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Analyzing the Willingness to Pay for Improved Domestic Water Supply in Moiben: Elgeyo/Marakwet County, Kenya

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Abstract
As the demand for water in rural Kenya keep increasing due to high population growth, the quality of its supply for domestic consumption is compromised by agriculture related pollution. River water supply in rural areas is a public good that may not be provided under normal market conditions. This article attempts to provide alternative market conditions in order to estimate the economic importance of improved domestic water supply to the surrounding community. It employed contingent valuation method in estimating willingness to pay (WTP) and assesses factors influencing the likelihood of WTP responses. A sample of 384 households living along Moiben river in Keiyo/Marakwet County was studied. Results indicated majority (56%) of the residents use the river for domestic consumption. The average amount residents are willing to pay for improved domestic water supply is Ksh 196 per month, showing their desire for better water management. Findings indicate that there were statistically significance between household size (0.021 with t value of 2.220) and WTP at significant level of 0.05. The reason may be that the cultural attachment to the family size could have encouraged the members of the community to the willingness to pay, since that the impact on the water supply is easily felt as a result of the family size and the daily activities which include domestic, agricultural, and industrial and some commercial activities which rely on this resource. Education has a positive correlation to WTP but not significant. It was also discovered that majority (76%) members of the community hold a secondary education and below and those with education from tertiary and above are 25%. The study recommends that both levels of Government should strengthen policies and regulations towards economic activities of the community and providing incentives that will encourage the youths in improving their education since that from the findings majority have basic education of secondary and below. The WTP estimates can be used by policy makers to determine pricing of the commodity for better provision of improved domestic water supply.
Keywords: Contingent Valuation Method, willingness to pay, water supply and water quality

1.0 Introduction

Water resource is relied on by both domestic and industrial purposes which is unevenly distributed (Masese *et al.*, 2009). From the studies of Akali *et al., (*2011); Carpenter *et al*., (2011), this resource is scarce with 2.5% available as fresh water for use though the earth is covered with 70% water. Kenya's estimated per capita water availability by 2008 was 792 m^3 (FAO, 2008) which is distributed unevenly (GOK, 2002) into five basins (FAO, (2008).

Rivers suffer from what Hardin (1968) describe as the tragedy of commons. This is due to its perception as a free resource and God given, without market value attached to it except the payment incurred during delivery by vendors. Therefore, this natural resource is over exploited and environmental problems creep in leading to; pollution, soil erosion, and loss of fauna and flora. WRI (2007) suggested management of water catchment areas to be the necessary step for developing countries to be water sufficiency all year round. Therefore, conducting analysis of WTP for improved local water services for rural residents is important (Johnson & Baltodano, 2004; Wasike, 1996). Studies of Sumukwo (2012), Bateman et al., (2002), Ingraham and Foster (2008), and Wasike, (1996), are in agreement that environmental goods can be valued by determining the WTP by the community through an organized project user groups.

Since water is an environmental commodity with excludability and indivisibility, as shown by Hardin (1968), it is not easy to place a monetary value since it may not be practical to buy or sell them in the normal market place. Several methods have been used by other studies to value water resource including use of; travel cost demand methods, for example Johnston et al. (2002) computed the consumer surplus (economic use value per person) for swimming, boating, recreational fishing; Hedonic pricing uses difference in value as the implicit price of the difference in river quality, Gardner and Barrows(1985), King and Sinden (1988) employed the above method on the relationship between land prices and water quantity and quality; other scholars who have used Contingent Valuation Method (CVM) include; Sumukwo (2012), Bateman et al., (2002), Ingraham and Foster (2008), and Wasike, (1996) where population is surveyed in all studies.

Since Moiben river ecosystem provides goods and services and performs many functions that are valuable to households then valuation is important for policy formulation and implementation. Valuation will help in understanding the relationship between the community and the river water consumption hence providing improved water quality at the water source (Mwami 1995; Lenehan and Martin 1997) and ensuring that the

resource is available both within the present generation, for present and future generations, efficiency and equitable infrastructure investment in the water sector, and decisions on efficient treatment of waste and mode of resource payment including: pricing, property rights, tradable rights' markets, taxes (Martin, 1997).

