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Assessing willingness to pay for water during the COVID-19 crisis in Ugandan households

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ABSTRACT

With the emergence of COVID-19, improving hygiene through handwashing with water and detergent is a priority. This behavioural practice requires that households have access to reliable improved water. One measure that can provide an invaluable source of information to measure access to improved water supply is willingness to pay (WTP). However, little is known about WTP for water during a pandemic such as COVID-19. Data from a cross-sectional survey was used to assess potential household determinants of WTP for water during March-June 2020 in 1639 Ugandan households. The focus is on the period March-June 2020 when the government of Uganda implemented a countrywide total lockdown in a bid to curb the spread of the deadly virus. Results indicate that most households were not willing to pay for water during March-June 2020. Sex of the household head, region of residence, water source, number of times hands are washed and whether a household buys or pays for water were significant explanatory household determinants for WTP for water. The results provide a rich understanding of the household factors that determine WTP for water during a pandemic. This evidence is important in guiding government and water utilities in developing sustainable regulations and policy interventions particularly during emergencies. The findings suggest that increasing or maintaining water revenues will be a challenge in emergencies if no attention is placed to addressing the disparity in socio-economic attributes associated with households' WTP.

1. Introduction

With the emergence of COVID-19 in China in December 2019 (Chan et al., 2020; Sohrabi, Alsafi, O'Neill et al. 2020; Yeboah, Takyi, Amponsah et al. 2020), improving hygiene through handwashing with water and detergent was made a priority globally by the World Health Organization (WHO) (UNICEF and WHO, 2020). Provision of improved water and better hygiene is in line with Goal six of the Sustainable Development Goals (SDGs) (United Nations Statistical Commission, 2016). Access to improved water by all has been declared a basic human right (Meier, Kayser, Amjad et al. 2012). Handwashing requires that households have access to reliable improved water. In 2019, WHO estimated 785 million people worldwide to lack access to improved water for drinking (WHO, 2019a). However, increasing scarcity of water

amidst increasing population growth remains a challenge in most developing countries (Kidane et al., 2019). The challenge is more profound in sub-Saharan Africa (SSA) where about 300 million people do not have improved water for use (Burt, Njee, Mbatia et al. 2017; Meunier, Manning, Quéval et al. 2019).

Countries in SSA have the highest disease burden resulting from poor water and sanitation (WHO, 2019b). Water scarcity can be caused by climate change or variability, limited resources, limited number of skilled personnel, and corruption (Montgomery & Elimelech, 2007; Calow & MacDonald, 2012; Tapsuwan, Burton, Mankad et al. 2014; Expósito, 2019; Kidane et al., 2019). In most parts of sub-Saharan Africa, limited access to improved water is largely as a result of limited financing. Most rural dwellers consider access to clean water as a human right, and therefore they should have access to it regardless of their

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financial contribution (Abramson, Becker, Garb et al. 2011). However, this places a huge financial burden on the side of government in terms of providing reliable water to all citizens. Yet, better hygiene would be compromised among households who cannot afford to pay for water (Naiga et al., 2015).

Despite the importance of water in promoting better hygiene and mitigating the spread of the COVID-19 pandemic, households are at times compelled to restrict water utilisation so they can reduce the water bills (Brennan et al., 2007). Yet, not having access to enough water for household use can facilitate the spread of the viruses and bacteria such as malaria, trachoma, diarrhea (Budget Monitoring and Accountability Unit, 2016; Burton, Cobb, Donachie et al. 2011; Meunier, Manning, Quéval et al. 2019). Failure of communities to afford and pay for safe water is a latent health risk that can escalate the spread of the COVID-19 pandemic. To mitigate this risk, Governments worldwide have instructed utilities not to cut off water for non-paying customers causing increased debt age, delays in paying water bills and reduction in revenue (Switzer et al., 2020). Yet the water utilities have to remain sustainable and be able to continue to meet their increased personal and maintenance costs (Berglund, Thelemaque, Spearing et al. 2021). Whereas maintaining continuity of supply is important during the COVID-19 pandemic, collected revenues are insufficient to meet the costs for water treatment and operation and maintenance of the water systems. According to the American Water Works Association, water utilities lost \$16.5 billion due to implementation of Government COVID-19 mitigation interventions by water (American Water Works Association, 2020). Therefore, it is of paramount importance to understand the factors that influence willingness to pay (WTP) for water services under emergencies such as the COVID-19 pandemic.

