An Analysis of Accessibility and Pricing of Water Supply in Rural Watersheds: A Case Study of Kakamega District, Kenya

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Abstract

The main purpose of this study was to assess accessibility to domestic water in terms of distance, time, and the rate at which households are willing to pay for this water from various sources and at different distances from home. As such, the objectives of this study were to:

- Establish the sources of domestic water supply and time/distance covered to water points,
- Assess the willingness and rate at which water users are willing to pay for domestic water, and
- Ascertain the factors that determine the rate at which water users are willing to pay for water.

To achieve the objectives of this study, both documentary and field based techniques were used to collect and analyse information. Interview schedules, key informant interviews and focus group discussions were used to gather the required data. In analysing data, descriptive statistics (frequencies, percentages, means and cross-tabulations) as well as inferential statistics (Chi-square, two-way ANOVA and multiple regressions) were used. Out of the 300 respondents, 85% and 77% collected domestic water from springs during dry and rainy seasons, respectively. Over 74% of the respondents got water from roof catchment during rainy seasons. Less than 10% of the respondents used other sources of water during both dry and rainy seasons. Cross-tabulation between water sources and sub-locations revealed that some sources of water such as tap, stream/river and wells were sub-location specific. However, spring and roof catchment as sources of water were used across all sub-locations used. The mean rates for those (89%) willing to pay for

water per 20 litre jerrycan were Ksh. 1.36, 1.00, 0.80, 0.29 for spring water, Ksh. 1.49, 1.12, 0.87, 0.35 for borehole water and Ksh. 1.74, 1.34, 1.06, 0.41 for tap water at distances of < 1.0, 1.0-2.0, 2.1-3.0, > 3.0 km, respectively. Two-way ANOVA test applied to verify the null hypothesis that there is no significant difference between mean rates respondents are willing to pay for water from various sources and different distances from home gave results ($P= 0.0000< 0.05$ for sources treatment and $P=0.0073<0.05$ for distance treatment) that led to the rejection of the null hypothesis. Similarly, multiple regression analysis applied to verify the null hypothesis that there is no significant relationship between acceptable water rates and spatio-temporal, socio-economic and demographic factors of the respondents resulted to the null hypothesis ($P=0.0341<0.05$). The regression gave explanatory power, as measured by coefficient of multiple determinations (R^2) of 0.55423.

The study concludes that all stakeholders in the domestic water supply sector in Kakamega should collaboratively develop main sources of water (springs and roof catchment). Based on contingent valuation, the government should set prices for water from all sources to encourage water and watershed conservation in addition to raising funds for coverage expansion.

Background to the Study Problem

Water is a scarce resource; yet crucial for human survival. This scarcity is linked to climate change; demand that exceeds available water resources and most importantly unsustainable use of the resource (Molle, 2000; Ogallo, 1996). Many parts of the world, notably the Middle East, are experiencing intense competition over limited water resources. This situation is more serious in shared drainage basins where it has heightened political conflicts (McCaffrey, 1993). The situation is not any better in Kenya. Over four-fifths of the country are arid and semi-arid and therefore experience water stress. Competition over water between agricultural, industrial, domestic and municipal needs has worsened, stretching the recovery of the hydrological systems (Orie, 1995; WRI, 1994). The majority of people in rural Kenya (about 58%) have no access to potable water despite

the government target to have provided water to all by the year 2000 (Kenya and UNICEF, 1998).

Given water's long history as a social good, there is need for demand management instruments if consumers have to use water wisely. The World Bank suggests adequate pricing of water as one of these instruments. It, for instance, attempts to bring about efficient use and correct allocation decisions for water management (Moigne , 1994; Rogers, 1992). This instrument enforces a price elasticity of water demand that water use is inversely related to the price charged. Appropriately set prices for water tend to ration environmental amenities and discourage environmental deterioration by cutting down on destructive and uneconomical consumption. Appropriate pricing of water attracts the conservational use of water resources and catchment areas to ensure the continuous flow of river systems. Guided by this philosophy, people are motivated to protect watershed areas by practicing afforestation, pollution control and general good land husbandry so that more clean water is available for use.

The ideal price for water needs to be determined by users through contingent valuation. User interests in water pricing policies include fairness of charges, stability, incentives for efficient use and affordability by low-income users and other vulnerable groups. Water pricing policies risk failure unless they are sensitive to the needs of all users who have to pay the rates governed by policies set (Reiter, 1999). Thus rates other than those coming from the users, are likely to reduce access of some users because they are non-affordable or worse, underpriced water in consideration of the economic ability of the beneficiaries (Moigne , 1994; World Bank, 1996 and Hukka, 1996). Participatory pricing of water should therefore stick to the balance between highest price users, who are willing to pay for the resource, and the full price of water calculated from marginal cost pricing (Emmerton, 1997; Rogers, 1992). This balance ensures that the poor are not deprived of this valuable commodity and at the same time water is not highly subsidized by setting tariffs below operation and maintenance (O&M) cost.

