Service constraints and willingness to pay in community-managed water supply services in Ghana

Emmanuel Kwame Nti and Camillus Abawiera Wongnaa
Department of Agricultural Economics, Agribusiness and Extension, College of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
Nana Sampson E. Edusah
Bureau of Integrated Rural Development, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, and
John-Eudes Andivi Bakang and Vasco Baffour Kyei
Department of Agricultural Economics, Agribusiness and Extension, College of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Received 8 June 2020
Revised 21 August 2020
Accepted 1 September 2020

Abstract

Purpose – The purpose of this paper is to support the development of effective strategies that enhance community water supply systems. The study examined service constraints and willingness to pay for better services in community-managed water supply services using empirical evidence from beneficiaries of a small-town water supply system in Ghana.

Design/methodology/approach – A survey design of both descriptive and exploratory research is adopted, the descriptive survey handles the quantitative aspect, while the exploratory survey handles the qualitative aspect. The authors collected data using a structured survey questionnaire from 387 beneficiaries who were public standpipe and domestic users. Descriptive statistics, Kendall's coefficient of concordance and Cragg's two-step model were the methods of analysis employed.

Findings – The respondents ranked lack of capacity (managerial) as the topmost constraint of the community-managed water system. The findings indicate that 57% of the beneficiaries were not willing to pay, whiles 43% were willing to pay. Also, results from Cragg's two-step regression model indicate that different sets of factors affect willingness-to-pay and amount-to-pay decisions. The study revealed that while a willingness-to-pay decision is influenced by income, education, marital status and customer service, the estimated-amount-to-pay decision is more influenced by income and education.

Originality/value – Building on the empirical evidence, the findings indicated that the water and sanitation management team can increase the current fee of GH¢ 5.00/1 m^3 (≈US$ 0.87) by increasing beneficiaries charge for a bucket of water from GH¢ 0.10p (≈US$ 0.017) to GH¢ 0.21p (≈US$ 0.036) for better services within the community. Importantly, the additional charge should take into consideration income and education which were noted to significantly influence the beneficiary's amount-to-pay decision for better services in the community-managed water supply system.

Keywords Willingness to pay, Community-managed, Sustainability, Water supply system
Paper type Research paper

Introduction

The study examined service constraints and willingness to pay for better services in community-managed water supply services using empirical evidence from a small-town water supply system in Ghana. Globally, Africa owns and shares 9% of the renewable water resources, but it is home to about 15% of the world's population (Wang *et al.*, 2014). There is a lacuna between water availability and water demand (Jacobsen *et al.*, 2012) and access to water is insufficient, while 65% of the population in rural Africa has limited access to the

World Journal of Entrepreneurship, Management and Sustainable Development
Vol. 17 No. 3, 2021
pp. 329-353

2042-5961
DOI 10.1108/WJEMSD-06-2020-0059

water supply. In urban Africa, about 25% do not have access to sufficient water supply (Africa, 2003). Over the last decades, community management is seen as the default approach for community water supply systems in many developing countries according to Hutchings *et al.* (2015), but rural communities are becoming increasingly vulnerable because of low access to a water supply. In sub-Saharan Africa, 319 m people out of over a billion people in the region are without access to quality drinking water (WWAP, 2017). Many ailments affecting most sub-Saharan Africa countries such as dysentery, typhoid and diarrhoea can be greatly reduced through the provision of safe and quality supply of water and (WSSCC/WHO, 2005) have attributed a total death of 1.6 m per year due to lack of improved water supply services.

In Ghana, access to improved water sources is 70% and coverage of piped water to premises is 19% (together 89% water coverage, 2% increase over previous estimates) and as such, Ghana has achieved the target for Millennium Development Goals (MDGs) as far as access to safe water is concerned (WHO, 2015). Nonetheless, major challenges persist in providing sustainable water supply services in many rural areas, including the Jacobu community in Ghana. To overcome some of the issues affecting the technical and operational efficiency of the water supply system, the community management model was proposed. The model emerged from the first International Drinking Water Supply and Sanitation Decade during the 1980s and was adopted by the Community Water and Sanitation Agency (CWSA) in Ghana, although it is still going through reforms. The introduction and completion of the water project at Jacobu under the community water management model served as a crisis relief. However, many projects have failed after implementing agencies have handed over completed projects to communities. The fundamental question that could be raised is about how water supply systems under the community management model can address service constraints and willingness to pay for water supply services?

The community management model remains the choice for governments as well as other donors for the management of community water supply services (Chowns, 2014). Unfortunately, various internal and external constraints associated with the community-managed water supply systems are overlooked and have not been investigated. It is always presumed that the community water management system would succeed without investigating the associated constraints. Laryea (1994), Lockwood *et al.* (2003), Lockwood (2004), Awoke (2012) have identified the general constraints in their studies in different countries and nonetheless, little has been done to identify constraints that affect the Jacobu small-town water supply system (JSTWSS) in Ghana. According to Whaley and Cleaver (2017), it is important to deal with the difficulties and heterogeneity that are found in community water supply services. To question management capacity to improve water availability and achieve sustainable water supply services to promote the prospects of economic growth and decent life in the coming years is critical while knowing beneficiaries of the water supply services' willingness-to-pay decision.

Although from the history of trial and error in the management of water supply systems (Macharia *et al.*, 2015), the community management model was designed to improve upon the management of community water supply projects that frequently fail to achieve its purposes after implementing agencies have handed over the project (Lockwood *et al.*, 2003). The collective willingness to improve and sustain the water facility is normally based on the social cohesion of a particular community and it equally relies on the identity of such a community. As Lockwood *et al.* (2003) observed in most rural settings, water user fees are not likely to fully cover all costs associated with operations and maintenance but they could gather a significant amount of money and if so, then the question is are communities willing to pay to sustain community-managed water systems?

However, to better achieve the sustainability of a community water supply system and better understand its management by the community, there is the need to investigate the service constraints associated with it as well as the willingness-to-pay decisions. The understanding of service constraints and willingness-to-pay decisions can help policymakers to appreciate the dynamics of the community-managed water supply system and take advantage of other opportunities to improve upon its management. This study, therefore, seeks to find out the major constraints in community-managed water supply services and assess the willingness of the community to pay for better services using the Jacobu water supply system in the Amansie Central District of the Ashanti Region of Ghana as a case study.

Literature review

The community management model of water supply services

The core in terms of explaining what the community management model is originated from "the idea that communities should operate and maintain their water supply systems" (Schouten and Moriarty, 2003). The original community management model remained mostly "supply-driven" until the 1990s when the World Bank started to promote the demand-responsive approach (Hutchings *et al.*, 2015). Thus, a strong motivation was attached to the community management model during the 1990s, where project sharing cost became a basis and since then, the model has proven to be the durable plan in terms of operationalizing the typical participatory development in the community sector (Whaley and Cleaver, 2017). Community management is defined basically as the principles where communities are part and parcel in the development of water supply systems including ownership and generally responsible for the operation and maintenance (Moriarty *et al.*, 2013; Hutchings *et al.*, 2015).

Different practitioners cite divergent views on the impact of community management on community water supply services. For example, Evans and Appleton (1993) summarized findings of a workshop with experts having experiences from 122 completed water projects from almost seven (7) developing countries such as Yemen, Uganda, Indonesia, Guatemala, Pakistan, Cameroon and Honduras. It was described that community management is widely adopted because it is reliable, sustainable, replicable, stimulates community development and also works very well. On the other side, development practitioners are also criticized for the spread of the community management model in a very quick way since it showed its limitation in Rwanda and according to the African Development Bank Group (2015), such limitations included lack of professional technical skills, non-payment of user fees regularly and poor financial management, especially funds misappropriation. Again, Chowns (2014) in his study revealed that community management is ineffective and also disempowers the very core management and at the community level, it breeds conflict, inequality and combines clientelism at a wider level. In the study, it was concluded that community management brings about the erosion of social capital and handing over of state responsibility (Chowns, 2014).

The combination of community management and the demand-responsive approach became the default approach in terms of delivering water supply in communities in many low- and middle-income countries (Egloff, 2016). However, as noted by Lockwood and Smits (2011), community management is now growing with a clear focus on the importance of professionalism in service delivery. To them, professionalizing has to do with moving the community management structure from its dependence by volunteering time on the part of community members including the use of *ad hoc* management procedures. That is, qualified members are equally paid as staff members to ultimately complete the task as far as operation and maintenance are concerned, whiles the power in terms of decision-making still relies upon a proper institution of the community (Lockwood and Smits, 2011).

