RURAL HOUSEHOLDS' PREFERENCES FOR MULTIPLE USES WATER SERVICES IN THE SEKORORO-LETSOALO AREA, LIMPOPO PROVINCE, SOUTH AFRICA A CHOICE MODELLING APPROACH

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Abstract

The provision of free basic water and a more equal distribution of water for productive uses are seen as important instruments to redress inequities from the past and eradicate poverty in South Africa (SA). Presently the government has committed itself to providing free basic water for all. However, provision of this water is still a problem especially in the rural areas. Financing of multiple use water services has been identified as an important ingredient for ensuring improved access to water for rural poor and at the same time accommodate for productive uses and broaden livelihood options for the poor in SA. Recent evidence has indicated the potential contribution that productive use of domestic water might make to food security and poverty reduction in rural areas of SA. Efficient, equitable and sustainable investment in improved domestic water services should be demand driven, that is, it should be based on a thorough understanding of effective demand by consumers for multiple use water services. The assessment of demand for improved domestic water services provides the basis for micro level analysis of consumer benefits from multiple water uses. Such studies are not common in SA's rural areas and most of the studies to date focus on either domestic or irrigation water demand. This study attempts to fill this gap by assessing the household demand for multiple water services in Sekororo-Letsoalo area in the Limpopo Province. Choice modelling is the approach used in this study to identify the attributes that determine demand for water services and quantify their respective importance. Households are presented with alternative water choices, corresponding to different levels of the attributes. In this study, the following attributes were used: water quantity, water quality, frequency of water supply, price of water, productive uses of water, and source of water. Choice modelling allows estimating the relative importance of these attributes for various groups (strata) of the studied population, and ultimately provides a measure of the willingness to pay for different aspects of water demand (attributes) and different water uses. Results show that households are willing to pay for water improvements.

Key words: choice modelling, multiple uses, rural households, water demand

1. Introduction

South Africa (SA) is a semi arid country with a mean annual rainfall of about 500mm, which is only 60% of the world average (Schulze *et al.*, 1997). The rainfall is poorly distributed spatially and temporarily. These climate characteristics coupled with poor groundwater availability limit the supply of water resources in SA.

Water scarcity is considered to be a major constraint to socio-economic development in SA (DWAF, 2003). In most parts of the country water resources are already fully utilized or overdrawn. The agricultural sector is the highest consumer of water accounting for about 62 % of the total water consumed while domestic and industry water use account for 32% and 6% respectively (AQUASTAT, 2005). Whilst domestic water use in rural areas accounts for a meager 5% of total annual water consumption, the efficient and equitable allocation of the water resource involves important trade-offs between different potential users and their rights. At the projected population growth and economic development rates, it is unlikely that the projected demand for water resources will be met and there will be increased competition among water users for the scarce resource. High pollution levels of surface and groundwater resources due to industrial effluents, domestic and commercial sewerage and agricultural runoff have worsened this situation (DWAF, 2003)

The domestic water sector in SA is characterised by significant inequities in terms of access to water inherited from the Apartheid era policies of 'separate development'. However, after the end of Apartheid, several institutional and policy reforms were undertaken to address the inequalities. The Water Services Act of 1997 and the National Water Act of 1998 provide the legislative framework for water services and water resource management respectively (Republic of SA, 1998). Since 1994, the national government was committed to its Reconstruction and Development goals, one of which was to improve basic water services as well as to improve levels of services over time. The Water Services Act decentralized the provision of water and sanitation services for domestic purposes to local governments with financial and technical support of provincial and national governments. Also, under this Act, provision of free basic water and sanitation services for all end users is compulsory.

The provision of free basic water and a more equal distribution of water for productive uses (i.e. irrigation, mining, and industry) are seen as important instruments to redress inequities from the past and eradicate poverty in SA (Republic of SA 1996). At present, the government has committed itself to ensuring that all people will have free access to at least 25 liters per capita per day of clean water (DWAF, 2005). However, the provision of free access to basic water services for all the users is still a major challenge for the water sector (DWAF 2003). At the same time, the SAn public sector is investing in infrastructures and management skills aimed at providing higher levels of water services, particularly in less advantaged areas. This effort has proved to be more difficult for municipalities in rural areas of former homelands due to inadequacy of human capital to plan, manage and control the water service infrastructure.