The Problem

Kakamega is a well-watered district with a mean monthly rainfall of 157.6mm. Availability of water in most parts of the year is likely to make people take it for granted resulting to unsustainable use. Households in the district obtain domestic water from various sources located at different distances. The sources of water and distances covered could to a certain extent determine the quality and quantity of water at household level (Valcurtis, 1986; Drangert, 1996 and Smith, 1996). Projects initiated to supply potable water have performed dismally poor making accessibility a serious issue among users. Problems that lead to poor performance remain largely undocumented apart from underpricing and inefficient collection of water revenue from user groups pointed out by Hukka (1996). This study addresses the following key question: What are the sources of domestic water supply? How far are water points from households? Are households willing to pay for water from various sources and what factors determine the highest price at which they (users) are willing to purchase water?

Research Methodology

Data used in this study came from two sources. The first was information from secondary (documentary) sources and the second was information from primary sources collected during fieldwork from respondents. The data was collected during fieldwork conducted between the months of February and May 2001. The research instruments that were used consisted of questionnaire schedules, focus group discussions and key informant interviews. Before the main study, a pilot survey was carried out to pre-test the research instruments and work out modalities of identifying respondents in the selected villages.

Summary of Results

Sources of Water

Out of the 300 respondents, over 85% collected their domestic water from springs during dry seasons. This figure, however, dropped to 77% during rain seasons. This is because respondents supplement water from their usual sources with water from roof catchment, though

still not well developed in the area. Only 3.7% use boreholes irrespective of season. This is despite an ambitious plan by the Government of Kenya in collaboration with Finland through KEFINCO and later on the Community Water Supply Management Project to provide water by sinking boreholes. This project was supply-driven and therefore failed to involve beneficiaries. Supply-driven initiatives do not involve the beneficiaries and are therefore unsustainable. Wells, as a source of water, are more popular when compared to both tap and borehole resources. About 5.7% and 8.0% use well water during the dry and rainy seasons, respectively. The use of wells was limited to the purpose for which the water was sought and the time of the year. This is because first; many people who had sunk wells had not taken water from the well for quality analysis and, therefore, were not sure of its quality and thus, the water was used for purposes such as washing and bathing. Secondly, due to either the lack of finance or technical know-how or both, most wells do not go up to the permanent water table, and therefore dry up during the dry season. Only about 5.3% and 6.0% use tap water as their source of water during dry and rain seasons.

Time Spent in Collecting Water

On average, sampled households spent 127min (2 hours) collecting water. The least amount of time spent on this activity is 6 minutes while the maximum is 720min (12 hours). The enormous amount of time spent fetching water does not in any way mean the resource is scarce, but due to the difficult terrain (steep slopes), water drawers have to traverse, undeveloped water sources especially unprotected springs, where drawers have to queue and wait for dirt to settle before fetching and crude methods of drawing water especially from wells. Thus, like the number of trips, the amount of time spent in fetching water is a function of amount of water used, number of households using a particular water point, nature of terrain, means of transport and distance to water point and nature of the water point.

Willingness and Rate to Pay for Rural Domestic Water

Willingness to Pay for Rural Domestic Water

Respondents were asked whether they currently pay for their domestic water from whichever source they obtain it. Only 11% answered in affirmative while 89% answered in the negative. It was noted that even those 11%, who said that they pay for water, did not pay per se, but for repair and cleaning around water points. Those who obtain water from protected springs or boreholes are asked to pay a small amount of money for repair work such as buying cement and pay a mason (in case of spring) and also buy spare parts for the pump and pay a technician (in case of a borehole). This only happens when water points need servicing or have broken down and thus need repair. A question was posed to the respondents, whether they would be willing to pay for their domestic water from whichever source they obtain it. Interestingly, 77% responded in affirmative while 23% answered in the negative. The 77%, who answered in affirmative, recognized that the world is changing in terms of population increase and resource scarcity and, therefore, everything is becoming monetised. As such, people need to accommodate the changes in order to match the changing times.

Water Rates for Respondents

Respondents were asked about the amount of money they were willing to pay per 20 l jerrycan of water from different sources (spring, borehole, and tap) and at different distances (< 1.0, 1.0-2.0, 2.1-3.0, > 3.0 km). The responses ranged from less than Ksh. 0.05 to 10, depending on the source of water and distance of the water point from home. When these different rates for various sources of water at different distances were averaged (summing rates of different respondents for particular source of water at a particular distance and dividing by the number of appropriate respondents), the results are presented in Table 1.

Table 3: Advantages and disadvantages of image data analysis using photo interpretation and quantitative analysis techniques

Distance / Source	< 1.0 km	1.0 –2.0 km	2.1 –3.0 km	> 3.0 km
Spring	1.36	1.00	0.80	0.29
Borehole	1.49	1.12	0.87	0.35
Tap	1.74	1.34	1.06	0.41

From these results, it is clear that the amount respondents were willing to pay for water differed with the source of water and its distance from the households. Respondents were willing to pay higher rates for tap than borehole water and least rates for spring water. On the other hand, the amount respondents were willing to pay inversely relate to the distance the water point is from home such that the nearer the distance to water point the higher the amount they were willing to pay. For instance, they were willing to pay Ksh. 1.49 for borehole water less than one kilometre away but only ready to pay Ksh. 0.35 when the water point is over three kilometres away. These variations in the amount respondents were willing to pay for water at different distances can be explained in terms of social externalities obtained by reduced time taken, energy expended, ill-health and general opportunity costs involved in collecting water nearer and far away from home. These variations in water rates demonstrate in a strong way that people are willing to pay a reasonably high amount of money for accessible water service in terms of distance and quality. These results compare favourably with those obtained by Altaf (1992), in their study on willingness to pay for water in rural Punjab, Pakistan. They found out that people in rural Punjab were willing to pay for water as long as the services were accessible and reliable.