Constraints in the community-managed water supply services

The involvement of community members in projects to achieve the needed sustainability is critical (African Development Bank Group, 2015). The community management model continues to enjoy many successes, it is important to note that it is not immune to certain constraints. Furthermore, two broad constraints can be identified, which are internal and external constraints (Laryea, 1994; Lockwood *et al.*, 2003; Lockwood, 2004; Awoke, 2012). The internal constraints are the influence of community dynamics, lack of cohesion, poverty, strong traditions, misplaced priorities, lack of capacity (technical, managerial and financial) within the community, lack of financial resources and political or social conflict. The external constraints, on the other hand, are lack of spare parts supply, lack of supportive policies and legislation in terms of extended support to help communities in various maintenances/ repairs, conflicts, time constraints [1], sectorial plans by other agencies, poor designs and political interference (Laryea, 1994; Lockwood *et al.*, 2003; Lockwood, 2004; Awoke, 2012). In this paper, constraints in community-managed water supply services are a combination of internal and external constraints.

Community perception of water system ownership

Community sense of ownership is defined as a psychological state in which individuals feel as if their community's water supply system is "theirs" (Pierce *et al.*, 2001; Marks and Davis, 2012). As noted by Marks *et al.* (2013), investigation related to the role that beneficiary's sense of ownership for their water supply infrastructure plays in determining system performance outcomes is limited till date. Practitioners argue that communities sense of ownership contributes to beneficiaries' willingness to operate, use and maintain their water system properly over the long term (Yacoob, 1990; Marks *et al.*, 2013). Also, community perceptions of ownership or sense of entitlement affects willingness to pay (Katz and Sara, 1997). Community members who often express dissatisfaction with the service and possess a low sense of ownership had little willingness to pay for the maintenance of the service (Katz and Sara, 1997).

Development practitioners again cite the essential role that community "sense of ownership" for water infrastructure plays in ensuring its sustainability (Madrigal *et al.*, 2011). It is however important to note the implicit assumption that all community members hold similar feelings of ownership for the water system (Whittington *et al.*, 2009), neglecting the potential for heterogeneous feelings of ownership which suggests a consistent and positive association between households' sense of ownership and sustainability (Marks *et al.*, 2013). For example, a study in rural Costa Rica revealed that most households in high-performing communities reported that the system was owned by the community itself, whereas households in low-performing communities were usually unclear about who owned the system or reported that the government is the owner (Madrigal *et al.*, 2011). It is evident that "limited community ownership of the water system" caused Kenya's historic challenges with the sustainability of its rural water infrastructure (Marks *et al.*, 2013).

Willingness to pay in the community-managed water supply system

According to Hutchings (2016), any other public services cost money which is not different from water services. Kleemeier (2000) stated that when it comes to payment of money, community members are commonly unwilling to pay in a situation where everything appears to be working perfectly. However, evidence exists which reveals that poor communities are even willing and able to make contributions for improved water supply services. For example, a study carried out by Manyena *et al.* (2008) in rural water supplies in Zimbabwe

found out that the majority of the community members were willing to pay but in reality not having the financial capacity to pay the real cost of maintenance work.

Similarly, a study conducted in southern Ethiopia also revealed that community members were willing to pay 1.5 times higher than their current water charges they were charged (Behailu *et al.*, 2012). On the contrary, a study carried out in Pakistan on willingness to pay in rural communities of Lahore found only 26% of the population who were willing to pay (Malik *et al.*, 2012). Moreover, there is other recent evidence by Hope (2015) that community-managed water supply systems have a lower willingness to pay when compared to service delivery option, whiles other researchers like Marks and Davis (2012); Franceys and Cavill (2012); Franceys *et al.* (2016) have a different opinion noting that even in a situation where users are willing to pay a tariff at some level, the most important problem is that it hardly covers the actual operations and maintenance costs, which could lead to the problem of financial sustainability.

Factors influencing willingness to pay and amount to pay decisions

According to Wahid and Hooi (2014), eight determinants are recognized in terms of willingness to pay for better service. These include income, drinking water health risk, quality of water taste, quality of watercolour, quality of filtered water, risk of water contamination, uninterrupted water supply and customer service that handle feedback and complaint and request from consumers. Also, family size, age, sex, distance from the source of water, educational level, daily water expense, affordability, level of satisfaction, occupation, type of water source and change in water service were some of the factors identified to influence beneficiary willingness to pay for better service (Mezgebo and Ewnetu, 2015).

The research methodology

The study area

The Jacobu community is the district capital of the Amansie Central District located in the Ashanti Region of Ghana. The district covers a total area of approximately 710 sq. kilometres (275.4 sq. miles). This constitutes about 2.5% of the total land area of the Ashanti Region (Amansie Central District Assembly, 2006). The population of the Amansie Central District is 90,741 and Jacobu which is the district capital has the highest population of 10,725 amongst all the other communities in the district as of 2010 (Ghana Statistical Service, 2010). The district lies in the forest dissected plateau region. The region is generally having an undulating shape with an average height between 150 and 300 m above sea level. According to Ghana Statistical Service (2010), majority of the households have their sources of drinking water from an improved source, which include mechanized borehole constituting 71.1%, whilst pipe-borne water outside the dwelling and pipe-borne water inside the dwelling constitute about 6.8 and 0.7%, respectively. Also, public taps or standpipes constitute about 12.7% as well as river or stream constituting 4.4%, protected well constitutes about 3.8% with the minimum usage of sachet water representing 0.5%. Figure 1 shows the map of the study area.

Data collection and the sampling technique

The study used data collected from beneficiaries of the JSTWSS in the Amansie Central District of Ghana. The mathematical approach by Yamane (1973) which is non-proportional was used to estimate the sample size. The sample size when the formula was applied gave 387 which were selected for the study. The formula is simplified as follows:

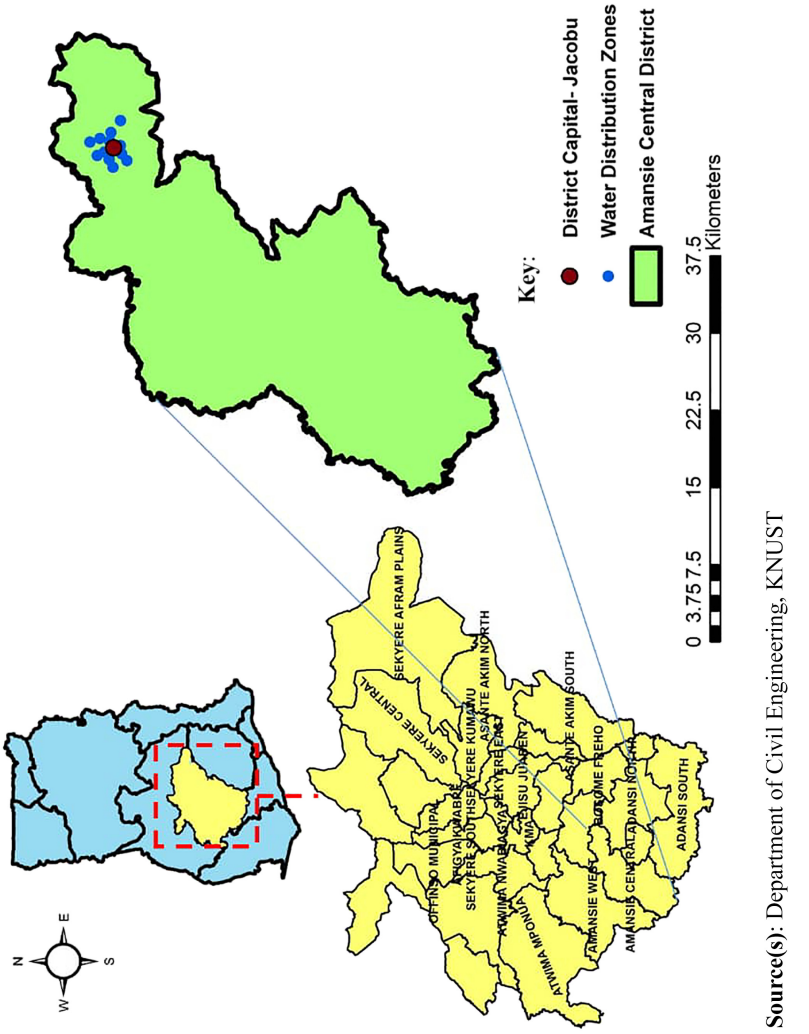

Figure 1.
Themap of the Amansie Central District chosen for the study

$$n = \frac{N}{1 + N\ (\alpha)^2} \quad (1)$$

Where

n = the sample size; N = the sample frame for the study and α = the confidence interval.