Free provision of water above the basic level is not without risk, as, if not carefully controlled and managed, it would place unsustainable demands on the financial resources of local and central government. An option to make financially viable the increased and improved water services in rural areas could come from the partial coverage of the investment and operating costs determined by these services. The raising of revenue from the water sector itself is therefore central to cost recovery from consumers and up-scaling of water services (Goldblatt, 1999).

Financing of multiple use water services has been identified as an important ingredient for ensuring improved access to water for rural poor and at the same time accommodate for productive uses and broaden livelihood options for the poor in SA (SA) (Lefebvre *et al*., 2005; Hope *et al*., 2003, Van Koppen *et al*., 2006). Recent evidence has indicated the potential contribution that productive use of domestic water might make to food security and poverty reduction in rural areas of SA (Hope *et al*., 2003; Hope and Garrod, 2004).

Efficient, equitable and sustainable investment in improved domestic water services should be demand driven. In other words, it should be based on a thorough understanding of effective demand by consumers for multiple use (both domestic and productive) water services (Whittington *et al*., 1998). The assessment of demand for improved domestic water services provides the basis for micro level analysis of consumer benefits from multiple water uses. Such studies are not common in SA's rural areas and most of the studies to date focus on either domestic water uses (Banda *et al*., 2004) or irrigation water use (Nieuwoudt *et al.,* 2004). This study attempts to fill this gap by assessing the household demand for multiple water services in the Sekororo-Letsoalo area, Maruleng municipality, Limpopo province, in the Olifants River Basin.

After having described the water users and uses in the study area, the paper applies the Choice modelling (CM) approach to estimate the relative importance of several characteristics (attributes) of water services and possible uses for different groups (strata) of local households. The CM approach is then applied to calculate local households' willingness to pay (WTP) for an improvement in the level of these water services.

The paper is organized as follows: Section 2 illustrates the analytical framework, section 3 illustrates presents the research methods, section 4 presents the results of the study, and section 5 concludes providing some policy implications of the findings.

2. Analytical Framework

Two main economic approaches are used to assess individual or household's demand for water. Both of them can be regrouped under the category of the stated preferences methods. These are the Contingent valuation method (CVM) and the Choice modelling (CM). CVM aims at estimating the value of a non marketed environmental good by inferring the value that its users are willing to pay for the good. CM is a generalization of the contingent valuation method in that it gives respondents a menu of cases from which they have to choose (Adamowicz *et al*., 1998). CM is a method for valuing non market goods by making use of attributes used to build policy scenarios. CM was used to elicit passive use values because it has several advantages over other methods (Hope and Garrod, 2004). Valuations of CM are based on attributes; this allows valuation of each of the attributes. CM also are useful for analysis of situational changes and trade off between attributes (Snowball et al, 2007; Hope and Garrod, 2004).

Data for CM are generated by systematic and planned process where attributes and levels are predefined to create choice alternatives.

The theoretical base of CM is in the random utility theory (RUT). The hypothesis of the RUT is that individuals make their choices based on the characteristics of the good along with random component. The random component may be as a result of the uniqueness of preferences of the individual or because the researchers may not have complete information about the individual. The theory therefore states that the utility of an individual j derived from a scenario i is not known but can be decomposed into a deterministic component V_{ij} and an unobserved random component, ε:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (1)$$

V_{ij} can be expressed as a linear function of the explanatory variables as follows:

$$V_{ij} = \beta' \chi_{ij} \quad (2)$$

Where β is a vector of coefficients associated with the vector χ of explanatory variables which are attributes of scenario *i,* and these include price, and the socio economic factors of individual *j*. Equation 2 shows that the socioeconomic variables can be included along with the choice set attributes (Snowball *et al*, 2007; Green, 2000).
The individual *j* would be assumed to choose an alternative *i* over k if $U_{ij}>U_{ik}$