One measure that can provide an invaluable source of information to measure access to improved water supply is willingness to pay (WTP) (Meunier, Manning, Quéval et al. 2019). This is because restriction to water use can result from non-willingness to pay for water (Brennan et al., 2007). WTP refers to what a person is willing to pay in exchange for an environmental good (Tylianakis & Skuras, 2016). When households timely meet the cost for the water they use, efficiency, equity and sustainability in water supply and utilisation is enhanced. This implies that water supply is largely dependent on economic factors such as willing to pay for water (Expósito, 2019). Failure to pay water bills has been noted to negatively affect service delivery in East Africa (Foster, Hope, Thomas et al. 2012). Other benefits that can result from willingness to pay for water are improvement of water reliability and generation of revenue to sustain or increase further supply (Kidane et al., 2019). Willingness to pay for water also improves water supply and infrastructure that leads to socio-economic development (Yami, 2016). Available evidence shows that areas with lack of access to improved water supply are at the same time having poor socio-economic indicators such as poor education, poverty, low income and respiratory diseases (Van Houtven, Pattanayak, Usmani et al. 2017). WTP for water can guide future water resources and use (Meunier, Manning, Quéval et al. 2019).

Few studies have examined WTP for water utilisation in developing countries (Khan et al., 2014; Wright, Muralidharan, Mayer et al. 2014). In Kenya, results from a household survey revealed that households are WTP for clean water products at lower prices (Blum et al., 2014). In Ethiopia, household income, education, family size, age of the respondent, water quality were reported to be associated with WTP (Bogale & Urgessa, 2012). In Tanzania, WTP for clean water was reported to be lower than standard retail prices (Burt, Njee, Mbatia et al. 2017). In Rwanda, it was reported that number of children, ownership of business, satisfaction with quality of water were determinants of WTP (Meunier, Manning, Quéval et al. 2019). Whereas these studies present evidence that households are willing to pay varying amounts for water services, little is known about factors that influence WTP under emergency situations such as COVID-19 pandemic in developing economies such as Uganda. Yet, evidence from such studies can help governments devise

policies to improve water supply. According to Meunier et al. (2019), there are three categories of variables that influence WTP for water: demographic, economic and water access. For example, better educated people are more willing to pay for improved water for household use than less educated people. Similarly, women are more likely to pay for improved water for household use than men, because women find themselves in a position that makes them more responsible for water collection than men (Meunier, Manning, Quéval et al. 2019). However, in Uganda, female headed households may be more likely to experience financial challenges than male headed households because most women are not engaged in formal employment (Mugabi & Kayaga, 2010).

Households with a higher number of household members are more willing to pay for water to meet the demand for water utilisation within the household than households with fewer household members (Wendimu & Bekele, 2011). Age of the household head has been highlighted to be a significant factor that influences WTP for water (Aslam, Liu, Mazher et al. 2018). An increase in age is associated with a decrease in the likelihood to pay for water because older people may not feel the urge to acquire a lot of water (Meunier, Manning, Quéval et al. 2019). The economic situation of a household has been reported to influence WTP for water (del Saz-Salazar, García-Rubio, González-Gómez et al. 2016; Expósito, 2019). Wealthier households are more likely to pay for water than poorer households because the former can afford (Van Houtven, Pattanayak, Usmani et al. 2017). Households with piped water inside in the household are also more willing to pay for water compared to their counterparts with water outside of the household. According to Meunier et al. (2019), WTP for water by households with piped water inside the household could be due to the time the household saves from moving a long distance to acquire water. According to Expósito (2019), people may be willing to pay for water to avoid disconnections, shortages or to maintain a reliable water supply in times of scarcity.

In Uganda, the national safe water coverage was estimated at 69% (rural areas) and 79% (urban areas) as of June 2019 (Ministry of Water and Environment, 2020), leaving about 8 million Ugandans without access to clean water (Water.org, 2020). About 20% of Ugandans and those earning less than UGX500,000 (USD 135) struggle to meet their monthly water bills (Budget Monitoring and Accountability Unit, 2016). The water bills covered by Ugandan water consumers are meant to cover operation, management, transport, administration, and stationery costs (Budget Monitoring and Accountability Unit, 2016). However, as part of the interventions to promote hygiene during COVID-19 outbreak, a presidential directive was given in March 2020 to the water utilities such as National Water and Sewerage Corporation and Umbrella Authorities of Water and Sanitation to refrain from carrying out any water disconnections on account of non-payment. This was aimed at providing water for all irrespective of affordability in order to promote better hygiene during COVID-19 outbreak.¹