The stratified sampling technique was employed by dividing the population into two main groups: core management members and community members/beneficiaries. The community members/beneficiaries were further divided into public standpipe and domestic/private users. The stratified sampling design was used because it is a method of selection in which every beneficiary of the target population has a known chance of being selected for the study. Data were collected from private/domestic and public standpipe users spread across 12 distribution zones which were Aboabo Road, Ebenezer, Esereso, Habitat, Krofrom, Monsie, Nteduom, Odumase, Pataabo, Tunsuom, Wawase and Hwentemase. The formula used in drawing a representative sample for each stratified group is given as follows:

$$n_1 = \frac{N_1 \times S}{N} \quad (2)$$

Where

n_1 = sample drawn; N_1 = total number of members in the stratified group;

N = total population under study; S = sample size for the study

However, for this study, the stratified groups were represented as follows:

Domestic/private users. This group was made up of community members/beneficiaries who are connected to the water supply system in the various 12 distribution zones across the community. By the time of conducting this study, 198 houses were connected privately and six (6) domestic/private users were selected in this stratum using Equation (2).

Public standpipe users. This group was also made up of the beneficiaries of the water supply system who are not connected to their various households but patronizes the pay-as-you-fetch public standpipes distributed across the community in the various 12 distribution zones. The standpipes by the time of conducting this study were 23 in number and used by the greater number of the beneficiaries. One public standpipe is a source of water for about 574 people in a distribution zone. In this stratum using Equation (2), 381 members were selected.

Then, the simple random sampling technique was applied to each stratum to draw the sample. The lottery method was used as a simple random sampling technique in selecting the respondents. For instance, in the case of Aboabo Road as a distribution zone, unnumbered pieces of paper which were 32 in quantity and numbered pieces of paper from 1 to 32 which were also 32 in quantity were mixed and presented to public standpipe beneficiaries who stay within the zone to make a selection. Beneficiaries who picked a numbered piece of paper in our lottery method were interviewed. This process was repeated for all the other 11 distribution zones. Similarly, six (6) households were randomly selected as private/domestic connection users from the 12 distribution zones. Table 1 summarizes the respondents selected for each distribution zone in terms of domestic and public standpipe users.

The study employed a structured survey questionnaire and a key informant interview guide as the primary data collection instruments with the community members/beneficiaries. However, for this study, all our findings are thus about public standpipe users since no meaningful statements can be derived from a quantitative analysis of six cases of the domestic/private users. Because of the dimension of the problem, the study sought to answer

Distribution zone	Domestic connection	Public standpipe
Aboabo Road	1	32
Ebenezer	0	32
Esereso	1	32
Habitat	0	32
Krofrom	1	32
Monsie	0	32
Nteduom	1	32
Odumase	1	31
Pataabo	0	32
Tunsuom	0	30
Wawase	0	32
Hwentemase	1	32
Total	6	381

Source(s): Author(s) own compilation

Table 1. Respondents in the various distribution zones selected for the study

these research questions: (1) what are the constraints in community-managed water supply services? (2) What is the perception of the community members on system ownership and are beneficiaries willing to pay more and how much? (3) Why are (or are not) beneficiaries willing to pay more? (4) What are the factors influencing willingness-to-pay and amount-to-pay decisions? A survey design of both descriptive and exploratory research is adopted, the descriptive survey handles the quantitative aspect, while the exploratory survey handles the qualitative aspect of why are (or are not) beneficiaries willing to pay more.

The analytical framework

Constraints faced in the community-managed water supply systems identified in the literature (Laryea, 1994; Lockwood *et al.*, 2003; Lockwood, 2004; Awoke, 2012) were used and beneficiaries were asked to rank the constraints in order of importance. Kendall's coefficient of concordance was used to measure the degree of agreement in this objective amongst the m set of n ranks. The main idea of this investigation was to find the total of each constraint ranked, while at the same time examining the variability of the totals. To measure service constraints using Kendall's coefficient of concordance, all the constraints identified were presented to beneficiaries for confirmation or otherwise by ticking and ranking as applied to their cases. The respondents ranked the constraints in the order of the most pressing to the least pressing using scales that were, respectively, assigned a value coded as 1 (if very high), 2 (if high), 3 (if low) and 4 (if very low) in that order. However, in calculating the ranks using the scores, the constraint with the minimum score is categorized as the most pressing constraint, whilst the one with the maximum score is ranked as the least constraint. The score for the ranking was equally used to calculate the coefficient of concordance and this was done to achieve the degree of agreement. The coefficient of concordance (W) ranges from 0 to 1 and it was 1 when the rank assigned by beneficiaries was precisely the same as those assigned by other beneficiaries and was 0 when there is a maximum level of disagreement amongst the constraints ranked. Kendall's coefficient of concordance (W) is defined by the following formula:

$$W = \frac{12\left[\sum T^2 - \frac{\left(\sum T^2\right)}{n}\right]}{nm^2\ (n^2 - 1)} \tag{3}$$

Where

T = the sum of ranks for constraints being ranked;

m = the number of beneficiaries interviewed;

n = the number of rankings/total number of constraints being ranked.

However, hypothesis validation and the significance test were done by using F-statistics;

H_0: denotes no agreement in the constraints ranked;

H_1: denotes an agreement in the constraints ranked.

In terms of the significance of the coefficient of concordance (W), the F-distribution was used which is specified as follows:

$$F = \frac{(m-1)\ W}{1 - W_c} \tag{4}$$

Where

W_c is the coefficient of concordance (W) calculated;

The F-statistic has $V1 = (n-1) - \frac{2}{m}$ degrees of freedom for the numerator;

$V2 = (m-1)[(n-1) - \frac{2}{m}]$ degrees of freedom for the denominator.

The decision rule is applied in such a way that if $Fcal > Fcrit$, then reject the null hypothesis and if $Fcal < Fcrit$, then accept the null hypothesis. Thus, the null hypothesis is rejected if the calculated F-value exceeds the tabulated F-value, indicating that respondents agree with each other on the ranking of the constraints.

On the second level of the analysis, descriptive statistics were employed in determining the perception of the community members on the system ownership as well as their willingness to pay. To determine how much more are beneficiaries willing to pay, the contingent valuation method using the dichotomous choice format was employed. The dichotomous choice format allows two possible responses to a payment question: "yes" and "no" (or "vote for" and "vote against"). It is important to note that the dichotomous choice format is nowadays preferred over alternative approaches because it controls hypothetical bias by allowing a follow-up question to the payment question (e.g. Hanemann *et al.*, 1991), which in some studies is an open-ended follow-up question. The bias arises because it is believed that surveyed responses without a payment mechanism may be inflated since the responses are constructed hypothetically. Responses to follow-up (e.g. "how much more are you willing to pay?") and to contingent valuation questions control the hypothetical bias. The willingness-to-pay figures reported by the respondents can simply be averaged to produce an estimate of mean willingness to pay if the payment question is open ended. Also, the views expressed on why are (or are not) beneficiaries willing to pay more were transcribed by the researchers and were analysed thematically to enable the textual presentation of the findings. Pseudonames were used for individual interviewees to ensure that the identities of participants remained confidential in the analysis.

On the third level of the analysis, many techniques have been employed in determining factors influencing willingness-to-pay and amount-to-pay decisions. Amongst the techniques include least squares multiple regression, ordinary least squares (OLS), probit and tobit models. According to Wan and Hu (2012) as well as Asante *et al.* (2018), the use of the tobit model provides estimates of joint determinants of both discrete and continuous willingness-to-pay decisions. Hence, using both the probit and the tobit regression models to determine the probability of factors influencing willingness-to-pay and amount-to-pay decisions separately may lead to confounding policy implications (Asante *et al.*, 2018). This is as a result

of the fact that the tobit model assumes that the two decisions are made jointly in estimating the determinants of the probability of willingness to pay and amount to pay, resulting in double counting the probability of willingness to pay (Waithaka *et al.*, 2007). The assumption that the two decisions are made jointly using the tobit model has been criticized that it may not always be reasonable because the discrete and continuous factors influencing willingness-to-pay and amount-to-pay decisions could be made at different stages and are likely to be influenced by different factors (Lin *et al.*, 1984; Wiredu *et al.*, 2015; Asante *et al.*, 2018). To avoid the many potential conflicts that could lead to confounding policies in the use of the least squares multiple regression, the ordinary least squares, tobit and the probit models alone, the two-step models which are Heckman selectivity and Cragg models have been proposed to account for the potential problems (Mal *et al.*, 2013; Yirga and Hassan, 2013; Asante *et al.*, 2018).

According to Mal *et al.* (2013), one of the important differences between Heckman selectivity and Cragg's double-hurdle models concerns the sources of zeros. In the Heckman model, it is considered that those not willing to pay will never pay under any circumstances and in Cragg's double-hurdle model, those who are not willing to pay are considered as a corner solution in a utility-maximizing model. Again, the Heckman model addresses selectivity bias and also requires the use of different sets of variables in each specification (Heckman, 1979). In contrast with Cragg's double-hurdle model, the same set of variables can be used in both stages and assumes that their effects on the two decisions are different (Cragg, 1971). Given that this is so, there is the need to examine whether the two decisions are joint or separate such that the decision on willingness to pay may be preliminary to the amount-to-pay decision. Where the decision is jointly made, the tobit model can be used to estimate the determinants of willingness to pay. However, where the decisions are made separately, then the willingness to pay may be characterized by selectivity bias.

