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Using economic instruments for water demand management: the case of Gros Islet, Saint Lucia

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The issue of water scarcity in developing countries has come to the forefront as a result of increasing levels of water consumption due to population growth and diminished precipitation brought about by the effects of climate change. Of particular concern is the situation of small island developing states where the impacts of water scarcity will be more pronounced. This case study investigated the effectiveness of the water tariff as an economic instrument for water demand management in the urban municipality of Gros Islet, Saint Lucia. Survey results compared with administrative data from the water utility show that the water tariff was effective, to a smaller extent, at reducing household water consumption with the help of public education and awareness campaigns. External economic pressures brought to bear by the Value Added Tax also contributed. Given the high consumers' willingness to conserve and pay for water, it is recommended that the water utility carries out a detailed study with the objective of designing a tariff structure that better reflects marginal cost pricing.

Water demand management to alleviate water scarcity

Water plays a critical role in human society. While many countries have sufficient water to meet all demands, the resources are sometimes unevenly distributed in both time and location. Competition for a diminishing supply of freshwater, especially in developing countries have led water resource managers to focus on the need for policy interventions that ensure the effective protection of this crucial resource. Kayaga and Smout (2006, p.1) indicate that due to population growth and increased pollution of freshwater sources, especially in urban areas, there is an ever increasing demand for a diminishing water supply. Researchers like Butler and Fayyaz (2006) and White (1998) also attribute rising demand to population growth but also mention rising standards of living, changes in lifestyle and demographic structure, rapid development, creeping urbanisation and, in some places, the possible effects of climate change.

Within the context of Caribbean Community (CARICOM) Small Island Developing States (SIDS) such as Saint Lucia, these impacts are even more pronounced due to the small geographical area from ridge to reef, a limited natural resource base and environmental vulnerability. Climate change is expected to negatively impact CARICOM SIDS as some researchers forecast an increase in the frequency and intensity of droughts, coupled with reduced seasonal precipitation (Nurse, McLean and Suarez, 1998, p.341). To this end water policies can be used to encourage water conservation.

Future water development and related capital expenditure are driven by policy. Emphasis on water use efficiency and policies to encourage wise water use and conservation practices serves to reduce the amount of water otherwise demanded. With reference to good water governance, this includes setting appropriate prices for water as well as investing in the development of the sector to improve the provision of water. In the present-day water economy, water demand management (WDM) involves shifting away from the goal of capturing more water towards that of designing demand and user-focused approaches that influence behaviour thus reducing consumption by conserving, reusing and recycling. Systematic planning, based on reliable information, and the formulation of fiscal policy, has the potential for containing demand and reducing the amount of capital expenditure needed. Shifting of national priorities from water resources

development to restoration of existing resources, augmentation of supply and enhancement of water quality serves to reduce the amount of capital funding otherwise required.

The water tariff as an economic instrument for water demand management

The main function of any water utility, charged with the responsibility of developing a water system, is to provide consumers with a safe, reliable and consistent supply of drinking water and wastewater services on a sustainable basis. Through tariffs (that is, the charges for potable water supply and wastewater services) water utilities obtain the required revenue to meet the cost of operation and maintenance, and capital investment to maintain and improve their services. Revisions of the tariff structure always favour an increase in water rates to ensure the utility achieves full cost recovery for its services.

While the primary function of a rate increase is to improve the financial viability of a water utility, it is expected that higher bill amounts charged to end-users will encourage them to reduce water wastage and adopt water conservation strategies. Although water demand management may not be considered when revising the tariff, an increase in the water rates can serve as a check on the quantity of water demanded by end-users.

Kayaga (2011:124) indicates that "*the most commonly used economic instrument for water demand management is the water tariff*." The Independent Competition and Regulatory Commission (2003:7) suggests that water prices should send the right signals to consumers about the true costs of producing the water they consume in order to motivate them to curb their demand, Research undertaken by Olmstead and Stavins (2007) and Kayaga and Motoma (2009:1) also emphasize the use of price increases in the water tariff as a cost effective method to manage water demand and promote water conservation among users.