For the conditional logit model (CLM) it is assumed that the error disturbances have a type 1 extreme value distribution:

$$\exp\left(-\exp(-\varepsilon_{ij})\right) \quad (3)$$

The selection of an alternative can be expressed as:

$$\mathrm{Uij} > \max_{k} \in_{ci,k\neq j} U_{ij} \quad (4)$$

Applying the CLM, the probability of choosing an alternative *j* among n_i choices for individual *I* is:

$$\begin{aligned} Pi(j) &= P\left[x'_{ij}\,\beta + \varepsilon_{ij} \geq \max_{k} \in_{ci} \left(x'_{ij} + \varepsilon_{ij}\right)\right] \quad (5) \\ &= \exp(x'_{ij}\,\beta) / \sum_{k} \in_{ci} \exp(x'_{ij}\,\beta) \end{aligned}$$

This means that the probability that the individual chooses j is equal to the probability that utility derived from j is greater than the utility derived from any other alternative (Whittington *et al*, 1990).

The most common econometric models used to process data in CM are the nested multinomial logit (NML), the conditional logit model (CLM) and the multinomial logit model (MLM). The MLM is applied to data where water service characteristics and household characteristics are included in the model. The NLM is a generalization of the MLM, which is applied to data grouped into nests tree-like structured. A respondent's decision is sequential. A CLM is applied to data where the explanatory variables are attributes. For this study, a CLM was applied as it seemed to be the best fit for the data, given that the explanatory variables are attributes and there is no status quo (i.e. choices are not sequential and there is no status quo in the choice experiment) (Greene, 2007).

3. Research methods

3.1 Study area

This study was carried out in the Sekororo-Letsoalo area, located within the quaternary catchment B72A of the Olifants River Basin, in the Limpopo province of SA. This research site is part of the Sekororo and Letsoalo tribal authorities and is located in Maruleng Local Municipality, Mopani District Municipality.

The study area includes 14 villages where, according to Bohlabela district Water Services Development Plan (2002), live 56,510 inhabitants. 89% of the population earn less than 162€/month, 95% is considered very poor, the majority depending on the government social grants for a living[1] (Statistics SA, 2001). A study carried out in 2003 by the NGO World Vision in 6 of the 14 villages shows that 39% of the sampled population relies on pensions and child grants whilst 49% rely on salaries and only 2.3% are into farming. 7.7% of the local households are reported to have no source of income at all.

The water access and water services vary across villages and wards. The percentage of households having access to private taps (inside yard) ranges from 20% to 65%, with an average of 40% for the whole area. Other sources of domestic water include public standpipes, vendors, and rivers/streams. Households do use water for productive purposes in the area as some are engaged in gardening, communal farming and have livestock. The mentioned World Vision study (2003) shows that about 43% of the households are involved in communal farming and 31% have communal gardens, whilst 63% reported that they breed livestock.

3.2 Data collection

Both primary and secondary data were used for this study. The secondary data came from government publications, research publications and reports, students' theses and reports. Primary data came from focus groups conducted with local stakeholders and household surveys. Secondary data were collected to identify the attributes and determinants of household's water demand. Focus group discussions were conducted in two of the 14 villages in order to validate the attributes gathered from literature and to allocate significant levels to these attributes. All data collected were used to design the choice experiment. The structured questionnaire was used to collect quantitative data about the households. Six enumerators (MSc students) speaking the local language were trained to interview the households.

[1] Households that have a monthly income of R800 or less are considered very poor.

3.3 Experimental design and sampling procedure

The focus group study allowed identifying the water services attributes to be used to design the options to be submitted to interviewed stakeholders in the form of cards for the choice experiment. Table 1 presents the attributes and levels that were identified from the focus group study.

In order to reduce the number of attribute and level combinations, an orthogonal design was used which allowed an investigation of “main” effects without being able to detect all interactions between attributes (Hanley et al., 2001). This is quite sufficient, since main effects usually count for 80-90% of the variation in the data of choice experiments (Willis et al., 2005, Snowball et al., 2007). For the orthogonal design we used the statistical package SAS.

The surveyed population was divided into two strata. Stratum 1 includes the households without private taps (in the yard), while stratum 2 is formed by household with private taps. All attributes indicated in Table 1 were submitted to stratum 1, whilst the attribute “source of water” was not part of the question sets for stratum 2.

