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Strategies for Managing Household Water Demand in Carcar City, Cebu, Philippines[1]

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ABSTRACT

The main drivers for economic development are dependent on water, which provides the basic need for survival and comfort. Water, with its competing uses and economic value, has become a scarce resource, particularly in areas where the population and the economy are thriving. Water usage in developing cities needs to be strategized to meet the growing demand caused by increasing population and business growth. A few studies on household water demand as a basis for demand management have been done for minor cities.

Carcar City, an urban city in southern Cebu, experienced an unparalleled population and economic growth after its cityhood in 2007. This situation put pressure on the Carcar Water District (CWD), the major water provider in the city, to expand its service capacity. Changes in water management has affected households in Carcar City, which comprise the majority of connections served by the CWD.

This study aims to analyze water demand among households in Carcar City. Policy implications for water demand management are drawn from the findings. The multiple regression results from primary data identified average price, household income, some housing attributes, household characteristics, and water conservation behavior variables as statistically significant in explaining demand for water. Hard and soft mechanisms based on the findings are recommended to manage water demand in Carcar City. Price, along with water use restriction policies and public education, can be effective for water demand management, which can be jointly undertaken by the water district and the local government unit.

[1] This paper was drawn from Serge Jude B. Bargayo's master's thesis titled "Water demand among residential household consumers in Carcar City, Cebu: Basis for demand management", with adviser Gerard L. Go, submitted to the School of Business and Economics, University of San Carlos, in February 2020. The authors are grateful to the thesis panel, Mr. Francisco M. Largo, Dr. Elizabeth M. Remedio, and Dr. Julius P. Relampagos, for their valuable insights. The usual disclaimer applies.
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INTRODUCTION

The concept of "water as an economic good" implies that water is a scarce good and has cost. With all its competing uses, water has an economic value. Delivering water to the taps of households requires investments in storage, drinking facilities, and underground distribution networks (Bernardo 2019).

Water supply is finite, limited, extremely changeable, and unsettled. Water is not only essential for life but also for economic development. The target to achieve access to clean water and sanitation for all by 2030, as adopted by the United Nation's Sustainable Development Goal No. 6, remains a major challenge for world economies (UN-Water 2018). This challenge, however, will become more critical in the future, with the increasing world population and standards of living, changing diets, and the intensifying effects of climate change.

Water usage in a developing city like Carcar in Cebu needs to be strategized because of the increasing population brought about by rapid business growth in the area. Carcar City, a major urban junction in southern Cebu, contributes to the economic growth of the province. Carcar turned from a municipality to a city in 2007. Subsequent to Carcar's cityhood, it experienced an unparalleled population and economic growth. The city's population grew from 100,632 to 124,874 in the period between 2007 and 2017. This 24.09-percent increase is equivalent to 2.18-percent average annual growth within the 10-year run.[3] Meanwhile, the number of construction activities in the city grew from 130 to 1,049, posing a 706.92-percent growth in 10 years.[4]

More businesses in an area can attract more migrating residents and households. Ongoing urbanization means increasing demand for water, which often results in a water shortage. Trends indicate a continued gap in water demand and supply that creates a tradeoff between quality and equitable distribution of water. There is a growing interest in water demand studies between large and small cities. Recent studies showed that water footprint consumption in large cities was more efficient than in small cities despite the increasing population in large cities (Mahjabin et al. 2018).

This study analyzes water demand among households in Carcar City by determining the factors that affect residential water demand as a basis for effective demand management. It is necessary to better explain how households use water to effectively manage and expand the water system in an area (Nauges and Whittington 2009). Understanding household water demand can advance more aggressive strategies to water demand management in cities. It also makes possible any interventions that bring about long term and substantial reductions in water use (Shan et al. 2015).

Water demand management has gradually found its place in Integrated Water Resource Management (Wang et al. 2009). Water supply management is not suitable because it treats freshwater as a limitless resource and rarely takes full account of the environmental and economic impacts (Frederick 1993). Supply-side management involves policies and activities that increase the availability and obtainability of freshwater.

However, as water service development augments a fixed area of supply, the resource becomes continuously scarce and any use of water can adversely affect its obtainability for other purposes. With this scenario, the management and construction of new facilities can turn into lesser means of adding into the aggregate supply. Thus, the project is plausibly to be of demand management rather than supply management (Frederick 1993).