This study set out to test two hypotheses using household data on water utilisation for the period March-June 2020, during when the country (Uganda) was under total lockdown. First, given the responsibility females in sub-Saharan Africa carry with themselves in households, we hypothesise that female headed households are more willing to pay for water for household use than male headed households. Second, households with piped water inside the household are more willing to pay for water than households that draw water for household use outside of the household. This is because having water inside the household can act as an incentive against having to walk long distances to get water. Therefore, this paper examines the household factors that determine WTP for water utilisation in Ugandan households during the COVID-19 crisis. To the best of our knowledge, this is the first

¹ NilePost. 2020. NWSC ordered not to disconnect water, provide enough water for isolation centre without billing. Available: <https://nilepost.co.ug/2020/04/01/nwsc-ordered-not-to-disconnect-water-provide-enough-water-for-isolation-centre-without-billing/>.

descriptive study to assess WTP for water utilisation in Uganda under emergency such as total lockdown (March-June 2020).

The main contribution of this study is to provide the household determinants of WTP for water utilisation under challenging situations such as during a pandemic. This study takes advantage of data collected during a total lockdown (March-June 2020) that was implemented in Uganda. Such information is important for government and water utilities to assess how to improve water infrastructure and financial viability during a pandemic (Meunier, Manning, Quéval et al. 2019). Information about willingness to pay for water can also help government to predict demand for and access to water (Van Houtven, Pattanayak, Usmani et al. 2017), and can also lead to better water conservation practices (del Saz-Salazar, García-Rubio, González-Gómez et al. 2016). Further, the results from this study can also guide government on how to improve sanitation, water allocation and water reliability based on financial constraints during a crisis (Expósito, 2019). In addition, understanding WTP is key to informing tariff structures, equity and affordability policies for sustainable water utility operation even during emergencies such as the COVID-19 pandemic. Finally, water institutions tend to focus more on the supply side without incorporating the demand side of the consumer. Yet, information about the demand side can provide insights into people’s ability to meet management and operations costs incurred by the water utilities (Wang et al., 2010; Arouna & Dabbert, 2012).

2. Data and methods

2.1. Source of data and sample size

The data used in this paper were obtained from a cross-sectional household survey in 40 small towns with piped water supply systems in four regions of Uganda: central (Kakooge, Kalagi, Katende, Kayunga, Kikyusa, Kyamulibwa, Kamuzinda, Matale, Sekanyonyi and Kiboga), western (Rwene, Rubuguri, Katagata, Kaihura, Kiyenje-Bwanga, Karuguza, Kakabara, Kabango, Buhimba, Kayinja and Isingiro), northern (Kamdini, Ciforo, Kitgum-Matidi, Laropi, Adwari, Agweng, Erusi, Amuru and Purongo) and eastern (Toroma, Gweri, Budaka, Bulambuli, Kibuku, Masafu, Nankoma, Namutumba, Namagera and Ocaapa). The study towns were randomly selected from a sampling frame of 259 towns with piped water services managed by six regional Umbrella Authorities as of July 2018. Fig. 1 shows the location of the study towns. The main objective of the study was to collect information about water utilisation in Ugandan households during the COVID-19 period. The survey collected information from 1,639 households.

2.2. The questionnaire

A quantitative measurement instrument was developed and administered to a cross-section of respondents randomly selected from within the study towns. To develop the questionnaire, a literature review was conducted to determine the relevant information related to water utilisation and response scale formats. The first draft of the questionnaire was pre-tested to assess the validity and reliability of the instrument. On the basis of pre-test results, the questionnaire was updated before it was deployed for main data collection. The questionnaire had a total of 75 items divided into eleven sections: The first section contains questions about household size and member demographics. The second section covers household water usage and sources of water. Sections three and four capture perceptions about COVID-19, water use and socio-economic impacts using a 5-point Likert-type scale with classifications from 1 (strongly disagree) to 5 (strongly agree). The other sections cover information about household income, livelihoods and expenditure (20 items), water bills, willingness and ability to pay (11 items).

Questionnaire administration commenced on Saturday, 1st August 2020 for some towns and ended on the 31st August 2020. Two methods of administration were adopted: Self-administration for respondents who were literate and claimed to understand the contents of the