However, the two models can be estimated separately and it is, therefore, logical to infer that the assumptions made in different stages are supported by Cragg's double-hurdle regression model (Cragg, 1971) and have been used to explain why some beneficiaries are willing to pay and why other beneficiaries are not willing to pay. This study, therefore, conducts a thorough diagnosis of separability and selectivity in willingness-to-pay and amount-to-pay decisions. To confirm separability in willingness-to-pay and amount-to-pay decisions, the log-likelihood ratio test is conducted. To do likelihood ratio test, probit, truncated and tobit models, as shown in Equations (5, 6 and 7), are estimated.

$$z = Prob\left(\frac{\mathrm{z}}{z^*} > \quad = 0\right) = \quad xy \quad + \varepsilon \tag{5}$$

$$y = E\left(\frac{\mathrm{y}}{y^*} > \quad = 0\right) = \quad x\beta \quad + \quad \mu\varepsilon \tag{6}$$

$$Y = (xy \quad + \quad \varepsilon) \quad + \quad (x\beta \quad + \quad \mu) = \quad xa \quad + \quad \omega \tag{7}$$

In the fifth model above, the sample beneficiaries chosen for the study consisted of those who are willing to pay and those who are not willing to pay. Let z denote the discrete decision of willingness to pay such that $z = 1$ for beneficiaries who are willing to pay and $z = 0$ for beneficiaries who are not willing to pay, z_i^* represents the latent variable for the probability of willingness to pay, x is a set of explanatory variables in the model, y is the set of coefficients of the explanatory variables and ε is the error term. In the sixth model, y represents the amount-to-pay decision, y_i^* is the latent variable of an amount-to-pay decision, β is the set of coefficients for the explanatory variables and μ is the error term. The tobit model combines the first two models to obtain the joint coefficient a, which explains both the willingness-to-pay and amount-to-pay decisions. In the seventh model, ω is the error term. From the three

models, the log-likelihood ratios are obtained and used to compute the likelihood ratio test statistic L as follows:

$$L = 2(LLR_{Probit} + LLR_{Truncated} - LLR_{Tobit}) \quad (8)$$

In confirming the use of the two-step model, the *LLRs* in Equation (8) following Katchova and Miranda (2004); Wiredu *et al.* (2015); Asante *et al.* (2018); Wongnaa *et al.* (2019) are the log-likelihood ratios of the three models which were conducted as a joint decision test that involves the estimation of willingness to pay with the probit model, amount to pay with truncated and tobit models separately as noted by Mal *et al.* (2013) were used to compute the likelihood ratio test statistic. However, the estimated L should be greater than the χ^2 distribution with degrees of freedom equal to the number of independent variables (including the intercept) in the models to justify the use of any of the two-step models (Katchova and Miranda, 2004; Mal *et al.*, 2013; Asante *et al.*, 2018). Importantly, selection between Cragg's and Heckman's two-step models becomes appropriate when the tobit model provides a consistent estimate of the determinants of willingness to pay if the L is less than the critical value (Mal *et al.*, 2013). Heckman's two-step model also accounts for selectivity bias, it becomes appropriate and is described below.

The first step of Heckman's model also involves the estimation of a probit regression model, the same as the first step of Cragg's model shown in Equation (6). The second step of the model is the OLS regression and is expressed using q to represent the amount-to-pay decision, q_i^* as the latent variable of an amount-to-pay decision, δ as the set of coefficients estimates and φ as the error term as expressed in Equation (9) below with the second term on the right-hand side as the inverse Mills ratio which corrects for selection bias in the OLS regression. A significant lambda suggests that the amount-to-pay decision depends on the initial discrete decision of willingness to pay for better services (Marchenko and Genton, 2012; Wiredu *et al.*, 2015), a condition which is not considered in Cragg's model.

$$q = E\left(\frac{q}{q^*} > 0\right) = x\delta + \lambda(xy) + \varphi \quad (9)$$

In the absence of selectivity bias, Cragg's model provides a relatively simple approach for estimating the two-step model, though the second stage of the model is also OLS regression but without the inverse Mills ratio. This is specified in Equation (10) below:

$$q = E\left(\frac{q}{q^*} > 0\right) = x\delta + \varphi \quad (10)$$

The descriptions of the explanatory variables X_s used in the two-step models are as follows:

Income. The income variable refers to the monthly money income of the household in Ghana cedis. It includes the income of the head from all sources. In reality, as the income of households increases, their demand for improved services increases. Furthermore, the willingness to pay increases when respondents' income was found to be above the poverty level (Malik *et al.*, 2012; Wahid and Hooi, 2014). According to Hensher *et al.* (2005), when income increases, the probability of the household saying yes to contribute for improved water supply services increases. It is therefore expected that income will affect willingness to pay positively.

Sex. This study expects female respondents to be more willing to pay than men since traditionally it is the role of women to clean the house including washrooms, cook, etc. As noted by Mezgebo and Ewnetu (2015), female-headed households happen to be more willing to pay for better services than their male counterparts simply because women are responsible for collecting water and are directly influenced by water-related problems. Also, a

study on affordability and willingness to pay in Ethiopia observed a difference in willingness to pay between men and women (Bayru, 2004).

Age. According to Mezgebo and Ewnetu (2015), there is a variation in willingness to pay for better services where elderly households are less likely to pay for the provision of the improved water supply service. This is the result of the concept that old people fear to invest in projects which will be implemented after long term and are highly related to one's income. Thus, the lower the age of the respondent, the higher is the monthly income and the higher is his/her willingness to pay for better services (Mezgebo and Ewnetu, 2015).

Education. The variable education is taken to capture the number of years the respondent spent in the formal school system. Usually, the enlightened population has a great impact on the demand for welfare facilities like water, health, education, amongst others. However, as explained by Mezgebo and Ewnetu (2015), education shifts the demand for water services to the right. This, therefore, implies that a household with a higher level of literacy has better chances of maximizing the utility and welfare from consuming and having access to clean and potable water. Mezgebo and Ewnetu (2015) recognized a positive sign for the level of education attained by households, indicating that households whose heads have higher education indicated higher willingness to pay than the less educated ones. Education is expected to have a positive and significant effect on community-managed water supply services.

Marital status. Coster and Otufale (2016) recognized a negative relationship between willingness to pay and marital status. Also, according to Mezgebo and Ewnetu (2015), married people are more willing to pay for the provision of improved water supply services as compared to their unmarried counterparts. The reason was attributed to the fact that married people are cautious of the health and other water-related risks stemming from poor water supply services due to family responsibility in the future than their single counterparts and more responsible in the use of water whiles keeping the home clean and hence are more likely to be willing to pay.

The level of satisfaction. A study on valuing water supply service improvement in Ethiopia by Gebreegziabher and Berhanu (2007) recognized a negative relationship between beneficiaries' level of satisfaction and their willingness to pay. It is essential to stress that when households face more interruption such that satisfaction level becomes lower, it results in a lower willingness to pay (Hensher *et al.*, 2005). Also, Mezgebo and Ewnetu (2015) reported that only beneficiaries who are unsatisfied with water services due to poor quality, less quantity and unreliability are likely to pay than those beneficiaries who are already satisfied. The level of satisfaction of a beneficiary is expected to influence willingness to pay for better services.

Continuous/uninterrupted water supply. A household may be willing to pay higher for an improved water value from the belief that they are not getting a continuous water supply and hence, interrupted water supply. It is however less likely that a household will be willing to pay for better services when they enjoy continuous water supply with no interruption. The variable uninterrupted water supply and in other words, continuous water supply is expected to influence willingness to pay for better services.

Customer service. According to Wahid and Hooi (2014), the importance of customer service centre is acknowledged as the centre that helps to handle feedback, complaints and requests from consumers. Hensher *et al.* (2005) reported on urban country respondents' preference to have a person answer the phone when they call the service centre rather than having a voice system to provide a message and that they are willing to pay for this service feature. The variable customer service and in this case handling of complaints, requests and feedback is expected to influence willingness to pay for better services. This is as a result of the fact that when people's complaints, requests and feedback are handled properly, they are more likely to pay for better services. On the other hand, when people's complaints, requests and

feedback are not handled, they are less likely to pay more for better services. Table 2 presents a summary of the variables used in Cragg's two-step model.

