Coping with poor water services and the demand for change in Trinidad and Tobago

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Trinidad and Tobago’s 1.3 million residents are provided water supply and sewerage services by a national utility whose service levels have been inadequate and deteriorating through the recent past, largely due to a lack of investment in utility infrastructure. A “willingness to pay” study assessed the degree of coverage and quality of service and the residents’ willingness to accept water tariff increases for an increase in service level. Willingness to pay for change is low, below current tariffs, due to scepticism about the likelihood of change and due to the ability to cope with bad service through the pervasive use of local storage.

Keywords: water demand; willingness to pay; contingent valuation; water tariffs; local storage; Trinidad and Tobago

Introduction

Access to clean water supplies has considerable and immediate impacts on public health and longer-term economic benefits to a household. Sustainable provision of clean water is of critical importance.

Trinidad and Tobago has 1.3 million residents in 340,000 households (Figure 1). The Water and Sewerage Authority (WASA), formed in 1965 by an Act of Parliament, is responsible for the expansion and maintenance of waterworks to supply all residential, commercial and industrial water demands, as well as for water resources management. WASA has been responsible for all wastewater treatment facilities since 2004. Domestic users account for 36% of the total water abstracted, industry for 14% and agriculture for only 1%, while the remaining 50% is unaccounted for water (WASA 2002).

The utility and its management have traditionally been politicized. High government revenues due to high oil prices and the perceived inevitability of central government cash transfers allowed cost recovery by the utility to be of low priority (Virjee and Gaskin 2003). The revenue base has decreased due to decreasing real rates over time as nominal water tariffs were only adjusted in 1937, 1986 and 1993 (WASA 2008b), billing efficiency was low and the labour force was overly large (16 staff per 1000 connections, [Stiggers 1999]). This resulted in insufficient funding (in 2006 the expense-to-revenue ratio was 2.4:1 [WASA 2008a]) for investment in physical infrastructure and an undermaintained, sub-optimal system.

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WASA reports that 92% of the population has water services in the form of an in-house piped connection, a standpipe within 200 m of their dwelling or free truck-borne water. The spatial and temporal variation in reliability is increasing and was reported by WASA as a full service equivalent (FSE) of 77% for 2002. The FSE is a distribution network water availability weighting based on the planned schedule of service (Nankani 1997). However, insufficient knowledge of and management systems for the network combined with a lack of district and household metering means there is a high uncertainty in the FSE number.

Water supply is metered for about 70% of industrial and commercial customers. Domestic customers are unmetered with rates based on the annual taxable value (ATV) of the property with quarterly rates up to TT$304 (US$50) for an in-house connection and of TT$33.75 (US$5.55) for a standpipe user. Domestic users account for about 75% of the total number of connections and 35% of the total revenue for 36% of total water usage (two-thirds of the total delivered water).

The need to recover costs and invest in infrastructure at WASA is considerable. While results are contingent on effective management, it requires an increase in water tariffs. Increasingly it is recognized that users must be consulted for systems to be sustainable (e.g. Sara & Katz 1998) and that analyzing consumers’ preferences and perceptions (e.g. McPhail 1993a) will increase the financial sustainability of utilities.
This paper discusses the results of a national survey which aimed to assess the current level of domestic water supply, wastewater, and electricity service experienced by the residents of Trinidad and Tobago (Virjee 2004). The survey aimed to ascertain the willingness to pay (WTP) for changes in the level of service experienced by users. The WTP methodology used is discussed, as are similar applications in developing countries. The survey results for water supply services are presented and compared to the official coverage values, and coping strategies associated with inadequate supplies are discussed. An econometric analysis of the WTP bids for improvements to water services follows and finally the policy implications of the survey results are discussed.

**Willingness to pay and contingent valuation**

In many developing country water supply systems service levels are poor or lacking. In attempting to upgrade existing systems, or implement new systems, it is beneficial to understand consumer perceptions towards proposed changes. A component of this is their willingness to pay (WTP) for the change sufficient to ensure net positive benefits, which may include a non-captured public benefit. Earlier work has argued that a lack of information on the WTP of users has led to the slow expansion of services, or large, inappropriate infrastructure poorly maintained due to deficient demand (World Bank Water Demand Research Team 1993). The arbitrary maximum “five percent” (of income) rule has, in some cases, limited the appropriateness of the system and decreased its sustainability (e.g. the case of Rabat [McPhail 1993b]).

