# Water value and demand for multiple uses in the rural areas of South Africa: The case of Ga-Sekororo

By

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I, Phillipa Kanyoka declare that the thesis/ dissertation, which I hereby submit for the degree MSc: Agricultural Economics at the University of Pretoria, is my own work and has not been previously submitted by me for a degree at this or any other tertiary institution.

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# Dedications

To my daughter and my husband, Celine and Wellington, who endured times of loneliness during the tiring moments of preparation of this document.

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# Abstract

The provision of free basic water for domestic uses 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). Although the government committed itself to providing free basic water for all, this result is still far to be reached, particularly in rural areas. Financing of multiple use water services was identified as an important ingredient to insure improved access to water for rural poor in SA and at the same time allow productive uses and broaden livelihood options. Recent evidence indicated the potential contribution that productive uses of domestic water might make to food security and poverty reduction in rural areas of SA. Following the principles of integrated water resource management (IWRM), efficient, equitable and sustainable investment in improved 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 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, where most of the economic analyses focus on either domestic or irrigation water demand. This study attempts to fill this gap by assessing the household demand for multiple use water services in Sekororo-Letsoalo area in the Limpopo Province. Choice modelling is the approach used to identify the attributes determining demand for water services and quantify their respective importance. Households are presented with alternative sets of water services, 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 strata of the studied population, and ultimately provides a measure of the willingness to pay for different aspects of water demand (attributes), including productive water uses. Results show that households in rural areas are willing to pay for water services improvements. Due to the poor quality of present water services in the area, users are primarily concerned with basic domestic uses and demand for non domestic water uses is low. Only households already relatively well served are interested in engaging in multiple water uses.

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# Chapter 1

# Background and Problem Statement

## 1.0 Introduction

South Africa 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. About 65% of the country receives rainfall below 500mm and droughts are a major threat in most parts of the country (DWAF, 2005). Over most of the country the average annual potential evaporation exceeds annual rainfall, which limits available surface water resources. These climate characteristics coupled with poor groundwater resources limit the supply of water resources in South Africa.

Water scarcity is considered to be a major constraint to socio-economic development in South Africa (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 6% and 32% respectively (AQUASTAT, 2005).

Following the principles of integrated water resource management (IWRM), 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 by 2009 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 (WSDP, 2003).

The domestic water sector in South Africa is characterised by significant inequities in terms of access to water inherited from the apartheid era policies of 'separate development'. However, after 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 South Africa, 1997; Republic of South Africa, 1998). Since 1994, the national government has been 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 from 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 South Africa, 1997). At present, the government has committed itself to ensuring that all people will have free access to at least 25 litres 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 SA public sector is investing in infrastructures and management skills aimed at providing higher levels of water services, particularly in less advantaged areas. This effort proved to be more difficult for rural municipalities located in former homelands, due to inadequacy of human capital to plan, manage and control the water service infrastructure and lack of appropriate financial means.

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 governments. 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 through the introduction of user fees. In fact, the raising of revenue from consumers is central to cost recovery of current investments and future 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 accommodating for productive uses and broaden livelihood options for the poor in South Africa (Lefebvre *et al*., 2005; Hope *et al*., 2003, Van Koppen *et al.*, 2006). Recent evidence has indicated the potential contribution that productive uses of domestic water might make to food security and poverty reduction in rural areas of South Africa (see Pérez de Mendiguren Castresana 2004; Hope *et al*., 2003; Hope and Garrod, 2004). Efficient, equitable and sustainable investments in improved domestic water services should be demand driven, that is, they should be based on a thorough understanding of effective demand by consumers for multiple use water services (both domestic and productive uses) (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 South Africa's rural areas and most of the studies to date focus on either domestic water uses (e.g. Banda *et al*., 2006) or irrigation water use (Nieuwoudt *et al.,* 2004). This study attempts to fill this gap by assessing the household demand for multiple use water services in Sekororo-Letsoalo area (Maruleng municipality, Limpopo province), located in the Olifants River Basin. This site has been chosen for this research because it is the site of a project on Multiple Use Water Services (MUS) led by the International Water Management Institute (IWMI).

This study aims at describing water users and uses in Sekororo- Letsoalo area. A choice modelling (CM) approach (or Choice Experiments, as the method will alternatively be named later on in this thesis) is applied to elicit determinants of water demand for households and to estimate the relative importance of several attributes (characteristics) of water services and possible uses for different groups of local households. The CM approach is used to assess the trade-offs among different attributes across households as well as to estimate local households' willingness to pay (WTP) for these water service improvements.

## 1.1 Research Questions

The research questions which this study tries to answer are as follows:

1) What are the current main uses of water and water services in the area and do these vary across household types?
2) What are the preferences of rural households in terms of water uses?
3) Are rural households willing to pay for services that cater for their multiple water uses? How much are they willing to pay?
4) What are the determinants of the households' water demand?

## 1.2 Research Objectives

The broad objective of the study is to assess the demand for improved domestic water services and hence provide the basis for micro level analysis of consumer benefits from multiple water uses in rural areas of South Africa (Sekororo-Letsoalo as the case study).

The specific objectives are as follows:

1) To identify the different water sources, uses and therefore build a typology of water-related livelihood activities and a typology of households based on these activities;
2) To identify the water services improvements desired by the households;
3) To assess households' willingness to pay for improved water services, including services for multiple water uses;
4) To assess the determinants of household willingness to pay for improved water services.

## 1.3 Research Hypothesis

1) Rural households use domestic water for multiple uses (domestic and productive uses). The pattern of access to and uses of domestic water is influenced by socio-economic characteristics of households (livelihood activities, family size, gender, age of household head, income) and local circumstances (Hope *et al.,* 2003).
2) Households desire improved water services which cater for their domestic and productive uses.
3) Rural households are willing to pay for improved water availability and accessibility that respond to their multiple uses. This therefore means that part of the cost of the service can be recovered through water user fees (Banda *et al.*, 2007).
4) A household's willingness to pay (WTP) for an improvement in water services is a function of the proposed changes in the attributes of the services, and of all other factors which influence the household's valuation of that change (including household's characteristics) (Whittington, 2002).

Table 1.1 presents the linkages between research objectives, research questions and hypothesis, data requirements and analytical approaches used in this study.

Table 1. 1 Linkages between research objectives, research questions, hypotheses and analytical tools used

| **Research Objectives** | **Research Questions** | **Research Hypotheses** | **Data Required** | **Analytical Tools** |
|---|---|---|---|---|
| To identify the different water sources, uses and therefore build a typology of water-related livelihood activities and a typology of households based on these activities | What are the current main uses of water and water services in the area and do these vary across household types? | Rural households use domestic water for multiple uses (domestic and productive uses). The pattern of access and uses of domestic water is influenced by socio-economic characteristics of households (livelihood activities, family size, gender, age of household head, income). | Household socio economic factors (e.g. household size, age of household head, household income, educational level, uses and sources of water) | Descriptive statistics |
| Identify the water services improvements desired by the households. | What are the water services which are desired by the households? | Households desire improved water services which cater for their domestic and productive uses. | Gather data on desired improvements of water services through focus group discussion and household survey | Descriptive statistics, focus group study |
| To assess household willingness to pay for multiple water uses. | Are rural households willing to pay for services that cater for their multiple water uses? How much are they willing to pay? | Most of the rural households are willing to pay for domestic water use. | Gather data on cost, monthly water bill, and desired water services option, through household survey. | Choice modelling |
| To assess the determinants of households' willingness to pay for improved water services. | What are the determinants of their water demand? | A household's WTP for an improvement in domestic water services is a function of the proposed changes in the attributes of the services, and of all other factors which influence the household's valuation of that change. | WTP bids, household characteristics, attributes of the services, all other factors which influence the household's valuation of that change. | Conditional Logit model, choice modelling |

## 1.4 Organisation of the thesis

Chapter two describes the study site, the Sekororo-Letsoalo area in Maruleng municipality, Limpopo province of South Africa. The household demography and the socio economic factors of the population are explored and a typology of water uses and users is proposed.

Chapter three reviews the theoretical and empirical literature related to water demand valuation for domestic and productive uses. This chapter focuses on studies that were done in developing countries to value water and assess determinants of domestic water demand. This section also reviews studies that used choice experiment to value other environmental goods. The objective of literature review is to identify determinants of water demand and approaches that can be used for the study.

Chapter four presents the methods and procedures used for this research. It describes how the choice experiment was designed using the results of a focus group study and secondary data. The sampling procedure and data collection method are also presented, as well as the data requirements, sources of data and data limitations.

Chapter five is the first analytical chapter which main objective is to assess the household demographics and typology of water uses and users. Frequencies, cross tabulations, Chi-square test, t tests and ANOVA were used to compare socio-economic variables and water services across sampled households and villages.

Chapter six presents the determinants of water services desired by interviewed households across strata, villages and several strata and sub-strata of households (strata of households are defined using the connection to a piped system; the level of income and the level of water consumption). This section models the household preferences for water services using a Conditional Logit Model (CLM).

Chapter seven gives a summary of findings, policy insights and conclusions from the study.

# Chapter 2

# Description of the study site

## 2.0 Background of the study site

This study was carried out in Sekororo-Letsoalo area, located within the quaternary catchment B72A of the Olifants River Basin, which is about 60km from Tzaneen in the Limpopo province. This area is part of the Sekororo tribal authority and Letsoalo tribal authority and is located in Maruleng Local Municipality, Mopani District Municipality (Fig. 2.1). Several research projects are currently going on in the area including two IWMI-led projects on "*Models for Implementing Multiple-use Water Supply Systems for Enhanced Land and Water Productivity, Rural Livelihoods and Gender Equity*" and "*The Challenge of Integrated Water Resource Management for Improved Rural Livelihoods: Managing Risk, Mitigating Drought and Improving Water Productivity in the Water Scarce Limpopo Basin*" (Multiple Use Systems and Waternet projects in short). This study is part of the Multiple Use Systems (MUS) project. The MUS project focuses on developing tested tools and guidelines for multiple-use water services delivery as an effective way to use water for poverty alleviation and gender equity. It adopted a participatory, integrated and poverty reduction focused approach in poor rural and peri-urban areas. One of the main assumptions of this project is that provision of water for multiple uses will increase poor people's ability and willingness to pay for water services and hence improve recovery of costs of the service from users (van Koppen *et al.,* 2006).

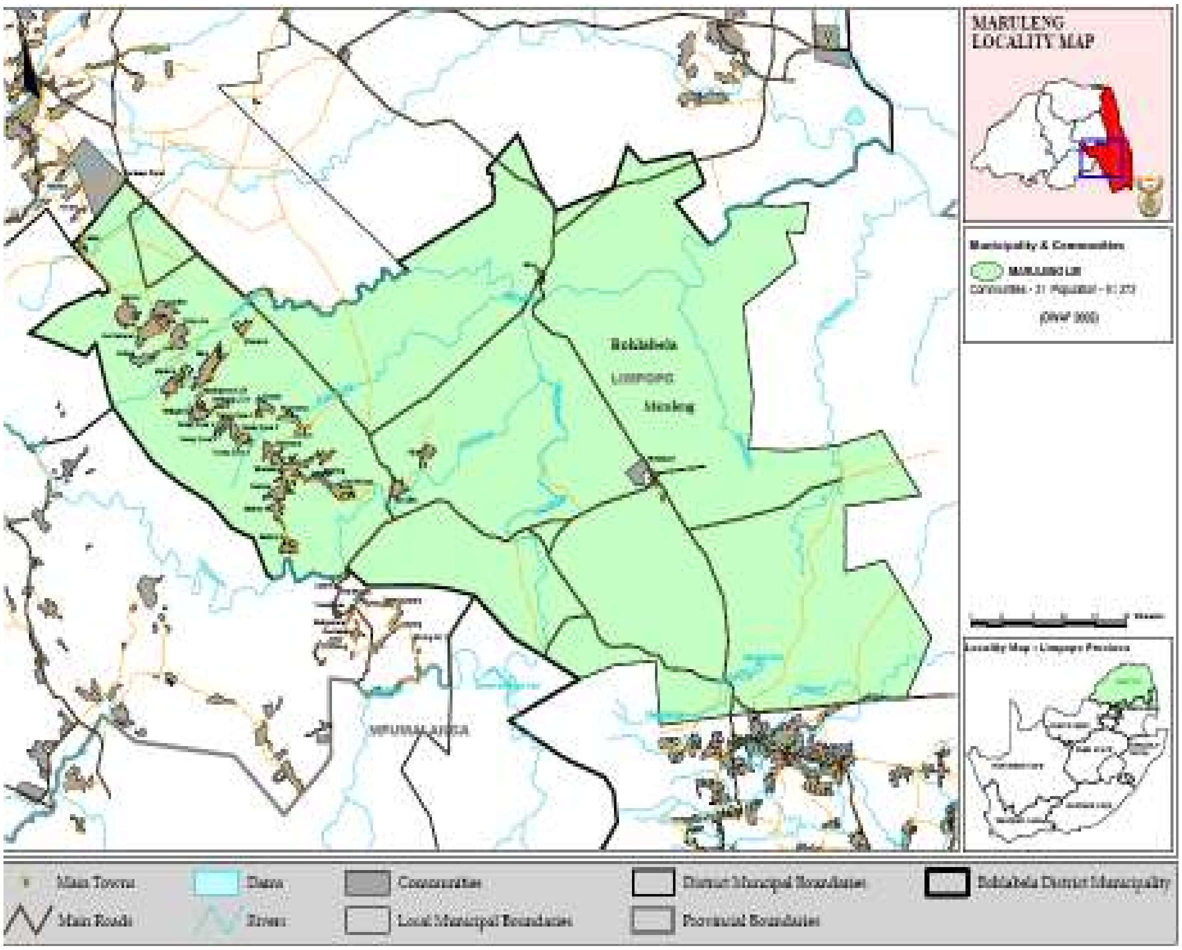



Figure 2. 1: Geographical location of the study site
Source: Maruleng Municipality WSDP, 2003