According to cheboiwo *et al* (2010) this area of study was with the best forest blocks of 40% forest cover but currently it is under threat from anthropogenic activities. Also an environmental impact report of the year 2010 by Mangat Lel & Partners on the construction of chebara dam pointed out that catchment area of the dam should be protected from pollution and destruction in order to achieve the dam's objectives and maintain high retention potential of precipitation in the upper catchment.

This study was developed from this background with the main aim of analyzing WTP for improved domestic water supply in Moiben river. To examine economic significance of Moiben river to the households, to find out the responsibility of river protection and to assess factors that influences the likelihood of WTP responses.

1.1 METHOD

1.1.1 Empirical Design and Data Collection

The pretest was done on 20 households from Kipkaren river using guided WTP questionnaire. In this study, oral interview and a checklist was used on an open-ended WTP questionnaire so that respondents would not be restricted by defined values (as in binary choice or closed-ended questions). The basic model used for valuation of this non-market goods is the CVM. This tool was administered on the two locations (Chetongei and Chepyemit) a total of 384 households which was sampled and one respondent per household was interviewed. Those who were able to read and write were allowed to fill in the questionnaires while for those who did not know how to write and read were provided with a volunteer to assist them with instructions not to influence the respondent answers.

1.1.2 Survey Design and Sampling method

This study adopted a field survey research design using CVM which has been proved to be the most reliable in the past studies. This design was used because of its descriptive nature which ease collection of data from the sample. The household is the central unit of the study and household head is targeted because being the household head is responsible with decision making on issues affecting the household. The sample size was randomly sampled for effectiveness and good representation of the study area (Mugenda and Mugenda (2003). The study area was stratified into two locations (Cheptongei and Chepyemit) targeting a total population of 384 respondents living 20km away from Chebara dam towards the source along Moiben river.

1.1.3 Contingent market survey

Since natural resource goods and service could not be traded directly in the market, the study elicited willingness to pay values for improved water supply by a hypothetical market scenario which described to the households about human activities taking place, and the impacts expected on the river from farming chemicals and soil erosion that would cause pollution.

It was after explaining to the community how the collected revenue would be used to provide improved domestic water supply that they were asked if they were willing to pay for river protection and state how they would wish to make their contribution. They preferred a form of community cess as a payment vehicle. This was chosen because the most common payment vehicles known to them is through taxes and donations.

The respondents were presented with an option of being given the opportunity to form river protection committee under a new management of 'Moiben community water service' for improved water supply in Moiben where all community members have equal say to the management of the project. They were further told that for the project to succeed one is expected to pay a monthly fee. The fees paid would be used for the general management of riparian ecosystem for continued supply of hygiene water. Thereafter the respondent would bid his/her maximum WTP values. Those not WTP were given the following options; don't want to participate, river has no value, not aware and too expensive. Responses to open-ended questionnaires were likely to minimize standard error and lower estimates of central tendency hence preventing bias. This study adopted logit model in analysis due to its nature in distributing error term independently, identically according to the value distributed but unlike in probit model where it assumes that the distribution is normal. Also logit is easy to estimate and interpret (Deaton and Muellbaner, 1980). This model is compatible to human behavior and it can forecast trends which conform to the expectations.

1.1.4 Techniques of Analysis

In order to bring order, structure and meaning to the information collected (Mugenda and Mugenda, 2003) data analysis was conducted. The analysis applied descriptive statistics for quantitative analysis. Data analysis tool used SPPS on the selected variables and Multivariate analysis. Then data analyzed was presented as mean, median, standard deviation, ranges and the frequencies in percentages. Also tests was done on some selected variables to test the effects on each other, for example the relationship between the dependent and independent variables examined using the Ordinary Least Squares (OLS) were carried out at alpha level of significance of

0.05.

