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Determinants of Household Willingness to Pay for Improved Water Supply: A Case Study of Baringo and Samburu Counties, Kenya

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Abstract:

Background: In Sub-Saharan Africa, the supply of affordable, accessible and safe drinking water particularly in rural areas lags behind global progress. Achieving the universal and equitable access objectives warrants an understanding of household behavior in relation to water services.

Purpose of the study: The aim of the study was to investigate the factors that influence willingness to pay for improved water service provision in a rural context in Kenya.

Methods: A total of 601 households in Baringo and Samburu Counties were randomly selected using probability proportional to size technique. The data was analyzed using descriptive statistics and logit regression.

Results: The empirical result shows that demographic characteristics of household, water source, quality and quantity, children responsible for fetching water, water access challenges and frequency of diarrhea are significant variables that explain willingness to pay.

Conclusion: The findings conclude with important policy recommendations; (i) demand-driven approaches in the design of water supply projects, (ii) enhanced water quality management, and (iii) awareness creation to achieve social and health benefits which can facilitate long-term access and sustainability.

Keywords: Improved water supply, willingness to pay, Baringo, Samburu, Kenya

1. Introduction

Over two billion people globally lack access to safe drinking water many of whom live in developing countries (Ritchie & Roser, 2019; UNICEF/WHO, 2019). Population growth, agricultural demands and rapid urbanization may further exacerbate water scarcity (Wada et al., 2016). Sub-Saharan Africa (SSA) has made phenomenal progress towards achieving universal supply of water and sanitation services with a quarter of the population gaining access to improved sources of drinking water since 2000 (UNICEF/WHO, 2019), though the region did not meet the Millennium Development Goals (MDGs) targets (Roche et al., 2017). Thus enhancing access to basic drinking water, sanitation and hygiene remains an immediate priority in the region.

According to the World Health Organization and United Nations Children's Fund (UNICEF) Joint Monitoring Programme, 66% of Kenyans (68% in urban areas and 63% in rural areas) had access to basic drinking water sources in 2019 (WHO/UNICEF Joint Water Supply and Sanitation Monitoring Programme, 2019). Even though there have been substantial improvements with regards to access to improved water sources, provision of safe and reliable water in rural communities remains relatively low. Inadequate financing of operation and maintenance, technical, institutional and social-economic factors are the main causes of failure of water supply projects in Kenya (Adams, 2012; Lockwood et al., 2011). These have led to several reforms in the water sector particularly the 2016 Water Act which provides a framework for development and management of water resources. Kenya's Constitution (2010), has provisions that stipulate the right of every citizen to adequate, clean and safe water including the consideration of minorities and marginalized groups in the design of water supply programs (GoK, 2010). Vision 2030 also highlights the need to improve access to water and sanitation for all by 2030 (Mwenzwa & Misati, 2014). It is therefore important to understand the social and economic factors that influence access to water geared towards achieving the goals outlined in the Kenya Vision 2030, the Sendai Framework for Disaster Risk Reduction (DRR) and the Sustainable Development Goal (SDGs) of universal and equitable access to improved drinking water and sanitation for all by 2030. In Kenya, the arid and semi-arid lands (ASALs) are most affected by water scarcity with decreasing water coverage in terms of quality, reliability and access to functional water sources (Afullo et al., 2014). The provision of clean water plays a key role in improving sanitation and hygiene particularly in preventing water-borne diseases. According to the Ministry of Health, Baringo and Samburu Counties were ranked 38 and 32 respectively, out of 47 on County sanitation in 2014 (Ministry of Health/Water and Sanitation Program, 2014).

Inadequate water supply systems affect the effectiveness of sewerage systems which results in water contamination and expose people to water-borne diseases. To improve the water supply situation, demand-side information is a prerequisite for the design of sustainable water projects including the implementation of cost recovery measures, infrastructure management services and the involvement of consumers in establishing the choice of appropriate water supply systems (Gulyani et al., 2005a). Therefore, this case study adds to literature (Gulyani et al., 2005a; Onjala et al., 2014; Rotich et al., 2018; Wagner et al., 2019) on drivers and barriers that influence household willingness to pay for improved water in a rural setting context. These results are important since they inform our understanding of user perception and can be used to predict the household's willingness to pay improved water supply systems.