[3] Retrieved from Philippine Statistics Authority (PSA)'s 2015 census.
[4] Retrieved from the Carcar City Engineering Department.

Carcar Water District

The major water provider in Carcar City is the Carcar Water District (CWD). It is a government-owned or controlled corporation and is under the jurisdiction of the Local Waterworks and Utilities Administration (LWUA). From 2007 to 2017, the demand for connection of potable water in Carcar City increased significantly from 2,985,514 cubic meter (m^3) to 4,549,398 m^3.[5] The 52.38-percent rate increase in water supply put pressure on the CWD to expand its capacity to meet the future demand of consumers. The numbers proved that the CWD experienced a faster increase in water consumption than the population growth in the area during Carcar's post-cityhood period.

The existing maximum water supply of the CWD is 194.5 liters per second (lps). This can accommodate a maximum of 120 households per lps or up to 23,340 households. The total number of the CWD's service connections as of June 2018 was 17,062, which translate to 50.89 percent of the total households in Carcar City. To serve 100 percent of the households in the city, the CWD needs to have an available water supply of 279.42 lps, leaving a shortage of 84.92 lps from the existing supply of 194.5 lps. The CWD has developed a master plan to provide enough supply for the city's growing population from 2018 to 2040.[6] The master plan consists of five new major sourcing projects, which are spread out across 22 years, from the northwestern side (mountainside) to the western side (going to the town of Barili), and southwestern and southern parts (toward the town of Sibonga) of its area of jurisdiction. The plan consists of eight deep-wells and targets a total of 182 lps, an addition to the existing source supply capacity of 194.5 lps. Once implemented, the eight additional deep-wells will give the CWD a total of 25 sources (6 springs and 19 deep-wells).

Based on the CWD data, water consumers in the city are categorized into residential, government, and commercial. The government is treated as a residential consumer based on the pricing and administrative rules of the LWUA. Water pricing for commercial consumers or businesses in the city is different. However, from the total number of connections of the CWD as of June 2018, commercial consumers covered only 4.98 percent (850 connections) of the 17,062 total connections, while the rest (95.02%) were counted as residential consumers.[7] This means that residential consumers had a greater impact on the scarcity and other changes on water supply in Carcar City.

Factors affecting water demand

Numerous studies have been conducted to estimate household water demand in developed and developing countries. Empirical water demand studies include price and household income variables as factors affecting water consumption. For other determinants, researchers used several variables (House-Peters and Chang 2011; Bandeira 2013). Explanatory variables depended on the availability of data and its applicability on the location.

Water price or tariff

Price negatively influences the quantity of water use from purchased sources (Arouna and Dabbert 2009). Studies have shown that water demand is price inelastic because water is a basic commodity with fewer substitutes and consumers have low awareness of the water tariff structure. Typically, the proportion of water expenditure to the total household income is small (Arbues et al. 2003).

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[5] Retrieved from the CWD Finance Division's monthly data sheet.

[6] The master plan was designed by the CWD general manager (GM) and his consultant to meet the future water demand of residents in Carcar City. This was based on the master plan gathered from the GM's office.

[7] Based on the numbers discussed, this study focused on residential household consumers as they comprised the bulk percentage of water consumers in Carcar City. Also, *barangays* (villages) in the mountainous portion of the city are mostly residential water consumers.

Gunatilake et al. (2001) emphasized that the average price of water in Pakistan represented a uniform or flat pricing across any water users regardless of their class, quantity consumed, and the amount paid. In the study of Hoglund (1999) in Sweden, the average price was positive and significant in one of the demand models. Using the average price, the price elasticity of demand was -0.2. The study concluded the importance of increasing the average price than the marginal price if the main or focal objective of taxing water was to reduce water demand due to excessive use.

Socioeconomic factors

In a study of water demand estimation in the United States (US) and Canada by Howe (2005), the results showed that a 100-percent change in the income of a household would lead to a 30-percent increase in the demand for household water. The study also emphasized that knowledge requirement for income elasticity of demand was fitting and appropriate in the formulation of pricing policies. Worthington and Hoffman (2007) pointed out that income through its correlation with education could be a reflective measure of water conservation taken by households by purchasing water-conserving appliances.