Question sets were generated randomly into 24 sets for stratum 1 (6 attributes) and 18 sets for stratum 2 (5 attributes). This set-up had D efficiency, A Efficiency and G efficiency indicators higher than 96 %. The 24 and 18 combinations for the two strata were then paired into 12 and 9 choice cards, each containing two sets of questions from which the respondents would select. At least 3 cards (one at a time) were presented each surveyed household to select their best water alternative between the two in the card.

A sample of 150 households was initially considered representative (1.928% of the population). The study was then conducted in 7 villages in the Sekororo-Letsoalo area where 167 households (62% belonging to stratum 1 and 38% to stratum 2) were interviewed. Selection of the villages was based on 1) type of water access and 2) distance from the mountains (proxy for water availability) according to the 2001 Census. The submission of an average of 3 cards to each respondent resulted in a number of observations to be processed of 167 x 3= 501.

Table 1: Attributes and levels used in the CM in Sekororo-Letsoalo

Attribute	Description	Levels	A priori expectation
 Quantity of water	There is variability in quantities of water used across households. Generally, the quantities used for domestic purposes range from 75 litres to 200 litres per household per day.	▪ 3 *25l containers per day ▪ 6 *25l containers per day ▪ 12*25l containers per day ▪ >12 *25l containers per day	Positive
Frequency of water supply	Currently piped water is not available at all times. For most of the villages they have piped water two times a week. In other sources like rivers water is also not available at some times because of seasonality	▪ Current ▪ Water available for limited hours everyday ▪ Water available all times of the day everyday	Positive
Quality of water	Most of the households complained that the water they drink is not of good quality even though there are no incidences of water borne diseases. In some parts they complained that piped water is salty or muddy and hence they cannot drink or cook using this water.	▪ Current ▪ Purified	Positive
 Price of water	Currenlty households in Sekororo and Letsoalo areas do not pay a monthly bill for water. A tariff could be introduced to cover water provision cost	• R0 per month ▪ R10 per month ▪ R50 per month ▪ R100 per month	Negative
Productive uses	Househods in Sekororo and Letswalo areas use water for productive uses like backyard gardening irrigation, beer making, and building. At the moment they complain that they are not using water for some of these productive uses because water is not enough. On the other hand water supply inststutions do not allow people to use piped water for productive uses.	▪ Current ▪ More	Positive
 Source	The main sources of water are private taps, public standpipes, river, borehole, spring, rainwater.	▪ Current water source ▪ Private tap	Positive

4. Results

4.1 Socio-economic characteristics of the respondents

Household heads represented 64% of the respondents. The age of respondents ranged from 19 to 86 years. 77% of the respondents were women and this was an advantage as women are generally the ones who know about household water uses and sources. Household size for the villages ranged from 5 to 8 members, with an average of 6 for the whole sample. The household heads' educational level is very low, as almost 60% did not reach secondary school and 30% did not receive any formal education. The unemployment rate is high: 64% of household heads are not employed. The average household income is R1,654 per month and the overall distribution of income is highly skewed. About 76% of the households can count on a monthly income lower than R1,600. 51% of the households rely on pensions whilst only 29% rely on salaries.

4.2 Characterisation of water uses and users

Per capita water consumption was found below the Reconstruction and Development Programme (RDP) standard (25litre/capita/day) for 41% of the households. Water access is a major problem: most interviewed people seem to prioritise water for domestic purposes before they can engage into productive uses. A small proportion of households (those consuming higher quantities of water) are currently implementing multiple uses of water. The results showed that 71% of respondents were willing to pay for an improved water network. Households which were not willing to pay were characterized by low water consumption, educational level and per capita income. Gender of the respondents had an impact on the willingness to pay for water network refurbishment as a higher proportion of men were not willing to pay.

4.3 Determinants of rural households' water demand and willingness to pay for water services

A CLM was adopted to interpret the data collected through the choice experiment. The dependent variable for this model was the choice of water alternatives whilst the explanatory variables were represented by the attributes of water service.

The two original strata were: households without access to private taps (stratum 1) and households with access to private taps (stratum 2). During data analysis, the sample was further stratified on the basis of household's water consumption and household's income. This further stratification led to the typology of households described below.