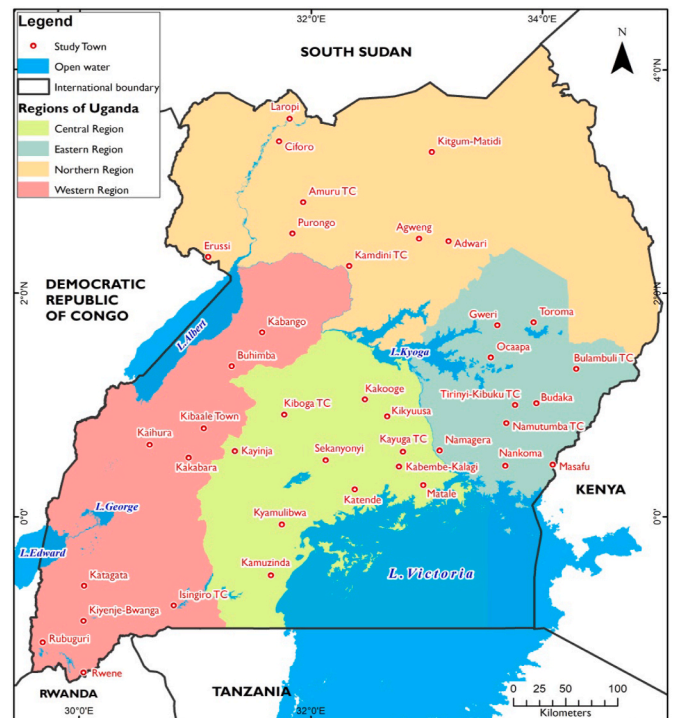


Fig. 1. Location of study towns.

questionnaire; and face-to-face administration by trained interviewers for respondents who needed to be guided through the contents of the questionnaire. The two methods used achieved a high response rate. A total of 1,639 useable questionnaires were delivered against a targeted sample of 1,500, giving a response rate of 100%.

2.3. Data collection and ethical clearance

Research assistants were trained to collect data using a paper questionnaire. Training of research assistants was carried out for two weeks prior to the start of the data collection exercise. Ethical clearance for the study was obtained from Makerere University Institutional Review Board. All participants had to consent to participate in the study.

2.4. Study sampling

This was a cross-sectional study design that used multi-stage cluster sampling technique. We employed a cross-sectional study design because it is cheap, easy to implement, quick, but most importantly, we wanted to capture measurements of a sample at a single point in time (Sedgwick, 2014). Stratified sampling was used to select sub-regions from each of the regions from the four main regions (Western, Northern, Central and Eastern) of Uganda. The Umbrella Authorities for water and sanitation were used to select the strata for all regions within the country. The study towns were sampled in such a way as to include at least one town from each sub-region. That is, Western (Kigezi, Ankole, Toro, Bunyoro); Central (North Buganda, South Buganda); Northern (Lango, Acholi, West Nile); Eastern (Busoga, Bugisu, Bukedi, Teso). Simple random sampling was then used to select households for interviews in study areas.

2.5. Measurement of variables

2.5.1. Dependent variable

Household heads were asked to state whether their households were willing to pay for water during the period of total lockdown (March-June 2020). Households were categorised into two groups: “Yes, willing

to pay for water” or “Not willing to pay for water”.

2.5.2. Independent variables

Ten-year age groups for the age of the household head were created: 18-27, 28-37, 38-47, and 48+. The survey collected information from both male and female headed households. Household heads were either currently married or not currently married. The ‘not currently married’ category comprised the widowed, separated, divorced and the never married or single. Households were categorised into two groups of household size: 1-4 or more than 5 household members. Education attainment was grouped into four categories: None, primary, secondary and tertiary or university. Household heads were asked to report on their main occupation. Responses were categorised into seven groups. For this study, household chores and all other employment was grouped together because of few cases. Other categories of main occupation were none, farming, salaried employment, self-employment, casual labour and student.

Households whose main source of water was wells, spring, stream or river were lumped together because of few cases. Other categories are piped water inside household, piped water outside household, harvested and borehole. Households were asked whether they pay for water to use in the household (Yes or No). Household heads were asked to state the average number of times they wash their hands; 2-6 or 7-15 times. Household heads were asked to report on whether the quantity of water used in the household for cooking, washing dishes or clothes, cleaning the house, flushing the toilet, bathing or washing hands between March and June 2020 increased, decreased or remain the same in relation to the quantity of water before March 2020. Households were grouped into nine categories of monthly income during the period March-June 2020: below USD 2.7, USD 2.7-USD 6.8, USD 6.8-USD 13.5, USD 13.5-USD 20.3, USD 20.3-USD 27.1, USD 27.1-USD 40.6, USD 40.6-USD 81.3, USD 81.3-USD 135.5 and more than USD 135.5.²

2.5.3. Data analysis

The STATA software version 15 was used to perform the analyses (StataCorp, 2017). The distribution of household characteristics was presented at the univariate level of analysis. A Pearson-chi-square test was calculated to test the association between selected household characteristics and WTP for water during the period March-June 2020. A binary logistic regression model (because the outcome variable is a binary variable: Willing to pay or Not willing to pay) was fitted to examine the correlates of WTP for water during the period when there was total lockdown (March-June 2020).