Household characteristics

Based on past studies about water demand, household characteristics like the size of household and the number of senior and minor members affect water demand. Arbues and Villanua (2006) proved that household size was statistically significant in a study of water demand estimation in Zaragoza, Spain. Larger households also had higher water consumption (Arouna and Dabbert 2009). In the study of Xayavong et al. (2008) in Perth, Western Australia, the coefficient of household members with ages over 65 years old was negative, while those with ages under 19 had a positive estimated coefficient. Younger household members were likely to consume more water with more frequency in laundering and intensive water use due to outdoor leisure activities.

Housing attributes

Housing attributes, which refer to the features of houses and water connection areas, are expected to impact water demand. For instance, lot area contributed to residential water demand in Perth, Western Australia (Xayavong et al. 2008). Water facilities like the number of faucets in a household posted positive significance in all three econometric models in the study on water demand of rural communities in Argentina (Bachrach and Vaughan 1994). The studies of Gunatilake et al. (2001) in Sri Lanka, and Sadr et al. (2016) in Jaipur, India, explicitly emphasized that the number and kind of toilets and showers had the highest proportion of water consumption. Many studies used home gardens as an exogenous variable in determining household water demand since plants need water to blossom. Binet et al. (2005) found in their study in French Island La Reunion that gardening positively influenced water consumption. The majority of households that had plants and gardens used sprinklers. In the same study of Gunatilake et al. (2001), a household having cottage industry that used water at home was found to have a statistically significant positive effect on water demand in Kandy municipality, Sri Lanka.

Water use behavior

In solving water scarcity, water conservation behavior had come out as important information and tool (Adams 2014). Carmela and Damiano (2016) used large data set from the Italian Central Statistics Office and established that variables on environmental concerns were significant in explaining water demand with a different sign. Respondents who had greater concerns for climate change, pollution, and resource exhaustion had a greater likelihood to conserve water, and alteration of environmental heritage had less likelihood in conserving water. These findings were similar to the study of Adams (2014) in the US that pro-environmental concern variables (energy, recycling, and willingness to sacrifice for the environment) had significant correlations with water conservation attitudes.

Policy implications based on studies

Policymakers play an essential role in formulating policies that can meet the targets in managing water demand (Bryx and Bromberg 2009). Leaders also have a vital role in enhancing demand management and boosting the performance of water utilities (Araral and Wang 2013). Changing societal behavior in conserving daily water use should be the main goal in crafting water policies (Tortajada and Joshi 2013). Many studies have shown the positive impacts of implementing such policies.

Water demand management involves hard and soft mechanism programs. Hard mechanisms can be categorized as pricing, restrictions, ordinances, and policies while soft mechanisms include education campaign, public awareness, and public consultations, which provide the stakeholders' involvement in water demand management. Hard mechanisms drive and direct consumers to control, and as much as possible, minimize water consumption, while soft mechanisms aim to change the societal behavior in conserving daily water use by directly influencing the household members' attitudes and behaviors (Tortajada and Joshi 2013).

Market and water prices are highly effective mechanisms of water demand allocation when successfully implemented (Abansi et al. 2018). Increasing block tariffs are commonly used in urban areas (Araral and Wang 2013). Consumers adjust their water consumption in response to marginal prices. The water tariffs set by the LWUA are based on economic valuation balancing affordability, conservation, and sustainability (Abansi et al. 2018).

In managing water demand in Southeast Asia, utilities adopt moral suasion and educate the public on water conservation. The methods often used in moral suasion are conversing with concessionaires on marginal cost information, comparing past consumptions with national averages, and discussing block-tariff details. Particularly in Manila, Philippines, which has to deal with a large number of informal settlements, water demand has been reduced effectively through community-based conservation programs (Araral and Wang 2013).

Xayavong et al. (2008) had some critical findings for water policies in Perth, Western Australia. While the government was allowed to influence the operational efficiency of the water district, such as having rebates to consumers in having the approved water-saving devices, there were still more rooms for new policies. The nonprice controls, such as the sprinkler restriction and the "Waterwise Rebate Programme" resulted in water conservation advocacies, and the findings also suggested that price could be used as an instrument to manage water demand.

Another technical mechanism aimed at freeing up large quantities of water is the use of greywater or wastewater from sinks, baths, and washing machines. Wastewater from these sources accounts for 60 percent of water outflow from homes that usually go directly to the storm drain instead of being reused in gardens and farms (Abansi et al. 2018).