Results and discussions

The preliminary analysis

Table 3 presents summary statistics of the explanatory variables used in the econometric models. According to Table 3, significant differences between beneficiaries who are willing to pay and beneficiaries who are not willing to pay at all exist in all the variables except age. There is a significant relationship between willing-to-pay beneficiaries and income. Also, a relatively high proportion of beneficiaries who are willing to pay are more educated than beneficiaries who are not willing to pay. The proportion of beneficiaries who are satisfied with the supply of water and also enjoy continuous water supply without any interruption is significantly higher amongst the group of willing-to-pay beneficiaries with p-values of 0.072 and 0.009, respectively. Also, customer service in terms of complaints handling and requests is significantly higher amongst willing-to-pay beneficiaries with a p-value of 0.000. Age of beneficiaries in the study area is also significantly higher for willing-to-pay beneficiaries. Table 3 below presents the summary statistics of the explanatory variables used in the econometric models.

The test of research questions

What are the constraints in community-managed water supply services?. Sustainable management of community water supply services requires management and beneficiaries to overcome the constraints faced in their management and daily operations. However, during day-to-day operations, the system encounters some constraints which have been identified in several case studies as far as community management of water supply services is a concern. The beneficiaries were presented with some constraints to confirm their existence and to finally rank them to see their applicability. The community members who are beneficiaries of the JSTWSS with 12 distribution zones in the Amansie Central District ranked *lack of capacity (managerial), lack of spare parts supply, lack of financial resources, conflicts and poor designs* to be the topmost five constraints. The least ranked constraints are

Variable	Description	Unit of measure	Expected sign
Income	Respondents' income	Ghana cedis (GH¢)	+
Sex	Respondents' gender	Binary = 1 if female 0 = if male	+/−
Age	Respondents' age	Years	−
Marital status	Respondents' status in terms of marriage	1 if married 0 = otherwise	−
Education	The actual number of years spent in school	Continuous	+
The level of satisfaction	Beneficiaries' level of satisfaction with the existing water services	1 = if satisfied 0 = otherwise	+/−
Continuous water supply	Uninterrupted water supply services	Binary = 1 if uninterrupted 0 = otherwise	+/−
Customer service	Handling of a complaint, request and feedback from consumers	Binary = 1 if the Jacobu small-town water supply system handles complaint and request 0 = otherwise	+/−

Table 2. Variable name, description, unit of measure and expected sign

Table 3.
Summary statistics of explanatory variables used in the econometric models

Variables	Mean	Willingness to pay (yes) (167)	Non- willingness to pay (no) (220)	Chi-square *p*-value
Income (Ghana cedis)	898.51	1,062.088 (769.7718)	776.4085 (410.2932)	128.4410 0.004
Sex (1 = female; 0 = male)	0.561	0.4610778 (0.499982)	0.6363636 (0.4821427)	11.8423 0.001
Age	36.65	37.08383 (12.2938)	36.32727 (10.31212)	46.8664 0.600
Marital status (1 = married; 0 = otherwise)	0.40	0.4491018 (0.4988986)	0.3590909 (0.4808279)	3.2104 0.073
Education (years)	14.08	15 (3.29661)	13.4467 (3.231454)	26.5957 0.046
The level of satisfaction (1 = if satisfied; 0 = otherwise)	0.855	0.8922156 (0.3110406)	0.8272727 (0.3788734)	3.2352 0.072
Continuous water supply (binary = 1 if continuous; 0 = otherwise)	0.821	0.8802395 (0.3256577)	0.7772727 (0.4170256)	6.8702 0.009
Customer service (binary = 1 if the JSTWSS handles complaint and request; 0 = otherwise)	0.620	0.7365269 (0.4418416)	0.5318182 (0.5001245)	16.8886 0.000

Note(s): Figures in parentheses are standard deviations
Source(s): Author(s) own compilation

political and social conflicts, lack of cohesion and lack of supportive policies and legislation (see Table 4).

The first major constraint that confronted most beneficiaries in the management of the water supply system was lack of capacity (managerial). The water supplied to the community is underground and its supply depends on electricity to pump the water, but its distribution has been erratic, especially during power outages which happen almost thrice in a month. The lack of capacity (managerial) ranked could be as a result of the composition of the water and sanitation management team. Most management teams may not have the requisite knowledge or training in water management to enhance the sustainable management of the water supply system. Also, it could be attributed to inadequate funds to meet the demands of beneficiaries, even though management may have the desire to supply water during power outages by using alternative sources of power but they may lack the ability to purchase and use alternative sources of energy.

From the foregoing, it would be very difficult to tell whether a lack of capacity in terms of management has a positive or negative effect on financial resources or long-term financial support. This is consistent with Kumar's (2005) statement that community-based development projects supported by the World Bank found that providing sustained long-term support beyond a single intervention performed better in capacity development than just a single intervention and its possible handing over. This causes water shortage in the community and has affected their management capacity until electricity is restored from the national grid for the system to be able to pump water for the community. The result is also in line with what Adokor (2012) indicated that there is concern over the capacity of local-level management structures to operate and manage water systems to achieve sustainability.

The second most serious constraint was the lack of spare parts supply when a beneficiary faces a supply problem, especially standpipe users with damaged parts that need to be replaced. This causes cut in supply for beneficiaries at a particular zone until the problem is fixed. Though some spares parts such as taps, PVC pipe 3¼, PVC pipe 1 Inch, tangent, air valves, padlocks and bulk meter including reserve pump were held in stock by the water management team and staff. This implies that there could be a physical barrier to access the spare parts for maintenance works to be done for beneficiaries or consumers which is very significant and could be not a question of finance, though the stocks could be insufficient.

Lack of financial resources also became the third constraint in the community-managed water supply services. This could be as a result of poor financial management stemming from

Constraints of community-managed water supply services	Mean rank	Ranking
Lack of capacity (managerial)	2.93	1
Lack of spare parts supply	3.35	2
Lack of financial resources	3.74	3
Conflicts	4.98	4
Poor designs	5.14	5
Political and social conflicts	5.17	6
Lack of cohesion	5.28	7
Lack of supportive policies and legislation	5.37	8
Test statistics		
$N = 387$	df = 7	
Kendall's $W = 0.206$	Asymptotic significance = 0.000***	

Note(s): ***significance at 1% level
Source(s): Author(s) own compilation

Table 4.
Constraints ranked by beneficiaries using the Jacobu small-town water supply system

the low trust on the part of the beneficiaries as far as both the management team and the staff members are concerned. However, improving transparency and accountability coupled with high levels of savings by the management team of the water supply system will accelerate the achievement of sustainable water management that will benefit all.

The estimated Kendall's coefficient (w) was 0.20, implying that there was 20% agreement amongst community members/beneficiaries of community-managed water supply system while ranking the constraints. The F-value obtained shows that the constraints ranked were statistically significant at 1%. This, however, implies that the null hypothesis should be rejected in favour of the alternative hypothesis. From the results, it can be concluded that there is a weak agreement amongst community members/beneficiaries regarding ranking of constraints.

What is the perception of the community members on system ownership and are beneficiaries willing to pay more and how much?. Importantly, the perception of a community about who owns the water supply system is critical in ensuring that the community will be willing to pay for better services (Katz and Sara, 1997). The beneficiaries of the water supply system were asked about who owns the system. Figure 2 shows that majority of the respondents representing 71% indicated that the system belongs to the community. About 13% also indicated that the system is owned by the district assembly, whiles 4% indicated that the water system belongs to the water management team, with 4% also indicating that the system belongs to the government. In all, 8.01% indicated that they do not know who owns the system as shown in Figure 2. The findings from this study reveal positive community knowledge of ownership of the water supply system. This is a result of the initial 5% contribution to the project cost by the community as part of the demand-driven approach.

After finding out the perception of ownership of the water supply system, respondents were then asked whether they were willing to pay for better services. Of 387 respondents, the study revealed that majority of the beneficiaries representing 57% were not willing to pay, whiles 43% were willing to pay (Figure 3). This is consistent with the findings of Hope (2015) that community-managed water supply systems have a lower willingness to pay when compared to service delivery.

In regards to the price of water, beneficiaries of the water supply system in the community currently pay GH¢ 5.00/1 m^3 which translates to GH¢ 0.10 pesewas for a bucket of water. Beneficiaries were asked to indicate how much more they are willing to pay and the result is presented in Table 5. The mean willingness to pay by beneficiaries is GH¢ 0.21 pesewas. This means that close to 43% of the beneficiaries who are currently paying for water are willing to

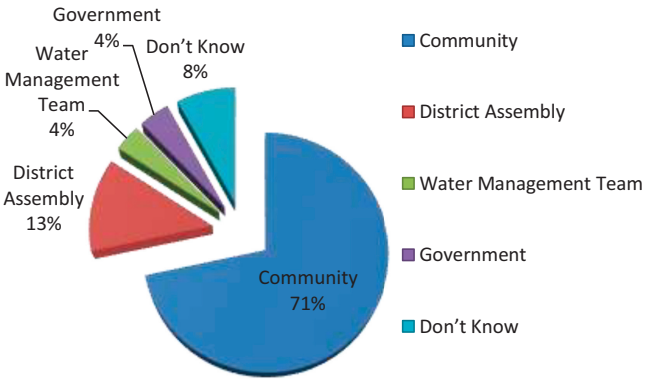

Figure 2.
Ownership of the water supply system

pay GH¢ 0.11 pesewas more for the hypothetical situation. Thus, the beneficiaries are willing to contribute at least GH¢ 10.50/1 m^3 of water in support for better services within the community.