2.5.4. Limitation

There are two main limitations associated with this study. First, the responses recorded in the survey for analysis could be affected by the effect of COVID-19 or responses may not necessarily reflect the COVID-19 pandemic. Thus, readers are cautioned against over-interpreting the results. Second, while the study was carried out in the four major regions of the country (Uganda), the results may not be representative since we visited only small towns.

3. Results

3.1. Household characteristics

The results in Table 1 are for household characteristics. Most household heads were in the age group 28-37 years (34%) and males (80%). Households from the western region constituted the biggest proportion of the sample (29%). Most household heads were currently married at the time of the survey (75%), and majority had secondary education (46%). Table 1 shows that most households had 1-4

Table 1 Household characteristics.

Background characteristics	Frequency	Percentage
Age of household head		
18-27	316	19.3
28-37	561	34.2
38-47	379	23.1
48+	383	23.4
Sex of household head		
Male	1311	80.0
Female	328	20.0
Region of residence		
Central	442	27.0
Northern	353	21.5
Eastern	374	22.8
Western	470	28.7
Current marital status of household head		
Currently married	1229	75.0
Not currently married	410	25.0
Household size		
1-4	960	58.6
5+	679	41.4
Main occupation of household head		
None	35	2.1
Farming	774	47.2
Salaried employment	334	20.4
Self-employment	359	21.9
Casual labour	92	5.6
Student	17	1.0
Household chores/Others	28	1.7
Level of education of household head		
None	46	2.8
Primary	488	29.8
Secondary	762	46.5
Tertiary/University	343	20.9
Monthly household income since March 2020		
Below USD2.7	30	1.8
USD 2.7-USD 6.8	208	12.7
USD 6.8-USD 13.5	227	13.8
USD 13.5-USD 20.3	214	13.1
USD 20.3-USD 27.1	288	17.6
USD 27.1-USD 40.6	251	15.3
USD 40.6-USD 81.3	263	16.0
USD 81.3-USD 135.5	125	7.6
More than USD 135.5	33	2.0
Total	1639	100

household members (59%). Farming was the most reported main occupation of the household head in the households we visited (47%). Most households had a monthly income of between USD 20.3-USD 27.1 during the period March-June 2020.

Table 2 shows that most of the households visited had piped water inside the household (39%), and the majority would pay for water

Table 2 Water use in household.

Water use in household	Frequency	Percent
Main source of water		
Piped water in household	648	39.5
Piped water outside household	424	25.9
Harvested	56	3.4
Borehole	280	17.1
Wells/Springs/Stream/River	231	14.1
Quantity of water in household used has increased due to COVID-19 since March 2020		
Increased	699	42.7
Decreased	329	20.1
Same as before March 2020	611	37.3
Whether household buys/pays for water used		
Yes	1243	75.8
No	396	24.2
Number of times wash hands		
2-6	1141	69.6
7-15	498	30.4
Total	1639	100

² The exchange rate used is 1 USD= UGX 3690.5 as at 10th December 2020.

(76%). About 43% of households reported that their water consumption had increased since March 2020. Five out of every seven household heads reported that on average they wash their hands 2-6 times a day.

3.2. Associations between selected household characteristics and willingness to pay for water

The results shown in Table 3 indicate that majority of households (67%) were not willing to pay for water in the period March-June 2020, and only a third willing to pay. The results indicate a significant association between the sex of the household head, region of residence, a monthly household income and WTP for water. Table 3 shows that the majority of male headed households (69%), households from the eastern region (78%) and households whose monthly income in the period March-June 2020 was USD2.7-USD 6.8 were not willing to pay for water compared to their counterparts.

Table 4 shows a significant association between the source of water, whether household buys or pays for water, number of times hands are washed and WTP for water. As expected, majority of households whose source of water is a well, spring, stream or river (76%) were not willing to pay for water. Another unsurprising finding is that majority of households who were not buying the water were not willing to pay for water (79%). Finally, majority of household heads (71%) who were on

Table 3
Associations between selected household characteristics and willingness to pay for water.