## 2.1 Socio demographic characteristics of the study area

The study area is composed of 14 villages located in the B72A quaternary catchment: Balloon, Bismarck, Enable, Ga-Sekororo (which includes Moshate and Mahlomelong), Lorraine, Madeira, Makgaung, Metz, Sofaya, Ticky Line (also called Hlohlokwe), and Turkey zones 1-4. According to Bohlabela district Water Services Development Plan (WSDP) the total population of these 14 villages was 56510 inhabitants in 2002 (Bohlabela district WSDP, 2003). Villages have different access to water resources depending on the distance from the mountains[1]. Information of distance from the mountain was used as the basis for selection of villages where primary data would be collected (Table 2.1).

The **v**illages fall into wards 1, 2, 3, 4 and 5 of Maruleng municipality (Census 2001 boundaries). Wards 1, 2 and 5 are partly included in B72A. Wards 1 and 2 include some commercial farms; ward 5 includes commercial farms, private game reserves and part of other quaternary catchments. Ward 3 and 4 are completely included into B72A. The total population of these 5 wards was 59319 inhabitants in 2001. In order to select villages from which the sample was selected, it was necessary to stratify households based on water access and distance from the mountain. We assumed that the level of present water services is a determinant of water services demand. From previous studies in the area we also know that access to water services vary across households. The only reliable and exhaustive information available on access to water services in the area is at ward level (Census 2001). Household information on water access is not available at village level. Therefore, we had to allocate the villages into their respective wards. It was quite difficult to identify which ward the villages belong to because ward boundaries have changed between 2001 and the last municipal elections of 2005/06. For this study the following distribution was assumed (see Table 2.1).

1Distance from the mountain is important as this affects household water access. This is mainly because of differential rainfall and numerous streams and springs on the slopes of the mountains, which dry up further downstream.

Table 2. 1: Population of the 14 villages in 2002 and distance from the mountains

| Village | Ward 2001 | Population 2002 | Distance from mountains[2] |
|---|---|---|---|
| Balloon | 1 | 3140 | Close |
| Ga-Sekororo | 1 | 3140 | Close |
| Lorraine | 2 | 8546 | Mid |
| Sofaya | 2 | 3055 | Close |
| Ticky Line | 2 | 7668 | Mid |
| Madeira | 3 | 3995 | Close |
| Metz | 3 | 8658 | Mid |
| Bismarck | 3 | 2735 | Far |
| Makgaung | 4 | 4647 | Close |
| Turkey zone 4 | 4 | 1479 | Mid/close |
| Turkey zone 3 | 4 | 1874 | Mid/close |
| Turkey zone 2 | 5 | 2036 | Mid |
| Turkey zone 1 | 5 | 2819 | Mid |
| Enable | 5 | 2718 | Far |
| Total | 59319 | 56510 | |

Source: Bohlabela district WSDP 2003

Results of Census 2001 show that 55% of the population is female and over 70% of the population are below the age of 40 (Census 2001). Table 2.2 shows that the dependency ratio is high as 62% of the population is not economically active. 89% of the population earn less than R19200 per year[3] and 76% of the population is considered very poor on the basis of household monthly income[4] (Table 2.5).

Table 2. 2 : Employment status of potentially active population in wards 1 to 5 of Maruleng municipality

| **Employment Status** | Wards 1-5 | |
|---|---|---|
| | Number of people | % of people aged 15 to 64 |
| employed | 4116 | 13% |
| unemployed | 7596 | 24% |
| labour force | 11712 | 38% |
| not economically active | 19410 | 62% |
| unemployment rate | 65% | |

Source: Census, 2001

2 Water flows from the mountains and villages which are close have better water access
3 €1=R10 in 2002
4 Households that have a monthly income of R800 or less are considered very poor

Table 2.3 shows the proportion of people employed in various sectors based on Census, 2001. The Table shows that a significant proportion of the population rely on pensions and social grants; agricultural/ forestry/fishing sector is an important source of employment as it employs 28% of the labour force. Results from census (2001) are consistent with those from two World Vision (a non governmental organization) studies in the area[5] which showed that 39% of the sampled population rely on pensions and child grants whilst only 49% depend on regular salaries and less than 3% get an income from agriculture. At least 4 % of the local households are reported to have no source of income at all (see Table 2.4).

Table 2. 3: Distribution of employed people per industrial sector in wards 1 to 5 of Maruleng Municipality

| **Sector** | **Percentage** |
|---|---|
| Agriculture/Forestry/Fishing | 28% |
| Community/Social/Personal | 34% |
| Construction | 7% |
| Electricity/Gas/Water | 1% |
| Financial/Insurance/Real Estate/Business | 3% |
| Manufacturing | 3% |
| Mining/Quarrying | 1% |
| Private Households | 7% |
| Transport/Storage/Communication | 4% |
| Undetermined | 5% |
| Wholesale/Retail | 8% |
| Total | 100% |

Source: Census, 2001

5 These studies included some villages which are not in the study area and considered household main source of income only. One of the studies (Enable ADP) covers 4 villages; Enable, Turkey, Worcester and Butswana and the other study (Kodumela ADP) covers 6 villages; Sofaya, Turkey, Makgaung, Moshate, Madeira and Metz.

Table 2. 4: Distribution of households on the basis of main sources of income in Kodumela and Enable ADP areas

| | Kodumela ADP | | Enable ADP | |
|---|---|---|---|---|
| **Income source** | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| Farming | 9 | 2.3 | 11 | 2.9 |
| Salary | 191 | 48.7 | 127 | 32.4 |
| Vending | 3 | .8 | 33 | 8.4 |
| Pension | 112 | 28.6 | 65 | 16.6 |
| Child grant | 38 | 9.7 | 127 | 32.4 |
| Other | 9 | 2.3 | 84 | 3.1 |
| None | 30 | 7.7 | 17 | 4.3 |
| Total | 392 | 100.0 | 392 | 100.0 |

Source: World Vision, 2005

Household incomes in wards 1 to 5 are very low. Table 2.5 presents the distribution of households according to their level of annual incomes in wards 1 to 5. 41% of households reported that they do not earn any income. The second income class in terms of number of households is between R4 800 and R9 600, with 24% of households. Only 5% of the households has income above R 38 400 a year. The findings by World Vision (2005) are consistent with Census (2001) results, as it shows that most households earn between R6000-R18000 (see Table 2.6). The two sources mainly differ on the percentage of households without any income, as World Vision study found that less than 10% of households have no source of income. This difference could be due to the difference of dates of survey (2001 for Census and 2005 for World Vision) and the way in which income information was collected in both studies: the Census calculated the household annual income by adding the individual monthly income of all members of the household collected in ranges; therefore the accuracy of this variable is unknown; conversely, World Vision study asked directly about the household income.

Table 2. 5: Distribution of households per class of annual income in wards 1 to 5 of Maruleng Municipality

| Annual income | Number of households | % of total households | Cumulative percentage |
|---|---|---|---|
| None | 4944 | 41% | 41% |
| R1 - 4800 | 1323 | 11% | 52% |
| R4801 - 9600 | 2859 | 24% | 76% |
| R9601 - 19200 | 1503 | 13% | 89% |
| R19201 - 38400 | 708 | 6% | 95% |
| >R38400 | 624 | 5% | 100% |
| Total | 11961 | 100% | 100% |

Source: Census 2001, own calculations

Table 2. 6: Distribution of households per class of annual income in Kodumela and Enable ADP areas

| | Kodumela ADP | | | Enable ADP | | |
|---|---|---|---|---|---|---|
| **Income** | **Frequency** | **Percent** | **Cumulative Percent** | **Frequency** | **Percent** | **Cumulative Percent** |
| None | 30 | 7.7 | 7.7 | 17 | 5.0 | 5 |
| R1- R2400 | 18 | 4.6 | 12.3 | 102 | 30.0 | 35.0 |
| R2401-R6000 | 69 | 17.6 | 29.9 | 133 | 39.1 | 74.1 |
| R6001-R18000 | 256 | 65.3 | 95.2 | 47 | 13.8 | 87.9 |
| R18001-R24000 | 9 | 2.3 | 97.5 | 17 | 5.0 | 92.9 |
| R24001-R60000 | 9 | 2.3 | 99.7 | 21 | 6.2 | 99.1 |
| >R60000 | 1 | .3 | 100.0 | 3 | 0.9 | 100.0 |
| **Total** | **392** | **100.0** | | **340** | **100** | |

Source: World Vision, 2005

## 2.2 Infrastructure and water access

Although 85% of the total population in South Africa has access to tap water, there is great variation in access to water across districts and rural and urban areas. In some rural areas, approximately 30% or less have access to tap water (Stevens, 2007). In the former homeland areas of the Olifants River basin, 45% of the population has water access which is below the RDP standard [6](Lefebvre, 2005). As is the case in many former homelands in South Africa, infrastructure development in Sekororo-Letsoalo area is very low and

[6]A household is said to have poor water access when it is 200m or more away from the nearest source of piped water.

water and sanitation services are very poor. In 2002, it was reported that 73 percent of the population consume up to10 litres of water per capita per day (Maruleng Municipality, 2002; Panesar, 2006). In addition, only 10 percent of its population is considered to have reliable access to water (Panesar, 2006).

Most of the infrastructure (which comprises weirs on streams or boreholes, reservoirs and reticulation systems supplying communal standpipes) was built during the apartheid by the former homeland government in the mid-eighties. Since 1994, the water supply schemes have been managed by DWAF, but only few improvements have been made. Efforts to improve water services have been limited mainly by the scarcity of local water resources, which are not sufficient to supply all the households, and the lack of proper planning and management of infrastructure (which is very old) due to shortage of human and financial capital in the local and district municipalities. Domestic water supply schemes are in the process of being transferred by DWAF to the District Municipality and they are in need of rehabilitation. The present water supply project from Mopani District municipality intends to source water from the Blyde River.

Table 2.7 presents the distribution of households per type of water access in the study area. Households in the area depend on diverse sources of water including in-dwelling tap, inside yard tap, community stand, borehole, spring, rain tank, river/stream, water vendor and stagnant water (like dams and pools). 38% of households have private taps connected to public water network. Yard taps are sometimes treated as community resources as some households in the vicinity collect water from these. In Sekororo-Letsoalo area there are mainly public standpoints where households collect water, but water supply from this source is very low and sometimes the standpipes are broken, such that households have to depend on other sources like rivers and ponds. 46% of households collect water from community stands. 53% of those who collect water from community stands are located more than 200m away from the stand (Census 2001).