Most WTP studies for water supply and sanitation services in developing countries have employed the contingent valuation (CV) method, a stated preference technique, as it is recommended as reliable for WTP elicitation (e.g. Ardila *et al.* 1998). A multi-part household survey presents the respondent with a hypothetical scenario describing the change to be valued using open-ended questions, bidding games, dichotomous choices or payment cards (Mitchell and Carson 1989). An early application evaluating the demand for improved water supplies in a project being installed by CARE in Haiti (Whittington *et al.* 1990) demonstrated that the CV method resulted in an understanding of the demands of users and in the design of a more appropriate system. A later large study with about 1200 respondents in rural villages in Pakistan (Altarf *et al.* 1992) demonstrated that the WTP of villagers surveyed was below the 5% of income rule of thumb often used in assessing affordability of service options. Briscoe *et al.* (1990) demonstrate that WTP information can be integrated with policy analysis to determine rates which allow for cost recovery and protect poor sections of society. A persistent criticism of the method has been that users, due to the hypothetical nature of the proposed scenario, have no incentive to give honest answers. In a unique study, Griffin *et al.* (1995) revisit households in Kerela, India, and determined that 91% of actual decisions to connect to the system were predicted by the survey prior to system implementation. Whittington *et al.* (1998) show how analysis of CV data can be used to design demand-responsive interventions by including significant minorities who are willing to pay considerably more than the average for upgraded private metered connections. Similarly, McPhail (1993a) shows the urban poor in Rabat are willing to pay for upgraded connections despite plentiful water available at a standpipe level of service.

**Methods: field procedures**

The current level of water supply services and the demand for changes to this service was assessed using a multi-part survey administered to a randomly selected national sample of...
1419 households in May – June 2003 (Virjee 2004). The questionnaire used had been developed through an iterative process with expert consultations and extensive pre-testing, which led to considerable revision of the initial draft document. The questionnaire contained multiple sections: a socio-economic section, a current level of service section and a contingent valuation section to understand the demand for change from the just-described status quo. The contingent valuation scenario was the ideal level of service – in-house service with guaranteed 24 hour reliability of supply with an adequate water pressure and high bacteriological and aesthetic water quality – which was set by WASA and the Regulated Industries Commission (RIC), the national utility regulator. This ideal scenario was offered to users with in-house piped supply and to those using lower levels of service. The service upgrades differed, as for the latter group it included a service upgrade to an in-house piped connection. The ideal situation was of interest to the regulator as the government of the Republic of Trinidad and Tobago (GORTT) was aiming for “developed country” status by 2020: “vision 2020”. The demand for intermediate service levels was not examined, nor was the scenario designed with technical feasibility in mind.

A bidding game format (e.g. Randall et al. 1974) was used to elicit the maximum WTP for service level changes due to its simplicity, using the median current water bill for in-house connections as the starting point. The Central Statistical Office’s (CSO) Continuous Sample Survey of Population (CSSP) sampling method was used to select 1419 households, using a two-stage stratification scheme based on geography and labour force characteristics (CSO 1989). The ideal basis for stratification, by water source used, was closed due to a lack of accurate data. The non-response rate was 12.5% and was due mainly to errors in the CSO-supplied listing records and the difficulty in accessing some remote areas. The CSO provided a list of trained enumerators from which 30 were selected to administer the survey. The selected enumerators were trained extensively, using role-plays and other methods, in the particulars of the methods used in this study. These enumerators were supervised by six trained supervisors.

**Survey results**

**Sample characteristics**

The proportion of female respondents (59%) was higher than male respondents, probably as most questionnaires were administered during the daytime when men were working out of the home. The measurement of the quality of service by respondents home during the day more accurately reflects the true level of service to the household. However, if these respondents are unemployed, the indicated WTP may not be completely representative. Eighty per cent of male and only 50% of female respondents were responsible for the water bill. Thus there may be a bias introduced through the gender bias in the sample. However, it is most likely that the female respondents, irrespective of bill payment responsibility, influence household budgeting and so would be reasonably able to assess their willingness to see and pay for changes to water services.