Background characteristics	Willingness to pay		(χ^2) p-value
	Willing	Not willing	
Age of household head			1.474 (0.688)
18-27	31.3	68.7	
28-37	34.6	65.4	
38-47	33.8	66.2	
48+	31.6	68.4	
Sex of household head			10.365 (0.001)
Male	31.2	68.8	
Female	40.6	59.5	
Region of residence			67.053 (0.000)
Central	42.1	57.9	
Northern	22.7	77.3	
Eastern	22.2	77.8	
Western	41.1	58.9	
Current marital status of household head			0.086 (0.769)
Currently married	32.9	67.1	
Not currently married	33.7	66.3	
Household size			0.136 (0.712)
1-4	32.7	67.3	
5+	33.6	66.4	
Main occupation of household head			4.027 (0.673)
None	37.1	62.9	
Farming	31.1	68.9	
Salaried employment	33.8	66.2	
Self-employment	36.2	63.8	
Casual labour	32.6	67.4	
Student	41.2	58.8	
Household chores/Others	28.6	71.4	
Level of education of household head			3.647 (0.302)
None	41.3	58.7	
Primary	35.0	65.0	
Secondary	32.6	67.4	
Tertiary/University	30.1	69.9	
Monthly household income since March 2020			83.453 (0.000)
Below USD2.7	40.0	60.0	
USD 2.7-USD 6.8	17.3	82.7	
USD 6.8-USD 13.5	25.6	74.4	
USD 13.5-USD 20.3	31.8	68.2	
USD 20.3-USD 27.1	25.7	74.3	
USD 27.1-USD 40.6	45.0	55.0	
USD 40.6-USD 81.3	39.2	60.8	
USD 81.3-USD 135.5	54.4	45.6	
More than USD 135.5	30.3	69.7	
Total	33.1	66.9	

Table 4
Associations between household water use and willingness to pay for water.

Water use	Willingness to pay		χ^2 (p-value)
	Willing	Not willing	
Main source of water			57.340 (0.000)
Piped water in household	29.6	70.4	
Piped water outside household	47.4	52.6	
Harvested	35.7	64.3	
Borehole	26.1	73.9	
Wells/Springs/Stream/River	24.2	75.8	
Quantity of water in household used has increased due to COVID-19 since March 2020			1.591 (0.451)
Increased	34.8	65.2	
Decreased	31.6	68.4	
Same as before March 2020	31.9	68.1	
Whether household buys/pays for water used			36.052 (0.000)
Yes	37.0	63.0	
No	20.7	79.3	
Number of times wash hands			30.424 (0.000)
2-6	28.8	71.2	
7-15	42.8	57.2	
Total	33.1	66.9	

average washing their hands 2-6 times were not willing to pay for water.

3.3. Factors associated with willingness to pay for water in Ugandan households

Table 5 shows odds ratios of WTP for water in Ugandan households. Results show that the sex of the household head, region of residence, source of water, whether household buys or pays for water and number of times household head washes hands emerged significant factors that are associated with WTP for water. The likelihood of not willing to pay for water is lower among female headed households (OR = 0.672; CI = 0.486-0.928) than among male headed households. Households from the northern (OR = 2.468; CI = 1.708-3.566) or eastern (OR = 1.923; CI = 1.348-2.743) regions were more likely not to pay for water than households from the western region during March-June 2020. Households whose source of water for use is piped outside of the household (OR = 0.444; CI = 0.335-0.589) or harvested (OR = 0.517; CI = 0.274-0.976) were less likely not to pay for water than households whose source of water is piped water inside the household. Households who do not buy water were about two times (OR = 2.125; CI = 1.581-2.857) more likely than households who buy water not to pay for water. Household heads who wash their hands on average 7-15 times a day were less likely (OR = 0.686; CI = 0.542-0.869) not to pay for water than household heads who wash their hands 2-6 times a day.

4. Discussion

The aim of this study was to examine potential household determinants of WTP for water during a pandemic. The study also investigated how WTP for water varied during emergency situations. This study was driven by the desire to provide empirical evidence required to inform water utilities such as the National Water and Sewerage Corporation (NWSC) and Umbrella Authorities (UA) on the improvement of their preparedness and management of similar emergency situations. Moreover, having information about WTP is key in informing formulation of sustainable regulations and policy interventions aimed at maintaining access to water for the vulnerable populations during and post emergencies. The findings from such analyses can act as a benchmark for government and water utilities to make decisions on water allocation (Expósito, 2019), water conservation (del Saz-Salazar, García-Rubio, González-Gómez et al. 2016), demand for water (Van Houtven, Pattanayak, Usmani et al. 2017) and water infrastructure (Meunier, Manning, Quéval et al. 2019).

The study indicates that 67% of households were not willing to pay

Table 5
Odds ratios from a binary logistic regression model predicting willingness to pay for water in Ugandan households in the period March-June 2020.