In order for the water tariff to be an effective economic instrument for water demand management water prices should reflect the marginal cost of producing potable water. Olmstead and Stavins (2008) are among the many authors who advocate for residential water prices that reflect marginal costs as a means of reducing demand. Marginal cost pricing of pipe-borne water sends a signal to end-users to be mindful of their water consumption habits. Olmstead and Stavins note that:

"*The efficient water price is the long-run marginal cost (LRMC) of its supply. LRMC reflects the full economic cost of water supply – the cost of transmission, treatment and distribution; some portion of the capital cost of reservoirs and treatment systems, both those in existence and those future facilities necessitated by current patterns of use; and the opportunity cost in both use and non-use value of water for other potential purposes*." (2008, p.2)

The extent to which consumer demand changes in response to a change in the price of water (that is, price elasticity of water demand) is key to the effectiveness of the water tariff as an economic instrument for water demand management. Several authors attempt to quantify the price elasticity of water demand as it relates to the impact of water pricing on consumption behaviour. For example:

1. Renzetti (2002) notes that the data from his case study of price elasticity of residential water demand in Ontario present fairly small values for potable water demanded, ranging from –0.1 to –0.3, while that for sewage collection, treatment and transport services is about –0.124 .
2. Disaggregated price elasticities for different income groups show significant variations. Renwick and Archibald (1998) note that "price responsiveness varied according to income and other household characteristics. Households with lower incomes responded more to higher water prices than wealthier households."
3. Inman and Jeffrey cite a study conducted by the UK Water Industry Research in 1996, which found middle-income households to be more responsive to tariff rises, compared to low- and high-income households.
4. Corbella and Pujol (2009) report on various research that found price elasticity for basic water use to be close to zero, while the one for leisure-related activities such as swimming pools and watering water gardens was approaching -1. This information is useful for designing water-conserving tariff structures.

Many Caribbean water utilities claim to use economic instruments as a water demand management measure, but in reality, most of the time they are only implementing a tiered tariff structure which is not being specifically carried out as part of WDM strategies. This scenario also applies to the water tariff implemented in the CARICOM island of Saint Lucia. This paper describes a case study which was undertaken in the island's urban municipality of Gros Islet. The overall purpose of the study was to evaluate the use of the water tariff as an economic instrument for WDM in a CARICOM SIDS. The research was

undertaken by the first author in 2013, in partial fulfilment of the requirements for the MSc degree at Loughborough University (Frederick, 2014).

Study setting, research objectives and methodology

Gros Islet, the northernmost urban municipality in the CARICOM island of Saint Lucia has experienced increasing shortfalls in water supply to householders. The situation is more pronounced during the dry season (that is, from December to May) as Gros Islet receives the lowest average annual rainfall on the island. These water supply shortfalls are expected to worsen due to population growth and socio-economic development in the face of reduced rainfall as a result of changes in the weather patterns associated with climate change.

Saint Lucia's lone public water utility, "The Water and Sewerage Company, Inc." (WASCO) alerted the Government of Saint Lucia of the need to expand its water reticulation network and sewerage infrastructure in order to meet the growing demands of its customer base. WASCO was in dire financial straits as its operating revenue was much lower than its operating expenses. In an effort to improve the financial viability of the company, the Government of Saint Lucia implemented a 100% increase to the water tariff commencing January 2000. Approximately thirteen and a half years later, the financial viability of the utility had not improved. It became necessary to review the water tariff once more. Hence, as of May 2013, the water supply and sewerage tariff increased by 66% and 52% respectively (National Water and Sewerage Commission, 2013).

