ESJ Social Sciences

Household Heads Characteristics and Access to Water in Kenya

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Doi:10.19044/esj.2022.v18n15p127

Submitted: 06 April 2022
Accepted: 16 May 2022
Published: 31 May 2022

Cite As:
Omondi B.A. & Jackson M.I. (2022). *Household Heads Characteristics and Access to Water in Kenya*. European Scientific Journal, ESJ, 18 (15), 127. https://doi.org/10.19044/esj.2022.v18n15p127

Abstract

Kenya has taken numerous steps in ensuring universal access to water among all households by 2030. However, the country may not achieve this by 2030 due to challenges related to the implementation of objectives including inadequate data on the indicators to allow for better policy formulation. The study aimed at finding out the effect of household head characteristics on access to water. The study employed multinomial logistic regression modeling using 2015/2016 Kenya Integrated Household Budget Survey data. Arising from the study findings, an increase in the income of the household head led to an increase in the household's access to clean water. Education levels (primary, secondary, and tertiary) of household heads compared to no education increased the probability of household heads selecting clean water sources. Being employed as well as being male increased the probability of accessing clean water. Further, residing in a rural area by a household head reduced the probability of using clean water compared to residing in an urban area. Based on the findings, the study suggests that there is a need to develop a policy around the key and significant household head characteristics to improve access to clean water in Kenya.

Keywords: Household Head characteristics, clean water, multinomial logistic regression, Kenya

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Introduction

Water forms the traditional list of basic human needs. It is directly related to people's well-being as well as prosperity. As such, it is part of the global 17 sustainable development goals (SDGs) developed by the UN member states in 2015 as a basis for poverty eradication, fair, healthier, and prosperous generations. SDG 6 is related to access to clean water. In addition, water also forms the basis for the African Union's priority aspiration of a prosperous Africa (African Union Commission, 2015). Access to clean water at an affordable rate is, therefore, important and should be a right of everyone given their necessity and the global aspirations as espoused in the SDGs and regional aspirations as espoused by the African Union Commission (AUC). According to Abubakar (2019), most of Africa's challenges and opportunities fall around among others water scarcity. Abdu, et al., (2016) assert that access to cleaner water leads to agricultural development, improved health, and improved education among other things. Agricultural development in turn leads to food security and employment opportunities among others. Improved health means reduced mortality rates, reduced disease burden, and better brain development among others while improved education in turn means better societal development (Orayo, 2020).

The study is anchored on both the utility maximization theory developed by Alfred Marshall in 1890 as well as the random utility theory developed by McFadden in 1974. The former theory is based on how a rational individual would make consumption decisions**.** The theory looks at how individuals spend their income on a set of goods or services based on their preferences and budget constraints. The theory assumes *maximization of utility* and individuals will always make purchase decisions that give them the greatest benefit. The theory concludes that individual consumers will always go for the combination of goods and services that maximizes their satisfaction given their income as well as the prices of the goods and services.

The latter theory which is the random utility theory is based on the maximization of utility and states that individual choice is based on the alternative with the highest utility. The utility derived from an alternative depends on the attributes of the alternative and the observed and unobserved attributes of the individual making the decision. The theory assumes that people are *excessively rational* and have an irrational passion for dispassionate rationality. The theory concludes that individuals would choose alternatives if the utility derived from them is greater than that derived from any other alternatives. Further, an individual would go for other alternatives if the utility derived from these alternatives are less or equal to the utility derived from other alternatives. The random utility theory informs the current study as the household head is treated as a rational decision-making unit and the household head can go for water sources that maximize their utility. The household

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

head's ability and the economic environment also contribute to the household head's choices on clean water. The household's ability in our case was based on household head characteristics like age, education level, sex, employment status, area of residence, and the household characteristics like household size. In Kenya, access to a safe, adequate, and reliable water supply is one of the central socio-economic development indicators (Government of Kenya, 2017). It is a fundamental right that every citizen should enjoy without any limitation. Lack of access to improved drinking water and time-intensive pursuit of water collection often prevents women from taking up income-generating activities and girls from going to school (Mwihaki, 2018). Access to clean water will therefore turn this round as it fosters faster economic growth in the country. In addition, safe water for domestic use also means a reduction in water-related diseases like diarrhea and therefore a healthier nation. Owing to the importance of water, the African Union's goal is that all households should have access to adequate clean water and sanitation facilities by 2025. All rural homes should meet the standards for habitation as contained in the African Union housing policy by 2040 (Africa Union Commission, 2014).

