Water concessioners willingness to pay for improvement of water supply services in Butuan City, Philippines

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Abstract. Water is one of the most valuable natural resources vital to the existence of any form of life. Water supply in rural and urban areas is an issue of prime concern, especially in Butuan City. This study assessed the consumers' willingness to pay (WTP) for improvements of water supply conditions and to identify the factors affecting WTP. The study revealed that majority (66.8%) of the respondents expressed their willingness to pay for an additional amount every month to improve the water supply. Households who are willing to pay conveyed the lowest price of 50 Php per month. Binary logistic regression revealed that WTP of the concessionaires are dependent on their food monthly budget and electric consumption. The result of the study would play a significant contribution to Butuan City Water Districts' future planning and decision-making related to the improvement of water supply and quality in Butuan City.
Key Words: water consumer, water services, water supply, economic valuation.

Introduction. Water is one of the most valuable natural resources vital to the existence of any form of life (Olajuyigbe & Fasakin 2010). But, as human population increases and demand more water of high quality for domestic purposes and economic activities, this valued resource is increasingly being threatened and access to it becomes a major challenge (Carr & Neary 2006). One of the most important factors to sustain human life and ecosystems is having an adequate supply of clean and safe water. Water is essential for developing cities since it is fundamental for daily domestic activities. Hence, irregular and uncertain access to safe water affects not only these activities directly but also households' health and workforce productivity indirectly (Asim & Lohano 2015). Appropriate management of water resources is essential for economic growth and human health for people who are dependent on water for drinking, growing food, generating energy, providing transportation, and maintaining healthy ecosystems (Dobriansky 2003). It is imperative to devise an integrated plan, not only to meet the future demand, but also to maintain the quality of service. Water supply in rural and urban areas is an issue of prime concern, especially in developing countries.

Butuan City, an urbanized city in the Philippines and the regional center of Caraga region is composed of 86 barangays. Out of 86 barangays, only 55 barangays are currently dependent and have access to Butuan City Water District (BCWD) for their water supply, while some barangays are still utilizing groundwater via water wells. Taguibo Watershed in Barangay Anticala is the main source of water that supports the city since 1974 (BCWD 2015). But water supply interruption has been a critical issue for the residents in the city. Water shortages are rampant during the rainy season and have failed to meet the needs of the intended concessionaires. The main reason of water supply interruption is due to high water turbidity caused by heavy rains over Taguibo watershed. The facilities of the water district were damaged during the tropical storm Jangmi on December 2014 which resulted in water shortage for more than a month

(Serrano 2015). Due to this, more than 200,000 concessionaires experienced low water supply.

Thus, this study determined the consumers' willingness to pay (WTP) for improvements in water supply services, identified the factors affecting WTP and described their impact on WTP for improved supply conditions through logistic regression analysis. It is essential to know whether people at different settings are ready to financially support the system for the improvement and maintenance of the service. Due to this, an assessment on household's willingness to pay for improved water supply services in Butuan City, Agusan del Norte was conducted. The result of the study is beneficial to Water District of Butuan City which can serve as input in making investment decisions based on benefits and costs for the improvement of water services. It can also provide the information on the monetary value of the benefits for improving the access to safe water.

Material and Method

Study area. Three urban barangays (Libertad, Doongan, and Villa Kananga) and two rural barangays (Ampayon and Bancasi) which are part of Butuan City were considered in this study. The city is served by BCWD which taps water from Taguibo watershed. Barangay Libertad is one of the urban barangays with a flat topography located away from the water source and is three kilometers away from the city proper. With 4,759 concessionaires, it is recorded to have the largest number of concessionaires. Deep wells and water stations are some of the alternative source of water in the area. Doongan is one of the oldest urban barangays in Butuan City with 2,457 water concessionaires. It is located away from the water source but is situated in a low-lying area near the city center. There are households utilizing alternative source of water in the village. Villa Kananga is an urban barangay and has the second highest number of concessionaires (3,109). It is located away from the water source and is situated in an elevated area near the city proper. Ampayon is a rural barangay having a population of 11,203 with 1,511 concessionaires and is located nearest to Taguibo watershed and closest to the main pumping station and filtration plant. Barangay Bancasi is also a rural barangay located far from the water source and has the least number of concessionaires.