Table 2. 7: Distribution of households per ward and access to water services in the study area

| Type of access to water services | ward 1 | ward 2 | ward 3 | ward 4 | ward 5 | Total |
|---|---|---|---|---|---|---|
| In dwelling tap | 12 | 51 | 87 | 81 | 75 | 306 |
| Inside yard tap | 567 | 573 | 1521 | 921 | 606 | 4188 |
| Community Stand | 162 | 1329 | 666 | 225 | 717 | 3099 |
| Community stand over 200m | 144 | 936 | 564 | 210 | 561 | 2415 |
| Borehole | 9 | 18 | 6 | 0 | 18 | 51 |
| Spring | 0 | 66 | 87 | 15 | 54 | 222 |
| Rain Tank | 0 | 0 | 6 | 3 | 3 | 12 |
| Dam/Pool/Stagnant Water | 0 | 15 | 15 | 3 | 24 | 57 |
| River/Stream | 126 | 141 | 126 | 63 | 807 | 1263 |
| Water Vendor | 3 | 3 | 3 | 0 | 6 | 15 |
| Other | 105 | 42 | 138 | 27 | 24 | 336 |
| % of households with private tap | 51% | 20% | 50% | 65% | 24% | 38% |

Source: Census 2001, own calculations

Water sources vary markedly across wards. Figure 2.3 shows the proportion of households with private taps in the study area. Most households (65%) in ward 4 have access to private taps whilst only 20% of households in ward 2 have access to private taps. In wards 1 and 3 at least 50% of the population have access to private taps. In ward 1 springs, rain tanks, dams and stagnant water are not used as sources of water. In ward 4 boreholes and water vendors are not used as sources of water. 60% of the households in ward 2 collect water from public standpipes and for 70% of these households the standpipe is more than 200m away from the homestead (see Table 2.7 and fig. 2.2).

Figure. 2.2 shows that in all wards a significant number of households have no access to private taps. Wards 3 and 4 have the best access to private taps whilst ward 2 has the worst.

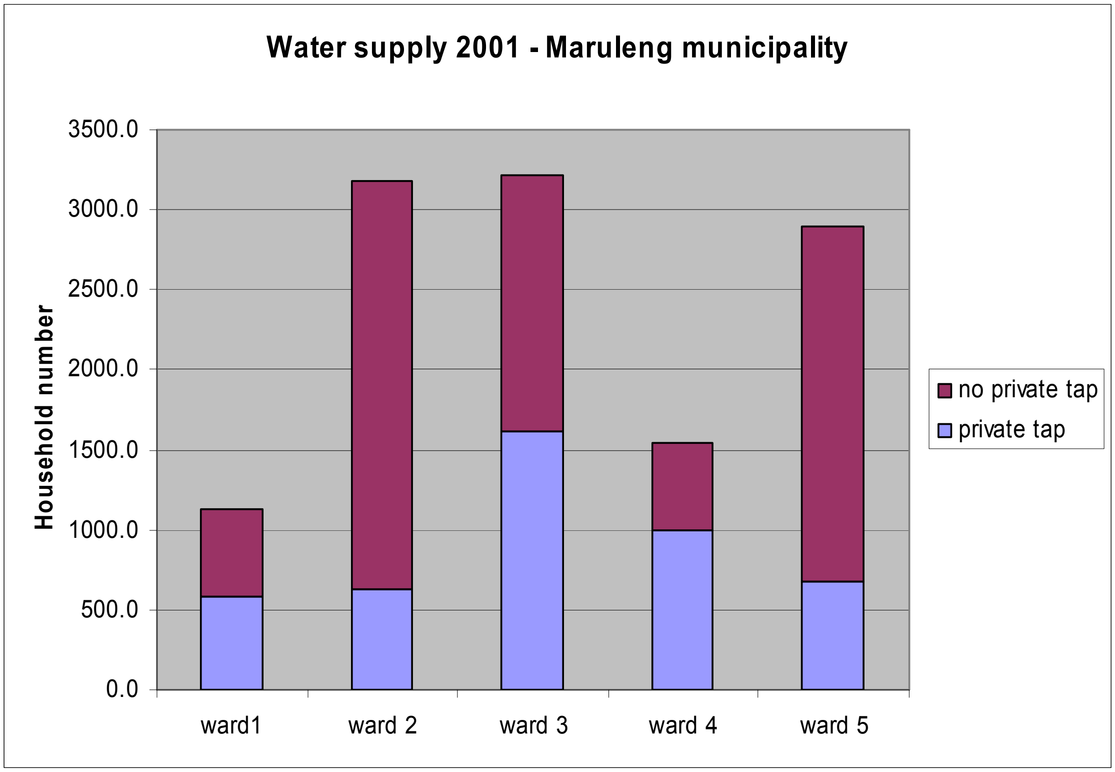



Figure 2. 2: Number of households with and without private tap per ward in the study area in 2001
Source: Census 2001

The World Vision survey (2005) shows that in Kodumela ADP 63.5% of the 768 households interviewed had access to a private tap (18.1% in house and 45.4% in yard) while no households had access to a private tap in Enable ADP (except maybe for 7.1% who had access to a borehole, but it is not specified whether the borehole is public or private). These results are consistent with Census (2001) even if some small discrepancies can be noted.

Households use water for productive purposes such as gardening, farming and livestock watering. The World Vision study (2005) showed that in Kodumela area about 43% of the households are involved in communal farming and 31% are engaged in community gardening, and 19.1% have their own backyard garden. 63% of the households reported that they have livestock (for Enable ADP the corresponding Figures are 41.8%, 30.1%, 20.7% and 63%) (Table 2.8).

Table 2. 8: Multiple uses of water in Kodumela and Enable ADP areas

| **Productive uses of water** | **Kodumela Area** | | **Enable ADP area** | |
|---|---|---|---|---|
| | **Number of households** | **Proportion** | **Number of households** | **Proportion** |
| Communal farming | 167 | 43% | 164 | 41.8 |
| Community gardening | 121 | 31% | 118 | 30.1 |
| Livestock ownership | 247 | 63% | 247 | 63.0 |

(Source: World Vision, 2005)

The high prevalence of poverty, high population density, high unemployment and poor access to water services as well as the multiple sources and uses of water in the study area are representative of the situation found in many former homelands in South Africa, making it an interesting site for this study.

# Chapter 3

# Literature Review

## 3.0 Introduction

This chapter presents an empirical review of studies carried out related to water demand valuation for domestic and productive uses. The objective of the literature review is to identify what has been done so far, how it has been done (methodological approaches) and the results and conclusions obtained. The literature review is important for identifying the gaps in knowledge. This section also reviews methodologies used by other scholars which can be adapted for this study. The literature review informs working hypothesis of the study.

## 3.1 Review of empirical literature on demand for domestic water services

Several studies have been done to assess households' demand for domestic water services and the determinants of water demand in developing countries. These studies follow three main approaches: travel cost method (TCM), contingent valuation method (CVM), and choice modelling (CM). The TCM is a direct (revealed preference) approach of valuing non market environmental goods (Tietenberg, 2003). This method has been widely used to estimate value of recreational sites based on the monetary value and time that is spent to enjoy the site. In the case of valuation of water services in the absence of market, the value of water is taken to be equivalent to the value of time spent collecting water from the water source. One of the major shortcomings of the revealed preference method such as the travel cost method is that it does not take into account the non use values of a resource.

Contingent Valuation Method (CVM) is a stated preference method (direct method) of estimating the value of a non marketed or non priced environmental good (or service). In this approach the respondent is asked how much s/he is willing to pay for a particular good or how much is willing to accept for the loss of a good or service given a hypothetical market for the good or service. One of the shortcomings of CVM is that it can not be used to assess trade-off of various attributes of water services.

Choice modelling (CM– or choice experiment) is a stated preference method, a generalization of the contingent valuation method in that a respondent is given a menu of cases from which to choose (Adamowicz *et al*., 1998). Cases (or policy scenarios) proposed to respondents differ from one another along several attributes, which can take different levels. Choice modelling is very attractive because it relies on the same random utility model structure as the contingent valuation method (Bennet and Blamey, 2000). The service levels and attributes can be collected by pre-testing of the questionnaire, secondary data and focus group discussions. Although this method has been used in very few studies, its flexibility in estimating impacts in terms of economic welfare from changing the provision of public goods has led to its popularity (Bennett *et al.*, 2001). The other merit of the CM approach is that results of the choice experiment illustrate trade-offs between attributes and prices making it easy to estimate values of services.

In the following sub-sections, we review studies that have been done to assess determinants of water services demand. First, we review those studies which used travel cost method (TCM), followed by those which used contingent valuation method (CVM) and lastly those that used the choice modelling (CM).

### 3.1.1 Travel cost method (TCM)

Whittington *et al.*, 1990 carried out a study in Kenya using the TCM approach, to determine the value of time spent hauling water. The results show that the value of time on water collection is high, and almost the same as the wage for unskilled labour. Households in the study area collected water from one source hence the travel cost method was appropriate for this study. Households were grouped according to their sources of water: collecting from an open well, buying from a kiosk and buying from a vendor. Results revealed that households buying water from vendors placed a high value on water collection and were spending about 8% of their income on water. A conditional multinomial logit model (CLM) was estimated to examine determinants of choice of water source. Explanatory variables for this model were money spent on water, time of water collection, a dummy for household perception for taste of water, household income, number of women in the household and years of formal education for the household heads. All the variables were significant with the exception of perception of water taste and education years. Authors concluded that benefits of improved water services are higher than those which are actually realised by households.

Mazvimavi and Mmopelwa, (2006) conducted a study to assess WTP for improved safe water in Okavango, North West Botswana. The travel cost method was used to estimate the value of water, whilst a contingent valuation survey was used to determine how much the households were willing to pay for improved water quantity and quality. The study showed that opportunity cost of time spent collecting water can be used to ascertain the value of water. The study concluded that most of the households were willing to pay for improved access to water but quite a significant number of households were not willing to pay either because of poverty or they felt that water should be provided by the government for free. Of those who were willing to pay, some were willing to pay in kind (payment in the form of cattle, goats or agricultural produce). The study also revealed that the water had multiple uses such that there were some problems of excessive use and pollution of water.

### 3.1.2 Contingent valuation method (CVM)

Contingent Valuation Method (CVM) has become a major tool for estimating the value of natural resources like water especially in developing countries (Whittington, 1998 and Merret, 2002). Over the last two decades a flurry of CVM studies have been undertaken to assess effective demand of water and sanitation services among rural households in developing countries. The studies which used CVM are as follow.

Whittington *et al*. (1990) analyzed determinants of water demand in Southern Haiti. A contingent valuation approach was used to determine how much households were willing to pay for public and private taps using a bidding game technique. Descriptive analysis was carried out to assess the proportion of income that household would be willing to pay for domestic water. To assess the determinants of household WTP two ordered probit models were applied, one for public taps and the other for private tap connection. In each of the two probit models the dependent variable was the probability that the household's WTP for a public (or private) tap falls within a particular interval. The regressors in the two probit models were: household wealth, household remittances (foreign income) (dummy), occupation index (dummy), household education level, distance from existing water source, quality index of existing source and sex of respondent (dummy). The results showed that household wealth, household education, and distance from existing water source and water quality were significant determinants of household willingness to pay for public and private taps.

Whittington *et al*. (1998) carried out a study to assess household demand for improved water and sanitation services in Lugazi, Uganda. Rapid appraisal techniques were used to collect information about the current water sources in the area. Questionnaires were administered but at the same time a number of other methods of collecting data which include observation, were also used. The appraisal showed that around 25% of the households purchased all their water from vendors implying that the households were willing to pay for water services. A contingent valuation survey was applied to solicit for households' willingness to pay for public and private tap water. Results of the contingent valuation study confirmed that most households were willing to pay for full costs of water from public taps and only a few can afford to pay for private connection even when offered at less than full recovery cost. A probit model was used to assess the determinants of willingness to pay for improved water services. The dependant variable in the probit model was a dummy variable: willingness to pay for public taps. The explanatory variables which were hypothesized to affect household willingness to pay for public taps were: monthly price of using the public tap, wealth group of the respondent, years of education of respondent, number of children in the respondent's household, household purchases of water from vendors (dummy), gender of respondent and tenure of house. The probit analysis revealed that the monthly price of public tap offered, wealth and household purchase of water from vendors were the key determinants of willingness to pay for public taps.

