supply uncertainty; intermittent and inequitable supply and haphazardly built high density housing making provision of water through conventional means extremely difficult. Although the average per capita availability of water in absolute terms is lower, lesser disparities within the planned zones imply that affluent classes actually receive far larger and even quantities of water than in poorer unplanned classes with higher unreliability and demand-supply gap being more than 45% of the demand in lower E, F and G classes. The estimated average demand-supply gap for planning classes clubbed together is 35.42% of the present availability (Table 5.2).

6.1.4 Quality perception: 22.58% households in planned areas rated poor quality of municipal water as the major environmental problem in their areas (Figure 5.7).
They had mainly concerns with its safety mostly pertaining to bacterial and chemical contamination and its potential negative effect on health. The usage of water purifiers is very high in planned areas mainly due to perceived improvements in the safety and aesthetic qualities of purified water compared to regular tap water – while 11.2% drink tap water directly without any form of home treatment, 88.8% households use some form of in-house water treatments. The penetration of UV type purifier ‘Aquaguard’ is highest – 44.19% people in planned areas use this purifier (Figure 5.8).

6.1.5 Regional disparity within the blocks: Demand for water services is intricately linked with the establishment of the city, in terms of spaces, services, settlements, planning classes, and resource availability. Existing water service conditions are highly heterogeneous across the city and these conditions are significantly associated with household planning levels reflecting regional disparity within the blocks. In socio-economic terms, practically all zones present a remarkable diversity, with a relatively clear distinction between different income groups, and low-income unplanned areas representing up to 50% of the urban population. Rising affluence comes with more attention to public health issues and a demand for better water quality.

6.2 Preference heterogeneity for differentiated water quality/supply

6.2.1 Customers’ preferences for water quality and reliability improvements are sensitive to differences in their scope of provision and gives differing value estimates, demonstrating ‘scope effect’. The factor that complicates the task of estimating customers’ preference for water quality and reliability improvements is the multi-dimensional nature of service provision. Quality and quantity attributes could be ‘differentiated’ and are lumpy in nature – i.e. they cannot be consumed in continuous amounts. People’s preferences for differentiated quality water in planned settlements are significant and they place higher value on high quality drinking water. This shows that respondents are sensitive to significant and substantive differences in the provision of differential water quality – ‘high quality potable’ and ‘not so high but safe’ for other domestic needs. It also demonstrates scope effects (a frequently aired criticism of CVM is its inability in many cases to demonstrate any impact on value estimates for a change in the scope of the good involved). People in planned areas with higher property class do see dual quality supply as a practicable assumption – not a pipe dream. Even in unplanned areas,
many customers have designed their own ‘point of use’ or ‘point of delivery’ methods for using dual quality water although in a small scale.

![Figure 6.2](image)

**Figure 6.2** People’s preferences for differentiated quality water in planned and unplanned areas

Many empirical valuation studies ignore the taste variations across the respondents in the sample. Estimating demand for water quality and reliability improvements under the assumption that preferences are homogeneous offers limited direction on the distributional consequences of policy outcome (Amador et al. 2005, Chesher and Santos-Silva 2002, Huttala 2000) and hence may lead to biased estimates of welfare for any specific individual (Morey 1999). This would further lead to different mean consumer surplus estimates for changes in characteristics such as quality of public water supply. If the quantity of environmental good demanded varies significantly between planning classes, this preference heterogeneity might lead to misinterpretation of results. A perceptible heterogeneity in customer’s preference provides remarkable lessons to policy makers on the distribution of costs and benefits related to a change in policy. Even though overall gain in welfare is positive, there exists a significant divergence among the respondents about the extent of these benefits between planned and unplanned areas. Existence of such differential demand and willingness to pay higher than the existing tariff for additional quality could bear out the rationale for providing such services and charging for it. Quality differentiated pricing among customers in planned and unplanned areas could be argued on several grounds; however, there is a need of getting hold of reliable
estimates of WTP for any proposed change in quality of services, if such pricing structure has to be welfare improving for the particular settlements.

6.2.3 Preference for water supply options and customers’ WTP varies with level of planning and affluences as categorized by property tax class. Preference for dual quality water is almost negligible in the unplanned areas implying that what they primarily need is better water supply (existence needs have priority over related luxury needs i.e., customers are motivated by unfulfilled wants, and that certain lower needs need to be satisfied before higher needs can be satisfied). For these customers having a ‘point of delivery’ dual quality supply may be imaginary and a luxury proposition.