Tables 2 to 9 present the results of the CLM for the different strata. The numbers shown in the tables are, for each attribute (variable) of the CLM regression, the estimated coefficient, the antilog of the coefficient, the implicit price and the significance of the coefficient.
The odds interpretation is calculated by taking the antilog of coefficient. Odds interpretation show how attribute level increases (or decreases) would result in a change in the probability of choosing a water alternative. Implicit prices[2] show the willingness to pay for improvement of the

[2] Implicit price= attribute coefficient/(price coefficient).

attributes. The overall performance of the regression can be evaluated by looking at the McFadden R^2 value. The McFadden value gives the proportion of the variance of the dependent variable which is explained by the variance in the independent variables. This value is a scalar measure which is between zero and 1. A model would be acceptable if its McFadden R^2 value is between 0.2 and 0.4 (Koutsoyanis, 1996).

Households with and without private taps

Results for stratum 1 (households without private taps) are presented in table 6.1. All coefficients except "productive uses" are significant and, with the exception of "price", all coefficients are positive, implying that improvements in each of these attributes are desirable to the households. All the signs of attributes coefficients therefore conform to economic theory. Analysing the antilog of coefficients, an increase in the quantity of water per day from one level to the next will result in a 1.01% increase in the respondent's probability of choosing the water alternative including this shift of level in the attribute. A one level increase in the frequency of supply of water would result in an increase in the probability of a respondent to choose this option by 3.7%. An increase in price of one level will result in a 1.09% decrease in the respondent's probability of choosing this option. Lastly, the shift from the current source of water to a private tap will result in an 11.6% increase in the respondent's probability of choosing this option.

Implicit prices values, calculated only for significant coefficients, show that households without private taps would be willing to pay for an improvement in the water service. Willingness to pay (WTP) of R0.10/month for a one liter/day increase was estimated. This implies that WTP of these households is R0.10 for 30 additional liters/month, or 3.33 R/m^3/month. Similarly, a WTP of R14.63/month was observed for an improvement in the frequency of supply from one level to the next. Quality of water is also an important determinant of households' WTP, as households would pay R19.44/month for purification of water. Finally, WTP for access to a private tap is the highest, corresponding to R27.67/month.

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Table 2: CLM Results of Stratum 1 - Households without private taps

Variable	Coefficient	Antilog of the coefficient	Implicit Price	P[|Z|>z]|
Quantity	0.004***	1.01	0.10	0.0045
Frequency of supply	0.563***	3.66	14.63	0.0000
Quality	0.749**	5.61	19.44	0.0233
Price	-0.039***	1.09	1.00	0.0000
Productive uses	0.071	-	-	0.7556
Water source	1.065***	11.61	27.67	0.0001

McFadden R^2 = 0.23

* significant at 10%
** significant at 5%
*** significant at 1%

Results from stratum 2 (households with private taps) are shown in table 3. The same attributes used for stratum 1 with the exception of "source of water" were included in the choice experiments for this stratum.

All the coefficients were significant with the exception of "productive uses". All the signs for coefficients conform to economic theory. Odds interpretation of the coefficients and implicit prices/WTP (for the significant coefficients) of households for the various attributes can be observed in columns 2 and 3 of table 3.

Table 3: CLM Results of Stratum 2-Households with private taps

Variable	Coefficient	Antilog of the coefficient	Implicit Price	P[lZl>z]l
Quantity	0.002**	1.00	0.06	0.0039
Frequency of supply	0.192*	1.56	6.60	0.0705
Quality	0.341**	2.19	11.74	0.0458
Price	-0.030***	1.07	1.00	0.0000
Productive uses	0.362	-	-	0.1640

McFadden $R^2 = 0.21$

The price elasticity of demand for water (the price coefficient) is higher for those households without private taps. This can be due to the fact that these households are poorer[3] than those with taps, and therefore more sensitive to the economic variable. For the two strata, the estimation is very significant, and this is consistent with the findings of Snowball *et al* (2007), who found that water price was very significant in an urban area of South Africa (Grahamstown), though the coefficient observed in this study was -0.067. Households with private taps have a higher preference for productive uses. This could be due to the fact that households without private taps are still worried about meeting their basic water needs before engaging in extra household uses of water.