Olmstead and Stavins (2008) found that for the same level of aggregate demand reduction, as imposed by the two-day-per-week outdoor watering restriction, the establishment of a market-clearing drought price in cities like Atlanta and Raleigh would result in welfare gains in the US and Canada. In Israel, there have been major changes in policy implementation on water demand (Katz 2013). Policymakers have implemented a series of policies to limit the use of water, such as washing vehicles using a water bucket instead of a hose, requiring newly constructed houses to have dual-flow and low-flow toilets, distributing water-saving faucets, and raising public awareness of water shortages. This campaign reached a high level and was incorporated into the school curriculum by drawing significant media attention after it publicized the water levels in the Sea of Galilee. In their research project, Howarth and Butler (2004) cited that the price and nonprice initiatives of Copenhagen Energy were responsible for water demand and distribution in Copenhagen, Denmark.

The human behavior aspect of water includes understanding how consumers use water and their consciousness and knowledge of water and its conservation. The Philippine Clean Water Act of 2004 promotes policies toward greater awareness of water and the environment. It includes the provision of "due public consultation" and the inclusion of individuals and civil society among the recipients of incentives and rewards in water management (Abansi et al. 2018). Based on research and industry experience, the proposed measures and the current water supply situation determine the public's acceptability of water demand management policies.

THEORETICAL AND CONCEPTUAL FRAMEWORK

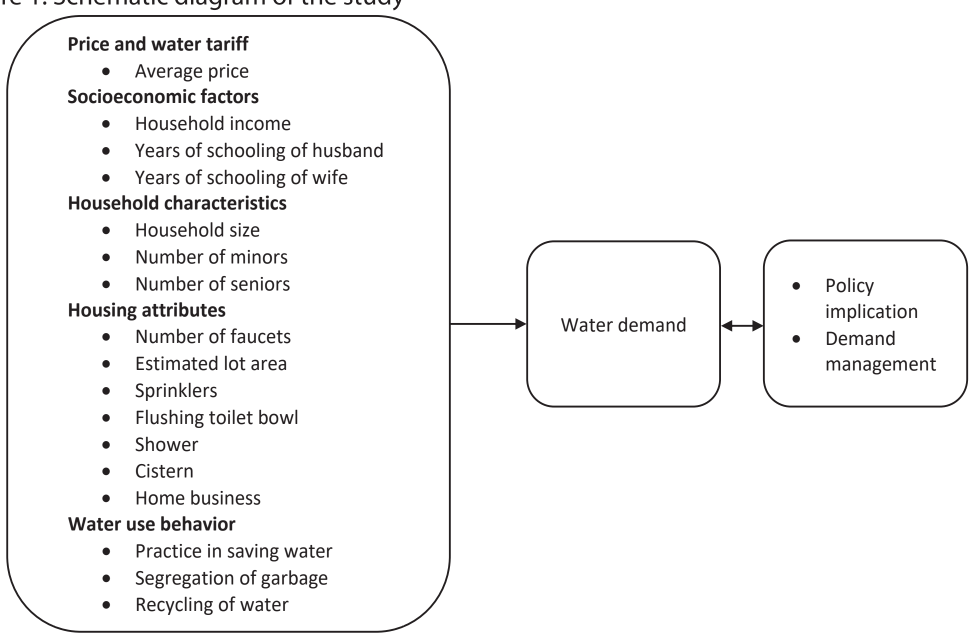
The microeconomic theory states that households tend to satisfy their needs and wants by consuming goods and services. Households decide to consume a certain level of water consumption (q_1) that satisfies their utility to produce water services and the rest of their budget to spend on other goods and service (q_2). The Marshallian demand for water is given by:

$$\ln q_1 = \beta_1 \ln P_1 + \sum \gamma_{ix} \ln Z_k$$

where P_1 is the price of water and Z_k represents other control variables like household size and income, among others. With the use of natural logarithm (ln), the resulting coefficients of the demand equation provide a percentage change measurement of the relevant variable or elasticity. Estimates for price and income elasticity of demand were obtained from the regression.

A conceptual framework for analyzing the factors affecting water demand as the basis for water demand management is illustrated in Figure 1.