1.1.5 Theoretical Model

This study used consumer theory as a framework of analysis. Consumer theory postulates that people express their preferences and constrains (income, and time) through the choices they make. It is concerned with how a rational individual decide on his consumption when faced with choices to make, he will choose that which suits best to his needs. Preference is considered to be transitive which mean that if presented with three goods ABC, it is believed that $A > B$ and $B > C$, then there is no way that $C > A$ instate $A > C$. Therefore related to CVM are contingent behavior, and choice analysis methods which are direct approaches to estimate economic value which rest on the consumer theory. The purpose of the contingent valuation method (CVM) is to elicit individuals' preferences, in monetary terms, for changes in the quantity or quality of nonmarket environmental resources. CVM valuation is dependent upon a hypothetical situation whereby a sample of population is interviewed on their willingness to pay or accept compensation for a change in the environmental quality / quantity. Each individual attaches a marginal utility to each characteristic of water source such as price, quality, and reliability (Wasike 1996). A rational individual faced with a choice of water use, he will aim at maximizing his utility by choosing according to accessibility and his economic distinctiveness (Lancaster, *1965,* McFadden, 1981, Bockstael et al, 1987). It is expected that household will choose from among the set of possible water sources that gives him greater or equal utility. This is dependent on combination of several factors as indicated below. The random term is included to solve the households that may not be consistent (Ben-Akiva and Lerma, (*1985)***.** The empirical analysis was carried out using multiple regressions below:-

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e$$

Where: Y= WTP value of river pollution, X1 to X7 are the socio-economic factors, X1=AGE:- it is expected that as the age increase the WTP decrease, older people demand for river goods and service is likely to be less, X2 = SEX:- women tend to use more water to men due to the nature of their daily domestic activities, X3== level of education:- well informed people are expected to set aside an amount to pay more for quality products than get free but poor services water resource included, X4= size of the land: -people with smaller piece of land are expected to be more willing to pay for the service than those with bigger piece. This is because those with smaller farms will want to do more intensive farming which require more water than those owning bigger pieces, X5= family income:- in microeconomics, increased income often leads to higher WTP. The reason is that more disposable income is available, X6= distance from the river:- those living near the rivers are in most cases affected more by any change on the quality and the quantity of the river thereby increases the WTP this means that the further the person lives the less likely the WTP, X7 = Household size:- the bigger the number the more they feel the impact on the river is expected, β =Beta and therefore βi to βn are predictors, a= the constant and e =error;

1.2.0 Results and Discussion

The analysis used SPSS and multivariate analysis as data analysis tool. All the tests were carried out at 0.05 alpha level of significance.

1.2.1 Socio-Economic and Demographic Characteristics

Table 1.0: Descriptive statistics of socio-economic characteristics of the households

Variable		Count	Percent
Age	18-28	98	27
	29-39	94	26
	40-50	83	23
	51-60	53	15
Gender	Male	196	56
	Female	163	44
Education	Primary	90	25
	Secondary	183	51
	College	61	17
	Degree	16	4
	Masters	9	3
Occupation	Unemployment	88	24
	business	107	30
	Farmer	110	31
	civil servant	41	11
	Teachers	13	4
Household Size	1-3	106	30
	4-6	138	38
	7-9	72	20
	above 10	43	12
Monthly Income	below 10,000	151	42
	11,000-20,000	141	39
	21,000-30,000	48	14
	31,000-40,000	11	3
	Above 41,000	8	2
land size	0-10 acres	160	45
	11-20	124	34
	21-30	49	14
	31-40	15	4
	41 and above	11	3

The questionnaires response rate was 94% indicating that not all response was valid. The study sought to get socio economic information of the household and was presented as in Table 1.0. The age ranged between 18years and 60years and above. The age distribution show that majority of them were age between 18-28 years hence they were young and energetic. Gender showed that 56% were male and 44% were female. Showing that the study captured more male than female this signify the socio-cultural structure of the community which considers a man as the head of the family.

Majority (75%) attained secondary school education and above. Showing that most of them have basic knowledge and are able to interpretation environmental factors easily. The highest percentage (31%) were farmers meaning that the society rely most on farming as the source of income as is the rural areas. Hence water requirements for both irrigation and domestic purposes is expected to be high. Study revealed that 24% of the respondents were unemployed. 45% were in formal employment. Majority of the respondents (69%) recorded to be with household members ranging between 4 and above, revealing that impact on the river is expected to be felt because of their daily activities which include domestic, agricultural, industrial and commercial activities just as in a rural setting. Income generation is mainly through farming (31%) and few are in formal employment while 24% rely on others. Most (42%) of the respondents have an earning of ksh. 10000/= and below. Findings revealed that 45% of the population living along the river own land less than 10 acres meaning the land with water accessibility is in high demand as in other places.