Also, the summary statistics (Table 3) supports that more than half of the beneficiaries who are willing to pay earn an average higher income of GH¢ 1,062.088 and are also satisfied (89%) with the current water service. Beneficiaries' level of satisfaction has a statistically significant relationship with their decision on willingness to pay (Table 3) with the chi-square value of 3.2352 and $p > 0.072$ at the 10% significance level. The fact that it is significant showed that the variable level of satisfaction with the existing water services by the beneficiaries was a major determinant and that policies to improve water supply services must not downplay customer satisfaction. The truncated results (Table 6) provide explicit decision support evidence on why beneficiaries may not be willing to pay much on average. The coefficient of income (−0.0000412) which is statistically significant at 10% reduces the average amount beneficiaries are willing to pay. Similarly, we noticed a consistent decrease in the average amount willing to pay by beneficiaries as their level of satisfaction decreases, although its coefficient value (−0.0330642) shows no significant relationship. Therefore, a high level of customer satisfaction on the water supply services should be central in either community, publicly and privately managed pipe water schemes, systems or services. Also, not relating to the willingness to pay could be attributed to the fact that since the majority of the beneficiaries are currently satisfied, they may not prefer paying above their satisfaction that they cannot afford. This result supports the findings of Mezgebo and Ewnetu (2015) who reported that only beneficiaries who are unsatisfied with water services due to poor quality, less quantity and unreliability are likely to pay than those beneficiaries who are already satisfied.

Why are (or are not) beneficiaries willing to pay more?. In response to the potential concerns about why are not beneficiaries willing to pay more, we further asked respondents to explain their unwillingness to pay. There were several reasons given for the unwillingness to pay. James, a 34-year-old beneficiary said,

> It is the duty of those managing the water to pay for any improvement of the system.

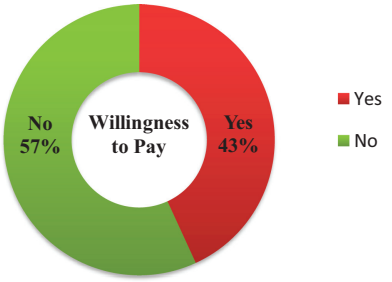

Figure 3.
Willingness to pay

	AWTP	SD	Min	Max
Mean WTP	0.21	0.1861	0.1	2.2
N	167			

Source(s): Author(s) own compilation

Table 5.
Average willingness to pay amongst beneficiaries who were willing to pay (currency: Ghana cedi)

Table 6.
Factors influencing willingness-to-pay and amount-to-pay decisions

Variable	Tier 1 Probit[a] Coefficient	SE	Tier 2 Truncated[b] Coefficient	SE	Tobit Coefficient	SE
Income	0.0003409**	0.000166	−0.0000412*	0.0000244	0.0002263**	0.0001007
Sex	−0.1966449	0.1553508	−0.0330137	0.0355103	−0.1337344	0.0924238
Age	0.0043284	0.0092918	0.0030084	0.002077	0.0020144	0.0055561
Marital status	0.3294157**	0.1712166	0.0428476	0.0399231	0.2010766 **	0.1008187
Education	0.0578306**	0.0270917	0.0212768***	0.0062019	0.0345863 **	0.015888
The level of satisfaction	0.0701525	0.2257274	−0.0330642	0.0604542	0.0442166	0.1260097
Uninterrupted water supply	0.3162741	0.2105902	0.0015053	0.0570363	0.1648606	0.1165975
Customer service	0.2848347*	0.1654859	0.0161176	0.0415982	0.1731151*	0.0969262
Constant	−2.020131***	0.6131399	−0.1489493	0.1463357	−0.4184716	0.3580788
The number of observation	326		133		326	
Wald/LR x^2 (8)	41.86***		18.28***		43.76***	
Prob > χ^2	0.0000		0.0192		0.0000	
Log-likelihood	−199.48236		31.465624		−302.52437	
Pseudo R^2	0.0950				0.0635	
Sigma			0.1909923***	0.0117105	0.7266682	0.0418481
Likelihood ratio statistic	*269.015268*					

Note(s): [a]probit estimate, which is the first stage or tier 1 of Cragg's "two-tier" model; [b]the second stage or tier 2 of Cragg's double-hurdle model; SE denotes standard error; the asterisks, *, ** and *** indicate significance levels of 10, 5 and 1%, respectively
Source(s): Author(s) own compilation

56-year-old Osei also shared his reason for not being willing to pay, and it was clear he doubted the capacity of the management team and staff. This was evident in his utterance:

> Because the money they have been collecting
>
> should be enough for them to manage the system
>
> and carry out any improvement of the system.

That was corroborated by Gyamfuwaa, a 42-year-old beneficiary:

> The charge is enough and all they should ensure
>
> is that consumer pay for their water usage.

Both Bio and Asare and many other respondents shared a similar sentiment about their unwillingness to pay. This was evident as their responses were written and quoted as saying:

> The community already made a financial
>
> contribution before the project was implemented
>
> and as such the water should rather be free.

A closer look at the results also confirms that majority of beneficiaries seem not to understand the management process of the system and such idea is attributed to the fact that only a few beneficiaries know what goes into the work of the management team and the staff members. Thus, considering the reasons given above for the unwillingness to pay, it is important to stress on education as the best tool to inspire community members/beneficiaries or individual households to understand the 5% initial contribution as demand-driven approach and as a way of participating in the project for greater ownership and sustainability of the system. Also, the water management team should do more and ensure that beneficiaries understand the community management model being adopted to help manage their water supply system sustainably.

Factors influencing willingness-to-pay and amount-to-pay decisions. Table 6 presents the results of Cragg's two-step model for willingness-to-pay and amount-to-pay decisions. As two models with two different hypotheses are developed, it is important to know which model is superior to the other. To determine this, we conducted a log-likelihood test as presented in Equation (8). It is important to note that where the decision is jointly made, the tobit model can be used. However, where the decisions are made separately, then the willingness to pay may be characterized by selectivity bias. The estimated lambdas from the Heckman two-step models (see Appendix-Table A1) are non-significant, indicating the absence of selectivity bias. The log-likelihood ratio test statistics of 269.015268 strongly rejects the tobit model. This implies that a beneficiary's decisions about willingness to pay and amount to pay are made in two different stages and our discussions are based on the findings of Cragg's model. From the probit model which is the first stage or tier 1 of Cragg's double-hurdle model, the probability of willingness to pay is found to be positively influenced by income, marital status, education and customer service. But a willingness-to-pay probability is less with sex, age, the level of satisfaction and uninterrupted water supply with the probit model.

The coefficient of income is positive and significant at the 5% level of significance for willingness to pay. This result is in line with what Wahid and Hooi (2014) and Malik *et al.* (2012) found that willingness to pay increases when respondents' income is found to be above the poverty level. The significant coefficient of income implies that beneficiaries with more income are more willing to pay for better services. This is because people with more income believe that paying more for the management team to get access to more funds can improve their services.

The coefficient of marital status is positive and significant at the 5% level of significance for willingness to pay for better services. This result indicates that married beneficiaries have a higher likelihood of willingness to pay for better services as compared to their unmarried counterparts. This result is similar to the findings of Coster and Otufale (2016) that recognized a positive relationship between willingness to pay and marital status. The result is an appropriate expectation because married women are cautious of water-related risks stemming from poor water supply services and are consistently responsible and making sure that water is available for domestic chores like cooking, washing, bathing, cleaning, amongst others.

Education shows a positive and significant relationship with willingness to pay at the 5% significance level. This result supports the findings of Mezgebo and Ewnetu (2015), which recognized a positive sign for the level of education attained by beneficiaries showing that beneficiaries who have attained higher education indicated higher willingness to pay than the less educated ones. Beneficiaries who have a high level of education are more willing to pay for better services simply because as individuals receive education, they tend to understand the need for better water supply services.

The coefficient of customer service and in this case, in terms of handling of complaints, requests and feedback is positive and significant at the 10% significance level. This result indicates that beneficiaries are more willing to pay when their complaints, requests and feedback are handled properly but are less likely to pay when their complaints, requests and possible feedbacks are not communicated. The study is similar to the report of Hensher *et al.*, (2005); Wahid and Hooi (2014) that identified that beneficiaries prefer to have a person answer phone calls when they call the service centre for a request, complaints or any possible feedback that needs to be communicated.