Figure 1. Schematic diagram of the study



Source: Authors' compilation

DATA

The study used primary data collected by the authors. The research environment was Carcar City, which had a total population of 119,664 in 2017. Carcar City recorded a population of 33,530 households as of June 2018 based on data from the Commercial Division of the CWD. A random sample of 398 households distributed among the 15 barangays was interviewed. The 95-percent confidence level or the ±5-percent margin of error was used to calculate the sample size. The household head or spouse was interviewed using a structured survey questionnaire. Data on water consumption and the amount paid were gathered from the CWD for respondents who were also its customers. Out of the 398 sampled households, 86.43 percent or 344 households sourced their water from the CWD. Other sources of water included water associations, public artesian well, and vended water.

Table 1 presents the descriptive statistics of the variables gathered in the study that were used in the regression analysis for households with water connection from the CWD.

Table 1. Summary of descriptive statistics of variables used in multiple regression, CWD households, 2019

Variables	Variable Code	(1) Mean	(2) Standard Deviation	(3) Minimum	(4) Maximum
Water consumption (m^3)	Q_d	19.76	10.79	2	77.33
Household income	HHI	55,324	57,312	3,000	350,000
Average price	AP	17.53	5.89	2.26	73
Household size	HHS	5.26	2.07	1	12
Average household age	AHA	32	10.88	13	87
Number of minors	AGEM	1.83	1.26	0	7
Number of seniors	AGES	0.53	0.83	0	3
Estimated lot area	LA	189.3	188.4	40	1,900
Total number of faucets	F	4.17	1.67	1	9
Sprinklers	GS	0.56	0.5	0	1
Rainwater tank or cistern	RC	0.21	0.41	0	1
Home business	HB	0.26	0.44	0	1
Years of schooling of husband	HE	13.1	2.55	0	18
Practice in saving water	SW	0.55	0.5	0	1
Recycling of water	RW	0.4	0.49	0	1

m3 = cubic meter
Source: Authors' compilation

The lowest amount was PHP 2.26 per m^3 and the highest was PHP 73 per m^3. The mean monthly household income was PHP 55,324, with a standard deviation of PHP 57,312. The average number of household members living in one roof was 5.2. For education, which was measured by years of schooling, the husband had the mean years of schooling of 13, signifying that he had reached third year in college.

The regression analysis considered several categorical or dummy variables. These variables included sprinklers, rainwater tank or cistern, home business, practices in saving water, and recycling of water. Fifty-six percent of the households connected with the CWD used sprinklers while only 21 percent had rainwater or cistern tank. Meanwhile, 26 percent of the households had business conducted at home. More than half of the households practiced saving water, such as using water from the bath to flush the toilet bowl or from washing kitchen utensils to water plants, while 40 percent of the households recycled water. Recycling of water was typically done by using water from cooking to water the plants or from washing utensils to flush the toilet bowl, among others.

Estimation

Multiple regression was performed using IBM-SPSS (Statistical Package for the Social Sciences) to estimate the factors affecting water demand as revealed by the related studies. The econometric model of this study is given by:

$$lnQ_d = \beta_0 + \beta_1 lnP + \beta_2 lnHHI + \beta_3 lnHHS + \beta_4 AGEM + \beta_5 AGES + \beta_6 lnLA + \beta_7 lnF + \beta_8 HE + \beta_9 WE + \beta_{10} GS + \beta_{11} FT + \beta_{12} SHR + \beta_{13} RC + \beta_{14} HB + \beta_{15} SW + \beta_{16} SG + \beta_{17} RW + \mu \text{ (error term)}$$

RESULTS AND DISCUSSION

Table 2 shows the regression results of the three specifications. The models used different combinations of variables, taking into consideration the possibility of multicollinearity problem, mean square error (MSE), adjusted R^2, and F statistic. Model A had the smallest MSE. In terms of adjusted R^2, the values were 78–79 percent for the three model specifications. In addition, the F-values of the three models were significant. F-statistic is the ratio of two variances and the test for overall significance of the regression.