Variable	Odds ratio	Confidence Interval
Age of the household head (RC = 18-27)		
28-37	0.993	0.707-1.393
38-47	0.980	0.671-1.431
48+	1.159	0.788-1.706
Sex of the household head (RC = Male)		
Female	0.672**	0.486-0.928
Region (RC = Western)		
Central	0.940	0.691-1.280
Northern	2.468****	1.708-3.566
Eastern	1.923****	1.348-2.743
Marital status of the household head (RC = Currently married)		
Not currently married	1.198	0.870-1.650
Household size (RC = 1-4)		
5+	0.903	0.703-1.159
Main occupation of household head (RC = None)		
Farming	1.319	0.623-2.794
Salaried employment	1.306	0.595-2.866
Self-employment	1.244	0.573-2.698
Casual labour	1.313	0.546-3.154
Student	0.650	0.181-2.330
Household chores/Others	0.989	0.314-3.111
Highest education level (RC = None)		
Primary	1.058	0.553-2.024
Secondary	1.215	0.637-2.317
Tertiary/University	1.378	0.693-2.739
Main source of water (RC = Piped water in household)		
Piped (outside)	0.444****	0.335-0.589
Harvested	0.517**	0.274-0.976
Borehole	0.814	0.574-1.153
Wells/Springs/Stream/River	1.001	0.684-1.465
Quantity of water in household used has increased due to COVID-19 since March 2020 (RC = Same as before March 2020)		
Decreased	1.184	0.862-1.627
Increased	0.857	0.658-1.116
Whether household buys/pays for water used (RC = Yes)		
No	2.125****	1.581-2.857
Number of times wash hands (RC = 2-6)		
7-15	0.686***	0.542-0.869
Monthly household income since March 2020 (RC = More than USD 135.5)		
Below USD2.7	0.513	0.172-1.534
USD 2.7-USD 6.8	2.064	0.864-4.932
USD 6.8-USD 13.5	1.142	0.493-2.643
USD 13.5-USD 20.3	0.909	0.394-2.099
USD 20.3-USD 27.1	1.367	0.599-3.120
USD 27.1-USD 40.6	0.684	0.299-1.565
USD 40.6-USD 81.3	0.923	0.405-2.102
USD 81.3-USD 135.5	0.566	0.237-1.347
Constant	1.230	0.336-4.496

Note: Base category is "Willing to pay"; RC = reference categories. **p < 0.05; ***p < 0.01; ****p < 0.001.

for water during total lockdown (March-June 2020) – in turn affecting the water utility revenue flows. The results in this study resonate with findings of International Benchmarking Network for Water and Sanitation Utilities (IBNET) who observed a 40% reduction in water utility revenues (World Bank, 2020). This is likely attributed to the negative economic impacts of the COVID-19 lockdown. We contend that not allowing people to leave their homes and shutting down several businesses led to a loss of income which in turn impacted WTP due to lack of resources. While this is likely to be the case, disconnections from water access during COVID-19 total lockdown were barred from happening as a result of the presidential directive. In light of this, governments should put in place subsidies to mitigate impacts of utility revenue deficits which could undo recent progress made even after the lockdown is lifted.

The results indicate that the sex of the household head, region of residence, water source, whether the household buys or pays for water and number of times hands are washed were significant explanatory determinants of WTP for water under emergencies. Our findings are

consistent with previous studies such as Chelangat et al. (2018) who found that socio-economic attributes such as gender and region of residence influenced a household's willingness to pay for water. However, these findings contradict those of Mezgebo & Ewnetu, 2015 who also found out that even when gender has a relationship with WTP, female were more likely to pay for water than males.

Our results confirm the hypotheses: female headed households are more willing to pay for water for household use than male headed households and households with piped water inside the household are more willing to pay for water than households that draw water for household use outside of the household. Female headed households would be more willing to pay for water than their male counterparts because of the household responsibility most women in SSA have of providing or collecting water for household use. Our results about gender being a significant explanatory determinant for WTP resonate with findings from a cross-sectional survey of 505 utility customers in eight urban centres in Uganda (Mugabi & Kayaga, 2010). While such a finding may imply that female household heads were more WTP for water under emergencies, it is also possible that the lower willingness to pay could have been linked to other factors that this study did not investigate.