A quick look at the results in Table 1 would lead one to conclude that there are significant variations between mean rates respondents are willing to pay for water from different sources and different distances from home. It is necessary, however, to determine the source of variations, that is, whether they are due to chance or are attributable to specific causes. To determine the sources of variations, a two-way ANOVA test was applied to verify the hypothesis that:

H_o: There is no significant difference between mean rates respondents are willing to pay for water from various sources and distances from home

The results of this test are presented in Table 2. The results indicate that the null hypothesis of no significant difference in the means of water rates respondents are willing to pay for water from various sources and distances cannot be sustained. The variations are, therefore, interpreted as significant and are not due to chance but due to certain specified causes.

Table 2: Results of two-way ANOVA *(Field data, 2001).*

Source of variation	Degrees of freedom(df)	Mean square(MS)	F-ratio	Significant F
Between distance	3	9777.44	2.44068	0.0073
Between sources	2	13229.03	3.30219	0.0000
Residual error	6	4006.13	-	-

The results presented in Table 2 show generally that there is significant difference between means of water rates respondents are willing to pay from various sources and distances from home. These results, however, do not distinguish, which sources of water and at what distance significantly differ with one another. To shade light on this issue, a paired t-test was performed to illustrate which paired sources of water and at what distance from the home differ significantly. Table 3 shows the results of this operation.

According to the results presented in Table 3, mean rates for different sources of water significantly differ from shortest distance covered to three kilometres. Beyond three kilometres, there is clearly no significant difference. For instance, there is no significant difference in the mean rates respondents were willing to pay for borehole and spring water ($P = 0.082 > 0.05$), spring and tap water ($P = 0.790 > 0.05$) and tap and borehole water ($P = 0.069 > 0.05$) whose water points are over three kilometres away from home. Generally, the mean rates respondents are willing to pay for water whose water point is

over three kilometres tend towards zero irrespective of the source of water. This can be interpreted to mean that as long as the water point is relatively far away from home, people become unwilling to spend money paying for such water. They expect to get water from such far away distances free of charge and are prepared to pay more for water from water points that are close to them. They would rather invest that money on acquiring efficient means of transport such as bicycles, wheelbarrows, ox-drawn carts or pay somebody to fetch the water for household than to buy.

Table 3: Results of paired t-test for mean rates respondents were willing to pay for water from different sources but at same distance

* Not significant at P< 0.05 *(Field data, 2001).*

Pair	**t-value**	**2-tailed significant**
Borehole water < 1.0 km: Spring water < 1.0 km	2.75	0.006
Borehole water < 1.0-2.0 km: Spring water 1.0-2.0 km	2.95	0.003
Borehole water < 2.1-3.0 km: Spring water 2.1-3.0 km	2.16	0.032
Borehole water > 3.0 km: Spring water > 3.0 km	1.77	0.082*
Spring water < 1.0 km: Tap water < 1.0 km	-4.92	0.000
Spring water < 1.0-2.0 km: Tap water 1.0-2.0 km	-5.56	0.000
Spring water < 2.1-3.0 km: Tap water 2.1-3.0 km	-4.83	0.000
Spring water > 3.0 km: Tap water > 3.0 km	-2.37	0.790*
Tap water < 1.0 km: Borehole water < 1.0 km	-3.57	0.000
Tap water < 1.0-2.0 km: Borehole water 1.0-2.0 km	-3.88	0.000
Tap water < 2.1-3.0 km: Borehole water 2.1-3.0 km	-3.59	0.000
Tap water > 3.0 km: Borehole water > 3.0 km	-3.71	0.069*

Conclusion

The government should adequately price water from all sources to enhance water as well as environmental conservation. The water rates should be decided upon from contingent valuation for the prices to be as inclusive as possible. The graduated rates should be given to those who cannot afford the set lifeline rates. Education and legal instruments should accompany this economic instrument of water conservation. The government and development agencies should address socio-economic factors that disable the ability of households to pay for water at accepted water rates. This can be done through implementation of the recommendations of the Poverty Reduction Strategy Paper (PRSP) that the government adopted recently. This will ensure that those who are qualified to benefit from graduated water rates are significantly reduced with time.

Acknowledgements

The Organization of Social Science Research in Eastern and Southern Africa (OSSREA), Addis Ababa, Ethiopia funded this study. The Community Water Supply Management Project in Western Kenya availed all the data needed for the study. Mrs Susan Wanjiru assisted in data collection. The University of Siegen is thanked for inviting me to participate in the summer school, while DAAD sponsored my participation through the Summer School Programme.

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