Table 2. Multiple linear regression results of residential water demand by the Carcar Water District, Carcar City, 2019

Variables (Code)	Model A	Model B	Model C
(Constant)	1.3	1.316	1.446
	(0.284)	(0.263)	(0.268)
Average price (ln AP)	-0.226**	-0.228**	-0.237**
	(0.049)	(0.048)	(0.049)
Average household income (ln HHI)	0.071**	0.103**	0.081**
	(0.026)	(0.024)	(0.025)
Household size (ln HHS)	0.574**	0.615**	0.575**
	(0.048)	(0.047)	(0.048)
Estimated lot area (ln LA)	0.057*		0.0002**
	(0.025)		(0.00007)
Total number of faucets (ln F)	0.141**		0.145**
	(0.053)		(0.052)
Number of minors (AGEM)	0.011		0.013
	(0.035)		(0.033)

Table 2. (continuation)

Variables (Code)	Model A	Model B	Model C
Number of seniors (AGES)	-0.064** (0.019)		-0.056** (0.018)
Year of schooling of husband (HE)	-0.041 (0.03)	-0.027 (0.029)	
Year of schooling of wife (WE)			-0.014 (0.031)
Sprinklers (GS)	0.160** (0.037)	0.207** (0.036)	0.179** (0.039)
Flushing toilet bowl (FT)		0.032 (0.03)	
Shower (SHR)		0.022 (0.0.34)	0.021 (0.033)
Rainwater tank or cistern (RC)	0.087* (0.039)	-0.127** (0.039)	-0.094* (0.039)
Home business (HB)	0.175** (0.036)	0.213** (0.036)	0.184** (0.0.35)
Practice of saving water (SW)	-0.080** (0.042)		
Segregation of garbage (SG)		0.069* (0.035)	
Recycling of water (RW)	-0.087* (0.038)	-0.158** (0.036)	-0.121** (0.033)
N	344	344	344
R- square	0.796	0.783	0.796
Adjusted R- square	0.789	0.778	0.79
Mean square	7.415	10.026	8.154
F-value	117.705	150.835	129.694
Durbin-Watson	1.857	1.888	1.846

* and ** indicate significance at 5% and 1% level, respectively
Standard errors are reported in parenthesis
Dependent variable: water demand (ln Q)
Dummy variables are GS, FT, SHR, RC, HB, SW, SG, and RW
Source: Authors' computation

Consistent with the theory of demand, the quantity demanded for water varies inversely with price and directly with household income. Both price and household income are statistically significant at 1-percent and 5-percent levels in the three specifications. In Model A, the demand for water is price inelastic (-0.226), signifying that its quantity demanded is less responsive or not sensitive to price changes. Water demand, as in other necessities, is inelastic. Estimates in Model A suggest that a 1-percent increase in price has resulted in 0.226-percent decrease in quantity demanded for water. Using the average price, Tan (2020) estimated the price elasticity of water demand to be -0.38 in Pandi, a second-class municipality in Bulacan that serves as a relocation site. The price elasticity of demand is comparable to the findings of a study in Sweden by Hoglund (1999), which obtained a price elasticity of -0.20 using the average price. On the other hand, the income elasticity of demand for water is 0.071, which means that a 1-percent increase in income results in 0.07-percent increase in demand for water. Household water demand in Bontoc, Mountain Province, increases as household income increases in a recent study by Marrero and Marrero (2018).

Household size and the number of seniors proved to be statistically significant in explaining water demand. Water consumption tends to increase with the number of family members per family unit. The results reveal that a 10-percent increase in household size raises water demand by at least 5 percent. In contrast, households with more seniors had lower demand for water. On average, a one-count increase in the number of seniors reduces the demand for water by 5–6 percent. This finding supported the study in Perth, Western Australia, by Xayavong et al. (2008) that seniors had a negative impact on water demand.

Among the housing attribute variables, the estimated lot area; total number of faucets, sprinklers, rainwater tank or cistern; and presence of home business have a statistically significant effect on water demand. Results indicate that on average, a 10-percent increase in the housing area is significantly associated with an increase in water consumption by at most 5.7 percent.

A positive coefficient for the number of faucets variable indicates that water consumption goes up with more faucets in the household. Estimates suggest that a 10-percent increase in the number of faucets also raises water demand by 1.4 percent. Also, a one-unit increase in the number of sprinklers increases water demand by at least 16 percent. Binet et al. (2005) pointed out that outdoor water positively influenced water consumption especially with the use of sprinklers. In contrast, water tank or cistern has opposing effects depending on the model specification. The result in Model A points out that having a rainwater tank or cistern resulted in lower water demand among households in Carcar City. This result validates that a household that saves rainwater in a cistern demands less water from the service provider as they tend to use this water for flushing and cleaning purposes. This finding confirmed the water demand study in Katerini, Greece, that a household that used rainwater had decreased their water consumption from the local water provider and supported the campaign on water conservation (Aravidis 2007).