According to the Development Initiative report (2018), Kenya is faced with several constraints to the provision of 100 percent universal access to safe water and sanitation by 2030. The constraints include a resource gap of around KES 1.2 trillion, over-reliance on donor contributions, high poverty incidence, fragmented policy frameworks, inadequate data for planning and budgeting, water pollution, and increasing population growth characterized by increased demand for water as well as climate change. The country also records significant inequalities in water access from an improved source that needs to be addressed so that all counties are at par. For instance, water access from an improved source increased between 2009 and 2015/2016 at the national level but rural areas are still left behind. At the national level, an increase from 56.1 percent in 2009 to 72.6 percent in 2015/16 was recorded. According to the report, 86.7 percent of urban households have access compared to 61.8 percent of rural households. However, 50 percent of households do not have access to water from an improved source between 2009 and 2015/2016 from over 10 rural counties exposing them to water-borne diseases among other challenges. There is however a significant inequality in access to water from an improved source. For instance, Taita Taveta, Embu, and Kisumu are doing well at over 80 percent while less than 30 percent have access in West Pokot, Wajir, and Marsabit among other counties in Kenya.

Household heads are an integral part of economic development since they are crucial decision-making units in society on access to clean water. The author explains the role of household heads concerning access to clean water. Understanding how household head attributes affect the access to clean water

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

is key in policy formulation for promotion, on of these crucial aspects of development. In addition, the significance of household heads access to clean water is underscored as an alternative or complement to government provision. This is more so important considering the handicaps faced by the government in the provision of clean water. Decision making by household heads and local authorities about basic infrastructure provision is seen as a contributing factor to the amount of time associated with these domestic labor tasks. Liao, Chen, Tang and Wu (2019) acknowledges that household head is the decision-maker of household affairs and as such there exists a relationship between their characteristics and the access to clean water or choice of energy in the household.

Kenya has taken numerous steps in ensuring that all households have universal access to water by 2030. However, the country may not achieve this goal by 2030 due to the challenges related to the implementation of the objectives including inadequate data on the indicators to allow for better policy formulation (Koolwal & Van de Walle, 2013). This therefore calls for alternative channels of achieving universal access to clean water in Kenya by 2030. This study is an effort towards this strand of thinking since it seeks to establish how the household through the household head can contribute to access to clean water. Specifically, the study explores which household head characteristics should be promoted to improve access to clean water. Previous studies on household heads characteristics and attainment of access to clean water focused on the households' demand for housing in Kenya (Kithinji, 2015), the socioeconomic determinants of households' access to safe drinking water as well as factors influencing urban-rural inequality in access to safe drinking water in Nigeria by Abdu, et al., (2016) and the roles and attitudes of urbanites towards urban water insecurity by Asibey, Dosu and Yeboah (2019) in New Juaben Municipality, Ghana. None of these studies established how household head characteristics influence access to clean water in Kenya. The study sought to answer the following question: what is the effect of household head characteristic on access to clean water sources?

Methods

To achieve the study objective, secondary data was obtained from the 2015/2016 Kenya Integrated Household Budget Survey (KNBS, 2015). Being the household budget survey, this set of cross-sectional data in Kenya was collected over twelve months and disaggregated data by county and at a national level. The survey collected data on a range of socio-economic indicators including household characteristics, housing conditions, education, and general health characteristics among others, and presented the findings at national, county, rural, and urban levels. In the identification and selection of study variables, the survey question asked the respondents to identify their

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main water source out of eight mutually exclusive alternatives that were further categorized into 4 mutually exclusive water sources.

Horowitz et al., (2014) highlight that the random utility model aims at modeling the choices of rational consumers among sets of n alternatives. The choice alternatives are labeled $1, \dots, n$. The model assumes that a consumer's preference among the alternatives can be described by a utility function from a vector $U_1, U_2, \dots U_n$ that is associated with the n possible alternatives. The random utility for the item i is therefore given by U_i. The theory stems from the maximization of utility and stastatesat the individual choice is based on the alternative with the highest utility. The utility derived from an alternative depends on the attributes of the alternative as well as both the observed and unobserved attributes of the individual making the decision.