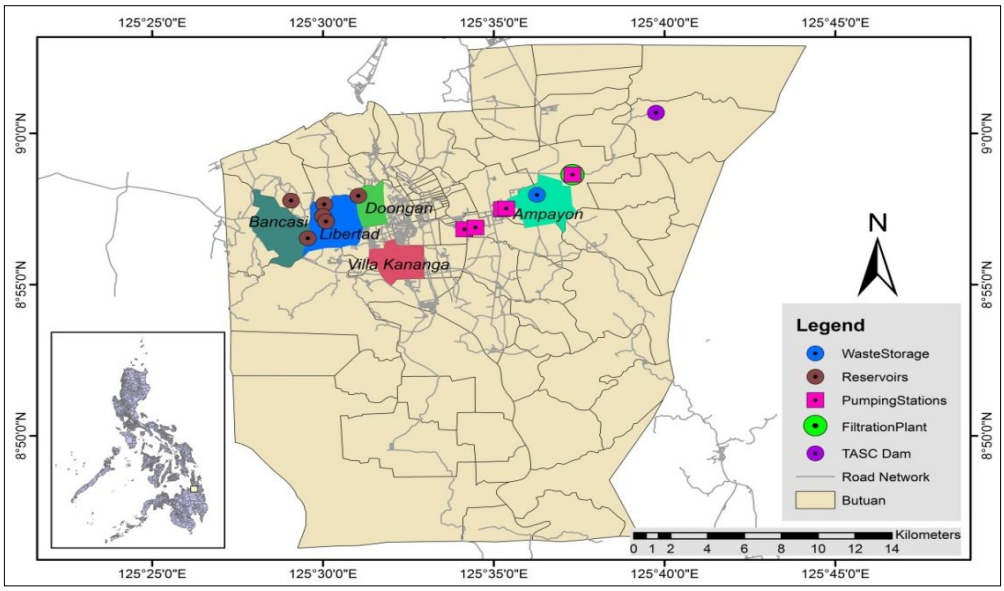

Figure 1. Map of the five selected barangays of Butuan City, Agusan del Norte.

Data gathering. This study employed the survey-based technique for the estimation of WTP. In this study, WTP was measured based on stated preference of the customer by asking them the maximum price that they are willing to pay for the improvement of water services. A structured interview schedule was used and administered to persons

who are heads of the household or any adult member of the family that were engaged in decision making.

A pilot survey was conducted on November 2017 in the five selected barangays prior to the actual household survey to test the validity of the interview schedule. The result of the pilot survey generated an 80% WTP and this was used to calculate the number of respondents that were considered in the study.

The computation of sample size for the household survey was determined using the formula:

$$N=\frac{(t)^2\,(p)(1-p)}{(e)^2}$$

where: N = total sample size;
t = 1.96;
p = willingness to pay generated from the pilot survey (80%);
e = acceptable margin of error is equal to 0.05.

Hence

$$N=\frac{(1.96)^2\,(0.8)(1-0.8)}{(0.05)^2}$$

N = 245.9

Since there were five areas and equal allocation of sample size was used in this study, 250 respondents were considered (Table 1). The number of respondents were sufficient to meet precision requirements for subgroup analysis. The equal allocation of sample size was done to control the subgroup sample size for important population.

Table 1

Number of respondents in every barangay

Barangays	*Total number of concessionaires*	*Number of respondents*
Ampayon	1,511	50
Bancasi	236	50
Doongan	2,457	50
Libertad	4,759	50
Villa Kananga	3,109	50
Total	12,072	250

Data analysis. Logistic Regression Analysis was utilized to determine the influence of socio-economic status on households' willingness to pay for a more improved water services. A regression model was used to predict the logit, that is, the natural log of the odds of having made one or the other decision. That is:

$$\ln(\text{ODDS}) = \ln\left(\frac{Y}{1-Y}\right) = a+bX$$

where: Y = is the predicted probability of the event which is coded with 1 (willing to pay) rather than with 0 (not willing to pay);
1-Y = is the predicted probability of the other decision;
X = is the predictor variable (food and electricity).

ODDS is the ratio of the proportion of those who are willing to pay over the proportion of those who are not willing to pay. The higher the ODDS, the more likely the WTP. The equation below is a result of manipulating the original logistic regression model, by exponentiation, which was used to predict the odds. In this case, it was used to compute for the predicted probabilities specific for an outcome.

The odds prediction equation is:

$$\text{ODDS} = e^{a+bX}$$

ODDS can be converted to probabilities with the equation:

$$Y = \frac{ODDS}{1+ODDS}$$

Results and Discussion

Households' common usage of water. BCWD water supply is commonly used for drinking, laundry, watering the plants, cleaning, cooking and bathing (Table 2). Water supplied by BCWD is highly used for cleaning, laundry and bathing by 100.0% of the respondents. The basic water usage of a household is for cooking, drinking and washing, also for food preparation, bathing, sanitation and laundry activities (Inocencio et al 1999). However, 2.8% of the respondents do not utilize the BCWD water for cooking, instead they used purified water. Only 14% of the respondents utilized water supplied by the local water district for drinking since most opted to use alternative sources for drinking like from groundwater and purified water available at water refilling stations. The study of Jiang & Rohendi (2018) revealed that despite available tap water, residential households access multiple water sources differentially for drinking and non-drinking purposes. Respondents spent an average of ₱296.88 additional cost for drinking water. Accordingly, particulate matters were sometimes noticed in the water. White and brown coloration and chlorine odor were also observed. Due to the uncertainty about biological contaminants and disinfection by-products from chlorination process, taste and odor, respondents chose to spend more money for drinking water to assure their health and safety, thus, water refilling stations that sell purified water are increasing due to high demand of safe water (Macatangay et al 2015). The minimum rate of the water provided by the BCWD is ₱208.65 pesos per 10 cubic meter which is considered as a minimum consumption for a family member of 6 in the Philippines. The average bill for water amounts to ₱361.91 every month.