About 60% of households lived in owner-occupied accommodation and almost 15% lived in housing with uncertain tenure, comparing well to prior CSO tenure profiles (e.g. CSO 2002). The WASA Act does not allow the utility to connect properties to the network where there is uncertain tenure, forcing such households (squatters) to rely on, at most, utility-supplied standpipe levels of service. The mean household income of the sample was TT$2900 (US$477) per month, which was similar to measures of income from formal
wages in other studies (CSO, 2002). Table 1 provides a summary of the characteristics of the survey respondents.

*Water supply service levels*

The study characterized the sources of water used by households and respondents ranked their importance subjectively since they are unmetered. The primary water source for 83% of the sample was either an in-house piped connection or a standpipe. This compares unfavourably with the utility’s reported rate of 92%. The discrepancy is most likely due to WASA’s coverage being a measure of access to piped infrastructure with no adjustment for availability of water due to routine scheduling. Water scheduling leads to periods when users must switch to alternate water sources, which was the case for 27% of households. Rainwater harvesting was used by 16% of households. Table 2 shows the water sources used by respondents.

Access to improved water sources, as defined by WASA, includes use of a standpipe at a maximum distance of 200 m. Of those whose primary water source was a standpipe, 60% were further than the mandated 200 m maximum distance and 20% were further than 800 m from the closest standpipe, thus further reducing measured access.

The reliability of the level of service was characterized as water availability in hours per week. Only 27% of the sample had water available for 24 hours seven days per week, while almost 30% of the sample received no water from WASA at all during the time of the survey. Despite the significant degree of intermittency of service, over 60% of the respondents in this study indicated that they required no further water supply due to the prevalence of local storage facilities. Sixty-eight per cent of respondents had water storage tanks on their premises with an average installed capacity of 610 gallons. As a result of these

| Table 1. Socio-economic profile of survey respondents. |
|-------------------------------------------------------|
| Total number of respondents sampled 1419             |
| Non-response rate 13%                                 |
| Total number of completed questionnaires 1235        |
| Proportion of females 59%                             |
| Proportion of females responsible for bill payment 21%|
| Median age of respondent 44                           |
| Median level of schooling attained Secondary          |
| Mean monthly household income TT$2900                |
| Own dwelling currently residing in 59%                |
| Squatting in present dwelling 8%                      |
| Proportion of respondents with access to electricity service 92% |

| Water source     | Primary: number of households | % of total | Secondary: number of households | % of households using a secondary source |
|------------------|-------------------------------|------------|---------------------------------|----------------------------------------|
| Piped water supply | 889                           | 72         | 5                               | 2                                      |
| Standpipe        | 139                           | 11         | 83                              | 24                                     |
| Truck-borne water | 36                            | 3          | 62                              | 18                                     |
| Supply from neighbour | 82                           | 7          | 42                              | 12                                     |
| Rainwater        | 79                            | 6          | 121                             | 36                                     |
| Natural sources  | 10                            | 1          | 27                              | 8                                      |
| Total            | 1235                          | 100        | 340                             | 100                                    |
coping mechanisms, 82% of those with tanks had a 24-hour water supply. The effect of local storage is to directly facilitate 24-hour water supply for at least half of the sampled houses.

The consumption of unmetered domestic water customers was estimated from the number of days of supply provided for by the total installed water storage. For households where storage did not afford a permanent water source, the average water consumption was 325 litres per capita per day. However, this estimate is depressed as households using stored supplies would ration their water use. This compares well to the 330 litres per capita per day of a 1991 survey of 53 households having relatively reliable water supplies, not constrained by scheduling practices (Delcan International Corporation 1992).

Wealthier households (earning over TT$5500 [US$905] per month) had better access to reliable water supplies than poorer households (earning less than TT$1500 [US$247] per month). Only 24% of poorer households had a 24-hour supply compared to almost 50% of wealthier households. Wealthier households also had access to in-house piped supply more frequently than lower income households with 15% of poorer households relying upon standpipes as their primary water source compared to only 3% of wealthier households. Compounding the reduced service level to the poor due to the reliability bias discussed above was the affordability of coping mechanisms. Only 58% of poorer households had water storage tanks compared to 84% of wealthier households. The quality of service offered to the poor is much lower, in terms of reliability of water as well as ease of access, as shown by the data in Table 3.

