

## CHAPTER 7: CONCLUSIONS AND POLICY RECOMMENDATIONS

### 7.1 Summary

Based on consumer theory this study estimated demand functions for water for Tshwane, in situations where supply is relatively stochastic. The regressions were applied to a sample of time-series data for the period 1995 to 2000. Separate functions were estimated for different types of household use, for industrial use and for two formerly excluded suburbs – Atteridgeville and Mamelodi. These users were selected so that comparisons could be made between different user classes as well as between different income groups.

The original hypothesis stated that the derived demand for water is downward sloping. On average, this study accepts the null-hypothesis, thereby rejecting the alternative hypothesis that water demand is upward sloping. Residential water demand did appear to be price inelastic with the locus of the estimate of elasticity near to that found for arid or semi-arid regions, between 0 and  $-1$ . In spite of the inconsistencies evidenced by a positive sign for the average price variables, explained by the data limitations, marginal price estimates proved to be informative. The results for agricultural smallholdings were consistent with the hypothesis that outdoor water demand is price elastic with a locus of the estimate of price elasticity between  $-1$  and  $-\infty$ . Industrial water demand also proved to be more price elastic with a locus of the estimate of price elasticity closer to  $-2$  and not the originally hypothesised  $-1$ .

The definition of price in previous demand studies has lead to numerous inconsistencies. Some of the studies have used the average price paid for all units consumed while others have used marginal price, the price of the last unit (Gibbs, 1978; Turnovsky, 1969). A significant difference in the results based on price specification is often observed. Theoretically, the cost of the last unit of water consumed or marginal price is the appropriate measure of price, giving the added advantage of enabling the analysis of consumer response to changes in the price structure.

These responses should also be two fold, responding not only to tariff changes based on cost recovery estimates but ideally to water tariffs incorporating the opportunity costs and

externalities associated with water use such as concerns of social equity, quality variations and drought relief or flood protection.

Results in this study are suggestive, rather than conclusive, as is the case in the majority of quantitative estimation studies (Gibbs, 1978). Further work is needed to improve the accuracy of data. However, some initial conclusions can be drawn to inform the Tshwane Municipality on the feasibility of using tariffs and prices to influence water demand, as follows:

- The outdoor (agricultural small-holdings) average price elasticities of demand are elastic, indicating that a one unit increase in price will result in a reduction of water demanded by twice that, provided these adjustments to price are medium to long term, allowing for consumer responsiveness.
- The outdoor (agricultural small-holdings) marginal price elasticities also indicated that consumers in this category were responsive to price changes, but interestingly, the greatest adjustments are made in the short-run and consumers become less elastic in the long-run indicating that water managers need to redress the pricing strategy over time as consumers reduce their levels of adjustment.
- Household responsiveness to price falls into a number of categories, and tends to be quite location and accommodation type specific when determining relevant tariff and pricing structures. In general pricing can be used to influence household water demand to some extent, in the long-run as consumers tend to become more aware of their billing structures and the level of household expenditure attributed to water use. In the short-term consumers are relatively unresponsive to price changes at this level, with the lower income level consumers situated in Atteridgeville and Mamelodi proving to be marginally more elastic to price changes than many of the other household consumption categories.
- Of all the consumer classes, the industrial consumer proved to be the most highly responsive user category to price changes. These responses becoming even more strongly elastic in the long-run. As a result, water demand savings can be made by implementing pricing strategies at this user level.

These results are to a large extent inconclusive due to the nature of the estimation errors and data limitations, indicating that substantial improvement in specification and

estimation could be achieved if the data set was expanded in terms of size and detail on prices and quantities related to water consumption. Furthermore, recent developments in the literature have identified a number of ways in which to account for the shortfalls inherent in a block rate pricing structure and to adjust for the positive signs on the price variables (Nauges, 2002; Strand and Walker, 2002). In light of these developments, it is advised that the models in this study be refined using the techniques from these recent findings.

## 7.2 Conclusions and Recommendations

This study was intended to build on international literature and be a platform from which water decision-makers could engage in the debate around water-pricing and tariff-setting in South Africa. From the outset, the availability and nature of the data dictated the outcomes and associated biases.

The impending urgency to address the rapidly expanding constraints to economic development and quality of life through access to dwindling supplies of water resources is currently driving research institutions, academia, water management institutes such as water boards and the Governmental Departments to find innovative and effective solutions. These solutions need to be informed, at least, at a first-best "guesstimate" level.

The quality of results is partly ascribed to the quality of the data on which it is based. In the water sector, substantially more detail is required for useful analyses and where this detailed data exists, it is important that analysts gain access to it – for the benefit of water management in the country. Where data is blatantly absent, concerted efforts need to be taken by the respective departments (local, provincial and national) to ensure that this data is recorded and disseminated to the relevant analysts, by conducting surveys, ensuring clearly defined reporting, and encouraging efficient information management.

Possible improvements in existing available data are:

- Larger samples
- Time-series data or panel data (balanced or unbalanced)
- Marginal costs of water, valued at market prices or opportunity cost
- Records of climatic conditions at all levels of analysis (rainfall, temperatures)
- Fluctuations within precipitation levels due to extreme weather events such as droughts

- Uniform quality ratings of water resources
- Household level income data including aggregations at a local, provincial and national level
- Population data at a micro and macro-economic level

Furthermore, the implementation of water demand management within South Africa requires further investigation into the following areas:

- Information on water use in each sector
- Institutional frameworks and water authorities, so that the correct levels in the management structure may be targeted for implementation and monitoring
- Consumer behaviour and incentives
- The marginal value of water
- Forecasting water demand
- Strategies for service provision
- Policies on water rights, cost recovery, pricing investment, private sector roles, environmental protection and restoration
- River basin activity and relationships
- Interrelations between water sources
- Integrated basin and watershed management

Supply management is no longer the only mechanism for achieving water security. Demand management is becoming an increasingly more viable option for wise water resource allocations. It is therefore, imperative that economic demand studies provide decision-makers with the most relevant and useful information, re-iterating the need for good quality water data and informed decision-making.

Econometric estimations, as performed here, provide testable hypotheses about consumer behaviour, and a basis from which demand elasticities for water can be computed for policy simulation and analysis, thus enabling the water sector in South Africa to be proactive in its response to international and local water demand pressures.

The use of pricing as one of the tools available under the umbrella of water demand management options is recommended in conjunction with water awareness programmes if reductions in water use are to be promoted. A multi-part tariff structure in line with the responsiveness of different consumer classes is recommended for the most effective

results. The achievement of clarity and understanding on water values across these classes is also encouraged as a means to determining the baselines from which pricing strategies can be implemented. The willingness to pay by consumers for certain levels of water availability can also be used to inform decision-makers around pricing policies during periods of drought or impending water stress. It is therefore recommended that this study serve merely as a guide to emphasise the advantageous implications of effective and efficient pricing policies where water resources are becoming inherently scarcer. Continued and fervent research around these issues is further encouraged.

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