Precisely, it U_1 is the utility for choosing an alternative1, U_2 for choosing 2 and U_n for choosing alternative n, then an individual's choice y over n alternatives will be given by;

$y_i = \{1\ if\ U_1 > U_n\ 0\ if\ U_1 \leq U_n$ ………………………………………………..1

Equation 1 implies that individuals would choose alternative 1 if the utility derived from this choice is greater than that derived from all other alternatives and will go for other alternatives if utility derived from these alternatives are less or equal to utility derived from other alternatives. The n possible outcomes of choice y will therefore be given by;

$y = 1,2, \dots, n$……………………………………...……………………………2

Borrowing from the concept of Horowitz et al.,(2014), the random utility function will be given by;

$U_1 = W'\beta_1 + Z_1'\alpha_1 + \varepsilon_1\ U_n = W'\beta_n + Z_n'\alpha_n + \varepsilon_n$ ………………………3

Where W' is a vector of characteristics of the individual consumer while $Z'$is a vector of the attributes of the choices the individual has to make. The random utility model gives the probability with which each alternative will be chosen so that;

$0 \leq P\{y = i\} \leq 1$ and $\sum_{i=1}^{n} \quad P\{y = i\} = 1$…………...………………..…4

The marginal effects shall be derived using the values of the estimated coefficients which are the odds ratio. The odds ratio will be given by;

$log\ log \left(\frac{p_{ij}}{p_{ik}}\right) = X_i'\left(\beta_j - \beta_k\right) = X_i'\beta_j$ if $k = 0$………….................................5

The probability that respondent selects alternative i can be assumed to be described by multinomial logit model so that;

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$$P\{y=i\}=\frac{exp\{X_i'\beta\}}{1+exp\{X_2'\beta\}+\cdots+exp\{X_n'\beta\}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

In developing empirical model, a theoretical framework was extended with the help of empirical literature to achieve the study objective. Based on the reviewed empirical literature, the economic environment as defined by the prices and consumer's income are extended when the specific consumer is considered. In our case, the consumer is the household head and therefore, the economic environments are his attributes such as sex, age, education level, and employment status according to the empirical literature. The characteristics of the household headed by this consumer include the household size and the residence of the household (that is urban, rural, or peri-urban).

Since the commodities considered are three, the addition of the attributes of the choices the individual has to make to the characteristics of the household head and the household itself yields three different extensions. The determinants of the choice the household head makes on the water source for domestic include the household head characteristics, household characteristics, and the frequency of fetching water by the household.
Therefore, equation 5 becomes;

$$log\ log\left(\frac{p_{ij}}{p_{ik}}\right)=\beta_0+\beta_1 income\ levels+\beta_2\ Age+\beta_3 Education+\beta_4 Sex+\beta_5 Employeemnet\ status+\beta_6 Household\ size+\beta_7 Area\ of\ residence+\beta_8 Frequecy\ of\ fetching\ water+\varepsilon_i \ldots\ldots\ldots\ldots 7$$

Where: ε_i Is the error term
Here the four possible mutually exclusive outcomes of choice on water source y_i are given by;

$$y_i=\{1\ if\ Surface\ water\ 2\ if\ spring\ water\ 3\ if\ borehole\ water\ 4\ if\ piped\ water$$

In operationalization definition, the KIHBS 2015/2016 defined surface water as water from rivers, stream, pond dam, among others, whereas spring water was defined by protected and unprotected spring water as well as rainwater collection, borehole water, as defined by borehole and both protected and unprotected dug well water and finally piped water was defined by piped water into dwelling, into the plot and public tap. The model as shown in equation 7 was estimated via the maximum likelihood estimation (MLE) technique. According to Orayo (2014), MLE has higher efficiency and produces better numerical stability. The study employed MLE to get more robust parameter estimates for household characteristics and access to clean

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

water. As informed by the empirical literature, several variables influence access to clean water. The variables used are summarized in table 1.

Table 1: Variables, definitions, and measurements

Category	Variables	Description	Measurement
Household head characteristics	Sex	The sex of household head	Dummy variable = {1 if a male 0 otherwise
	Age	The number of years of a household head	Positive integers
	Education level	The level of education of the household head	Categorical variable= {1 if primary, 2 if Secondary, and 3 if tertiary}
	Area of residence	The place/area the specific household resides	Dummy variable= {1 if rural,0 otherwise}
	Employment status	The employment status of the household head	Dummy variable = {1 if employed 0 otherwise}
	Income levels	Proxied by the type of dwelling the household live in	Dummy variable = {1 if permanent, 0 otherwise}
Household Characteristics	Household size	The total number of household members living in each household	Continuous variable measured as members living in the household
Attribute specific to water	Frequency of fetching water	The number of times the household went to fetch water	Count variable (positive integers)
Attribute specific to housing	House rent	Amount of rent paid for the house	Continuous variable measured in KES

Source: KIHBS 2015/2016 and Own conceptualization

To achieve the objective, STATA version 14.0 software was used whereas data was analyzed using multinomial logit regression model. This is because the dependent variable had multiple responses. The study determined the log odds of the independent variables as well as the marginal effects of the same variables. Following Orayo (2020), the resulting coefficients were not interpreted but the marginal effects were interpreted.