Similarly, the likelihood for households with piped water inside the household to pay for water bills is higher than households who get their water for household use outside the household. Having water for domestic use inside the household may act as an incentive, which compels households to meet the cost of water (Meunier, Manning, Quéval et al. 2019). Further, households may be willing to pay for water if the demand for water for domestic use is high. The data shows that household heads who wash their hands 7-15 times a day are more willing to pay for water than their counterparts who wash less than 7 times a day. It is obvious that non-willingness to pay for water is associated with households who either harvest water for domestic use or those who do not buy. However, we note that the results of the study could be influenced by the government's decision not to carry out any water disconnections. It is possible that people's responses that speak to non-willingness to pay for water could have been influenced by information related to the presidential directive of not having anyone disconnected from accessing water.

The analysis in this study is essential in informing the impacts of COVID-19 as well as informing tariff structures, equity and affordability policies for sustainable water utility operation even during emergencies such as the COVID-19 pandemic. The findings reported in this study indicate that 67% of the households are not willing to pay for water during lock down. These results imply a ripple effect where water utilities are at a risk of losing approximately two-thirds of their revenue during times of a pandemic which could have implications for their financial sustainability.

From a policy perspective, our results suggest that development of moratoriums on shutoffs will be enhanced if additional attention is given to the associated socio-economic characteristics such as sex of the household head, income levels, and type of water connection. Therefore, in times of crisis, the government should intervene to ensure that all citizens are able to access improved water without compromising sustainability of the water utilities. However, the government interventions ought to use socio-economic attributes of the intervention area in developing location specific targeted guidance that aims to achieve water sustainability.

Analysis of literature points to suggestions that the water sector which is challenged with providing universal access to sanitation and hygiene services especially during infectious outbreaks, government subsidies might offer one of the means to financing safe sanitation especially to households from low income streams. A properly designed incentive model promoted by the government can overcome financial insufficiencies and ensure the sustainability of water access and usability. The government's instructions to water utilities on suspension of water disconnections due to non-payment of bills may not necessarily

benefit the vulnerable poor households since they do not have their own water meters (Mosello, 2017). The utilities also have to bear the burden of maintaining water supply amidst reduced revenue which may have implications on their financial sustainability. The study highlights the current state of WTP for water during a pandemic and provides an indication of hygiene and sanitation practices in Ugandan households. The results provide a rich understanding of the household factors that determine WTP for water during a pandemic and can guide government intervention during pandemics and other emergency situations on water allocation, infrastructure and sustainability. Further, results can also guide water regulatory process during pandemics and establishment of service levels and appropriate tariffs. This information can be useful for planning and devising cost effective ways of delivering services to customers especially in times of crisis.

The study results show that even in emergency situations, socio-economic characteristics are associated with WTP and this is in agreement with findings from literature (Meunier, Manning, Quéval et al. 2019). However, we note that the influence of these attributes varies in space. When governments are not in position to incorporate these attributes in policy formulation, there is a possibility of suppressing the performance of water utilities in terms of revenue generation which may create a vicious cycle. This kind of alternative approach which incorporates socio-economic attributes is a first step to making water utilities more sustainable particularly during emergencies.

The study findings reveal that emergency situations exacerbate social concerns of equitable access to water but we recommend that the responsibility to design and implement social measures should belong to governments. There is therefore need to design a sustainable tariff structure that engenders access to water for the poor households but at the same time ensures financial viability of utilities. The governments should develop an incentives framework to assist water-stressed households in times of pandemics. We recommend out-put based subsidies that do not mask the utilities' efficiency problems. Such a framework would benefit other public services such as electricity supply.

5. Conclusion

This study highlights the current state of WTP for water during public health emergencies – providing an indication of hygiene and sanitation practices during a pandemic. The findings suggest that more than half of households are not willing to pay for water during lockdown due to a pandemic. While non-payment of water bills during the COVID-19 pandemic may partly be due to the government's directive to suspend water cut-offs during the COVID-19 pandemic, we argue that this can have a negative effect on sustainability of water utilities. Moreover, the minority rich who may afford are likely to be hit the hardest since the majority poor do not have personal water meters. The findings from this study call for appropriate government interventions for improved water access during public health emergencies.

Consent for publication

Not Applicable.

Availability of data and materials

The datasets used in this study are available from the corresponding author on reasonable request.

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CRedit authorship contribution statement

Jotham Ivan Sempewo: Coordinated manuscript writing, Funding acquisition and reviewed the literature. **Peter Kisaakye:** Formal analysis, manuscript writing and conceptualization. **John Mushomi:** Conceptualization, Conducted literature review. **Martin Dahlin Tumutungire:** Coordinated data collection, Conceptualization, Manuscript writing. **Ronald Ekyalimpa:** Conducted literature review and Discussed the results, All authors read and approved the final manuscript.

Declaration of competing interest

The authors declare that they have no competing interests.

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