Tier 2 of Cragg's double-hurdle model was used to determine the factors influencing the amount-to-pay decision as shown in Table 6. Tier 2 which is truncation was as a result of the fact that those beneficiaries who are not willing to pay for better services were excluded from the analysis. The likelihood ratio test statistics revealed that the continuous decision of the amount to pay does not depend on the discrete decision of willingness to pay, which strongly rejects the tobit model which was mostly influenced by the decision of willingness to pay and not by the amount-to-pay decision. Tier 2 of the Cragg model fits our data in explaining the factors influencing the amount-to-pay decision. The variables having a significant positive coefficient are income and education, whereas marital status, uninterrupted water supply, sex, age, the level of satisfaction and customer service are found to have negative significant impacts on the amount-to-pay decision.

Income is often predicted to be related to amount to pay because of its logical relationship with the ability to pay. From tier 2 of the Cragg model in Table 6, the sign for the income variable was negative and was significant at 10%. This implies that as the income of the beneficiary decreases, the amount they are likely to pay also decreases, which affects their ability to pay for better service. The result may explain that beneficiaries' amount to pay increases when their income increases and this result suggests a potential role for the water and sanitation management team to be considerate on the economic status of the beneficiaries since an increase or decrease of their income may affect the amount they are willing to pay.

The coefficient of education shows a positive effect and is also significant in tier 2 of Cragg's model for the amount of money beneficiaries are willing to pay for better services. It is not surprising that beneficiaries who are highly educated would pay a higher amount of money for better water supply services and this may be explained by the important opportunity education gives to people to understand the effects of water supply services and its consequences on health. This is similar to what Mezgebo and Ewnetu (2015) identified that education shifts the demand for water services to the right whiles having access to clean and potable water. Importantly, as far as factors influencing the amount of money beneficiaries

are willing to pay for better service are a concern, then beneficiaries with higher income and who have high education are more willing to pay for better services.

Conclusion and policy implications

The community management model remains ultimate software for community water systems. The study revealed that lack of capacity (managerial) is the major constraint that community-managed water systems are dealing with. In this study, there is an improvement to the methodologies used in estimating willingness-to-pay and amount-to-pay decisions. In general, estimating the probability of willingness to pay alone does not provide a true understanding of the factors that influence the entire process and it is important to avoid misleading conclusions and not to assume that the two decisions are only jointly made but to include separability test to apply the appropriate estimation to avoid potential conflicts that could lead to confounding policies. Using Cragg's two-step model, the study shows that willingness-to-pay and amount-to-pay decisions are distinct decisions affected by different sets of factors. The results indicate that income, education, marital status and customer service (in terms of handling beneficiary's complaint, request and feedback) were the factors influencing willingness to pay. A quick look at the results shows that 57% were not willing to pay more but 43% of the beneficiaries were willing to pay GH¢ 0.11 pesewas more for better services. Income and education were noted to significantly influence the beneficiary's amount-to-pay decision for better services. The study recommends the development of skills/capacity building, given that the major constraint is lack of managerial capacity, through training, seminars and workshops, especially for the water and sanitation management team who mostly may not have the requisite knowledge or training in water management to enhance the sustainability of the water supply system. It is also recommended that the water and sanitation management team should consider that the income level of beneficiaries was realized to determine willingness-to-pay and amount-to-pay decisions. Therefore, the management team can consider abolishing the low domestic connection charge compared to the high public standpipe payment system. This is to say that the water and sanitation management team should charge the domestic consumers relatively more simply because they can afford and use the excess amount of money to subsidize beneficiaries who cannot afford as a result of their unwillingness to pay. To ensure sustainable management of water for all, revenue mobilization should be paramount with continuous education to avoid future challenges of financial sustainability as a result of the observed unwillingness to pay in the community-managed water system.

Note

1. Donor-funded projects have short time frames within which certain actions should be accomplished and not always feasible.

References

Adokor, M.I. (2012), "Assessing the capacity of communtiy level management structures to operate and manage water facilities sustainably: a study of the Bosomtwi District of the Ashanti Region", available at: http://ir.knust.edu.gh/handle/123456789/7617 (accessed 8 September 2017).

Africa, U.-W. (2003), *The Africa Water Vision for 2025: Equitable and Sustainable Use of Water for Socioeconomic Development*, Economic Commission for Africa, Addis Ababa.

African Development Bank Group (2015), "Water supply and sanitation in Africa: findings, lessons and good practices to improve delivery", *Independent Development Evaluation*, Abidjan,

available at: https://idev.afdb.org/sites/default/files/documents/files/Water%20Supply%20and%20Sanitation%20in%20Africa%20%20Findings%2C%20Lessons%20and%20Good%20Practices%20to%20Improve%20Delivery_0.pdf (accessed 12 April 2018).

Amansie Central District Assembly, A. (2006), *4-Year Medium Term Development Plan (2006-2009)*, DPCU, Jacobu.

Asante, B.O., Villano, R.A., Patrick, I.W. and Battese, G.E. (2018), "Determinants of farm diversification in integrated crop–livestock farming systems in Ghana", *Renewable Agriculture and Food Systems*, Vol. 33 No. 2, pp. 131-149.

Awoke, Z. (2012), "Assessment of challenges of sustainable rural water supply: Quarit Woreda, Amhara region", in *A Project Paper Presented to the Faculty of the Graduate School of Cornell University in Partial Fulfillment of the Requirements for the Degree of Master of Professional Studies*.

Bayru, A. (2004), *Affordability and Willingness to Pay for Improved Water Supply in Urban Areas of Ethiopia*, Ethiopian Economic Association, Addis Ababa.

Behailu, S., Kume, A. and Desalegn, B. (2012), "Household's willingness to pay for improved water service: a case study in Shebedino District, Southern Ethiopia", *Water and Environment Journal*, Vol. 26 No. 3, pp. 429-434.

Chowns, E.E. (2014), "The Political economy of community management: a study of factors influencing sustainability in Malawi's rural water supply sector", Doctoral dissertation, University of Birmingham, Birmingham.

Coster, A.S. and Otufale, G.A. (2016), "Households' water-use demand and willingness to pay for improved water services in Ijebu ode local government area, Ogun State, Nigeria", *Ethiopian Journal of Applied Science and Technology*, Vol. 7 No. 2, pp. 33-42.

Cragg, J.G. (1971), "Some statistical models for limited dependent variables with application to the demand for durable goods", *Econometrica: Journal of the Econometric Society*, Vol. 39 No. 5, pp. 829-844.

Egloff, L. (2016), *Operation and Maintenance in Community Managed Rural Drinking Water Supply Systems*, Essay on Development Policy, NADEL MAS-Cycle 2014-2016.

Evans, P. and Appleton, B. (1993), "Community management today: the role of communities in the management of improved water supply systems", in *IRC Occasional Paper*, IRC, Vol. 20, The Hague.

Franceys, R. and Cavill, S. (2012), *A Comprehensive Literature Review on Charging for and Subsidising WASH Services*, UNICEF-WASH/PD, New York.

Franceys, R., Cavill, S. and Trevett, A. (2016), "Who really pays? A critical overview of the practicalities of funding universal access", *Waterlines*, Vol. 35 No. 1, pp. 78-93.

Gebreegziabher, K. and Berhanu, A. (2007), "Valuing water supply service improvements in Addis Ababa", in *Ethiopian economic assocoation, proceedings of the fifth international conference on the Ethiopian Economy*, Vol. 5 No. 3, pp. 978-999.

Ghana Statistical Service (2010), *2010 National Housing and Population Census; Population by District and Sex*, Ghana Statistical Service, Accra.

Hanemann, W.M., Loomis, J. and Kanninen, B.J. (1991), "Statistical efficiency of double-bounded dichotomous choice contingent valuation", *American Journal of Agricultural Economics*, Vol. 73 No. 4, pp. 1255-1263.

Heckman, J. (1979), "Sample selection bias as a specification error", *Econometrica*, Vol. 47 No. 1, pp. 153-161.

Hensher, D., Shore, N. and Train, K. (2005), "Households' willingness to pay for water service attributes", *Environmental and Resource Economics*, Vol. 32 No. 4, pp. 509-531.

Hope, R. (2015), "Is community water management the community's choice? Implications for water and development policy in Africa", *Water Policy*, Vol. 17 No. 4, pp. 664-678.

Hutchings, P. (2016), "Supporting community management: a synthesis of successful rural water services programmes in India" Cranfield CERES, available at: http://dspace.lib.cranfield.ac.uk/handle/1826/11314 (accessed 25 January 2018).

Hutchings, P., Chan, M.Y., Cuadrado, L., Ezbakhe, F., Mesa, B., Tamekawa, C. and Franceys, R. (2015), "A systematic review of success factors in the community management of rural water supplies over the past 30 years", *Water Policy*, Vol. 17 No. 5, pp. 963-983.

Jacobsen, M., Webster, M. and Vairavamoorthy, K. (2012), *The Future of Water in African Cities: Why Waste Water?*, The World Bank, Washington, DC.