Further to this, the Government of Saint Lucia introduced the Value Added Tax (VAT) in October 2012 which led to a rise in the cost of living for householders. Consumers' now have a reduced amount of disposable income available to meet the cost of the various utilities enjoyed in their household. In each instance, the primary function of the increase in water rates was to improve WASCO's financial situation. However, it is believed that each tariff increase, particular that of May 2013, performs a secondary environmental function to encourage end-users to discontinue water wastage and adopt water conservation strategies. The aim of this study was to examine the extent to which the national water tariff has been effective at encouraging water use efficiency in the water scarce urban municipality of Gros Islet, Saint Lucia.

The research aim was achieved by meeting the following research objectives:

- To assess the perceptions of householders in Gros Islet regarding how effective the water tariff has been at influencing them to adopt water saving strategies.
- To assess the level of awareness of householders in Gros Islet regarding the importance of installing water efficient technologies for water conservation.
- To explore secondary data on the amount of water saved via the reduction in household water demand by WASCO's Gros Islet customers.

The following research questions were derived from the above research objectives:

1. What is the trend of domestic water consumption in in Gros Islet?
2. What is the quantity of water recovered by a reduction in household water demand?
3. How effective has water tariff been at promoting efficient water use by householders in Gros Islet?
4. How willing are Gros Islet domestic consumers to use water conservation strategies?

Adopting a case study methodology, both quantitative and qualitative data were collected using the following methods:

- a household-level questionnaire survey;
- a guided tour of the premises of select households to record first-hand observations of the water conservation strategies employed;
- semi-structured interviews with management staff of WASCO and the National Water and Sewerage Commission (NWSC);
- Collation and analysis of consumer billing data from WASCO's customer database.

Results and discussion

Research question 1 – Trends in gross consumption patterns

Figure 1 shows the trend of consumptions between 2000 and 2013, mapped against the increasing urban population. It shows that overall consumption was on an upward trend up to 2009, but showed a decrease in 2010 and 2013. On the whole, gross per capita consumption has reduced from about 21 gallons per day in

2000, to about 19 gallons per day in 2013, putting into consideration a 30% increase in the population during the same period.

The year 2010 showed a high decrease over the 2009 demand, mainly because of the drought caused by the El-Nino event. As a result, WASCO rationed the water supply and applied restrictions, which were strictly enforced. Also, by October 2010, much of the island's water reticulation network was damaged due the passage of Hurricane Tomas. It is therefore not surprising that when the conditions improved, water consumption went up in 2011 and 2012. However, as shown in Figure 1, water consumption decreased by about 15% in 2013. According to responses by heads of households, the biggest important factor contributing to this reduced consumption is WASCO's programme of installing meters onto customers' premises, which raised the metering coverage to 98% of all the properties. Hence, most consumers are now billed based on volumetric rates. This is one of the important steps of moving towards economic cost pricing (Kayaga, 2011).