More than 85% of the sampled households are willing to pay extra than their current water bill for improved water supply services with a majority of them (55.83%) voting for single quality improved supply with a mean WTP of Rs 189.32 per month (US $ 4.15). Segregated into planning classes, households in unplanned areas are willing to pay Rs 144 to Rs 157 per month (US $ 3.16 to 3.44) at an average consumption of 12.6 kl/m; and Rs 248 to Rs 257 per month (US $ 5.44 to 5.63) with an average consumption of 19.8 kl/m in planned areas. In kilolitres terms, households in planned areas are willing to pay Rs 12.98 per kl (US $ 0.28) while those in unplanned areas are willing to pay Rs 12.50 per kl (US $ 0.27) for single quality improved water supply. The results indicate that customer’s WTP per kl in both planned and unplanned areas is almost similar thereby indicating limited cross subsidy between subgroups. A large number of households (31.09%) in the planned areas favour decentralized dual quality supply over centralized single quality continuous supply with a mean WTP of Rs 289 per month (US $ 6.34). However, higher infrastructure cost and risk of cross-contamination between potable and non-potable water may limit their application.

6.3 Cost of unreliable supply and coping strategies

6.3.1 Types of coping strategies: Due to water agency’s inability to provide efficient and reliable supply, customers have adopted several strategies to make the supply reliable in terms of both quality and quantity. These strategies are generally of two major types – enhancement strategies and accommodation strategies. Enhancement strategies are designed to increase the level and quality of water supply. These include developing alternative supply often supplementing water available through the public system, buying water from vendors, filtering water for
drinking and cooking purposes etc. Accommodation strategies, by contrast, adjust behavior to accommodate an unreliable piped water supply. For example, accommodation strategies might include shifting the hours of washing clothes or bathing to times that correspond to the availability of water. In extreme situations, accommodation might mean consuming less water, bathing less frequently, and sacrificing general hygienic standards. Typically, the residents need to supplement public supplies with water obtained from private sources, and this is usually much more expensive. The extent to which this is done – the proportion of water procured privately against the quantity supplied is determined by individual households demand and socio-economic characteristics. Several households use multiple averting measures, for example using private tankers and community standposts for sourcing water and boiling for purification.

**Figure 6.3** Monthly cost of unreliable water supply versus water bill paid to the utility with planning classes (in Rs per month per household)

### 6.3.2 Unreliability cost varies characteristically with planning level and customer’s willingness to pay:

Customers spend significant amount of money in devising and adopting enhancement and accommodation strategies to make the supply reliable. An increasing proportion of customers are already making their own investments to simulate 24 × 7 water supply at the household level – borewells, surface and overhead storage tanks, booster pumps, tankers suppliers, etc. These investments
are supplemented with water purification methods such as filtration and boiling. Poor people have to accept uneven share of the impact of unreliable water supply services. Customers inconvenience results in loss of household income or productive time.

On an average the cost of unreliable water supply is 4.34 times higher than the monthly water bill paid to the water Utility (Figure 6.3). Whereas the average cost of unreliability in planned and unplanned areas is Rs 377.75 per month, the average monthly water bill is Rs 89. It can be said that with increase in quality of life and planning status, households spend higher amount of money to avert unreliability – it is Rs 2525 per annum in lower stratum property class G and goes up to Rs 6000 for class A. Planned and unplanned areas put together, the average cost of unreliability is Rs 4533 per annum per household in the MCD areas.

6.3.3 Customers collectively bear the negative externality in planned areas: There are several instances of reciprocal externality wherein households themselves absorb the cost of over-extraction, in terms of declining water tables, and cost of salinity in terms of decentralized treatment cost. People in planned areas seek collective action to ensure cost minimization by a decentralized treatment option for high quality potable water. In several housing societies, the economies of scale act as externalities leading to an optimum investment in the decentralized treatment technology (such as RO or ion exchange plant) and the emergence of a voluntary co-operation by the residents for a good quality water supply.