Goldblatt (1999) examined effective demand for improved water supplies in two informal settlements in Johannesburg, South Africa. The main objective of the study was to assess the potential for cost recovery from consumers to raise revenue to improve supply of domestic water services. A contingent valuation method was used to solicit household willingness to pay for private piped water connections using a bidding game technique. The CVM survey was in the form of a structured questionnaire soliciting for basic socio-economic characteristics of the household, household water use and practices. To assess the potential for cost-recovery they compare WTP bids with operating and maintenance costs of improved water services. The study concluded that the amount households were willing to pay was not sufficient to cover capital costs for individual household connection but enough to cover the costs at limited consumption level like public standpipes.

Raje *et al*. (2002) examined household willingness to pay for municipal water in Mumbai, India. The objective of the study was to ascertain whether consumers would accept an increase in water charges. A contingent valuation method was used to assess households' WTP more for water services. The level of satisfaction with current water services was assessed using a Likert's scale[7] and results revealed that majority of people were satisfied with the present service. A binomial logit model was applied to examine factors influencing household willingness to pay for municipal water. The dependent variable was willingness to pay for improved water services (dummy), whilst explanatory variables were the level of satisfaction with current water service, faith in the service provider and affordability. Affordability and belief (faith) in the management of the

[7] This scale ranges from 1 to 5. 1 is the least desirable level of satisfaction and 5 would be the best level of satisfaction

project operations and utilization of funds were found to be the key determinants of WTP more for improved water services.

Ntengwe (2004) carried out a study in Kitwe and Lusaka, Zambia to determine the linkages between awareness of water issues, ability to pay for water, affordability of water services and cost recovery. The sample was subdivided into five groups depending on the availability of water. Awareness on water issues was measured before and after seminars on water awareness. A contingent valuation survey was conducted to solicit information about WTP for water. Least squares and ANOVA were used to develop the regressions and analysis of data. Cost recovery was also measured by recording the amount paid by each consumer for water services. The findings of this study revealed that WTP alone does not result in cost recovery (the amount that people were willing to pay was less than the full cost of the service) and that awareness enhances the potential for full cost recovery. Affordability and water quality also increased WTP and cost recovery.

Mbata (2006) carried out a study to identify the determinants of WTP for private water connection in Kanye, Botswana. A contingent valuation survey was used where iterative bidding gave information on households' WTP for private tap water. To assess the factors affecting households' willingness to pay for water services, the author applied a multiple linear regression. The dependant variable in the regression model is WTP bid by household, whilst the explanatory variables were household income, household size, and education level of the respondent, age of respondent, distance from existing water source, employment status of household, gender of respondent and incidence of water borne diseases. Results of econometric analysis showed that household income, household size, education of respondent, distance from existing water source, employment and awareness were significant determinants of household WTP for tap water.

Pattanayak *et al*. (2006) conducted a study to determine households' WTP for improved water services offered by the private sector in South West Sri Lanka. A contingent valuation survey was done to solicit for data on households' socio economic factors and WTP of a household for improved water and sanitation services. A multiple linear regression model was used to assess the determinants of water demand. Scenario simulations were done to predict how improved water services would affect water use and these were also compared to the current water services. The study concluded that poverty and costs of water are the main significant factors which affect demand. Other factors which also significantly affect water demand are household location, household access to alternative water source and households' perceptions of current water services.

Farolfi *et al*. (2006) used the contingent valuation method to analyse household willingness to pay for an improvement in domestic water quantity and quality in rural areas of Swaziland. The CVM revealed that households in rural areas were more willing to pay for water quantity and quality compared to urban households. To ascertain the factors influencing household willingness to pay for water quality and quantity two Tobit regression models were estimated, one for the water quality and the other for water quantity. The dependant variable for the model was the probability that the households were willing to pay for higher quality (or higher quantity). The variables: household income, water consumption, source of water, age of household head, gender of household head, collection time were found to be significant determinants of household WTP for improved water quantity. The variables that were found to determine WTP for quality were similar to those of the preceding model except that collection time was replaced by practice of taking avoidance measures against waterborne diseases.

Banda *et al*. (2007) also applied the contingent valuation approach to examine the determinants of water quantity and quality in Steelport Sub-basin in South Africa. One of their findings was that a higher proportion of households (62%) were willing to pay for improved quantity compared to improvements in water quality (41%). A Tobit model was applied to assess factors influencing the probability that a household is willing to pay for both improved quantity and quality. For the first regression, the dependant variable was a dummy: willing to pay for improved quality or not. The explanatory variables in the first regression were availability of water, household income, whether or not the household has a tap (dummy), water used per capita and age. The results of the first step regression model revealed that availability of water, households' access to a tap and water per capita were significant determinants of willingness to pay for water quantity. The dependent variable in the second step regression model was the amount of money the household is willing to pay for improved quality. The regressors in the second step regression model were household income, household's monthly water consumption and water use quality ranking. All the ascertained explanatory variables were found to be significant determinants of WTP for water quantity and water quality.

### 3.1.3 Choice modelling (CM)

Blamey *et al*. (1999) applied choice modelling to assess the value of water in communities with different water supply options in the Australian Capital Territory. Due to the increased pressure on water resources, there was need for policy intervention in the form of increasing water supply, reducing demand or a combination of the two. Each community was presented with five different options from which they had to select their most preferred choice of water service. The attributes of water supply were water quality, quality of the environment, cost, aquatic environment, maintenance of habitat for animals and nature and style of the urban environment characterized by areas of grass and trees. The results of the conditional logit model show that there is a negative relationship between household water cost and water use. The households' decisions about water supply option tend to depend on water supply as well as the price of water. The status quo was the least preferred option and this implies that the households preferred an improvement in water supply. The households were willing to pay for improvement in water services as well as conservation of species and the environment.

Hope and Garrod (2004) applied choice experiments in a rural area in Limpopo province, South Africa to examine the preferences of households for changes in domestic water services. The attributes for this study were domestic water source, quality, quantity, possibility of irrigating a kitchen garden in the dry season and dry season river failure. A multinomial logit was the econometric method applied to assess the household preferences. The results showed that largest welfare gains occur when the households upgrade from use of groundwater to house tap. Improvement in water quantity would result in higher utility increase compared to improvement in quality for the rural households in this area. Welfare estimate from irrigating kitchen garden crops in the dry season suggests a low adoption rate that may limit poverty reduction impacts. This study revealed that convenience of a water source (that is reduced collection time, less physical effort) significantly affects the household water supply choices.

Yang *et al*. (2006) examined factors that influence the demand for alternative water supply and sanitation services in Negombo, Sri Lanka. Conjoint survey (choice modelling), where the respondent was presented with four choices of water service options and their attributes and a respondent had to select one they prefer. Respondents had to choose from the following options: private tap, mini grid, public stand posts or opt out (choosing the current water source which is non piped water). Econometric models which were used were conditional and mixed logit models. Explanatory variables (which were mainly attributes of the water service) proposed were: monthly water bill, volume of water per day, hours of water supply[2], safety of tap water and different levels for water safety and water sources. The rest of explanatory variables were interactions[8] between these attributes and whether the household was poor or not; this was done to test if there were significant differences between the poor and non poor households. Identification of the level of poverty was made on the basis of the monthly per capita consumption. This data was classified and the bottom two deciles of the distribution were taken to be the poor. The study revealed that consumption charges, volume of water, safety of water, hours of supply were key determinants of the choice of water source. It was also clear that although private taps and mini grid are preferred to public taps; most households prefer the status quo (non piped water). The interaction terms showed that consumption charges significantly affected the poor more than the non poor; and the poor are less satisfied with the status quo and this implies that poor households are more price-sensitive.

Snowball *et al.* (2007) applied choice modelling to elicit the household's willingness to

[8] Interaction term of poverty and other attributes implies multiplying an attribute by the dummy for household poverty.

pay for improvement in water attributes in the middle income urban area of South Africa. The attributes that were identified for this experiment were bacteria, water discoloration, water pressure, interruption of water supply, frequency of water meter problems and monthly water bill for water. The conditional logit model (CLM) and the Heteroscedastic Extreme Value model (HEV) were used to estimate the determinants of water service choice. All the attributes had the expected signs and only water pressure and frequency of water meter problems were not significant. The most important determinants of water demand were water quality (water discoloration and bacteria count) and interruption to water supply.

Nam and Son (2005) carried out a study to assess the willingness to pay for improved water services and the consumers' preferences for water services of households in Ho Chi Minh City, Vietnam. The study used both contingent valuation and choice modelling and compared the welfare estimates from both methods. Choice modelling was also used to investigate the attributes of water supply (water quality, water pressure and price) which were important to respondents. For the contingent valuation survey, households were divided into two strata: households which have access to piped water and households without piped water. Both groups were asked questions to derive willingness to pay for improved attributes of water service. Choice modelling was conducted only for households without piped water. These households were presented with four choices (including the status quo) of improved water projects defined by water quality, pressure, and prices. Results of the CVM show that households' WTP estimates were higher than the current water bills. The median WTP of non piped households was double the average monthly water costs thus higher than that for piped households. Choice modelling results show that for non-piped households, water quality is a much more important attribute than water pressure.

## 3.2. Determinants of water demand

A number of determinants of household preferences for water services were identified from literature. These determinants are discussed below:

*(i)* *Water source*

Households could be willing to move from one water source to a better one. Households generally prefer to have water sources which are closer to their homes and reliable. Most households might prefer to have private taps so as to ensure that they have convenience (Banda *et al*., 2006; Hope and Garrod, 2004; Farolfi *et al.,* 2006; Hope, 2006; Yang *et al*., 2007).

*(ii)* *Water quality*

Quality of water affects households WTP for water service improvement. There is a negative relationship between current water quality and WTP for water improvement. Households which have poor water quality are more WTP for water service improvements compared to households who have better water quality (Banda, 2004; Hope and Garrod, 2004). Most households prefer to have clean and purified water for domestic uses like cooking. Households are also concerned about having water which is not contaminated by bacteria, has a good smell and taste, is clear and not muddy. There is a positive relationship between WTP for water service improvements and incidence of water borne diseases and other water related health problems (Whittington *et al*., 1990; Mbata, 2006).

*(iii)* *Possibility of using water for productive uses*

Use of water for productive uses affects households' WTP for water service improvements. Using water for productive purposes like irrigating the garden, livestock watering, brick making, beer making means that the household can generate money from these uses. Generally, households should prefer to have water for multiple uses like garden irrigation as this improves their livelihood and ability to pay for water services (Van Koppen *et al*., 2006).

*(iv) Confidence in the service provider*

Confidence with the service provider increases household WTP for water services. If the households do not have faith in the way water service is being managed they might not be willing to pay for water service (Raje *et a.l*, 2002; Ntengwe, 2004; Davis, 2004).

*(v) Price of water*

The demand curve for water is downward slopping, household monthly water bill is expected to have a negative relationship with WTP for water service improvements (Raje *et al.*, 2002; Yang *et al.*, 2006; Snowball *et al.*, 2007).

*(vi) Household water consumption*

There is a negative relationship between current household water consumption and WTP for improved water service (quantity). Households which already have enough water have no incentive to pay more for improvement in quantity because when household has enough water, they become more worried about higher level service like water quality and taste (Banda *et al*., 2006; Hope and Garrod, 2004; Hope, 2006; Farolfi *et al.*, 2006; Yang *et al.*, 2006; Pattanayak *et al.*, 2006).

*(vii) Distance from existing sources or collection time*

There is a positive relationship between water collection time in the present situation (distance to the water source) and WTP for water services improvement. Households who are far from the source of water may want a more easily accessible source (Whittington *et al.*, 1990; Calkins *et al.*, 2002; Farolfi *et al.*, 2006; Banda *et al.*, 2007).

*(viii) Frequency of supply of water*

The current frequency of supply of water (hours of water supply per day) have a negative relationship with WTP for water services improvement. This suggests that the more reliable the current water supply is, the less the households are WTP for water service improvement. This water frequency of supply is related to the type of water source (Yang *et al.*, 2006).