1.2.2 How river resource is used

Table 1.1: River Resource Utilization

Resource Usage	Frequency	Percent
Domestic	199	56
Agricultural	141	39
Commercial	19	5

Results show that 56% of the respondents use water for domestic purposes while 39% use it for agricultural purposes showing that most people rely on the river for their agricultural activities which is regarded as the countries backbone and is known to use a lot of fertilizers if irrigated horticulture.

1.2.3 River Moiben protection responsibility

Table 1.2: Water Protection Responsibility

Responsibility	Frequency	Percent
NGO	75	21
Government	171	48
Individual	113	31
Total	**359**	**100**

69% believed others to be responsible with protection responsibility of the river (Government and Non-Governmental Organizations) which means that the society is ignorant on their role in environmental protection responsibility. Since that this area is mainly surrounded with forests, households believe that all environmental responsibility rests upon others.

1.2.4 EXAMINING WTP FOR IMPROVED DOMESTIC WATER SUPPLY

Hypothetical market was presented to respondents of Cheptongei and Chepyemit locations. They were assured that all the community members will have equal say to the project management. They were explained on how the project will be successful and their role in paying a fee for the management. They were explained on how the money contributed will be used to plant trees, pay the staff and guards. Most of the respondents were willing to pay for improved water supply. The few who were not WTP was asked to give a reason to why they were not willing.

1.2.5 Willingness to Pay Response

Those who were willing to pay for improved water protection were 289 respondents. This represented 80% of the sampled population, while 20 % (70) of the same populations were not willing to pay. 9% (32) of respondents were not willing to pay saying the project is too expensive and the government should take control of it. 11% (38) were not ready to participate on the project saying it will be corrupted by the national and the county government; some gave an example of the current Lake Victoria Water Project saying its source is Moiben River and none of the resident is employed.

1.2.6 Improved Domestic Water Supply

The study sought the respondent's willingness to pay for improved domestic water supply.

Table 1.3: Improved Domestic Water Supply

Bids (Amount Kshs)	Frequency	%	Total
50	121	34	6050
150	91	25	13650
250	66	18	16500
350	41	12	14350
450	21	6	9450
550	19	5	10450
	359	**100**	**70450**

The study findings reveal that, (34%) of the respondents willing to pay an amount Kshs. 50 monthly, (25%) gave a value between Kshs. 150, (18%) gave a value of Kshs 250, (12%) stated a value of Kshs. 350, 21 (6%) said were willing to pay Kshs. 450 and (5%) respondents were willing to pay a value above Kshs 550. From the findings, Moiben residents are willing to pay an average of Ksh.196 per month for improved water supply. This is expected to be used in managing the environment.

1.2.7 Determinants of WTP

The table below was computed in order to estimate the factors that determine the WTP for Improved Domestic Water Supply in Moiben river.

Table 1.4: ANOVA

ANOVA was carried out. The significance level was set at 95% with and α=0.05.The test statistics are summarized in table 1.4 below: this was to determine the factor that is significant to the willingness to pay.

Model	Coefficients	S.E	t-value	Sig.
Constant	-	.127	8.08	.000
Age	0.006	0.018	.107	.915
Gender	0.056	0.043	1.05	.295
education	-0.052	0.024	-.954	.341
Household size	0.114	0.023	2.22	. 021
Land size	0.030	0.021	.560	.576
Monthly income	0.037	0.023	.691	.490
Distance to the river	0.012	0.020	.225	.822

a. Dependent Variable being WTP

Based on the results household size was found to be positive and significant WTP as determined. This indicate

that as the size of the family increases the more they are willing to pay. Monthly income was positively related to WTP but not significant. Unlike in other studies like Sumukwo (2012), Afroz et al. (2010) and Whittington et al (1998) where monthly income was positive and significant. Age of the household head showed that the aged were more willing to pay for the protection unlike the younger generation. This could be that the young people have land which is still under custodian of their parents and also that the activities of the young is mainly in the urban areas, therefore affecting their willingness to pay for this service. Gender had positive effect on WTP for improved domestic water supply. This imply that females are more willing to pay than males which reflects the cultural role of females to carry out most of the domestic activities according to most of African setting. Distance from the river was found to positively influence WTP and insignificant. This imply that as the distance of the household increase from the river the more they are WTP meaning that those living near the river have less regard to environmental protection. This could be that those living along the river believe that it is their right to have the river hence no need to pay for its service.