6.3.4 ‘Convergent validity’ may not always work in developing countries context: Revealed preference questions (coping cost on unreliable supply with quality limitations) were also included for later comparison with stated preference results (willingness to pay for a better and reliable supply); and, it is concluded that both values being similar is neither necessary nor a sufficient condition for the validity of CV studies. People may have higher personal coping cost to avert unreliable supply, but when it comes to paying to water utility, they may be willing to pay lesser their coping cost. This gives differing revealed values and actual stated values (WTP), for example, people in unplanned areas spend Rs 290.5 per month and those in planned areas Rs. 443 per month as coping cost against unreliable supply, but their stated mean WTP for a better and reliable supply is Rs 144–157 and Rs 248–257 respectively. Reasons for this could be low belief in the service provider where
respondents did not fully believe that the new system would work reliably. This also shows protest responses where customers feel that they should not have to pay for improved water. For example, in India, people still regard public water supply as a social and public good which government has to provide at low price. The importance of the coping cost benchmark is that it exceeds customer's WTP value that adds to the credibility of the estimated results.

![Comparison of unreliability cost, willingness to pay and monthly bill for customers in planned and unplanned areas](image.png)

**Figure 6.4** Comparison of unreliability cost, willingness to pay and monthly bill for customers in planned and unplanned areas

### 6.4 Policy outcome: implementing reform project in a heterogeneous environment

A particular policy decision which is informed by social values will affect large numbers of people, making some better off and others worse off to varying degrees (Weimer and Vining 2005). Presumably, the decision maker wishes to choose policies that produce the largest possible increases in social wellbeing or welfare (Allenby 1999). When decision makers choose from alternative policies, they identify the favourable (beneficial) and adverse (costly) consequences associated with each alternative and choose the preferred option. That is, if one scenario dominates the rest in the choice occasion, then it has more of all good attributes and less of all the bad attributes. However, it is evident from the present study that implementing reform project in a heterogeneous environment can become complicated by a number of reasons, such as:
(a) Differential ‘supply-preference’ regime – *one size does not fit all*
(b) Difficulties in implementing reform project aimed at improved service levels in heterogeneous planning environments
   (i) Land tenure
   (ii) Political position in *planning the unplanned*
   (iii) Limits to technology – planning under existing settings often under pressure with retrofitting
   (iv) Cost recovery of accessing existing services
   (v) Political will to charge higher and efficient rates and commercialize public utility

### 6.4.1 Differential ‘supply-preference’ regime – *one size does not fit all*

In the present study, if planned and unplanned areas are put together, then single quality continuous supply becomes the most preferred choice. However, water supply service requirements can be disaggregated into many quantity, quality, and reliability attributes. Similarly, there is a demand for differential services which stems from diverse social and planning settings and quality of life of customers.

Rising affluence comes with more attention to greater reliability and a demand for better water quality. As customers have varying bundles of need in different end-uses, planning classes, and locations; the current ‘one size fits all’ infrastructure does not always meet their utility effectively or efficiently. In such environment with unreliable services, customers learn to live with the existing realities and devise their own system to cope and adapt, often to a new system with varying degree of dependence on the services provided by the public utility. The coping and adapting mechanisms often overlap depending upon knowledge of the choice/technological options available which in turn depends upon society’s level of affluence dictated by the planning class. There are a number of technological and institutional ways to satisfy the various bundles of customer’s needs more than what the current infrastructure systems provide. Customers with greater awareness of the unreliability decide to adopt a secondary system often at the society level. This is quite evident in the planned areas where diffusion of decentralized options emerges to compete with Utility’s inability to provide efficient services. Such innovations spread fast throughout the social system and are often shared by several households modifying behavioral patterns. Customers are able to support such decentralized options because they increase their wellbeing and hence they enlarge their ability to pay the required contribution from their discretionary income making them financially sustainable.
6.4.2 Difficulties in implementing reform project aimed at improving service levels in heterogeneous planning environments

(a) Land tenure: Both legality and locality of settlements guide the future cost of installing new services and on the willingness and ability of poor and underprivileged communities to pay higher rates for reliable water services. Growth in economic activities and opportunities has led to increasing housing demands resulting into growth of unauthorized colonies, squatter settlements and extension of laldora in urbanized villages without provision of adequate water services. In order to recover significant portion of the costs, the local bodies are required to give appropriate land entitlement and tenure status and recognize the value of including unplanned communities in the network and provide them with reliable water services when it is obvious that this will add to revenue base through increased metering and billing.

(b) Political position in ‘planning the unplanned’: The political position – willingness of local government to bring unplanned in the mainstream of urban development process is very critical in ensuring reform objectives. Considering the settlement pattern in the urban areas under the jurisdiction of the MCD, the DUEIIP (2001) puts the population residing in JJ clusters at 3 million – about 24.5% of the total population. Further, 15% were residing in unauthorised/regularised colonies, 13% in resettlement colonies and 9% in urbanised villages – all of which has been classified as ‘substandard housing’. Therefore, there is a huge challenge in terms of providing acceptable level of services in these areas that are outside strict planning controls. People living in unplanned areas cannot be ignored politically or financially as far as supply of reliable water to them is concerned.