Table 2

Common usage of water among respondents

Common usage	*Frequency*	*Percent*
Drinking	35	14
Laundry	250	100
Watering plants	240	96
Cleaning	250	100
Cooking	243	97.2
Bathing	250	100

Households' water service satisfaction. Satisfaction is important to any services provided by a company or government offices. Results revealed that respondents were slightly satisfied of the system of BCWD and its services (Table 3). Availability of supply in a day varies with location. Areas connected to old distribution lines and near the Taguibo watershed or pumping stations like Ampayon and Doongan are likely to have abundant water supply but with interruptions during rainy season. On another hand, areas connected to new distribution lines located at highly elevated areas like Bancasi and Villa Kananga are experiencing less than six hours of water supply in a day even with fair weather. More water interruption can last for three days to two weeks during rainy season. Though barangay Libertad is located away from the water source, presence of the three reservoirs supports the water system in the area. The respondents were slightly satisfied with the rate of the discharged for consumption. During fair weather, there is high water pressure during night time in four areas except in barangay Bancasi, but during rainy days, water pressure is very low and sometimes do not supply water at all. According to BCWD, low supply or interruption of water during rainy days is due to the high turbidity of the Taguibo river. Majority of the respondents (52.8%) suggested that there should be continuous water supply even during rainy days. Frequent interruption of the water supply was observed in different barangays especially during prolonged and

heavy rainfall. Due to the high turbidity of the river, infiltration gallery located in Barangay Anticala is forcebly closed. Though five pumping stations are working as a back-up water source, the production is sometimes inadequate to supply 55 barangays that are dependent to BCWD.

In terms of cleanliness and safeness for drinking, most respondents believed that the water is clean and safe for domestic use but not for drinking. Most of them buy purified water for drinking purposes or use water extracted from groundwater. Some people are still utilizing the water supplied by BCWD for drinking without undergoing filtration process while others used electronic water filters. Apart from the discontinuity of water supply, concessionaires complained some cases of unpleasant water odor, and unclear water due to presence of sand particles. About 3.8% of the respondents have encountered dirty water supply, thus, they suggested that BCWD should improve the cleanliness of the water they provide in terms of color, odor, and taste. The presence of chlorine in the water can be detected by its odor and taste. According to BCWD, the acceptable residual chlorine concentration in their system is 0.5-1.5 mg L^{-1}. However, Department Administrative Order (DAO) 26-A emphasized that the maximum level for residual chlorine should only be 0.2-0.5 mg L^{-1} (DENR 1994). BCWD have exceeded the amount of residual chlorine by 1 mg L^{-1} based on the acceptable standard set by the Department of Environment and Natural Resources.

Respondents are slightly satisfied in terms of manpower and other extra services. Some shared that it took 3 days for the BCWD to send staffs to repair broken water pipelines. Delays of water reconnection are also experienced by some of the respondents.

In terms of billing and payment, respondents were somewhat satisfied of their service. They noted that despite water interruption, billing is up to date as well as the disconnections. Respondents believed that there should be some billing adjustments during long days of water interruption. Some respondents (6.8%) also suggested that water bill based on the minimum rate of 208.65 PhP equivalent to consuming 10 m^3 should be changed. They mentioned that water bill should be based on the actual volume consumed in a month.

Table 3

Level of satisfaction among respondents of the system of BCWD and its services

Indicators	*Mean*	*Standard deviation*	*Level of satisfaction*
Availability of water supply in a day	2.02	0.93	Slightly satisfied
Rate of water discharge for consumption	2.34	1.03	Slightly satisfied
Quality in terms of cleanliness and safetynessfor drinking	2.12	0.94	Slightly satisfied
Manpower for repair and other extra services	2.49	0.93	Slightly satisfied
System of billing and payment	2.74	1.19	Somewhat satisfied
Overall	2.34	1.00	Slightly satisfied

Note: Mean response falling within 1.00-1.50: not at all satisfied; 1.51-2.50: slightly satisfied; 2.51-3.50: somewhat satisfied; 3.51-4.50 very satisfied; 4.51-5.00 extremely satisfied.