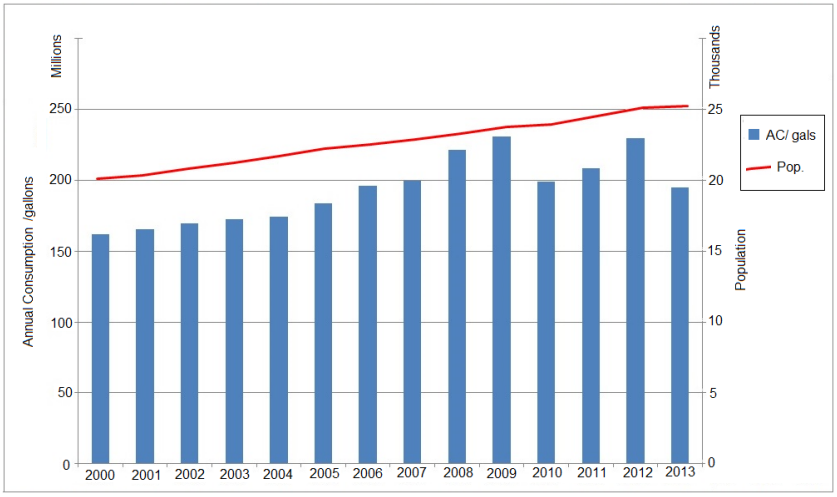

Figure 1. Change in Water Consumption versus Population Growth

Source: Frederick, 2014

Research question 2 – Water savings

The amount of water saved by WASCO in 2013 was calculated to be about **34,662,000** gallons of water. If this trend is maintained, WASCO could make substantial amount of "negalitres". "Negalitres" have been described as the quantity of water that becomes available to the utility when users reduce their water consumption (Wolff and Gleick, 2003). It is a virtual quantity of water that can help extend the utility's supply service to customers before having to invest in developing new water sources in the short run. For water utilities that face challenges of water production capacity (either in terms of availability of water resources, or water treatment capacity, or both), the saved water can be used to expand services to the areas that are currently unserved, or receiving intermittent water supply (Kayaga and Motoma, 2009). According to WASCO managers, this water will be used to improve service continuity and reliability for sections of the town which were hitherto receiving rationed services.

Research question 3 – The effectiveness of the tariff structure as a tool for water conservation

The study was inclusive on the strength of the direct correlation between the increase in tariff levels and water conservation measures. However, several respondents on the guided tours of household premises expressed their opinion that it is actually the VAT and other rising costs of living that have effectively contributed to their desire to keep their water bills down. According to the consumers' responses, the pre and post January 2000 water tariffs were largely ineffective in promoting efficient water use among Gros Islet's domestic consumers. Similarly, the May 2013 water tariff seems to have achieved limited success mainly among householders of wealth quintile 3. Middle class householders showed a greater preference

toward investing in unsubsidised water saving technology in the short run in order to reap long term financial benefits. However, householders from wealth quintiles 1, 2, 4, and 5 preferred to change their water consumption habits and/or install rainwater harvesting technology.

Most householders expressed a higher willingness to pay for water services, if the quality of service is improved. They were also ready to invest in various water saving devices such as water-saving taps (55%), low-flow shower heads (52%) and low-flush-toilets (36%). This shows that there may be greater scope for WASCO to increase the price for higher economic efficiency.

Research question 4 – Consumers' perceptions on water conservation strategies

The results from the household survey show that it is more of public education, compared to the tariff increase, that has influenced the consumers to adopt water conservation measures. Householders have been adequately sensitised to the benefits of water conservation through public education and awareness activities spearheaded by WASCO, the NWSC, the National Emergency Management Office (NEMO) and the Water Resources Management Agency (WRMA). The implementation of water conservation strategies in the household is dependent on the socio-economic status of the occupants. Costly water saving devices and technologies are more prevalent in affluent households, while lower income families are more likely to change their water use habits as their primary conservation strategy.

Conclusion and recommendation

This study was primarily an MSc dissertation, and so had limited resources in terms of time, money, personnel. These constraints did not allow expanding the scope to include an in-depth examination of, and disaggregation between the effects of metering; introduction of VAT on water bills; and targeting of education/awareness campaigns. Nonetheless, the findings of this case study support the arguments of researchers advocating for a properly structured and volumetric-based water tariff to encourage consumers to reduce their water demand. The findings of the study were inconclusive with respect to the adducing evidence of effects of the tariff on water conservation with respect to changes during the pre- and post-January 2000 periods. On the other hand, implementation of increased water rates as in May 2013, coupled with increased metering coverage seemed to have had a bigger influence on householders' propensity to minimise their water bills. Their primary attempts to keep their bill amounts down produces a secondary effect of reduced water consumption.

The motivation to control their water bill is also fuelled by the external effects of an increased cost of living, especially with the introduction of VAT as of October 2012, coupled with information received during public education and awareness activities on sustainable water use. These are encouraging results and it is recommended that the water utility should maintain the momentum of encouraging water conservation in the end-users' properties through the use of multiple tools and measures. The utility should commission a detailed study on the design of a tariff structure that will engender water conservation for the existing socio-economic conditions. At the same time, the utility should intensify public education and design economic incentives to encourage behavioural change and installation of water-saving devices in the customers' properties.

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