Generally respondents felt that the water quality was high, though there were some reports of low aesthetic parameters such as taste and colour. Standpipe users were more dissatisfied with water pressure due to the direct impact, in terms of queuing and waiting times. Those with piped connections are able to install tanks and pumps to circumvent poor pressure in the mains supply and so had higher levels of satisfaction.

Many water users in Trinidad and Tobago do not directly pay their water rates as it is either included in their rent or because they have uncertain housing tenure. Fifty-five percent of the sampled households pay their water rates directly, while 70% of the standpipe users and almost 30% of the in-house piped users were not responsible for their water rates. Standpipe users are often unaware of their responsibility to pay water rates, resulting in minor revenue loss to the utility as standpipe rates are low. About 10% of the sample depended upon non-utility suppliers for supplementary water supply at an average amount of TT$640 (US$105 per quarter) or four times the average water bill in the survey.

**Multivariate analysis of WTP bids**

Multivariate logistic regression (logit model) was used to understand the measured WTP values. The probability that the improved option is chosen is a linear function of the characteristics of the household, the features of the option and a random error
component which includes the uncertainty of the respondent and measurement error due to omitted variables.

Separate models, explaining the variance in the accepted contingent valuation bids, were calculated for customers dependent upon their water sources, as the water sources used require different coping mechanisms and attitudes, resulting in different preference functions. The first model, $Pr_{in-house}$ was constructed to explain preference structures of households depending upon an in-house connection exclusively, Equation (1); the second, $Pr_{in-h+sec}$ is for those who in addition rely upon some secondary source, Equation (2); and the third, $Pr_{no-in-h}$, for those whose primary source is some other water supply, Equation (3),

\begin{align*}
Pr_{in-house} (imp) &= 0.003 - 0.009PIS + 0.004CB + 0.055Inc - 0.201TrW \\
Pr_{in-h+sec} (imp) &= -0.453 - 0.009PIS + 0.110Inc + 0.458TrW + 0.803BR - 0.649OCh \\
Pr_{no-in-h} (imp) &= -0.187 - 0.008PIS + 0.141Inc - 2.49St + \alpha Age + \beta Loc
\end{align*}

where $Pr (imp)$ is the probability that the improved option is chosen, $PIS$ is the price of the improved supply (TT$/quarter), $CB$ is the current bill amount (TT$/quarter), $Inc$ is household income (1000TT$/month), $TrW$ indicates whether the household currently treats water (1-no; 0-yes), $BR$ is the number of bathrooms in the dwelling, $OCh$ indicates whether the household incurs other water charges (1-no; 0-yes), $St$ is the fraction of the week that storage lasts, $Age$ is the age group of the respondent (<20, 20–29, 30–39, 40–49, 50–59, >60), and $\beta Loc$ is the geographic location of the household (Port of Spain, San Fernando, Arima, rest of Trinidad, Tobago). The results of the logit models for the three different cases (Equations 1, 2 and 3) are summarized in Table 4. They are those with the highest level of model fit of the numerous variations in model specification tried.

The relative importance of the variables in determining WTP is obtained from an examination of the price elasticity of the WTP, summarized in Table 4. The price elasticity is defined as the per cent change in WTP resulting from a 1% change in a parameter (e.g. $PIS, CB, Inc, St$) and the quasi-elasticity is defined as the per cent change in WTP resulting from a unitary change in a parameter ($TrW, BR, OCh, Age, \beta Loc$). The per cent change in WTP is based on the average quarterly water bill of the sample (TT$155/quarter) and on the average values of the parameters for the sample ($PIS = TT$137/quarter, $CB = TT$155/quarter, $Inc = TT$2900/month, $St = 0.28$ weeks).

Across all models, household income is the most highly significant parameter in determining WTP and the only parameter that is elastic (Table 4). The positive income parameter implies that richer households are willing to pay more for the improvement offered. The WTP is higher for households with lower current service levels as indicated by the increase in the elasticity from 1.0 to 2.0 to 2.6 with decreasing current service level (Table 4). The price of the improved option has a marginal negative effect. Although it is highly significant in all three models, the average price elasticity of $-0.007$ (Table 4) indicates that households do not feel they can much reduce the quantity of water that they use even when the price increases. All other household parameters, which vary across the models, are inelastic.