An improvement in the quantity of water available has almost the same impact on the two groups of households' choice of water service. Conversely, an improvement of the frequency of water supply is perceived as more important for households without private taps. This could be interpreted as a perception of water availability by these households linked to the access to water and its reliability more than to the quantity of water available. The very high coefficient of "water source" for the households without private tap confirms the influence of the physical presence of a reliable tap close to the household in terms of choice of water services.

Both groups of households allocate higher relevance to a water quality improvement rather than to a better frequency of supply. This is due to the strong concern about the generally poor qualitative level of the resource. Nevertheless, because of the dramatic conditions of water collected from the rivers/streams or even from collective taps, households without private taps allocate even higher importance to this attribute (0.749) than households with private taps (0.341).

WTP for the different attributes follows the above explanations but is influenced by the higher price coefficient for households without private taps.

Household's water consumption and water services choices

In order to interpret more precisely the results from the two strata presented above, it appeared worthwhile to cross the character used to define the two strata presented in the previous session with another variable: the household's consumption of water per day. After having observed the average consumption of water for the whole surveyed sample, it was decided to consider

[3]Mean monthly income per capita for households without private taps is R248 and R462 for households with private taps.

"households consuming less water" those having a daily water consumption lower than 150 liters and "households consuming more water" those having a daily consumption higher that 150 liters.

The introduction of this new variable allowed splitting the whole sample into four groups: "households with private tap consuming more water"; household without private tap consuming more water"; "households with private tap consuming less water"; "households without private tap consuming less water". Tables 4 to 7 present the results of a CLM applied to the four sub-groups of households.

The results show that all the attributes except "productive uses" for households without private tap consuming less water (which is also the only non significant coefficient) still conform to economic theory.

In the group without private taps (tab. 4 and 5), the higher coefficients shown by the households consuming more water for "frequency of supply" and "water source" indicate that the requirement of a more reliable and close water supply source is stronger in households where water consumption is higher. "Productive uses" (even if not significant) is positive and higher than in stratum 1, confirming that higher water consumption and therefore availability induces more interest of extra-household water uses. Households without private taps consuming more water are less concerned with water quality but more concerned with water price, as their high consumption of a more expensive resource would have a negative influence in their familiar budget.

Table 4: Stratum 1a- Households without private tap consuming less water

Variable	Coefficient	Antilog of coefficient	Coefficient/(price coefficient)	P[lZl>z]
Quantity	0.004**	1.01	0.10	0.0105
Frequency of supply	0.422***	2.64	11.63	0.0033
Quality	0.716**	5.20	19.73	0.0458
Price	-0.036***	1.09	1	0.0000
Productive uses	-0.039	-	-	0.8790
Water source	1.006***	10.14	27.71	0.0008

McFadden $R^2 = 0.28$

Table 5: Stratum 1b- Households without private tap consuming more water

Variable	Coefficient	Antilog of coefficient	Coefficient/(price coefficient)	P[lZl>z]
Quantity	0.004	-	-	0.2720
Frequency of supply	1.251***	17.82	24.80	0.0031
Quality	0.548	-	-	0.6138
Price	-0.050***	1.12%	1	0.0023
Productive uses	1.011	-	-	0.1909
Water source	1.779**	60.12	35.27	0.0261

McFadden $R^2 = 0.34$

Interestingly, when private taps are available (tables 6 and 7), the frequency of supply is less important for households consuming more water than for households consuming less, as the latter are probably more affected by interruptions of the service even when the tap is physically within the premises. The higher coefficient for the attribute "productive uses" when consumption is higher seems to confirm the findings about the emergence of the interest for extra household uses when basic needs are satisfied.

Table 6: Stratum 2a- Households with private tap consuming less water

Variable	Coefficient	Antilog of the coefficient	Coefficient/(price coefficient)	P[|Z|>z]
Quantity	0.002*	1.00	0.057	0.0503
Frequency of supply	0.243*	1.75	9.02	0.0781
Quality	0.209	-	-	0.3349
Price	-0.027***	1.06	1	0.0000
Productive uses	0.102	-	-	0.7431

McFadden $R^2 = 0.17$

Table 7: Stratum 2b- Households with private tap consuming more water

Variable	Coefficient	Antilog of coefficient	Coefficient/(price coefficient)	P[|Z|>z]
Quantity	0.003**	1.01	0.071	0.0265
Frequency of supply	0.101	-	-	0.5524
Quality	0.620**	4.17	17.24	0.0374
Price	-0.036***	1.09	1	0.0000
Productive uses	0.935*	8.61	26.02	0.0633