Results

Table 2 presents the mean values of the dependent variables. The mean, was employed to explain the nature of the distribution of data for the various variables.

Table 2: Descriptive statistics of dependent variables

Dependent Variable		No of observations	Unit of measure (Dummy that sets to:)	Frequency (%)
Water Source	Surface water	20,698	1 if Surface water	23
	Spring water		2 if Spring water	15
	Borehole		3 if Borehole water	26
	Piped		4 if Piped water	36

Source: Own calculation

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The summary statistics presented in Table 2 shows the frequency for the various factor variables used as dependent variables. According to Table 4.1, 36 percent of the household heads were using piped water, 26 percent used borehole water, and 23 percent used surface water while 15 percent used spring water. Since piped water is considered the cleanest, majority of household heads were using clean water. This tallies with the national assertion that about 50% people in Kenya have access to clean water (Government of Kenya, 2017).

Table 3: Descriptive statistics of independent variables

Independent Variable		**Observations**	**Unit of Measurement**	**Mean/ Frequency (%)**	**Standard deviation**	**Minimum**	**Maximum**
Age		21146	Years	43.6	14.7	18	80
Education	No education	17165	1 if No education 2 if Primary 3 if Secondary 4 if Tertiary	0.4			
	Primary			54.4			
	Secondary			30.1			
	Tertiary			15.1			
Sex (Male=1)		21773		66			
Employment Status		21756		36			
Household size		21773		4.3	2.5	1	28
Residence (Rural=1)		21773		60			
Water Frequency		19863	Per Month	2.2	1.6	0	40
Rent		13939	Per Month	2,605.50	5,571.90	300	150,000

Source: Own calculations

The summary statistics presented in Table 3 shows the mean and frequencies for the various variables used as independent variables. On the other hand, the mean for water frequency and rent are interpreted as the average monthly unit of measure for the various variables while mean for age and household size is the average age for household head and average household size respectively.

From summary statistics, the average age of household head is 44 years old while the minimum age is 18 years and maximum age is 80 years. This means that the surveyed population was still within the productive years and can head a household. The results show that, 54.4 percent of the household heads attended up to primary level of education, 30.1 percent up to secondary level of education while 15.1 percent attended up to tertiary level of education. 0.4 percent of the household heads had no education. This implied that majority of household heads in Kenya have basic literacy skills of reading and writing.

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The results in Table 3 indicated that 66 percent of the household heads were male. This implied that Kenya is still a patriarchal country. The study observed that 36 percent of the respondents were employed. This means that majority of the household heads are either out of the labor force or are unemployed. Also, the results, illustrate that the average household size is four persons. The household with smallest number of persons had one person while maximum had 28 persons. This implied that majority of households in Kenya have declined relative to the sizes in the 1960's (United Nations, 2017).

Table 3 further shows that 60 percent of the household heads reside in the rural areas. This implied that majority of households are rural dwellers while on average 40 percent reside in the urban. This was expected as rural area is vast compared to urban areas in Kenya (Government of Kenya, 2017). In addition, the findings indicate that on average a typical household will fetch water twice a month. However, there are other households who would fetch water as high as 40 times a month, while others as low as once in a month. This underscores that there is inequity in access to clean water in Kenya. The results show that on average, a household head will pay a monthly rent of Kshs. 2,605.50. The household head who incurs the minimum rent would pay Kshs. 300 per month, while the one incurring the highest expense pays Kshs. 150,000 per month. This implies that the choices of housing in Kenya are markedly varied.