(c) Limits to technology – planning under existing settings often under pressure with retrofitting: The locality of the settlement in which the communities are living, the neighbourhood area including distance and ease of access to nearby storage reservoir due to narrow roads and dense population- the lack of planning also limits the technology as well as the level of services that can be provided in such congested areas. Along with high population density in unplanned colonies, there is a high proportion of tenancy occupation. There is acute water scarcity and high levels of contamination because of a combination of factors operating at both the colony and household levels. Clearly there is a huge challenge to retrofit the current infrastructure.
(d) **Cost recovery of accessing existing services:** Information on customers’ WTP suggests that even poor people in unplanned areas are interested in being ‘valid paying customers’ of the utility if they are provided with acceptable levels of service. It is important to break the vicious cycle of poor service delivery, unwillingness to pay, lack of revenue, and further deterioration of service. It is also important to break free of the “charity” approach to service provision for the poor. Poor people have shown that they would rather pay for good quality services than get low quality services for free. In order to ensure that the planned improvements fully address the needs of these people – and that water utility is seen as meeting its own stated intentions in this regard – targeted, adequately funded and well-designed measures need to be formulated. Water sales to the unplanned sector can capture a significant market share constituting as much as 60% of the total potential market. Given that any supply change must ultimately be financed, the problem of determining appropriate water pricing strategies for large urban areas of NCTD becomes highly complex, due to the city’s heterogeneity in term of service conditions and socio-economic characteristics.

(e) **Political will to charge higher and efficient rates and commercialize public utility:** Lack of political will to commercialize water utilities and charge cost-based tariff is a real issue still to be addressed adequately in developing countries context (Buchanan 2003, Cowen and Tynan 1999). Since water supply is considered a social and moral obligation, the onus of providing water has traditionally been thrust on the government, made available at heavily subsidized rates. Continued political interference is considered as being an impediment to cost recovery and tariff increase even when customers are willing to pay higher than the existing rates. This approach not only results in ‘unwillingness to charge’ for water services, but also in other unsustainable water policies, without guaranteeing appropriate cost recovery mechanisms (Reut et al. 2002). For example, the water utility managed by local government might assert that it should supply its people with ‘free’ water, even when institutional capacities and funding arrangements to provide reliable water services are not in place (Crane 1994). Since water supply is considered a moral and social obligation, the onus of providing water has conventionally been thrust on the government, made accessible at heavily subsidized rates. This study has shown that a major chunk of Delhi’s urban population is willing and able to pay for a reliable water supply that has no health risk of contamination. The WTP figures estimated from the surveys indicate that majority of the people, almost 75 % of these semi-formal and informal settlements in unplanned settlements are willing to pay an amount that is equivalent to the basic
recurrent costs of a full level of piped water supply. Currently 43.69% of the surveyed population is willing to pay substantially higher than the O &M cost even though the indirect cost of unreliable supply to them is higher than their willingness to pay. This WTP amount can be used to create equity based policy of water tariffs reflecting planning status of a customer group. The aggregated WTP amounts show that the authorities could collect sufficient resources for modernization of service and also reduce existing subsidies by about 70%; remaining subsidies could be targeted on households with lower planning levels, particularly in class G and H. According to the vision document of the water Utility (DJB 2005), the basic government policy is that water services should be self-financing at both local and regional levels. The only expectation to this is that, where poor communities are not able to afford basic services, local government may provide subsidy for construction of basic minimum services but not the operating and maintenance or retrofitting costs. This implied that there might be scope for additional steps to be taken, such as improving the quality of service so as to provide justification for price increases and/or expand demand to increase the level of supply and cover operating and maintenance and even investment costs.

6.5 Future policy developments and investment decisions: whither the customer’s preference?

The study has shown that customers are able to support their desire for better water supply services by paying the required contribution for improved services. Customers’ preference for services and their WTP vis-à-vis planning class can be used to determine an appropriate equity based tariff policy and financing package for the improved water supply system. An assessment of water tariffs and WTP for such services reflecting their planning status would therefore lead to the creation of a revenue stream which will enable repayment of capital and interest as well as a self-financing operation for the maintenance of the network. However, good cost recovery is reliant on supportive government policy and Utility’s institutional structures to bill and collect expressed willingness to pay meeting customers demand more effectively (WSP 2006).