Finally, having a home business raises water demand by at least 17 percent. The empirical result of the presence of business at home also supported previous findings that having business at home had positive effect on water demand.

The dummy variables that capture water use or conservation behaviors are statistically significant in explaining demand. The negative signs of the dummy variables—recycling of water and the practice of saving water—indicate that the households adopting these behaviors consume less water. Water conservation behavior turned out to be an important factor in solving water scarcity problems (Adams 2014).

Both the number of minors and the years of schooling for husband have the expected signs but are not statistically significant. The negative sign for the coefficient for husband's years of schooling indicated that a household whose husband has a higher education tends to save or consume less water.

Tests for normality, heteroscedasticity, and multicollinearity were conducted to check the assumptions of the classical linear regression model. To check for the normality of the regression, the normal P-P plot standardized residual was done. The result showed that there were no drastic deviations of data points that follow the normal (diagonal) line. To check for the heteroscedasticity, a scatter plot on

SPSS was performed. The problem of heteroscedasticity was not present where a cone or fan shape in the data was not observed. The variance inflation factor (VIF) was used to check for multicollinearity. None of the VIF values of the predictors was above 10.00 and all were below 2.7, which are the best-case values.

POLICY IMPLICATIONS

From the regression results, water demand is price inelastic. Even if the quantity demanded for water among consumers is less responsive to price changes, price can be used by the CWD to manage demand. A price increase is also a signal function, making people aware that water is limited and valuable and therefore encourage water conservation (Zhong and Mol 2010). If the water district sets a target of 5-percent decrease in quantity demanded for water, price increase will be 22 percent, given the price elasticity of demand of -0.226. The average price paid per m^3 will be PHP 21.39. The feasibility of this price increase is discussed below.

The CWD follows the increasing block tariff (IBT) scheme under the regulation of the LWUA and is classified under Category B. The IBT is designed for water demand management that gives consumers a higher price for every different block. Comparing the CWD's pricing with other water districts belonging to Category C, like the Bayawan Water District (BAWAD) in Negros Oriental, the CWD's tariff rate is lower even if it belongs to a higher category.[8] BAWAD has a minimum rate of PHP 230 for the first 10 m^3 and the average consumption is only about 15 m^3. Thus, the CWD's tariff at only PHP 146 for the first 10 m^3 consumption is still cheap among other water districts in the country.[9]

Table 3. Water rates in Region 7, as of 2018

Water district	Service connection	Minimum rate (PHP)
Dalaguete	5,405	101
Tabuelan	3,860	120
Ayungon	3,205	125
Clarin	1,188	132
Tanjay	6,736	139
Carcar	**17,527**	**146**
Metro Cebu	190,505	152
Metro Siquijor	2,382	160
Sibulan	8,803	165
Balamban	12,769	170
Talibon	2,925	175
Bogo	9,145	201
Bayawan	5,223	230

PHP = Philippine peso
Source: Local Water Utilities Administration (2018)

As of 2018, the CWD's minimum water fee ranks 6th among the 13 lowest water districts in the region and is next to Tanjay City, Negros Oriental, which belongs to Category C.

[8] See Table 3 for the CWD's current residential rate.
[9] See https://lwua.gov.ph/water-districts/categories-credit-classification/ for the detailed rates of all water districts in every region.

Tanjay City's total number of connections is only 6,736, compared with the CWD's 17,527 connections. The LWUA has mandated the local water districts that the households' water expenditure must not go beyond 5 percent of the average monthly household income of the low-income group, which was at PHP 9,296 as of 2011. Table 4 shows the CWD'S current water tariff rates. The PHP 146 rate for the first block is 1.57 percent of the average monthly family income. The CWD's current pricing at PHP 146 for the first block is 1.57 percent of the average monthly family income.[10] In 2015, the average family income of the lowest income group (under PHP 40,000) in Region 7 as reported by the Philippine Statistics Authority was PHP 12,762 per month. Therefore, the CWD's existing tariff rate for the first block is only 1.14 percent of this average income. A household in Carcar City will only need 15.6 m^3 of water monthly based on world observation that 50 to 100 liters of water per day is needed by every person to live and ensure that his basic needs are met in a comfortable way.[11] The calculated 15.6 m^3 is lower than the current average of 19.76 m^3.