Table 4: The effect of household head characteristics on access to clean water

		Coefficients		
Variable	**Surface Water**	**Spring water**	**Borehole water**	**Piped water**
Income levels		-0.226*** (0.059)	0.130** (0.052)	1.010*** (0.053)
Age		0.018 (0.013)	0.011 (0.012)	0.011 (0.012)
Age squared		-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Primary education		0.839* (0.440)	-0.028 (0.313)	0.494 (0.387)
Secondary education	Base Outcome	1.158*** (0.442)	0.318 (0.316)	0.972** (0.389)
Tertiary education		1.585*** (0.450)	0.658** (0.325)	1.149*** (0.396)
Sex (Male=1)		-0.061 (0.060)	0.065 (0.055)	0.124** (0.056)
Employment status (Employed=1)		0.187*** (0.059)	0.187*** (0.053)	0.397*** (0.054)
Household Size		-0.038*** (0.012)	-0.033*** (0.011)	-0.167*** (0.012)

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Residence (Rural=1)	-0.052 (0.065)	-0.471*** (0.056)	-1.249*** (0.055)
Water frequency	-0.006 (0.019)	-0.030* (0.017)	0.096*** (0.016)
Constant	-1.535*** (0.514)	0.254 (0.394)	-0.003 (0.454)
Post Estimation diagnostics			
Number of observations	14,370		
LR Chi2 (36)	3157.26***		
log likelihood	-17972.003		
Pseudo R^2	0.0807		
Prob $>chi^2$ =		0.0000	
Independent of Irrelevant Assumption (Statistic) $chi^2(21) = (b - B)'[(V_b - V_B)^{-1}](b - B)$ (V_b-V_B is not positive definite)	93.10		
Key			
Standard errors in parentheses Where *** p<0.01, ** p<0.05, * p<0.1			

Source: Own calculations

Table 4 shows that the model had a likelihood ratio test with a Chi square test statistic of 3157.26 with 36 degrees of freedom and a corresponding P-value of 0.000. This means that the calculated Chi square statistic is greater than the tabulated at one percent level of significance. Therefore, at one percent level of significance the coefficients of the respective variables are jointly significant in explaining variations in the choice of water source by household heads. The Pseudo R square is 0.0807 implying that the variables jointly explain 8.07 percent of the variations in household head choice of water source. According to Hoffman and Duncan (1988) this coefficient of determination is adequate for a multinomial choice variable. Therefore, the findings in table 4 can be used to estimate the marginal effects (ME) of the respective variables as shown in table 5. For diagnostic test, the chi square under Hausman test for independence of irrelevant alternatives was 93.10 which mean that the estimated multinomial logit model met the asymptotic assumptions of the test as chi-square was greater than zero and is valid under the Independence of Irrelevant Alternatives (IIA) assumption (Fry & Harris,1998). Therefore, the characteristics of surface water choice alternative by household head do not impact relative probabilities of choosing borehole water, spring water or piped water.

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Table 5: The effect of household head characteristics on access to clean water marginal effects

Variable	Surface Water	Spring water	Borehole water	Piped water
Income levels	-.0574***	-.0879***	-.0488***	.1941***
	(0.0072)	(0.0067)	(0.0080)	(0.0079)
Age	-.0021	0.0015	.0003	.0003
	(0.0016)	(0.0015)	(0.0017)	(0.0017)
Age Squared	.00002	0.7759	-0.3772	-.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	-.0631	.0803**	-.0792	.0620
	(-0.0563)	(0.0346)	(0.0606)	(0.0554)
Secondary	-.1251**	.0857**	-.0675	.1069*
	(0.0565)	(0.0350)	(0.0609)	(0.0557)
Tertiary	-.1664**	.1204**	-.0409	.0869
	(0.0571)	(0.0363)	(-0.0617)	(0.563)
Sex (Male)	-.0079	-.0178 **	.0057	.0199**
	(0.0076)	(-0.0073)	(0.0083)	(0.0079)
Employment Status(employed)	-.0415***	-.0014	-.0060	0490***
	(-0.0072)	(0.0069)	(-0.0079)	(0.0077)
Household size	.0130***	.0039**	.0090***	-.0258***
	(0.0015)	(0.0014)	(0.0017)	(-0.0017)
Residence (Rural)	.1047***	.0784***	.0208**	-.2039***
	(0.0073)	(0.0068)	(0.0082)	(0.0083)
Water frequency	-.0031	-.0037*	-.0133***	.0201***
	(0.0023)	(0.0022)	(0.0027)	(0.0023)

Key
Standard errors in parentheses
Where *** p<0.01, ** p<0.05, * p<0.1

Source: Own calculation

Discussions

Table 5 shows that an increase in income reduces the probability of a household head selecting surface water, spring water and borehole water by 5.74, 8.79 and 4.88 percentage points respectively while at the same time increases the probability of the household head selecting clean water (piped water) by 19.41 percentage points. This means that increase in income of the household head increases the chances of household using clean water. The study finding aligns with how a rational individual faced with alternative choices and limited income would go for decisions that give them maximum utility in the theory of the consumer. The study findings further agree with that of Asibey et al., (2019) that studied the roles and attitudes of urbanites towards urban water insecurity in Ghana and revealed that individual's income played a significant role in determining the preferred coping strategy to water shortages with poor households going for cheaper and unsafe alternatives to water sources.