In model 1, for users whose exclusive supply is an in-house connection to WASA’s network, households who currently treat their water at home, by boiling, bleaching, filtering
Table 4. Logit model parameters and elasticities’ (in bold italics) describing the choice to accept the improved water supply service.

| Variable                                                                 | Model 1<sup>a</sup> | Model 2<sup>a</sup> | Model 3<sup>a</sup> |
|-------------------------------------------------------------------------|----------------------|----------------------|----------------------|
| **Variable**                                                            | Exclusive            | In-house piped        | Non-in-house          |
|                                                                        | in-house piped       | supply + secondary    | piped supply          |
| Intercept                                                               | 0.331 (2.37)         | −0.453 (1.73)         | −0.187 (0.453)        |
| Price of improved supply<sup>(PIS)</sup> (TTS/quarter)                  | −0.009 (13.03)       | −0.009 (8.16)         | −0.008 (11.56)        |
| Current bill amount<sup>(CB)</sup> (TTS/quarter)                        | 0.004 (7.17)         | 0.010 (2.62)          | 0.141 (3.23)          |
| Income<sup>(Inc)</sup> (1000TTS/month)                                  | 0.055 (2.72)         | 0.110 (2.62)          | 0.52 (3.61)           |
| If household currently treats water<sup>(TrW)</sup> (1 – No; 0 – yes)   | −0.201 (1.75)        | 0.458 (2.41)          | 0.52 (3.61)           |
| Number of bathrooms in dwelling<sup>(BR)</sup>                          |                      |                      |                      |
| Whether household incurs other water charges<sup>(OCh)</sup> (1 – No; 0 – yes) | −0.649 (1.86)        | −0.42 (1.86)          |                      |
| Fraction of the week that storage lasts<sup>(St)</sup>                  |                      |                      |                      |
| Age group of respondent<sup>(Age)</sup>                                 |                      |                      |                      |
| Under 20 years                                                          |                      |                      |                      |
| 20–29 years                                                             | 0.400 (1.23)         | 0.26 (1.23)           | 0.141 (3.23)          |
| 30–39 years                                                             | 0.892 (3.66)         | 0.57 (3.66)           | 0.52 (3.61)           |
| 40–49 years                                                             | 0.744 (3.57)         | 0.48 (3.57)           |                      |
| 50–59 years                                                             | 0.568 (2.51)         | 0.37 (2.51)           |                      |
| 60 years and over                                                       | 0.707 (2.91)         | 0.46 (2.91)           |                      |
| Geographic location of household<sup>(Loc)</sup>                        |                      |                      |                      |
| Port of Spain                                                           | 0.945 (1.76)         | 0.61 (1.76)           |                      |
| San Fernando                                                            | 0.331 (0.60)         | 0.22 (0.60)           |                      |
| Arima                                                                   | 0.776 (1.99)         | 0.50 (1.99)           |                      |
| Rest of Trinidad                                                       | 0.163 (0.44)         | 0.11 (0.44)           |                      |
| Tobago                                                                  |                      |                      |                      |
| **Sample size**                                                         | 722                  | 167                   | 346                   |
| Likelihood ratio statistic<sup>(χ²)</sup>                               | 227                  | 94                    | 177                   |
| Pseudo R²                                                               | 0.14                 | 0.14                  | 0.13                  |
| Log-likelihood                                                         | −911                 | −367                  | −733                  |

<sup>a</sup>- t-values are in parentheses and all parameters are significant at the 10% level unless otherwise indicated. The parameter values indicate the size of the effect on the probability that the improved choice is taken.

<sup>b</sup>- Elasticities defined as % change in WTP resulting from a 1% change in parameter X or quasi-elasticities defined as % change in WTP resulting from a unitary change in parameter X. Per cent change in WTP based on the average quarterly water bill of the sample (TT$155/quarter) and average parameter values.
or some other method, are willing to pay more than those who are not (elasticity of $-0.12$, Table 4). As the cost of most home-treatment methods are characterized by relatively large variable costs and relatively small fixed costs, improvements in water quality result in immediate savings to the household. Variables describing the prevalence of storage facilities were not significant; as storage costs are likely fixed there are no financial benefits of increased reliability in the short term. The location variables were also not significant implying that the average WTP was similar for residents of rural and urban areas. Age was also not significant.