2. Materials and Methods

The study utilizes a baseline data collected by Kenya Red Cross Society (KRCS) conducted in its sites for the strengthening disaster risk reduction and emergency response project in Baringo and Samburu Counties of Kenya. The baseline survey was administered in November and December 2019 through face-to-face interviews administered by trained research assistants. During the survey administration, informed verbal consent was obtained from the study participants following a detailed explanation of the study in local dialect before conducting the interviews. Participation was voluntary without any coercion or penalty for refusal to participate in the study. Probability-proportional-to-size sampling was used to randomly select the villages and households in each sub-county. In total, 65 villages and 601 households including 317 drawn from Baringo (North, South and Tiaty sub-counties) and 284 from Samburu (East and North sub-counties) were surveyed. A logit regression model was chosen because of the dichotomous nature of the dependent variable used to identify the factors that influence household's willingness to pay for water services. While the average marginal effects provide further analysis of the mechanism of the relationship estimated with regression. The dependent variable, willingness to pay for the water services was a binary response taking values of (0,1) that is household willing to pay or not for improved water supply. The response was regressed against household demographic characteristics, socio-economic factors and the water supply situation. Analyses were performed using STATA version 13 (Stata Corp, College Station, USA).

3. Results and Discussion

3.1. Socio-economic Profile of the Households

Summary statistics of selected variables for the surveyed households are presented in Table 1. Overall, majority of the household heads in the survey were male household heads (67%) and 33% were female household heads. Education levels were generally low with 49% having no formal education, while 30% had completed primary education and 7% having had post graduate qualification. The average age of the respondents was 36 years, with about 36% below 29 years, 32% between 30 and 39 years, while 4% accounted for those that were above 69 years of age. Regarding the main source of water, the results indicate that rivers, streams and rainwater are predominant (40%) sources of water in Baringo and Samburu counties, followed by communal boreholes and dams (15%), public taps (13%) while 11% fetched water from open public wells. Only a few households (5%) have access to 'in-house piped' water, implying that most of the water sources in the study area are not reliable or safe for consumption.

Variable	Frequency (N)	Percent (%)
Male headed households	403	67.05
Female headed households	198	32.95
Education level household head		
Illiterate	293	48.75
Primary	183	30.45
Secondary	82	13.64
Tertiary/University	43	7.15
Age		
Below 29 years	215	35.77
30-39 years	191	31.78
40-49 years	92	15.31
50-59 years	52	8.65
60-69 years	28	4.66
Above 70 years	23	3.83
Household water sources		
Rain/river/stream	251	41.76
Communal boreholes/dams	96	15.97
Public taps	73	12.15
Open public wells	54	8.99
Protected public wells and springs	74	12.31
Piped into dwelling	30	4.99
Neighbor's borehole	5	0.83
Pond/Lake	18	3.00

Table 1: Selected Household Characteristics
Source: Author's Computation, Study Data, 2019

With regards to the challenges experienced in accessing water, long distance to current water source (52%), competition with livestock and other wild animals (24%), costs (14%) and lack of availability of water (3%) were the main problem in accessing water. Other challenges experienced include; drying up of the water source especially during drought, poor water quality, long queues at the sources, and risks posed by snakes, crocodiles and other wild animals.

3.2. Factors That Influence Household Willingness to Pay for Improved Water Supply

Majority of the households in the study area had relatively low willingness to pay, 63% indicated that they would not be willing to pay for improved water services. This behavior consistent with previous studies (Ahuja et al., 2010; Ashraf et al., 2010; Dupas, 2014; Null et al., 2012) and in Kenya (Kremer, et al., 2009; Null, et al., 2012) have demonstrated a low willingness to pay for water treatment and quality. This has been attributed to households undervaluation of water services, behavioral preconceptions, limited resources and comprehension of water resource management (Ahuja et al., 2010; Foster & Hope, 2017; Olaerts et al., 2019).

The results from the binary logit model and the marginal effects are presented in Table 2. The results show that demographic (sex of the household head, household size), source of water, quantity of water used on a daily basis, children responsible for fetching water, water access challenges, need to improve water quality and frequency of diarrhea had a significant influence on the willingness to pay.