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Table 4 shows that the coefficient of age on spring water regression is 0.018 and that on borehole and piped water regression as both 0.011, with a corresponding P-value greater than 0.1 across all water sources. Table 4 further shows that the marginal effects of age on surface water, spring water, borehole water and piped water is -0.0021, 0.0015, 0.003 and 0.003 respectively. The P-value is however greater than 0.1 across all water sources. This means that the calculated Z statistic is less than the tabulated Z statistic at five percent level of significance. This means that the null hypothesis for this coefficient is not different from zero and is not rejected at five percent level of significant. Age is therefore not statistically significant across all water sources and as such the age of the household head does not influence the choice of water sources. Based on the random utility theory for utility maximization, age can be considered among the observed and unobserved attributes of individual making rational decisions for attainment of the highest utility. However, the study finding differs with this notion as age does not influence choice of water source. The study further differs with that of Abdu et al., (2016) on socioeconomic determinants of households' access to safe drinking water in Nigeria that established that age among other variables, have positive effects on likelihood of accessing safe drinking water as well as being responsible for urban-rural inequality in access to safe drinking water. The fact that age of the household head does not influence the choice of the water sources implies that government efforts to improve access to clean water should not target a particular age group rather it should focus on the society as a whole.

Table 4 shows that the coefficient of age squared on all water sources is -0.0000 with a corresponding P-value greater than 0.1 across all water sources. Table 5 further shows that the marginal effects of age squared on surface water, spring water, borehole water and piped water is 0.0002, 0.7759, -0.3772 and -0.000 respectively. The P-value is however greater than 0.1 across all water sources. This means that the calculated Z statistic is less than the tabulated Z statistic at five percent level of significance. This means that the null hypothesis for this coefficient is not different from zero and is not rejected at five percent level of significance (Orayo, 2020). Age squared is therefore not statistically significant across all water sources. Also, age of the household head has non-linear effect on household's head choice of water sources.

Table 4 shows that the coefficient of primary education of the household head is 0.839 with a corresponding P-value greater than 0.1 for the spring water regression. This means that the calculated Z statistic is greater than the tabulated Z statistic at 10 percent level of significance for spring water regression. This implies that the null hypothesis that the coefficient is not different from zero is rejected at 10 percent level of significance. However,

Table 4 shows that the coefficient of primary education in the borehole and piped water regression have P-values greater than 0.1. This means that the calculated Z statistic is less than the tabulated Z statistic at five percent level of significance for both borehole and piped water regression implying that the null hypothesis for these coefficients are not different from zero and is not rejected at five percent level of significance. Since the household head having primary education is weakly significant its marginal effect in Table 5 were interpreted. The results show that the marginal effects are 0.0803. This implies that an increase in the level of education of the household head from increases the probability of household head selecting spring water by 8 percentage points.

Table 4 shows that the coefficient of secondary education of the household head is 1.158 with a corresponding P-value less than 0.1 for the spring water regression. This means that the calculated Z statistic is less than the tabulated Z statistic at 1 percent level of significance for spring water regression. Table 5 further shows that the coefficients of secondary education of household head is 0.972 with a corresponding P-value less than 0.1 for the piped water regression. This means that the calculated Z statistic is less than the tabulated Z statistic at 5 percent level of significance for piped water regression. This implies that the null hypothesis that the coefficient is not different from zero is not rejected at 1 percent level of significance and at 5 percent significance level on spring water and piped water respectively. However, Table 4 shows that the coefficient of secondary education in the borehole water regression have P-values greater than 0.1. This means that the calculated Z statistic is less than the tabulated Z statistic at five percent level of significance for borehole water regression implying that the null hypothesis for these coefficients is not different from zero and is not rejected at five percent level of significance. Since the household head having secondary education is significant in spring water and piped water regression, its marginal effect in Table 5 were interpreted. The results show that the marginal effects are -0.1251, 0.0857 and 0.1069. This implies that an increase in the level of education of the household head from no education to secondary school education reduces the probability of household head selecting spring water by 12.51 percent. A similar effect however increases the probability of household head selecting borehole water and piped water by 8.57 percent and 10.69 percent respectively.