McFadden $R^2 = 0.24$

Household's income and water services choice

Another aspect considered worth to be analysed was the household income, as this could be explicative of current access to water services or of the capacity to pay service improvements. Households were therefore grouped on the basis of per capita income per month and CLM was applied to the resulting four sub-strata separately. Median income was R 8.04 /capita/day. It was decided to consider "poor households" those earning less than the median income per capita, corresponding, for a family of 6 members, to 1,450 R/month. Due to the few observations available for poor households having private taps, CLM was applied only to stratum 1. Tables 8 and 9 show the results of CLM applied to stratum 1 crossed with the income variable.

Table 8: Stratum 1c - Households without private tap and lower income

Variable	Coefficient	Antilog of coefficient	Implicit price	P[|Z|>z]
Quantity	0.003*	1.01	0.07	0.090
Frequency of supply	0.496***	3.14	11.27	0.004
Quality	0.930**	8.51	21.14	0.045
Price	-0.044***	1.11	1.00	0.000
Productive uses	-0.190	-	-4.32	0.780
Water source	1.036***	10.87	23.55	0.005

McFadden $R^2 = 0.20$

Table 9: Stratum 1d - Households without private tap and higher income

Variable	Coefficient	Antilog of coefficient	Implicit price	P[|Z|>z]
Quantity	0.005**	1.01	0.15	0.013
Frequency of supply	0.682***	4.81	20.46	0.001
Quality	0.574			0.246
Price	-0.033***	1.08	1.00	0.001
Productive uses	0.235	1.72		0.470
Water source	1.149***	14.10	34.48	0.007

McFadden $R^2 = 0.18$

It is clear that the higher elasticity to water price for households with lower income has a negative impact on their WTP for all attributes. Quantity and frequency of supply seem to be the most sensitive attribute for relatively wealthier households, whereas water quality is the higher concern for poorer households. Households with relatively higher income are also more willing to pay for private tap water.

5. Conclusions and policy implications

The CM approach applied to the rural households in the Sekororo-Letsoalo area showed clearly that local inhabitants are concerned with water availability and quality. This concern results in a clear WTP for improved water supply and services.

This WTP is related to the actual capacity to pay of the different households, and this depends on the income level of the respondents.

Multiple uses of water are not frequent in the studied area and this mainly because the general scarcity of water pushes local households to be concerned first of all about basic domestic uses. A clear interest to engage in multiple uses was observed only in those households that already have enough water to satisfy basic domestic needs. This would confirm that very poor conditions in terms of water availability not only reduce drastically the current livelihood of rural households, but their ambitions and willingness to improve their status is affected as well. Only the satisfaction of basic human needs induces a certain push to engage in extra-household water uses that could enhance the economic conditions of the family.

The calculated WTP per household are very comparable to those observed in similar rural conditions by Banda et al., (2007) and demonstrate that there is room for policies aimed at improving rural domestic water infrastructures and services through a mechanism of partial recovery of the investment and operating costs through the introduction of water tariffs based on the quantity consumed.

IWRM in developing countries passes also through the efficient and equitable allocation of water to rural domestic users. The lack of equity in the provision of water services in these areas is flagrant today. A minimum amount of water must be supplied free of charge and in a reliable way (collective taps, private taps) to all rural households. These households demonstrate to be WTP, in accordance to their low income, additional amounts of water. These additional amounts would improve further the quality of life of rural households and can be used for extra-household uses such as backyard irrigation, beer production, etc., which are likely to foster local economies and improve local livelihood.

A multiple-step system to charge residents for water could then be adopted, where the first step (basic human needs) is free of charge, and the following ones apply progressive unitary prices to the water consumed on the basis of the demand analyses conducted in the area and the resulting WTP.

CM applied to the Sekororo-Letsoalo area showed the utility of stated preferences methods to elicit local residents' demand characteristics and WTP for various aspects of water services. The combined use of different economic methods (for instance the travel cost in addition to the CM, or a dichotomous choice method such as the CVM) would certainly improve the accuracy of the results and increase their soundness.

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