Over the last one decade, urban areas in India have been facing a higher degree of complexity in terms of service provision and infrastructure expansions creating new challenges for institutions (Kundu and Thakur 2006). The reform objective over the next 25 years requires a fresh approach regarding the appropriate mix of public and private funding and institutional structure that could replace those in existence (World Bank 2006, 2005). In the current situation, the water Utility is considering
wider reform and contributing through planned allocation towards the total costs, but is unsure of the ability of its customer’s willingness to pay. This lack of confidence stems from past inefficiencies. If the Utility lacks clear position on whether the state, or customers, should pay for the new infrastructure or upgrading the existing ones, reform objectives cannot be sustained for long. Generally, it can be assumed that regardless of state water policies, there is shortage of money available to pay for the costs of upgrading schemes or creating new infrastructure. Therefore, it may be better to make estimates of all costs of each option in order to ensure that a CV scenario could be used to work out tariffs that will recover at least some proportion of total costs other than O & M costs both in planned and unplanned areas. The current situation creates an economic environment which is unfriendly to increasing customers’ faith in service provider. It costs far more to have unreliable water supply than to meet the costs of efficient services. Ideally, efficient pricing reconciles the benefits and when customers are getting better and reliable services, willingness to pay will be more – now and in future.

6.6 Summary of important findings

1. Levels of water supply as well as consumption between planned and unplanned colonies are uneven varying distinctly with property class.
2. Even though affluent planned colonies receive far larger and even share of water than the poorer unplanned colonies, they demand more hours of supply than the existing duration.
3. Demand-supply gap in planned colonies is nearly 20% less than the gap in unplanned colonies.
4. A high proportion of customers in both planned and unplanned areas use ‘point of use’ treatment options for potable requirements. The usage of water purifiers is very high in planned colonies mainly due to perceived private health benefits in the safety and aesthetic qualities of purified water compared to the municipal water.
5. Even in unplanned areas, many customers have designed their own point of use or point of delivery method for using dual quality water, although in a small scale.
6. With increasing planning class and discretionary income, households spend higher amount of money to avert water supply unreliability both from quality and quantity angle.
7. Unreliability cost burden on planned households are 1.3 times higher than those in unplanned households. Overall, the unreliability cost is 4.34 times higher than the current monthly water bill paid to the municipality.

8. More than 85% of the households are willing to pay extra than their current water bills for improved water supply services.

9. Households’ willingness to pay varies with level of planning and affluence as categorized by the property tax class.

10. There is a difference in value estimates measured through revealed and stated preference behaviour. People may have higher private coping costs to avert unreliable supply, but when it comes to paying to the water Utility, they may be willing to pay lesser than their coping cost. Reasons for this could be low faith in the service provider. This also shows protest responses where customers doubt about Utility’s capabilities in providing them with the improved water supply.

11. Customers’ implicit WTP per kiloliter of water based on their average consumption is almost equal in both planned and unplanned colonies. In view of this finding, there is a scope for successive reduction in cross subsidy between these two groups.

12. A large number of households in planned areas favour decentralized dual quality water over single quality improved supply. However, single quality improved supply becomes the most popular choice if planned and unplanned households are put together. This preference variation across sampled households testifies scope effect, i.e., differential water quality and reliability provision have differing value estimates.

6.7 Scope for further research

(i) The effects of different attributes of the scenarios on the probability of choice cannot be explored, although this would provide information valuable to policy formulation.

(ii) Customers’ perception of quality of service levels may differ from the actual level of services for a variety of reasons. The divergence between perceptions and the actual levels presents a genuine problem. There might be some divergence between perception and objective measurement, (for example, customers’ perceived and measured reliability could differ) and this too can add to complexity such as ‘protest responses’ or strategic bias. In practice customers’ behavioural decision processes could be complicated by changing community values
and external interrupts such as political factors governing master plans, land entitlements etc.

(iii) Measuring social and economic costs associated with water supply unreliability and benefits accrued from improved infrastructure can sometimes be too complex where capital and infrastructure cost of provision is invisible. The difficulty in doing a financial cost analysis for water supply in the present context is twofold - first, cost of retrofitting, i.e., cost of conversion from presently intermittent and inefficient supply to a continuous supply in a city with differing age of infrastructure and heterogeneous settlements could be uncertain. Secondly, it is difficult to find out the benefits of reduced resources (raw water & energy savings) over a long run with continuous supply due to capital invisibility in the sector.