The coefficient of sex of household head was negative and significant at 1% level, implying that male household heads are less likely to pay for improved water services compared to their female counterparts. The marginal effect result shows that keeping other variables constant at their mean values, being male decreases the likelihood for households' willingness to pay for water service by 32%. This result lends credence to previous studies (Crow et al., 2012; Graham et al., 2016) that found that women carry the burden of water in most rural communities. Household size was found to have significant effect at the 1% level of significance with a negative parameter estimate which implies that willingness to pay for water services decreases as household size increases. This could be attributed to the higher demand for water by larger families and the availability of labour that can be used to fetch water from various sources. The marginal effects indicate that if family size increased by one person, it would result in a 5.8% decrease in the willingness of a household to pay for water services. Previous empirical studies have been reported in other studies (Islam et al., 2019; Rotich et al., 2018).

This study found that the primary water source substantially influenced households' willingness to pay for water services at the 1% level of significance. Households that reported that they had piped-water connection and those who accessed public taps were more likely to pay. The marginal effects show that households that use piped water supply connections and public tap water as their main source of drinking water are 66% and 45% more likely to pay for services as compared to those that use other sources such as borehole, lakes and rivers. A considerable proportion (12%) of the households in the study area indicated that they fetch water from the public taps hence they would be willing to pay to enhance accessibility. This may be because water from public taps maybe affordable as compared to private connections implying that affordability is an important determinant of whether people would pay for improved services. Furthermore informal water markets can improve public water supply thereby enhancing social welfare of poor households (Venkatachalam, 2015).

Water consumption also influenced willingness to pay at the 5% level of significance. The marginal effect of this variable reveals that a unit increase in water used by household on a daily basis increases the likelihood of payment for services by 0.1%. This is in line with previous studies, (Gulyani et al., 2005b; Meunier et al., 2019; Olajuyigbe & Fasakin, 2010), who observed a positive relationship between households' inclination to pay for improved water supply and per capita water consumption for domestic and productive uses.

Households where children were reported to be the primary collector of waters, were more likely to pay for water supply improvements by 58% than those households where adults had main responsibility for fetching water. This implies that concerns about children wellbeing and the potential benefit of free-up time for schooling, household chores, amongst other productive activities positively influenced the decision to pay. Our findings are congruent with previous studies (Tussupova et al., 2015).

The regression results also indicate that barriers to accessing water had a positive and significant influence at 1% level. The marginal effects show that households who experienced intermittent water supply and periods they were unable to access alternative water sources were more likely to pay for reliable water services by 34%. The result agrees with the findings of (Balana & Catacutan, 2012).

Furthermore, awareness of the importance of consuming clean water positively influenced willingness to pay. The marginal effects on water quality indicates that perception of poor water quality would increase likelihood of paying for quality water services by 20% as compared to those than those who regard the water as safe, *ceteris paribus*. Some of the measures undertaken by the household included boiling, use of chlorine, water filters amongst other purification practices. Several studies have shown a strong correlation between averting behavior, hygiene practices and willingness to pay for safe drinking water among rural communities (Brouwer et al., 2015; Nauges & Berg, 2009; Onjala et al., 2014b).

Similarly, the results also revealed a positive relationship between the diarrheal disease and willingness to pay. The marginal effects indicate that an increase in the frequency of diarrhea would increase the likelihood for households' willingness to pay to avert diarrhea. This finding suggests that households aware of the adverse health effects of contaminated water such as waterborne ailments such as diarrhea which would result in health expenditures on treatment of these diseases. Past studies have also found an association between water-related diseases and willingness to pay for improved water supply systems (Dhungana & Baral, 2017; Kremer, et al., 2012).

Education, income and time required to fetch water were some of the other variables which were expected to have a significant relationship with willingness to pay, though the study found that they did not influence households'

decision in Baringo and Samburu counties. It was expected that education would increase level of awareness and desire for improved services (Haq et al., 2007; Mezgebo & Ewnetu, 2015). However, our results could not establish a statistically significant relationship this insignificant finding is consistent with (Gulyani et al., 2005b).

Several studies have shown a correlation between the between income and payment for water services, wealthier households are more likely to pay for connection to piped water supply and other social services while poorer households rely on alternative sources such as boreholes, dams, rivers, streams and rain water (Kanyoka et al., 2008; Makwinja et al., 2019; Rotich et al., 2018). Other studies have also found an insignificant relationships associated with underreporting of actual household income (Rahman et al., 2017).

With regards to time, as an indicator of the distance households have to travel to fetch water could limit water access and consumption. According to the WHO and UNICEF, access to improved drinking water is determined by access to a source that is less than one kilometer from dwelling and requires a total fetching time of 30 minutes or less (Gulyani et al., 2005b; Nygren et al., 2016; Unicef, 2017).