Households' willingness to pay. For eliciting the WTP, the respondents were informed about the scenario where an improved status of tap water services is represented such that the household will receive continuous water supply with sufficient pressure, and the water will be of good quality and potable without boiling or any other treatment. WTP measures the increase of households' well-being after it has access to a tap water suitable for drinking. The majority (66.8%) of the respondents were willing to pay an additional amount every month to improve the water supply and services while 33.2% were not willing to pay an additional amount (Table 4). Some studies also exhibited that most residents are willing to pay a certain amount per month for improvements in quality of tap water and access (Chatterjee et al 2017; Van Houtven et al 2017).

Most of the respondents (43.2%) expressed willingness to pay the lowest amount (₱50.00) while the rest of the respondents are willing to pay the amount higher than

₱50.00 (Table 4). Most of the respondents chose the lower amount rather than the higher amounts. It somehow follows the theoretical probability of WTP which is sloping downward. This means that the lower the bid amount, the higher is the probability of respondents willingness to pay, and the higher the bid amount the less likely respondents will be willing to pay (Celeste 2009).

Table 4

Amount in Philippine peso the respondents' are willing to pay

Amount in Pesos	*Frequency*	*Percentage*
Not willing to pay	83	33.2
Less than 50 PhP	108	43.2
51 PhP – 100 PhP	49	19.6
101 PhP – 150 PhP	5	2.0
151 PhP – 200 PhP	2	0.8
201 PhP – 250 PhP	2	0.8
251 PhP – 300 PhP	1	0.4
Total		100

The main reason for respondents who were not willing to pay was that they have no desire to pay for more to improve the current services of the agency since they can afford to buy purified water for drinking. Respondents spent an average of 296.88 PhP as an additional cost for purified drinking water because particulate matters and chlorine odor were sometimes noticed in the water supplied by BCWD. The demand for cleaner water increases thus the demand for purified water by water refilling stations also increases (Magtibay 2004). People from any localities prefer to use purified water sold by refilling stations for it is cleaner and safe to drink. Due to the uncertainty about biological contaminants and disinfection by-products from the chlorination process, taste and odor, respondents chose to spend more money for drinking water to assure their health and safety, thus, water refilling stations that sell purified water are increasing due to the high demand of safe water (Macatangay et al 2015). Other consumers mentioned that they are not satisfied with the existing service thus they do not want to pay more.

Factors affecting willingness to pay. Logistic Regression was used to predict the relationship between independent and dependent variables. Data gathered from the survey were used as predictors. This model determines positive response on the WTP because more respondents were willing to pay. This approach to prediction was possible for 66.8%. Table 5 provides the regression coefficient (B) to test the statistical significance and the all-important odds ratio for each variable category. Food and electricity are significant at 0.1 level.

Table 5

Logistic regression model for willingness to pay

Variables	*B*	*S.E.*	*P-value*	*Exp(B)*
Food	0.169	0.090	0.061	1.184
Electricity	-0.145	0.074	0.051	0.865
Constant	0.499	0.363	0.170	1.647

The predictors were food monthly budget and electric bill. The model is expressed as:

Probability (willingness to pay) = exp {0.499+0.169[food] - 0.145[electricity]}

From the model illustrated above, the *B* coefficients represent the contribution of each independent variable such as food and electricity to the outcome variable which is the WTP. Willingness to pay of the concessionaires is dependent on their food monthly budget. With a positive regression coefficient of 0.169, having a direct relationship, this suggests that when food consumption is high, the willingness for improved water supply

will also increase. Households are more willing to pay for improved water if they have high food consumption maybe because water is critical not only for food security but for general security as well. Water is vital in food production, crops and livestock need water to grow. Also, household size and composition affect the food budget of the family, since according to Jacobson et al (2010), there is a strong correlation between family earnings and number of people per household regarding expenditure on food at home. Demand for food is expected to increase with the proportional increase in household size and total household resources (Deaton & Paxson 2010). According to Arbues et al (2010) household size affects demand for water positively recognizing the fact that more members also mean more extraction of the resource. As households with high food budget most likely cook foods more often. It could be associated with the food preparation which requires continuous and clean water supply for cooking purposes. However, households with high electricity bill would not be willing to pay more for improved water supply. This result may be related to their ability to pay, as electric bill increases, budget tightens and WTP falls. Or they prefer not likely to invest in water than investing for electrical consumption. With a negative value of the regression coefficient (-0.145) it implies an opposite relationship that as electricity bill increases the WTP for improved water services will decrease.

Conclusions. Concessionaires believed that paying additional amount will help improved water supply system. They wanted an improved water service ensuring adequate maintenance and enhanced water treatment facility. However, more than half of the respondents expressed their willingness to pay for improved water supply at the lowest bid amount of ₱50.00.

The variable that affects their willingness to pay is their monthly food budget and electricity consumption. As the food budget increases, the willingness to pay increases, and willingness to pay decreases as electricity consumption increases. This will always be possible 66.8% of the time.

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