*(ix)* *Education level of household head*

Generally, it is expected that there exists a positive relationship between education level of the head (especially women) and the WTP for improved water quantity and quality. More educated women are more likely to be aware of health implications and uses of water for productive purposes. Level of education of the household head may affect WTP positively since women are the ones mostly involved in water collection (Whittington *et al.*, 1990; Banda *et al.*, 2006; Davis, 2004; Mbata, 2006; Pattanayak *et al.*, 2006).

*(x)* *Age of household head*

The relationship cannot be pre-determined as it depends on a number of factors. On one hand older household heads may not be willing to pay for multiple uses of water as they are old and are content with their way of life (Davis, 2004). On the other hand, the older household heads may be willing to pay for multiple uses because they have acquired enough assets and can afford to pay for multiple uses of water. This WTP could also be because as people get older they are more strained by walking long distance to collect water (Farolfi *et al.*, 2006).

*(xi)* *Gender* of respondent

Since it was traditionally the role of women to collect water and they are more involved in productive uses of water, women are expected to be more willing to pay for multiple water services (Farolfi *et al.*, 2006). On the other hand, households which have many women may not be willing to pay for water as they have enough labour to collect water (Whittington *et al.*, 1990).

## 3.3 Conclusion

A number of studies on water demand determinants were revealed. With the exception of one study conducted in developing countries (Africa and Asia). A number of determinants of water demand were identified and these are both socio economic factors and the attributes of the water service. Most of these studies assessed demand for domestic uses of water and productive uses. Two main approaches (both stated preferences) were used to assess determinants of water demand; CVM and CM. The literature review guided hypotheses (cf. section 1.3) for this study and identified methods that can be applied. Choice modelling was selected for this study because it has several advantages over the CVM (cf. section 4.1.1).

# Chapter 4

# Methods and Procedures

## 4.0 Introduction

This chapter explores the methods and the procedures that were used to carry out this study. The chapter is organised as follows. The first section presents the theoretical framework guiding the study. Section two presents the empirical framework used to test the hypotheses in the study. Section three discusses the data sources, data collection techniques, sampling procedure and choice experiment design.

## 4.1 Theoretical Framework

### 4.1.1 Comparative advantages of CM and CVM approaches

Two main economic approaches are used to assess individual or household's demand for domestic 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 is an important survey-based procedure for eliciting the economic value of the quality and availability of non-market commodities (Nicklitschek and Leon, 1996). In implementing the CVM survey, a respondent is presented with questions on whether or not he or she is willing to pay/be reimbursed for a change of some characteristics of the commodity in question. Respondents are therefore facing a dichotomous choice.

CM is a generalization of the CVM in that it gives respondents a menu of cases from which they have to choose (Adamowicz *et al*., 1998). CM (or Choice Experiments) is a method for valuing non market goods by making use of attributes to build alternative scenarios. The respondent compares the options in terms of his/her utility and chooses the option that maximizes his/her utility. As compared to CVM where the focus is on willingness to pay, CM allows the researcher to pose to the respondent a number of constructs to understand the influence of variations in the level of attributes on their choice (Adamowicz, 1995; Louviere, 1996). According to Hanley *et al.* (1998), as quoted by Anand (2001), choice modelling makes it "…*easier to estimate the value of the individual attributes that make up an environmental good…This is important since many management decisions are concerned with changing attribute levels*".

Choice modelling is applied to this study because it has several advantages over CVM. The ability of CM to analyse complex situations (multi attributes and multi dimensions of goods and services) makes it very useful for policy analysis (Alfnes, 2003; Mazzanti, 2001). CM is also useful for analysis of situational changes and trade-off between attributes (Snowball *et al.*, 2007; Hope and Garrod, 2004). Choice modelling enables implicit prices for each of the attributes and welfare impacts for multiple scenarios to be estimated. Choice modelling also minimises respondents' strategic behaviour through avoidance of direct eliciting of WTP by relying on expressed choices ((Mazzanti, 2001).

However, it should be noted that despite its advantages, choice modelling approach also has some weaknesses. Choice experiments are hypothetical and cannot take all real market constraints into account. Choice models are based on hypothetical data and may not be useful in predicting actual existing markets (Alfnes, 2003). Choice models are based on individuals; hence it is difficult to capture collective decisions (Ben–Akiva *et al.*, undated; Alvarez-Farizo *et al.*, 2006).

### 4.1.2 Theoretical base of CM: the random utility theory

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

The theoretical foundations of CM are in the random utility theory (RUT) (Ben-Akiva and Lerman, 1985; McFadden, 1973). The hypothesis of the RUT is that individuals make their choices based on the characteristics of the good along with a random component. The random component may be 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 $U_{ij}$ of an individual $i$ derived from a scenario $j$ is not known but can be decomposed into a deterministic component $V_{ij}$ and an unobserved random component, $\varepsilon_{ij}$:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

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

$$V_{ij} = x'_{ij}\ \beta \tag{2}$$

Where $\beta$ is a vector of coefficients associated with the vector $x'$ of explanatory variables, which are attributes of scenario *j,* and these include price, and the socioeconomic factors of individual *i* (Snowball *et al.*, 2007; Greene, 2000).

The individual *i* would be assumed to choose alternative *j* over alternative *k* if $U_{ij}>U_{ik}$.

The assumptions placed on the random component of the utility define the statistical model utilized. Given that the explanatory variables are attributes, a conditional logit model (CLM) was used in this study. For the CLM it is assumed that the error disturbances have a type 1 extreme value distribution: $\exp\left(-\exp(-\varepsilon_{ij})\right)$.

The selection of an alternative can be expressed as:

$$\mathrm{U_{ij}} > \max_{k} \in_{ci,k\neq j} U_{ik} \tag{3}$$

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

$$P_i(j) = P\left[x'_{ij}\,\beta + \varepsilon_{ij} \geq \max_k \in_{ci} \left(x'_{ik}\,\beta + \varepsilon_{ik}\right)\right] \tag{4}$$

$$= \exp(x'_{ij}\,\beta) / \sum_k \in_{ci} \exp(x'_{ik}\,\beta)$$

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

## 4.2 Empirical Framework

### 4.2.1 Choice of the econometric model

A number of econometric models can be used to estimate determinants of water demand. The most widely used econometric models for processing data in CM are the multinomial logit model (MLM), the nested multinomial logit (NML), and the conditional logit model (CLM). These three models are all used to analyse choice of an individual among several alternatives.

The MLM focuses on an individual as a basis for analysis. The individual's characteristics, which are constant across alternatives, are used as the explanatory variables in this model. Coefficients of explanatory variables show their respective effect on the probability of choosing an alternative relative to the reference category (in this case this would be the present water services) which is considered to be the benchmark (Long, 1997).

The NLM model is a generalization of the multinomial logit model. It is applied to data where water service characteristics and household characteristics are included in the model. The NLM model is used when the scenarios are grouped into a decision tree and the respondent's decision making process is sequential. The respondent has to choose either to opt for a new option or choose the status quo. The researcher uses a structure that partitions the alternatives into groups, 'nests'. Nested multinomial logit can be used even in cases where assumption of independence of irrelevant alternatives (IIA) is violated. IIA assumes that the probability of choosing one alternative over another is not affected by the presence or removal of additional alternatives (Bienabe and Hearne, 2006; Greene, 2007).

The CLM is applied to data where the explanatory variables are characteristics or attributes of alternatives. Explanatory variables in a CLM assume different attribute levels in each alternative (Hoffman and Duncan, 1988). The conditional logit model also assumes independence of irrelevant alternatives (IIA), (Snowball *et al.*, 2007). For this study, a CLM was applied as it seemed to be the best fit for the data, given that we are interested in knowing what types of water services people are desiring (especially if they desire services that cater for multiple uses). It would have been useful to include households' characteristics as well but this would have implied a much larger sample, which was not possible in the context of a master research. There is no status quo in the experiment. [9](Greene, 2007).

### 4.2.2 Characterisation of household water sources and uses and livelihood typologies

In order to characterize the different water sources, socioeconomic characteristics of households, and livelihood activities, we used descriptive analysis. Univariate analysis was used to construct frequency Tables, means etc. Bivariate were used to assess the relationships between different variables related to domestic water use, livelihood activities and socio-economic characteristics of households. The bivariate analysis includes the use of cross tabulations (contingency Tables) to assess the association between categorical variables (e.g., sex of the household head and the type of water

[9] A MLM could not be used for this because all the explanatory variables are water choice attributes and not household characteristics. The NML model is not adapted for this data given that the status quo is excluded in the design (see section 4.3.3).

source and use) and correlations between continuous variables. The univariate and bivariate analyses served to identify the variables to be used for building a typology of households. T-tests and ANOVA were used to compare means among villages and between the piped and non piped households as well as to compare the poor and the wealthier households.

## 4.3 Data sources and data collection techniques

Both primary data and secondary data were used for this study. Secondary data was obtained from government publications, research publications and reports, students' theses and reports. Secondary data were collected through literature review aimed at identifying attributes and determinants of household's water demand. Primary data was obtained through focus group discussions with local stakeholders, key informants interviews and household surveys. Focus group discussions were carried out in two of the 14 villages in order to validate the attributes gathered from secondary sources and to allocate significant levels to these attributes. Data collected from focus group discussions was used to design the choice experiment. A structured questionnaire was used to collect quantitative data on household demographics, current water services and hypothetical choices over water services. Six enumerators (MSc students from the University of Limpopo) speaking the local language (Pedi or Northern Sotho) were trained to interview the households.

### 4.3.1 Secondary data

Secondary data was collected to identify the attributes and determinants of household water demand. Government publications (Census 2001 data and Maruleng Municipality) and reports (World Vision, 2005 and Panesar, 2006) of other similar studies in the area were used to assess the current situation in terms of water services in the area and identify household preferences on water services. From the literature, household willingness to pay for improved water services is a function of the attributes of the improved water services, household socioeconomic factors and household perception towards the government policy and the water service provider. In this study we decided to focus on attributes so as to understand which water service attributes determine household water demand. The assumed explanatory variables and their expected direction of effect were presented in chapter 3.

### 4.3.2 Focus group discussions

Focus group discussions were undertaken in June 2007 in Madeira and Worcester (2 of the villages in the study area[10]) to validate the attributes gathered from literature and allocate locally relevant levels to these attributes. Eight groups, each composed of 6-12 people of the same sex and age group were interviewed. Discussions were facilitated by trained facilitators asking mostly open ended questions so as to allow people to speak freely. Each of the enumerators was given a set of questions, called the questioning route or the interview guideline which were arranged in a natural and logical way so that they were easily understood by participants. The main purpose of the focus group study was to validate the findings from secondary sources as well as to identify the present multiple uses of water in the area, the existing and desired water services and the most relevant attributes to characterize them.

[10] Note that Worcester is not formally part of the 14 villages of the study area but it is very close and similar to villages with a very poor access to water like Enable.

The results of this focus group study are summarised below:
Main water-related problems in Sekororo-Letsoalo area are (1) Global water scarcity and seasonal shortages, (2) Pollution by animals, (3) Long distance to points of water collection, (4) Lack of infrastructures (storage, pipes, pumps, and boreholes), (5) Lack of management and maintenance (breakdowns) and (6) Inequitable allocation of water resources between village sections.

All people reported that they use water for domestic uses, but there is variability in quantities of water used across households. Generally, quantities used for domestic purposes range from 75 to 200 litres per household per day. This variation in water consumption is a function of a number of factors including type of water source, distance to the source or point of collection, household size, reliability of water supply etc. At present, the municipality allows people to use piped water only for domestic purposes. Use of piped water for productive uses such as irrigation and backyard gardening is not allowed and people who violate this are fined. In Sekororo-Letsoalo area, water is scarce such that it is only sufficient for domestic purposes. In villages, which are far from the mountains like Enable and Worcester, water access is even worse and most people use water from the river. In villages where water access is poor like Worcester, the water committee has to ensure that everyone collects only 60 litres per household per day. In some cases the community contributes money to buy pipes (for example when the pipes burst) to improve water delivery.