In model 2, households relying on in-house pipe supplies and a secondary source will pay more as their water needs increase, as the cost of water, in terms of time and inconvenience, increases with the use of multiple water sources. A crude measure of this water need is the number of bathrooms in the dwelling, and WTP increases with an increase in that metric (quasi-elasticity of 0.52, Table 4). Where households incur charges in addition to their water bill for their secondary source, for instance from a water tanker, they are willing to pay more than households whose secondary source of water is free (quasi-elasticity of $-0.42$, Table 4). Again, this is reasonable given the immediate avoidance of expenditure associated with a service upgrade. The variable concerning treatment of water is again significant but positive with a quasi-elasticity of 0.33 (Table 4). It is likely that the cost of treating water is increased for users relying upon multiple water supplies, so the benefits of increased water quality are realized in the medium term. This is supported by the increased levels of dissatisfaction with water quality among users depending upon multiple water sources. Again, the presence of local storage does not affect the WTP. Age and geographic location, similarly, are not significant.

In model 3, for users who depend wholly on non-in-house piped water supplies, where houses can store sufficient water to meet their weekly water needs, their WTP for change is lower as the benefits associated with a more consistent supply have already been achieved through the installation of local storage. Age impacted upon WTP, with those between the ages of 30 and 50 being willing to pay significantly more than those under 20. This is most likely due a higher value placed on their time by those who most likely have families and work full time. In addition non-in-house piped users were willing to pay different amounts for service improvements depending upon their geographic location. Those in rural areas, suffering from distant standpipes and delays in truck-borne water in times of shortage, would be willing to pay more to avoid the coping costs associated with a poor supply. Furthermore, the lack of reliability in San Fernando, the major city in the south of the Trinidad, increases its residents’ WTP.

The preferences of respondents were related to the current levels of service as indicated by the different relevant specifications given by the three different model specifications. This conclusion is further supported, as when the data were pooled and a single model estimated, the parameters describing current water supply were significant. The insignificance of some policy-relevant variables, such as age and location of respondent, is likely due to choice homogeneity in the respondent pool representative of a homogenous population.

### The demand for improved water services

Table 5 shows the average willingness to pay for an upgrade in the service level from the current status quo level to the ideal level described in the CV scenario for users of different current primary sources. The monthly WTP for exclusively in-house piped
connections is 20% lower than the average bill (TT$128 per quarter) measured in the survey. Given that 75% of the respondents paid their water bills within one month, it is most likely that those with coping infrastructure, such as local storage, to alleviate the inconvenience associated with the poor supply, have a lower demand for service level changes.

The WTP for an improved service by users who use the WASA in-house connection as their primary source of water – but also depend upon secondary sources to supplement their primary source – is lower than those who depend on WASA entirely. The WTP of such users is TT$99/quarter or 40% lower than current average bills. Most likely such respondents assume that any improvement in the WASA supply will not remove the requirement of depending upon secondary sources, and so will not reduce the coping costs associated with their water supply.

Users without an in-house piped connection are willing to pay for the service upgrade associated with the CV scenario. This implies that the CV assessment is sensitive to scope (e.g. Smith and Osborne 1996) as the scenario offered to such respondents included the added benefit of a service upgrade to an in-house connection. These users are willing to pay TT$175/quarter or a 10% increase over the current average in-house bill. This result implies that the value users derive from water supply connections resides in the proximity of supply as intermittence can be circumvented through the installation of inexpensive plastic storage tanks at the point of use. Though many standpipe users have local tanks, the distance to the standpipe and the need to share access with other users in the vicinity makes it more difficult to fill and use those tanks, so the utility associated with a service upgrade, in terms of distance to the water source, is larger.