Table 4 shows that the coefficient of tertiary education of the household head is 1.585 and 1.149 with a corresponding P-value less than 0.1 for the spring water and piped water regressions. This means that the calculated Z statistic is less than the tabulated Z statistic at 1 percent level of significance for spring and piped water regressions. This implies that the null hypothesis that the coefficient is not different from zero is not rejected at 1

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

percent level of significance. Table 4 further shows that the coefficient of tertiary educa,tion of the household head is 0.658 with a corresponding P-value less than 0.1 for the borehole water. This means that the calculated Z statistic is less than the tabulated Z statistic at 5 percent level of significance for borehole water regression. This implies that the null hypothesis of the coefficient is not different from zero and is not rejected at 5 percent level of significance. Since the household head having tertiary education is strongly significant, its marginal effect in Table 5 was interpreted. Table 5 shows that the marginal effects are -0.1664 and 0.1204 on surface and spring water. This implies that an increase in the level of education of the household head from no education to tertiary education reduces the probability of household head selecting surface water by 16.64 percent while this advancement in education increases the likelihood of household head using spring water by 12.04 percent.

From the foregoing discussion, primary education increases the probability of a household head selecting spring water, secondary education reduces the chances of a household head selecting surface water while at the same time encourages the household head to select spring and piped water. Tertiary education on the other hand reduces the probability of a household head selecting surface water and enhances the probability of a household head selecting spring water. This means that as the education of the household head increases from no education to primary education through tertiary education, their probability of selecting a clean water source increase. This finding is like that of Abdu et al., (2016) on socioeconomic determinants of households' access to safe drinking water in Nigeria that established that education level among other variables is responsible for urban-rural inequality in access to safe drinking water. The findings as well concluded similarly to a study of Abubakar (2019) who also established education as a key factor influencing housed access to drinking water in Nigeria. The finding confirms the theoretical underpinning that rational decision-making units presented with different choices will go for the alternative that gives them the highest utility with education considered among the observed and unobserved attributes of the decision maker in the random utility theory. The implication is that education is a tool that policy makers and the government can use to influence household heads to select clean water sources.

Table 4 shows that the coefficient of sex on spring and borehole water regressions is -0.061 and 0.065 respectively with a corresponding P-value greater than 0.1. This means that the calculated Z statistic is less than the tabulated Z statistic at five percent level of significance, implying that the null hypothesis for this coefficient is not different from zero and is not rejected at five percent level of significant. Table 4 however shows that the coefficient of sex on piped water regression is 0.124 with a corresponding P-value less than

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0.1. This means that the calculated Z statistic is greater than the tabulated Z statistic at five percent level of significance, implying that the null hypothesis for this coefficient is different from zero and is rejected at five percent level of significance. Table 5 further shows that the marginal effects of sex on surface water and borehole water is -0.0079 and 0.0057 respectively with P-value greater than 0.1. However, the marginal effects of sex on spring water and piped water are -0.1078 and 0.0199 respectively with P-value less than 0.1. According to the study findings therefore, being male reduces the probability of household head to use spring water by 0.79 percent while being male increases the probability of using piped water by 1.99 percent. The study considers sex as part of the observed attributes of rational decision-making unit under the random utility theory for utility maximization The study findings is similar to that of Abdu et al., (2016) on socioeconomic determinants of households' access to safe drinking water in Nigeria that established that gender among other variables, have positive effects on likelihood of accessing safe drinking water. This implies that sex is a tool that policy makers and the government can use in the efforts to provide clean water.

Table 4 shows that the coefficient of employment status on spring water, borehole water and piped water is 0.187 and 0.397 respectively with the corresponding P-values less than 0.1 across all water sources. This means that the calculated Z statistic is greater than the tabulated Z statistic at one percent level of significance. This means that the null hypothesis for this coefficient is different from zero and is rejected at one percent level of significance. Table 5 further shows that the marginal effects of employment status on surface water and piped water is -0.0415 and 0.0490 respectively. This study finding shows that being employed reduced the likelihood of using surface water by 4.15 percent and increased the likelihood of using piped water by 4.90 percent. The fact that a change from being unemployed to being employed increases the probability of a household head selecting piped (clean) water sources implies that labor market outcomes are important for the access of clean water. Those with employment, and therefore, employment incomes are more likely to select clean water sources unlike those without. This study agrees with that of Asibey et al., (2019) on roles and attitudes of urbanites towards urban water insecurity in Ghana that established that poor household goes for cheaper and unsafe alternatives to water sources. Therefore, efforts by the government and other stakeholders geared towards increasing employment rates in the Kenyan labour market are important tool of increasing access to clean water.