The most common water sources in Madeira are private taps and river; whilst in Worcester the most common sources are river and public standpipes. Most households in Madeira use private taps and they only have to use the river as a source when taps are not running. In Worcester another water source is spring water. Only one group (the males in Madeira) managed to quantify how much water they use for each of the activities but the quantities which were reported were underestimated. This could be because the males are not the ones who are involved in water collection and they are also not the ones who do these household activities so they do not really know the exact quantities. The other seven groups could not quantify the water they use for each purpose.

In very dry areas such as Worcester households depend on the river and public standpipes, which are supplied with borehole water. At the time of the study, most of the standpipes were not working except for two. Households in Worcester also reported that groundwater supply was very low and could not meet current demand. In some cases when there is no water coming from all the other sources, the municipality has to carry water in trucks to areas where it is needed.

Households reported that they use water for other non-domestic uses which include backyard gardening, building, irrigation, beer making and for livestock (including chicken projects). Currently most households have backyard gardens for subsistence purposes only. Households reported that they are engaged in gardening during the rainy season only because of lack of water.  Only a few households in the areas with better water access (such as private boreholes) have backyard gardens all year round but the areas are very small because they do not have enough water. Most households reported that they would like to expand the areas of their backyard gardens and areas for irrigation so that they increase production and sell part of their produce to improve their livelihoods. Households in Sekororo-Letsoalo area reported that scarcity of water is limiting their engagement in non-domestic uses like building houses or livestock rearing. Few households use water for building, beer making and livestock project. They reported that they would like to expand the scale of these activities if water access improves.

All eight groups identified a number of problems in water access. They indicated that there is a problem of drying up of the river during the winter season and in low rainfall years. Four of the groups also expressed their dissatisfaction with the manner in which piped water is managed. A group of older women in Madeira even proposed that their water consumption should be metered so that households manage their own water consumption. The group reported that households are able to pay for water since they are already paying for electricity. The male groups wanted the control to be improved but they suggested that they do not want meters since they are not willing to pay for water. However, it is clear that people are able to pay for water since in some cases people have to hire donkeys or cars to go and collect water from remote sources. In Worcester some people pay as much as R40 per trip to hire donkeys to go and collect water when there is insufficient water in the area. Also as a community, people contribute financially and in kind (labour) to improve water access and this shows that people are willing to pay for improved water access.

The desired improvements in water services which were proposed by participants were both individual as well as collective solutions. The desired improvements were a function of the current water supply situation and socio-economic factors. Two groups in Worcester (where water access is poor) said that they wish to have their water sources; river and springs protected so as to improve water quality and quantity. Five groups said they desire an increase in the number of reservoirs and boreholes. In Worcester participants mentioned that they need to have rain water harvesting tanks for each household to ensure good quality, quantity and reliable water supply. Only two groups in Worcester mentioned that purification of water would be an improvement for them. Two groups from each of the villages pointed out that they would desire to have private taps.

Table 4. 1 Summary of desired improvement and attributes of water services in Sekororo-Letsoalo area

| **Desired improvements** | **Corresponding attributes** | **Uses** |
|---|---|---|
| Rainwater harvesting tanks for all | Availability and reliability | All |
| Water meters | Regulation of uses | All |
| New boreholes | Quantity, availability | All |
| New reticulation, bigger pipes | Quantity, availability | Productive |
| New storage facilities | Reliability | Productive |
| Private taps | Distance | All |
| Improved management | Regulate quantity, ensure responsible use and equity | All |
| Fencing springs and wells | Quality | Domestic |

(Source: Focus group discussions, June 2007)

### 4.3.3 Choice experiment design

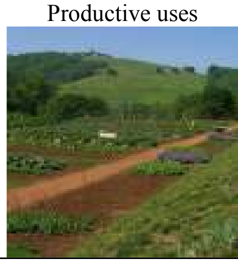
The focus group study enabled us to identify the water service attributes to be used to design the options to submit to respondents for interviews in the form of choice experiment cards. Table 4.2 presents the attributes and levels that were identified from the focus group study.

Design of choice experiment was informed by previous studies which used choice experiments (Snowball *et al.*, 2007; Hope, 2006). The surveyed population was divided into two strata. Stratum 1 includes households without private taps (in house or in the yard), whilst stratum 2 consists of households with private taps. All attributes in Table 4.2 were submitted to stratum 1, whilst the attribute 'source of water' was excluded from stratum 2. This attribute was left out because it would not make sense to ask households who already have private taps to choose between private tap and any other inferior water source. The status quo scenario was not included as one of the water options because this status-quo differs across households.

Use of the full factorial design of all the possible combinations of attributes and their levels yielded ($2^3*4^3*3^1$)=384 choice sets for stratum 1 and ($2^2*4^3*3^1$)=192 for stratum 2. In this full factorial design, all the two-ways and higher order interactions are uncorrelated and can be estimated. However, the use of a full factorial design is not practical as it will be tedious to consider all the possible combinations. The orthogonal design was therefore applied to reduce the number of attribute level combinations proposed for choice. The orthogonal design allows 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 account for 80-90% of variation in the data of choice experiments (Willis *et al.*, 2005, Snowball *et al.*, 2007). Orthogonal arrays are categorized by their resolution. The resolution identifies which effects, possibly including interactions, can be estimated. Orthogonal arrays come in specific numbers of runs (such as 16, 18, 20, 24, 27, 28 ...) for specific numbers of factors with specific numbers of levels (Kuhfeld, 2000). In this choice experiment we used 18 and 24 runs for the households without private taps and those with private taps respectively.

The goodness of experimental design can be quantified by evaluating the A-Efficiency, D-Efficiency and G-Efficiency. These measure the goodness of the design relative to the hypothetical design that may be far from possible hence they are measures of absolute design efficiency and values close to 100% are desirable(Kuhfeld, 2000). In this study 24 and 18 choice sets were generated for stratum 1 and stratum 2 respectively because they had D-efficiency, A-Efficiency and G-efficiency over 96 % (See Table A1 and A2 in Annex 1). The choice sets were paired into 12 and 9 choice cards, each containing two sets of water service alternatives from which the respondent would select one. At least three choice cards were presented to each household. These cards were drawn randomly such that each card had an equal probability of being selected.

Table 4. 2: Attributes and levels used in the Sekororo-Letsoalo choice modelling study

| Attribute | Description | Levels | Expected effect on probability of choice |
|---|---|---|---|
|  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. The quantity of water used is, ceteris paribus, a function of its availability. Households in rural areas would often like to use more water than what they currently use if only this water was available. | ▪ 3 *25l containers per day<br>▪ 6 *25l containers per day<br>▪ 12*25l containers per day<br>▪ >12 *25l containers per day | Positive |
| Frequency of water supply | Currently piped water is not available at all times. In most of the villages people get piped water two times a week. In other sources like rivers water is also not available at some times because of seasonality of the hydrological cycle. | ▪ Current<br>▪ Water available for limited hours everyday<br>▪ Water available all times of the day everyday | Positive |
| Quality of water  | Most of the households in the area complain that the water they drink is not of good quality even though there are no incidences of water borne diseases. In some villages inhabitants complained that piped water is salty or muddy and hence they cannot drink it or use it for cooking. | ▪ Current<br>▪ Purified | Positive |
|  Price of water | Currently households in Sekororo-Letsoalo area do not pay a monthly bill for water.<br>A tariff could be introduced to cover part of the costs of water provision and services. | • R0 per month<br>▪ R10 per month<br>▪ R50 per month<br>▪ R100 per month | Negative |
| Productive uses  | Some households in Sekororo-Letsoalo area use water for productive uses like backyard garden irrigation, beer making, and building. At present they complain that water is not enough for some of these productive uses. On the other hand water supply institutions do not allow people to use piped water for some productive uses. | ▪ Current<br>▪ More | Positive |
|  Source | The main sources of water used in the area are private taps, public standpipes, rivers, boreholes, springs, and rainwater. The source of water has a vital impact on the quantity, frequency of supply and quality of water consumed by a household. | ▪ Current water source<br>▪ Private tap | Positive |

### 4.3.4 Household Survey

A structured questionnaire was used to collect quantitative data about the households. This structured questionnaire was designed to solicit for household demographic information, information on present water use, source and quality of water, socio-economic characteristics of the households, livelihood activities, and preferred choices in terms of water services, which includes their WTP for water services for multiple uses. Six enumerators (all Master students from the University of Limpopo) who spoke the local language (Pedi) were trained to administer the questionnaire. The respondents were mostly the household heads or any member of the household who knew about the households water use. Since the females know more about the households water uses, this survey was focusing on interviewing women in cases where they were available.

Selection of the sample

The household survey was conducted in 7 out of the 14 villages. Selection of villages for household survey was on the basis of two criteria: type of water access and distance from the mountain (as a proxy of water resources availability). The most reliable and exhaustive information on access to water services was from the Census 2001 and was available at ward level. Access to private tap varies a lot across wards: wards 1, 3 and 4 have generally a better access to water services with a higher percentage of households with private tap and wards 2 and 5 have a poor access with less than a quarter of households with private tap. Selected villages are supposed to be representative in terms of population of the whole wards (in terms of household socio-economic characteristics and access to water services). The distribution of population of the 7 selected villages across wards is identical to the distribution of the total population of the study area.

On the basis of the water access presented in chapter 2, the following sample was drawn from the villages as shown in Table 4.3.

Table 4. 3: Characteristics of selected villages

| **Villages** | **Access to water services at ward level (*)** | **Ward** | **Distance from mountain** | **Population 2002** | **Population of selected villages in % of total ward population** | **Distribution of the selected villages population across wards (**)** | **Presence of an irrigation scheme** |
|---|---|---|---|---|---|---|---|
| Ga-Sekororo | Good | 1 | Close | 3140 | 53% | 10% | No |
| Lorraine | Poor | 2 | Mid | 8546 | 57% | 26% | Yes |
| Metz | Good | 3 | Mid | 8658 | 56% | 27% | Yes |
| Makgaung | Good | 4 | Close | 4647 | 57% | 14% | Yes but not working |
| Enable | Poor | 5 | Far | 2718 | | | No |
| Turkey 1 | Poor | 5 | Mid | 2819 | 52% | 23% | No |
| Turkey 2 | Poor | 5 | Mid | 2036 | | | No |
| Total | | | | 32564 | 55% | 100% | |

(*) the access to water services in the selected villages is assumed to be representative of the access at ward level
(**) this distribution is very similar to the distribution of the whole population of the study area across wards

The sample stratification is derived from the characteristics of villages and wards as shown in Table 4.4.

Table 4. 4: Sample stratification

| Villages | % of private tap in ward | Village population 2002 | Total household number (1) | Sampled households (2) | Sampled households with private tap (3) | Sampled households without private tap |
|---|---|---|---|---|---|---|
| Ga-Sekororo | 51% | 3140 | 628 | 14 | 7 | 7 |
| Lorraine | 20% | 8546 | 1709 | 39 | 8 | 31 |
| Metz | 50% | 8658 | 1732 | 40 | 20 | 20 |
| Makgaung | 65% | 4647 | 929 | 21 | 14 | 7 |
| Enable | 24% | 2718 | 544 | 13 | 3 | 10 |
| Turkey 1 | 24% | 2819 | 564 | 13 | 3 | 10 |
| Turkey 2 | 24% | 2036 | 407 | 9 | 2 | 7 |
| Total | 38% | 32564 | 6513 | 149 | 57 | 92 |

(1) on the basis of 5 persons per household
(2) proportional to the number of households in each village
(3) equal to sampled household number per village time percentage of households with private tap in the corresponding ward

<u>Determination of the sample size</u>

There is a trade-off in selecting the sample because there is need to balance the costs versus the precision required. The optimal sample size depends on the three considerations below;

- Getting the smallest subgroup from the population which accurately represents the population.
- The precision is the level that is required or how much sampling error is acceptable. The lowest sampling error would be more desirable.
- The standard error or level of variation of the character of interest should be small. In this case the character of interest is the proportion of households having access to a private tap.

$$n = \frac{z^2 \prod(1-\prod)}{\left[SE(p)\right]^2}$$

$$n = \frac{1.96^2 0.5(1-0.5)}{0.08^2}$$

$$n = 150.0625$$

Where SE (p) is the standard error of a proportion
$n$ is the sample size
$\prod$ is the standard error of the population
Z is the coefficient corresponding to the population size
Confidence interval is 95%

The Table 4.5 shows the size of sample required for different levels of precision and different confidence intervals. In this survey the sample size is 150, which corresponds approximately to a level of precision of 8% and a confidence interval of 95%.