Katchova, A.L. and Miranda, M.J. (2004), "Two-step econometric estimation of farm characteristics affecting marketing contract decisions", *American Journal of Agricultural Economics*, Vol. 86 No. 1, pp. 88-102.

Katz, T. and Sara, J. (1997), *Making Rural Water Supply Sustainable: Recommendations from a Global Study*, The World Bank, Washington, DC.

Kleemeier, E. (2000), The impact of participation on sustainability: an analysis of the Malawi rural piped scheme program, *World Development*, Vol. 28 No. 5, pp. 929-944.

Kumar, N. (2005), *The Effectiveness of World Bank Support for Community-Based And-Driven Development: An OED Evaluation*, The World Bank, Washington, DC.

Laryea, N.O. (1994), "Challenges and prospects of community management in Ghana", in *Affordable Water Supply and Sanitation. Proceedings 20th WEDC Conference*, Colombo, pp. 44-45.

Lin, T.-F. and Schmidt, P. (1984), "A test of the Tobit specification against an alternative suggested by Cragg", *The Review of Economics and Statistics*, Vol. 66, pp. 174-177.

Lockwood, H. (2004), *Scaling up Community Management of Rural Water Supply: Thematic Overview*, IRC International Water and Sanitation Centre, Delft.

Lockwood, H. and Smits, S. (2011), *Supporting Rural Water Supply: Moving towards a Service Delivery Approach –A MultiCountry Synthesis*, IRC International Water and Sanitation Centre, The Hague and Aguaconsult, Wivenhoe.

Lockwood, H., Bakalian, A. and Wakeman, W. (2003), *Assessing Sustainability in Rural Water Supply: The Role of Follow-Up Support to Communities*, Bank Netherlands Water Partnership, The Hague, pp. 1-48.

Macharia, E.W., Mbassana, M. and Oduor, M.J. (2015), "Assessing sustainability of rural water projects in Naivasha, Kenya, case study: Maraigushu water project", *European Journal of Business and Social Sciences*, Vol. 4 No. 07, pp. 52-83.

Madrigal, R., Alpízar, F. and Schlüter, A. (2011), "Determinants of performance of community-based drinking water organizations", *World Development*, Vol. 39 No. 9, pp. 1663-1675.

Mal, P., Anik, A.R., Bauer, S. and Schmitz, P.M. (2013), "Bt cotton adoption: a double-hurdle approach for north Indian farmers", *AgBioforum*, Vol. 15 No. 3, pp. 294-302.

Malik, A., Yasar, A., Tabinda, A.B. and Abubakar, M. (2012), "Water-borne diseases, cost of illness and willingness to pay for diseases interventions in rural communities of developing countries", *Iranian Journal of Public Health*, Vol. 41 No. 6, p. 39.

Manyena, S.B., Mutale, S.B. and Collins, A. (2008), "Sustainability of rural water supply and disaster resilience in Zimbabwe", *Water Policy*, Vol. 10 No. 6, pp. 563-575.

Marchenko, Y.V. and Genton, M.G. (2012), "A Heckman selection-t model", *Journal of the American Statistical Association*, Vol. 107 No. 497, pp. 304-317.

Marks, S.J. and Davis, J. (2012), "Does user participation lead to sense of ownership for rural water systems? Evidence from Kenya", *World Development*, Vol. 40 No. 8, pp. 1569-1576.

Marks, S.J., Onda, K. and Davis, J. (2013), "Does sense of ownership matter for rural water system sustainability? Evidence from Kenya", *Journal of Water, Sanitation and Hygiene for Development*, Vol. 3 No. 2, pp. 122-133.

Mezgebo, G.K. and Ewnetu, Z. (2015), "Households willingness to pay for improved water services in Urban areas: a case study from Nebelet town, Ethiopia", *Journal of Development and Agricultural Economics*, Vol. 7 No. 1, pp. 12-19.

Moriarty, P., Smits, S., Butterworth, J. and Franceys, R. (2013), "Trends in rural water supply: towards a service delivery approach", *Water Alternatives*, Vol. 6 No. 3, p. 329.

Pierce, J.L., Kostova, T. and Dirks, K.T. (2001), "Toward a theory of psychological ownership in organizations", *Academy of Management Review*, Vol. 26 No. 2, pp. 298-310.

Schouten, T. and Moriarty, P. (2003), *Community Water, Community Management. From System to Service in Rural Areas*, ITDG Publishing, London.

Wahid, N.A. and Hooi, C.K. (2014), "Factors determining household consumer's willingness to pay for water consumption in Malaysia", *Asian Social Science*, Vol. 11 No. 5, p. 26.

Waithaka, M.M., Thornton, P.K., Shepherd, K.D. and Ndiwa, N.N. (2007), "Factors affecting the use of fertilizers and manure by smallholders: the case of Vihiga, Western Kenya", *Nutrition Cycling in Agroecosystems*, Vol. 78 No. 3, pp. 211-224.

Wan, W. and Hu, W. (2012), "At-home seafood consumption in Kentucky: a double-hurdle model approach", in *Selected Paper for Presentation at the Southern Agricultural Economics Association Annual Meeting*, Birmingham.

Wang, H., Wang, T., Zhang, B., Li, F., Toure, B., Omosa, I.B., Chiramba, T., Abdel-Monem, M. and Pradhan, M. (2014), "Water and wastewater treatment in Africa–Current practices and challenges", *Clean - Soil, Air, Water*, Vol. 42 No. 8, pp. 1029-1035.

Whaley, L. and Cleaver, F. (2017), "Can "functionality" save the community management model of rural water supply?", *Water Resources and Rural Development*, Vol. 9, pp. 56-66.

Whittington, D., Davis, J., Prokopy, L., Komives, K., Thorsten, R., Lukacs, H., Bakalian, A. and Wakeman, W. (2009), "How well is the demand-driven, community management model for rural water supply systems doing? Evidence from Bolivia, Peru and Ghana", *Water Policy*, Vol. 11 No. 6, pp. 696-718.

WHO (2015), "Progress on sanitation and drinking water: 2015 update and MDG assessment", *UNICEF/WHO Joint Monitoring Programme for Water Supply and Sanitation*, New York and Geneva, available at: www.wssinfo. org/fileadmin/user_upload/resources/JMP-Update-report-2015_English.pdf (accessed 4 March 2018).

Wiredu, A.N., Zeller, M. and Diagne, A. (2015), "What determines adoption of fertilizers among rice-producing households in Northern Ghana?", *Quarterly Journal Of International Agriculture*, Vol. 54 No. 3, pp. 263-283.

Wongnaa, C.A., Adams, F., Bannor, R.K., Awunyo-Vitor, D., Mahama, I., Osei, B.A. and Ackon, A. (2019), "Job creation and improved consumer health through commercialisation of tiger nut yoghurt: a willingness to pay analysis", *Journal of Global Entrepreneurship Research*, Vol. 9 No. 1, p. 4.

WSSCC/WHO (2005), "Sanitation and hygiene promotion: programming guidance", available at: https://apps.who.int/iris/bitstream/handle/10665/43189/9241593032.pdf (accessed 15 February 2017).

WWAP (2017), *The United Nations World Water Development Report 2017*, Wastewater: The Untapped Resource, UNESCO, Paris.

Yacoob, M. (1990), "Community self-financing of water supply and sanitation: what are the promises and pitfalls?", *Health Policy and Planning*, Vol. 5 No. 4, pp. 358-366.

Yamane, T. (1973), *Statistics; an Introductory Analysis*, Harper and Row, New York.

Yirga, C. and Hassan, R.M. (2013), "Determinants of inorganic fertiliser use in the mixed crop-livestock farming systems of the central highlands of Ethiopia", *African Crop Science Journal*, Vol. 21 No. 1, pp. 669-682.

Appendix

Variable	Stage 1: probit Coefficient	SE	Stage 2: OLS regression Coefficient	SE
Income	−0.0000112	342.956	0.000538	26.62546
Sex	0.0885281	464837.3	0.6859069	6595.061
Age	0.0105209	19493.59	0.0732114	267.9169
Marital status	0.0942187	526805.2	0.7336651	
Education	0.0302035	60970.73	0.1710964	2202.758
The level of satisfaction	0.0419038	846486.3	0.0649923	8344.547
Uninterrupted water supply	0.0485633	796433.3	0.7199983	
Customer service	0.0146497	584574.6	1.059122	6864.325
Constant				
The number of observation	133		133	
Wald x^2 (8)	0.00		0.00	
Prob > χ^2	1.0000		1.0000	
Sigma	2687878.4			
Mills ratio (λ)	2,687,878	1.42e + 13		

Table A1. The Heckman selection model

Corresponding author
Emmanuel Kwame Nti can be contacted at: kwame.nti@yahoo.com