Independent Variables	Logit Model			Average Marginal Effects		
	Coef.	Std.Err	P> z	Coef.	Std. Err	P> z
Sex of the household head (Female=0: Male=1)	-2.453	0.953	0.010	-0.319	0.111	0.004
Age	0.033	0.031	0.293	0.004	0.004	0.286
Household size	-0.443	0.178	0.013	-0.058	0.021	0.005
Education level household head						
Illiterate (<i>Reference</i>)						
Primary	0.434	0.802	0.589	0.056	0.102	0.586
Secondary	0.413	1.448	0.776	0.053	0.189	0.779
Tertiary/University	1.332	1.804	0.460	0.177	0.237	0.455
Marital status						
Married (<i>Reference</i>)						
Single	0.325	1.173	0.781	0.042	0.156	0.786
Widowed/separated	-1.712	1.675	0.307	-0.181	0.133	0.175
Average household monthly income						
<3,000 (<i>Reference</i>)						
KES 3,001-5,000	0.084	0.727	0.908	0.011	0.100	0.908
KES 5,001-10,001	-1.253	1.367	0.359	-0.156	0.154	0.309
KES 10,001-20,000	-1.479	1.470	0.314	-0.180	0.154	0.243
Main source of water for domestic use						
Open public well	2.270	1.581	0.151	0.311	0.208	0.136
Piped into dwelling	5.248	2.129	0.014	0.663	0.165	0.000
Pond or Lake	0.081	2.115	0.969	0.009	0.236	0.970
Protected public well/spring	1.643	1.191	0.168	0.218	0.149	0.144
Public tap	3.270	1.352	0.016	0.452	0.160	0.005
Rain, River or stream	0.278	1.168	0.812	0.032	0.131	0.809
Time to fetch water						
Less than 30 minutes (<i>Reference</i>)						
31-60 minutes	-1.217	1.057	0.250	-0.157	0.133	0.237
Over 1 hour	-0.600	0.984	0.542	-0.081	0.131	0.538
Quantity of water used per day (litres)	0.009	0.005	0.069	0.001	0.001	0.055
Children fetch water	4.426	1.660	0.008	0.576	0.191	0.002
Periods unable to access water	2.637	1.074	0.014	0.343	0.126	0.006
Main source water functional	-2.170	1.625	0.182	-0.283	0.205	0.168
Livestock keeping	-0.020	0.894	0.982	-0.003	0.116	0.982
Measures to improve water safety	1.500	0.696	0.031	0.195	0.083	0.019
Frequency diarrhea occurrence						
Every month (<i>Reference</i>)						
Every week	3.258	1.798	0.070	0.371	0.171	0.030
Within two weeks	2.666	1.569	0.089	0.285	0.115	0.014
Less often than monthly	2.512	1.603	0.117	0.264	0.125	0.036
Constant	-2.377	3.277	0.468			
Pseudo R2 = 0.38.65; LR chi2 (28) = 53.13; Prob>Chi2 = 0.003; Log likelihood = -42.1585						

Table 2: Logit Regression Results of Factors Influencing Willingness to Pay for Water Services

Source: Author's Computation, Study Data, 2019

4. Conclusion and Recommendations

Water scarcity is more pronounced in ASALs due to climate change and variability which has led to an increase in drought frequency and intensity. Accordingly, improving access to safe and affordable water for affected communities will enhance resilience of rural communities to climate variability. The results of the study indicate that despite the reliance on unreliable water supply sources, most of the households are still unwilling to pay for water supply services. An important policy implication of these results is the need to consider centralized water improvements strategies as they may be more feasible as compared to individual connections, cost-sharing and retail interventions. Therefore, establishment of safe shared/communal drinking water sources may increase the rate of returns and sustainability of water supply projects. The case study further showed that demographic characteristics, prevailing water situation such as source, quality and quantity, children's role of fetching water, water access challenges and incidences of diarrhea affected willingness to pay, which suggests that water resources management in ASALs must aim at balancing demand and climate-induced water stress. The study recommends that stakeholders and policy makers in Baringo and Samburu Counties should consider these traits in designing demand driven water supply projects. Additionally, emphasis on awareness building activities regarding water quality and the associated health benefits can generate demand for more efficient and sustainable improved water supply which would result in enhanced long-term outcomes in the future.

5. Conflict of Interest

The authors declare that they have no competing interests.

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