**Table 4. 5: Size of the sample and representativeness of the mother population**

| Standard Error (Precision) | Size of the sample | | |
|---|---|---|---|
| | C.I=. 95% | C.I=99% | C.I=90% |
| 0.1 | 96.04 | 166.41 | 67.65063 |
| 0.09 | 118.5679 | 205.4444 | 83.51929 |
| 0.08 | 150.0625 | 260.0156 | 105.7041 |
| 0.07 | 196 | 339.6122 | 138.0625 |
| 0.06 | 266.7778 | 462.25 | 187.9184 |
| 0.05 | 384.16 | 665.64 | 270.6025 |
| 0.04 | 600.25 | 1040.063 | 422.8164 |
| 0.03 | 1067.111 | 1849 | 751.6736 |
| 0.02 | 2401 | 4160.25 | 1691.266 |
| 0.01 | 9604 | 16641 | 6765.063 |

A sample of 150 households, equivalent to 1.928% of the population, was initially considered representative. However, 167 households were interviewed. Of the 167 households, 62% had no private taps, while 38% had private taps. 3 to 6 choice cards were presented to each of the interviewed households. On average, each household was presented with 4 choice cards. In total 857 cards were presented to households.

# Chapter 5

# Characterisation of households' demographics, livelihood, and characterisation of water uses and users

## 5.0 Introduction

This chapter presents and discusses the findings of the survey conducted on household demographic characterization, typology of water users and uses in the Sekororo- Letsoalo area. The chapter is divided into two sections. The first section is on households' demography. It provides a descriptive analysis of the sampled households and compares the socio-economic variables chosen to represent the households. This section also makes a comparison of the socio economic factors between the piped (households with private taps) and the non piped households and also across villages. The second section presents characterisation of water uses and users. This chapter compares the finding of the study with the other studies which were done in the same area and elsewhere.

## 5.1 Household Characteristics

The study was conducted in seven (of the fourteen) villages of Sekororo-Letsoalo area, where the estimated population of the 14 villages is 56,510 (WSDP, 2003). Villages were characterised according to the different water access using the data from the 2001 Census. The total number of households interviewed was 169, of which 27% and 25% were from Metz and Lorraine respectively. Turkey 2 had the least number of households interviewed (Table 5.1).

**Table 5. 1: Distribution of sampled households by village**

| Village | Frequency | Proportion (%) |
|---|---|---|
| Metz | 45 | 26.6 |
| Turkey 1 | 15 | 8.9 |
| Makgaung | 23 | 13.6 |
| Lorraine | 42 | 24.9 |
| Enable | 16 | 9.5 |
| Ga-Sekororo | 17 | 10.1 |
| Turkey 2 | 11 | 6.5 |
| **Total** | **169** | **100** |

(Source: Survey data, 2007)

Household size ranges from 1 to 15, with an average of 6 for the total sample (Table 5.1). However there are variations across villages. Turkey 1, Enable and Makgaung have higher household size than the total sample average whilst Metz and Turkey 2 have lower household size (5).

Table 5.1: Mean household size in the study area

| Village | Mean household size |
|---|---|
| Metz | 5 |
| Turkey 1 | 8 |
| Makgaung | 7 |
| Lorraine | 6 |
| Enable | 8 |
| Ga-Sekororo | 6 |
| Turkey 2 | 5 |

(Source: Survey data, 2007)

Table 5.2 shows that household heads were in most cases the respondents for this survey (64% of respondents). Age of respondents ranged from 19 to 86 years with a mean of 47 years. 77% of the respondents were female whilst only 23% were male. This was an advantage as the females are generally the ones who know about the household water use and the sources as they are responsible for most of the household duties. Of all the households heads who were interviewed only 20% were male heads whilst the female household heads were 80% (Table 5.3).

Table 5.2: Gender and position in the household of the respondent

| | Gender of the respondent | | Total |
|---|---|---|---|
| | Male | Female | |
| Not household head | 17 | 44 | 61 |
| Household head | 22 | 86 | 108 |
| Total | 39 | 130 | 169 |

(Source: Survey data, 2007)

Figure 5.1 shows that the education level of the respondents is very low; more than 95% of the household heads did not go beyond matric. Only 4% have diplomas and degrees whilst 30% have not received any school education. Finally, 1/3 of the interviewed population has primary level of education and 1/3 received secondary education.

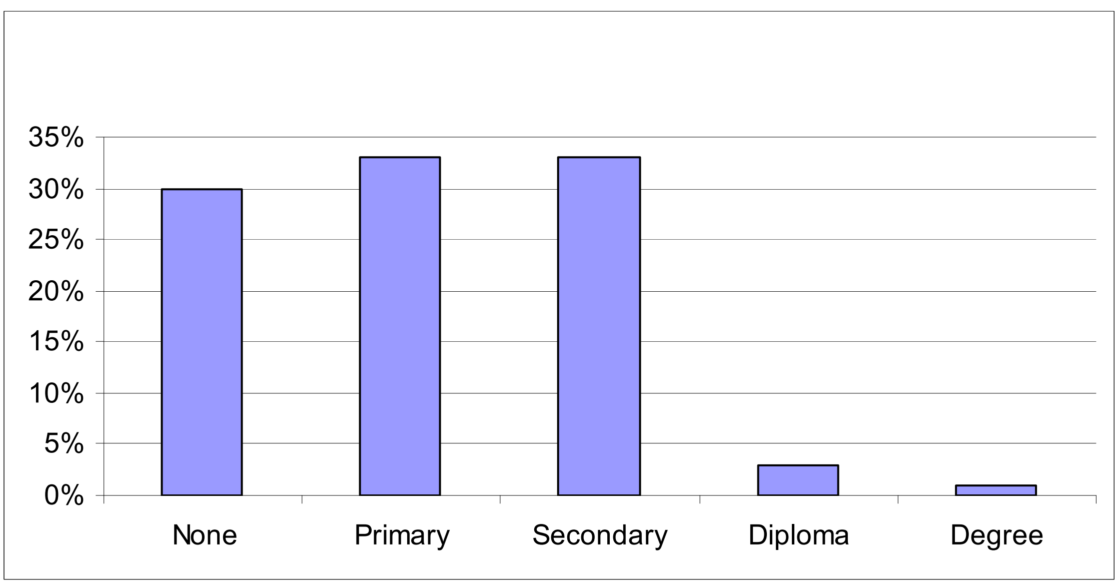



Figure 5. 1: Distribution of interviewed household head per education level
(Source: Survey data, 2007)

Unemployment is a problem in the area; only 20% of household heads have formal jobs and many households rely on pensions (37%) for their livelihood. Only 1 % of the population considered themselves as full time farmers and they produce mostly for their own subsistence with very little surplus for the market. 21% of the household heads reported that they are unemployed and do not have any source of income whilst 4% are self employed, 7% are farm workers whilst 6% are not formally employed and depend on piece jobs[11] for income. The households with the highest level of income have a member working in the public sector and constitute 8% of the sample. 4% of the household heads are farm workers and are employed in large commercial farms surrounding the area.

There are variations in employment status across villages. 24%, 33% and 24% of the household heads in Turkey 1, Turkey 2 and Ga-Sekororo are unemployed. In Enable, Metz and Makgaung only 6%, 13% and 17% are unemployed respectively. Reliance on pensions and social grants also varies across villages, in Makgaung and Ga-Sekororo more than half of the population relies on pensions. The public sector employees are mostly in Metz and Lorraine (which are the villages with the highest population according to the 2001 Census) whilst in Makgaung, Ga-Sekororo and Turkey 2 there was no public sector employee in the sampled population.

Table 5.3: Occupation of the household head

| Occupation | Frequency | Proportion (%) |
|---|---|---|
| Farmer | 2 | 1.2 |
| Pensioner | 62 | 36.7 |
| Public sector employee | 13 | 7.7 |
| Unemployed | 35 | 20.7 |
| Self employed | 7 | 4.1 |
| Farm worker | 7 | 4.1 |
| Domestic worker | 12 | 7.1 |
| Mining or industrial worker | 18 | 10.7 |
| Piece jobs | 10 | 5.9 |
| Community preschool | 3 | 1.8 |
| **Total** | **169** | **100** |

(Source: Survey data, 2007)

[11] Piece jobs are informal short term jobs.

About 76% of the households live on a monthly income lower than R1 600. Mean household monthly income is R1 653.52 which is higher than the rural poverty line of R1 000 (SARB, 2000), with a standard deviation of 2 083 showing that the household income is highly variable across households. Income is higher among households who are formally employed and least among full time farmers and pensioners.

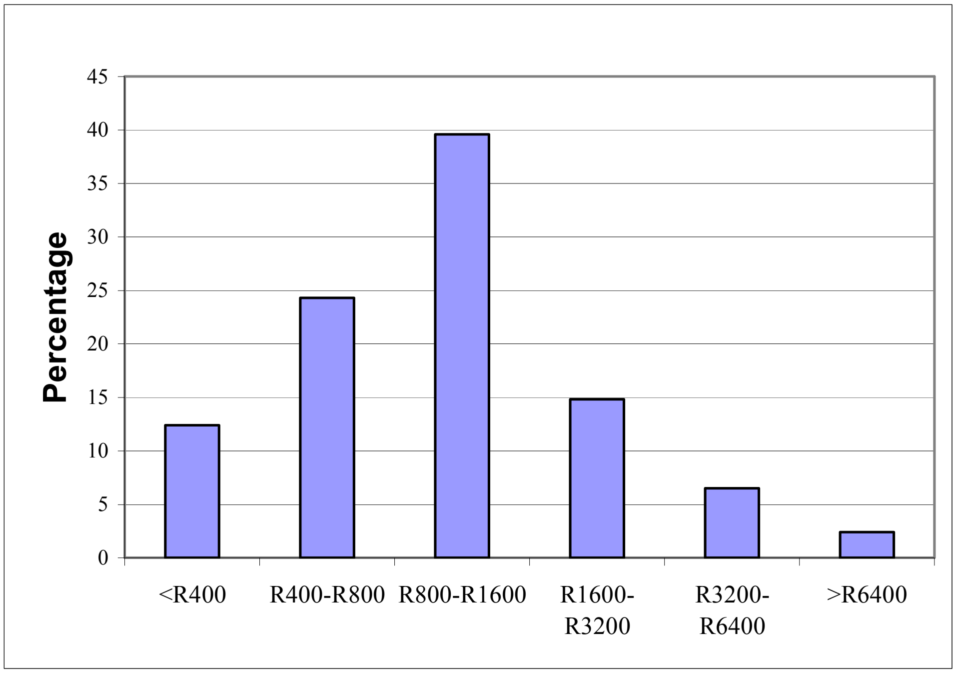



Figure 5. 2: Distribution of households per class of monthly income in Sekororo-Letsoalo area
(Source: Survey data, 2007)

The income distribution across households is similar to Malatji's and Nyalungu's surveys results (Malatji-Nyalungu surveys (2005)), which looked at the income distribution of mainly farming households in the same area in 2005. Their studies found out that the majority of households have income in the range of R800-R1600 (Table 5.4). The findings of this current study are however different from the Census results for the wards 1 to 5 (Cf. Table 5.5) and this could be due to the fact that the census did not probe for informal income. On the other hand, this difference could be attributed to time gap between the Census and this survey, as changes in income could have occurred over the last 6 years.

Table 5.4: Distribution of households per class of monthly income (in Rands) from Census (2001) and Malatji and Nyalungu surveys (2005)

| **Source** | **None** | **<400** | **400-800** | **800-1600** | **1600-3200** | **3200-6400** | **>6400** |
|---|---|---|---|---|---|---|---|
| Census 2001 wards 1 to 5 | 41% | 11% | 24% | 13% | 6% | 5% | 2% |
| Malatji-Nyalungu surveys (2005) (159 households) | - | 21% | 16% | 34% | 23% | 4% | 1% |

Source: Census (2001) and Malatji-Nyalungu surveys (2005)

Income varies across gender. The mean income for male headed households (R2 514.29) is significantly higher than that of female headed households (R1 119.49). This could be because more males are involved in formal jobs.