In 1994 (Mycoo 1996) a survey was carried out in the east–west corridor of Trinidad, between Port of Spain and Arima, to assess the WTP for water service improvements. At that time households were willing to pay, on average, TT$208 per quarter and 80% of the sample was willing to pay more than they were currently paying. The current survey found the average WTP to be TT$140 per quarter for the nation-wide sample and TT$143 per quarter for the east–west corridor. This indicates that the WTP for service improvements has eroded over the past decade. The first and most significant reason is the continued poor performance of the water utility (Virjee and Gaskin 2003). As the utility, through numerous local management changes and an international management contract, has failed to improve service and has been continually chastized in the media for corruption, users are no longer waiting for or believing in the possibility of change. It is also reasonable to assume that increased investment in coping mechanisms has made users somewhat immune to the intermittence of water supply. This argument is supported by the finding in this survey that 68% of the respondents had water tanks whereas only 37% had tanks in 1994 (Mycoo 1996).

| Water source                                | Mean willingness to pay (TT$/quarter) |
|---------------------------------------------|---------------------------------------|
| WASA in-house piped connection only         | 128                                   |
| WASA in-house connection + secondary source | 99                                    |
| No in-house connection                      | 175                                   |
Policy conclusions

This survey shows three main results: first, the current water service levels in Trinidad and Tobago are deficient; second, that in 2004, there appeared to be no consumer surplus with which to finance service changes through increased tariffs; and third, that WTP is only elastic to consumer income. Services are characterized by intermittent supply, variable pressure and quality. As a result, users have invested in coping mechanisms, the most prevalent being inexpensive plastic tanks. The willingness to pay for improved water sources has been eroded over time mostly due to inefficient management of the utility, and decreasing levels of service in recent years (WASA 2007). Private sector involvement in the utility in the mid-1990s did not repair the utility and the significant politicization of that effort has effectively closed that route to utility reform. Users who currently use low levels of service, such as standpipes, are willing to pay more for improved services, due to the convenience of proximity rather than availability of water. As installed coping mechanisms are long lasting, it is difficult to see how changes in the reliability of supply will increase the willingness to pay for the improved service as capacity to cope remains at no additional cost to the user and limitations in the CV method prevent analysis of such partial policy changes.

The results of the survey depend heavily upon the question posed in the CV scenario. As such, the single “ideal” situation can miss capturing consumer surplus existent for changes in other ways and there is potential for misspecification of the scenario. Methods which allow for the exploration of such attribute-based changes in policy, such as choice modelling (e.g. Louviere et al. 2000), provide promise in this regard. These survey results imply numerous issues for policy-makers in the future. There has not been sufficient tariff increase to sustain sufficient capital investment, service expansion and maintenance at the utility. Using the CV method, this study has shown that, in 2004, the willingness of water customers to finance the gap between the costs and the revenues at the utility is minimal even with large improvements in the quality of service. Whereas in 1994 users were willing to pay almost double their current bills, users presently are almost unwilling to pay current rates. This makes the task of the regulator and water authority difficult. To increase service levels by installing infrastructure requires increased finance, while to increase rates at present would most likely be politically expensive or would require a significant education and consultation campaign. Ultimately rates must cover costs for the utility to be sustainable. The regulator could institute a service-level linked tariff, and, though such a regulatory mechanism may be expensive, the need for such information and management systems is required to allow for long-term utility planning.

The vision 2020 programme of GORTT has provision of water as one of its goals, and it proposes to reach this goal by increasing tariffs to reflect the cost of supply. The Regulated Industries Commission (RIC) has the task of setting the tariffs and has been undertaking economic analyses and, due to the low WTP, an extensive stakeholder education and consultation programme to propose management changes and an increase in tariffs that reflects the cost of supply. In the short term the minimum service will be raised to two days’ supply per week (WASA 2008b). In RIC’s 2008 proposal (WASA 2007) water charges will be the sum of variable costs, which are based on volumetric consumption instead of annual rateable value, and fixed costs, which are split 20% to 80% for the domestic and non-domestic classes respectively; they will also include several mechanisms to subsidize low-income users. The rate structure reflecting the calculated cost of supply to users in two classes is TT$2.64/m³ for domestic users and TT$28.92/m³ for commercial, industrial and agricultural users. The industrial area at Point Lisas, which is
supplied by a desalination plant, will be charged TT$6.08/m³ which reflects 75% of the desalination costs. These proposed rates will result in an average increase in domestic user charges of 177%. RIC intends to revise these rates once the universal metering programme enables a more accurate calculation of water use and hence unit costs for the previously un-metered domestic class. The proposed rate increase is beyond the WTP determined in this study in 2004 but in the range of the WTP found in 1994 (Mycoo 1996) when a higher service level existed.

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