Table 4 shows that the coefficient of residence on spring water regression is -0.052 with a corresponding P value greater than 0.1. This means that the calculated Z statistic is less than the tabulated Z statistic at one percent

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level of significance. This means that the null hypothesis for this coefficient is not different from zero and is not rejected at one percent level of significance. The coefficient of residence on borehole and piped water regressions is -0.471 and -1.249 respectively with P-value less than 0.1. This means that the calculated Z statistic is greater than the tabulated Z statistic at one percent level of significance. This means that the null hypothesis for this coefficient is different from zero and is rejected at one percent level of significance. Table 5 further shows that being in the rural increases the probability of household head using surface water, spring water and borehole water by 10.47 percent, 7.84 percent, and 2.08 percent respectively. Being in the rural however reduces the probability of using piped water by 20.39 percent. This study finding is in line with the findings of Abdu et al., (2016) that established rural-urban inequality in access to safe drinking water is associated with that household head attributes. This implies that if a household head migrates from an urban setup to a rural set up their probability of selecting clean water sources reduces. Efforts to address inequality in the access of water between rural and urban areas should therefore be enhanced.

Conclusion

The study sought to establish the effect of the household head characteristics on access to clean water. It was established that when a household head moves from being unemployed to being employed, his or her probability of selecting clean water sources increases. Therefore, the study concludes that labor market outcomes are important in determining access to clean water. Specifically, finding a job increases the probability of a household head selecting clean water sources. Considering income levels, the study concludes that, an income source is important in determining access to clean water. Specifically, engagement in any income generating activity by household head increases their probability of accessing clean water. Age was found not to influence choice of clean water. The study therefore concludes that government effort in provision of clean water should not target any specific age group.

Additionally, the study established that all education levels (primary, secondary and tertiary) compared to no education increased the probability of household head accessing clean water. The study concludes that education is crucial for access to clean water in Kenya as the higher the education level, the more the household head have access to clean water. In addition, sex significantly increased choice of clean water sources. Therefore, the study concludes that male headed households have access to clean water sources relative to female headed ones. Finally, the study established that when a household head moved from the urban to the rural, their probability of accessing clean water source increased. The study therefore concludes that

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area of residence of household head means inequality of access to clean water in Kenya.

Based on the study findings, the following recommendations are made.

First, arising from the conclusion that favorable labor market outcomes increase the probability of a household head selecting clean water sources, the study recommends that employment opportunities should be expanded in the country. This could be achieved in the short-term through an expansionary monetary or fiscal policy such as *'Kazi Mtaani'*. In the medium to the long term this could be achieved through sustained expansion of the economy that creates employment opportunities in the private sector and the public sector. The expanding economy should be complemented by relevant training such that the increased labor market opportunities find a workforce that is ready to take up the opportunities.

Secondly, from the conclusion that the higher the education of household head from primary through tertiary, the higher the chances of them accessing clean water, the study recommends investment in the education sector by the government in the country. This could be achieved by the government providing free primary and secondary education in the country as well as making colleges more affordable for citizens so that a majority of the citizens have access to education. The free education initiatives should be accompanied by the government designing a curriculum that integrates the training on the use of clean water in schools (primary, secondary, and higher education institutions).

In addition, from the conclusion that being male increases the chances of household heads accessing clean water, the study recommends social welfare programs and reduced inequalities in the country. This could be achieved by the government through the relevant ministries and county governments working hand in hand to enhance the existing social programs like women empowerment programs to promote access and use of clean water as envisaged in Kenya's vision 2030. Finally, from the conclusion that as household head moving from the urban to the rural, their probability of accessing clean water source reduces, the study recommends for equity in distribution of resources across the country. This can be achieved through devolution of resources by the government in Kenya.

Acknowledgements: We would like to acknowledge Kenya National Bureau of Statistics (KNBS) for permitting us to use their data (2015/2016 Kenya Integrated Household Budget Survey) in arriving at the conclusions of the study. Also, we would wish to recognize the technical support of Mr. Joseph Abuga Orayo. His knowledge of STATA software and economic modeling were helpful. This study was made possible via a scholarship awarded by Germany Academic Exchange program (DAAD).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Author(s) Contributions: The conceptualization of the work was arrived at, by both authors. Analysis was largely done by Anyango where Dr Mdoe guided in the process of interpretation of the outputs as well as substantively revised it. Both authors approved the submitted version and agree to be accountable for their own contributions and for questions related to the accuracy or integrity of any part of the work.

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