Table 4. Carcar Water District's increasing block tariff-residential, Carcar City, 2019

Block	Cubic meter (m^3)	Rate (PHP)
First	0–10	146 minimum
Second	10.01–20	15.60/m^3
Third	20.01–30	18.20/m^3
Fourth	30.01–40	21.20/m^3
Fifth	40.01–up	24.70/m^3

m3 = cubic meter; PHP = Philippine peso
Source: CWD Commercial Division (2013)

Holding household income constant, the monthly household water expenditure from the price increase of 22 percent will be PHP 401.47, which is 0.73 percent of the average monthly household income (PHP 55,324) in this study, and 3.15 percent of the average monthly household income of low-income group in the region (PHP 12,762) under the PHP 7,890 to PHP 15,780 income bracket. In addition, the price increase conforms to the LWUA's conditions for price increase to be not more than 60 percent from the current rate and not more than 5 percent of the average monthly family income of the low-income group.

Local leaders should be proactive in requiring a rainwater cistern when granting building permits to new housing constructions. Rainwater can be used for cleaning the household area, washing vehicles, watering plants and driveways, as an alternative in directly using the treated water from the CWD.

In terms of water conservation behaviors, households that save and recycle water also reduce their monthly water consumption. Under the soft mechanisms, public education campaign on water conservation is an essential aspect of demand management in the sense of altering the behavior of individual water consumers in a massive scale (Bryx and Bromberg 2009). Engaging the public and other stakeholders rather than pushing the public to conserve water can have longer and sustainable effects on demand management. Moral suasion can also be adopted to influence the behavior of household members by relaying the negative effects of having water resources run dry.

[10] This information was gathered during the interview with the Officer-in-Charge of the CWD Finance Division.

[11] See https://www.un.org/waterforlifedecade/pdf/human_right_to_water_and_sanitation_media_brief.pdf for detailed water needs.

Public education can be undertaken jointly by the CWD and the local government of Carcar City. The CWD can include discussions on block tariff pricing, effects of water shortage and drought, practices in saving and recycling of water, and introduction of greywater usage. Through public consultations, people become more engaged because they can voice out their ideas and feel that they are part of community programs. Araral and Wang (2013) found that raising public awareness, particularly in Manila, that has to deal with large informal settlers, was effective in reducing water demand.

With the statistically significant results of variables like having sprinklers and cistern tanks in the regression analysis, the local government unit (LGU) of Carcar can initiate steps in managing water demand in the city. The Carcar LGU should undertake a systematic water educational program and not only occasional campaigns by prompting end-users to conserve water even if there is no drought. This campaign should focus on banning the use of hose (sprinklers) for pavements and drive paths, washing cars, and watering plants in households. Specifically, this educational program can emphasize hosing/sprinkling (using the water district's disinfected and filtered water) of the household's paved areas and restricting hours on watering plants by two days per week between 6 am and 8 am (in order to shun from loss of evaporation). The policies of a two-day-per-week outdoor watering restriction and car washing using buckets have been successfully implemented in other countries (Olmstead and Stavins 2008). The Carcar LGU can focus on using hoses/sprinklers with the CWD's disinfected/filtered water since there are costs in extracting and disinfecting.

The convenience of sprinkling increases water consumption with a positive result in water demand in this study. To have a sustainable effect on water demand management, the CWD should regularly coordinate with the LGU on the effectiveness of every action in water demand management.

CONCLUSION

The water pricing of the CWD serves a good ground for water demand management, given that the ratio of the average monthly water expenditure to the average monthly household income is very low at 0.67 percent. Compared with other water districts in the region, the current CWD tariff is cheap. Also, 36.68 percent of the sample households belonged to the middle-middle income group or PHP 31,560.01 to PHP 78,900 income range based on the income classification of Albert et al. (2018).

The significant factors affecting water demand supported the findings of the related literature cited in this paper. Price and nonprice programs can be hinged from the significant variables in the multiple regression analysis. Like other cities that have successfully adopted both the hard and soft mechanism, Carcar City should be able to do the same.

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