1.2.8 Testing for Correlation matrix between WTP and independent variables

WTP is the dependent variable while independent variables were age, gender, education level, household size, land size, monthly income, and distance from the river. Correlation between dependent and the independent variables were necessary to be done; this was to find out the relationship between the WTP and the independent variables and within the independent variables and the direction it takes.

Table 1.5: Pearson Correlation Coefficients

	AG	G	EDL	HH	LS	MI	RD
AG	1	-069	-.062	.361	-.049	-.035	.061
		.195	.244	.000	.355	.507	.251
G	-.069	1	.101	-.032	-.023	.005	.053
	.195		.055	.544	.658	.920	.318
EDL	-.062	.101	1	.059	.058	.146**	.131*
	.244	.055		.266	.270	.006	.013
HH	.361	-.032	.059	1	-.017	.103	.082
	.000	.544	.266		.746	.052	.121
LS	-.049	-023	.058	-.017	1	.037	-.026
	.355	.658	.270	.746	.182	.482	.618
MI	-.035	.005	.146**	.103	.037	1	-.011
	.507	.920	.006	.052	.482		.830
RD	.061	.053	.131*	.082	-.026	-.011	1
	.251	.319	.013	.121	.618	.830	

Note: **. Correlation is significant at the 0.01 level (2-tailed).

*. *Correlation is significant at the 0.05 level (2-tailed).*

PC - Pearson Correlation

Sig. - Sig. (2-tailed)

G- gender; EDL- education level; EML- employment; HHS- household size; LS- land size; MI- monthly income; RD- distance from the river; WTP- willingness to pay.

In determining the relationships using Pearson correlation at 0.01 2-tailled significant; age was negatively related to education -0.062; this reflects that the young are more educated than the older members of the community. While negatively related to Land size -.049 and income -0.035, this show that aged have more land than the young and income of the old is more than of the young. Age is positively related to household size 0.361; distance to the river 0.061. This show that the aged have more family members and live far from the river. This is true considering cultural attachment that older members of the community have more land than the young which cannot be possible with the current demand for land near the rivers which shrink every day. Gender is positively related to education 0.101; low related and positive to income 0.005 and distance to the river 0.053. This tells us that female captured were more educated than the males, most females reported to be living further away from the river than the males and control more income than their counterparts.

Other variables had the following correlation: Education is positively correlated to income 0.146**; Household size is positively related to income 0.103, age 0.361, education 0.059 and distance from the river 0.082 while negatively related to land size -0.017 and gender -0.032. Land size is positively related to income 0.037 and negatively related to distance from the river-0.011. There is no highly related independent variable found in the study hence there was no problem of multicolliniarity.

1.3 Conclusion and policy Recommendation

From the study, the findings show that households are willing to pay for improved domestic water supply. 80% are willing to pay an amount which is an average of Ksh.196. This show that household attach a value to this

environmental resource which is non-exclusivity and indivisible has as market conditions require. The analysis done on the independent variables and the WTP were not significant though positive except the household size. Based on the results, it can be reported that there was positive and statistically significant ($p<0.05$) between household size and WTP as determined by ANOVA. This imply that the bigger the number of household members the more willing to pay for improved domestic water supply. Furthermore, results show that though there was positive effects on WTP, there was no statistically significant between WTP and age, gender, education, land size, monthly income and distance from the river as determined by ANOVA. The variables show that they cannot influence decision making. The more the household get educated the more they are willing to pay which is true with the economic theory. Also to income, as an individual earn more the more he is willing to pay. So it is expected that the household who earn more are likely to pay for improved management. On gender, females are more willing to pay than males. This reveal roles of women to avail water in the house as is dictated by the African culture, therefore females feel the weight of poor water supply and are readily willing to pay for service improvement.

Since households are willing to pay for improved domestic water supply, the WTP estimates above can be used by policy makers to determine pricing of this commodity for better provision of the service.

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