Table 5.5 shows that the household income varied with income source. A significant part of households with the lowest income (31%) depend on social grants whilst 25% of this income category depends on remittances and 25% depend on piece jobs.  Pension earners form the majority of the two middle income classes (respectively 69% and 50%). Most of the high income households (>R3200/ month) depend on salaries.  These results show that the household incomes for the low income earners and the middle class are mostly from pensions.

Table 5.5: Distribution of monthly household income in Sekororo-Letsoalo area

| **Distribution of households per source of income and income class** | **<R400** | **R400-R800** | **R800-R1600** | **R1600-R3200** | **R3200-R6400** | **>R6400** | **Total** |
|---|---|---|---|---|---|---|---|
| Salaries | 6% | 29% | 18% | **41%** | **83%** | **80%** | 29% |
| Pensions | **31%** | **43%** | **69%** | **50%** | 8% | 20% | **51%** |
| Farm income | 0% | 2% | 0% | **3%** | 0% | 0% | **1%** |
| Piece jobs | 25% | 14% | 9% | 6% | 8% | 0% | 1% |
| Remittances | 25% | 5% | 3% | 0% | 0% | 0% | 4% |
| off far jobs | 13% | 7% | 1% | 0% | 0% | 0% | 3% |

(Source: Survey data, 2007)

Table 5.6 shows that the greatest share of household income (59%) is from formal employment even though only less than a 1/3 of the sample is formally employed. This shows a high degree of income inequity where very few people have high incomes while many are poor. Of those who are formally employed, the highest incomes are for those who work in the public sector representing only 8% of the total population. The second largest source of income is represented by pension sand grants (32%). Self employment contributes 5% of the total income in Sekororo-Letsoalo area. The results show that households with low incomes have multiple sources of income whilst households with the highest income have only 2 sources which are salaries (98%) and only 2% from pensions and social grants.

Table 5.6: Distribution of monthly household income across sources per income classes in Sekororo-Letsoalo area

| **Source of income** | **<R400** | **R400-R800** | **R800-R1600** | **R1600-R3200** | **R3200-R6400** | **>R6400** | **Total** |
|---|---|---|---|---|---|---|---|
| Salaries | 10% | **40%** | 27% | **55%** | **98%** | **98%** | **59%** |
| Pension and grants | **25%** | **42%** | **63%** | 35% | 1% | 2% | 32% |
| Piece jobs | **31%** | 10% | 7% | 3% | 1% | 0% | 5% |
| Self employment | 15% | 1% | 3% | 3% | 0% | 0% | 2% |
| Remittance | 19% | 4% | 0% | 3% | 0% | 0% | 1% |
| Farm income | 0% | 2% | 0% | 1% | 0% | 0% | 1% |
| **Total Household income** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

(Source: Survey data, 2007)

The results are consistent with the findings by Malatji and Nyalungu (2005) which showed that the biggest share of income was that from salaries (41%) and pensions (29%). In their study they also showed that 20% of the households had an income from farming whereas in this study only 1% of the study population reported that they have income from farming. This difference could be attributed to the fact that in Malatji and Nyalungu's surveys the sample was stratified in a way that targeted mostly farming households. This was not the case in this study as the stratification was based on households' water access only (Table 5.7).

Table 5.7: Distribution of annual household income across sources per income classes

| % of annual income from | R1 - 4800 | R4801 - 9600 | R9601 - 19200 | R19201 - 38400 | R38401 - 76800 | over R76801 | Total |
|---|---|---|---|---|---|---|---|
| Employment | 12% | 7% | 20% | **37%** | **69%** | **98%** | 41% |
| Off farm activity | 7% | 5% | 1% | 2% | 13% | 0% | 3% |
| Livestock | 2% | 3% | 2% | 4% | 0% | 1% | 2% |
| Crops | **69%** | **50%** | 26% | 17% | 5% | 1% | 20% |
| Remittances & grants | 0% | 7% | 6% | 7% | 3% | 0% | 5% |
| Pension | 10% | 30% | **45%** | **34%** | 10% | 0% | 29% |
| **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

Source: Malatji's and Nyalungu's surveys (2005)

**Incidence of poverty**

There are many definitions for poverty and there are debates about what should be considered as the National poverty line in South Africa. Using the rural poverty line in 1999 prices adjusted for inflation, the poverty line for 2007 would be R1600 (own calculation using SARB 2000) in South Africa. Based on this adjusted poverty line, we calculated that 76% of the surveyed households are poor whilst 37% are ultra poor[12]. Of the sampled population, Turkey 1 has the highest incidence of poverty (80%) whilst Enable has the least incidence of poverty (50%) (Table 5.8).

According to World Bank (2007) anyone who consumes less than US$1 per day is considered to be extremely poor whilst a person who consumes less than US$2 per day is poor. Using the international poverty line (World Bank, 2007), around 49% of the people in Sekororo- Letsoalo area are extremely poor, whilst around 77% are poor (Table 5.8 and figure 5.3a).

Figure 5.3b shows the distribution of income across households. This Lorenz curve shows that income not fairly distributed as very few households have most income whilst the majority have very low income.

[12] Households which earn an income of R12000/annum and below are considered to be poor. The SARB (2000) indicated that using the 1999 prices, rural poverty line in South Africa was R12000/annum. Taking 2000 as the base year, price index was 92.78 in 1999 and 150.27 in 2007 (SARB, 2008). R9600/ annum is considered as the ultra poverty line (Leatte, 2006).

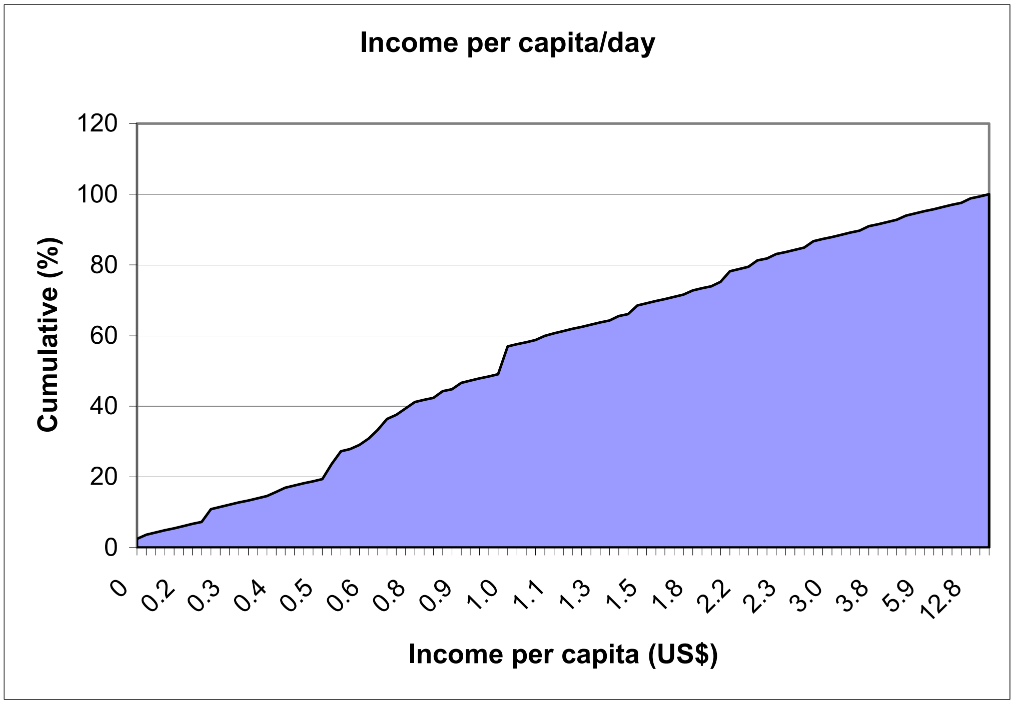



Figure 5. 3a: Cumulative distribution of households per income per capita per day
(Source: Survey data, 2007)

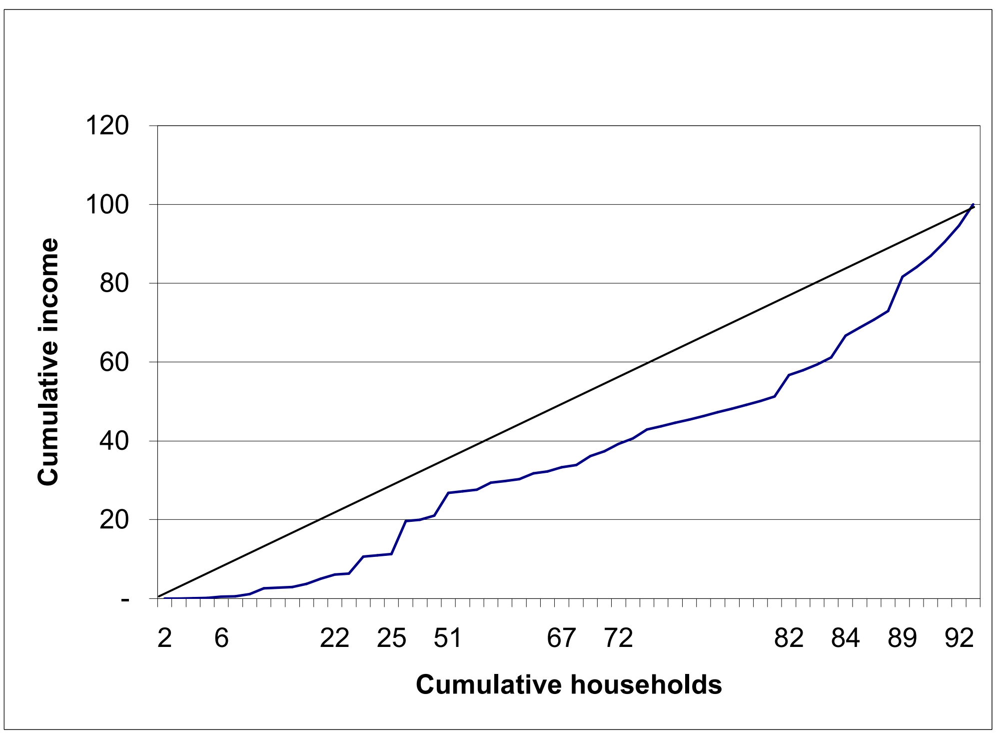



Figure 5. 3b: Lorenz curve showing distribution of income across households.
(Source: Survey data, 2007)

Table 5.8 shows that the mean income in each of the villages ranges from R936 (Turkey 2) to R1916 (Makgaung). However, according to F-test, this difference is not significant. ($F=0.65$ and $p=0.69$). The village with a highest poverty incidence is Turkey 1 (80%) whilst Enable has the least poverty incidence (50%). Villages with a higher proportion of people with formal employment have higher mean incomes.

Table 5.8: Distribution of household income and poverty across villages in Sekororo-Letsoalo area

| **Village** | **Mean household monthly income (Rands)** | **Proportion of households which is poor in each village** | **Incidence of poverty based on the international poverty line** | |
|---|---|---|---|---|
| | | | Proportion of households which is poor (less than US$ per capita per day) | Proportion of households which is extremely poor (less than US$ per capita per day) |
| Metz | 1884.89 | 66.67% | 62% | 40% |
| Turkey 1 | 1157.33 | 80% | 80% | 80% |
| Makgaung | 1916.96 | 56.52% | 74% | 57% |
| Lorraine | 1817.86 | 64.29% | 81% | 43% |
| Enable | 1560.63 | 50% | 75% | 44% |
| Ga-Sekororo | 1268.24 | 64.71% | 76% | 53% |
| Turkey 2 | 935.91 | 54.55% | 73% | 36% |
| Total sample | 1653.52 | 76.3% | 73% | 48% |

(Source: Survey data, 2007)

Figure 5.4 shows that not only men are responsible for generating income for the household. Women seem to be playing a pivotal role in generating household income. The results show that in 37% of the households women earn income whilst the men have a 33% probability of generating household income[13]. Children also “earn” income in the form of grants.

[13] It is worthwhile noticing that this does not mention anything about the proportion of income.

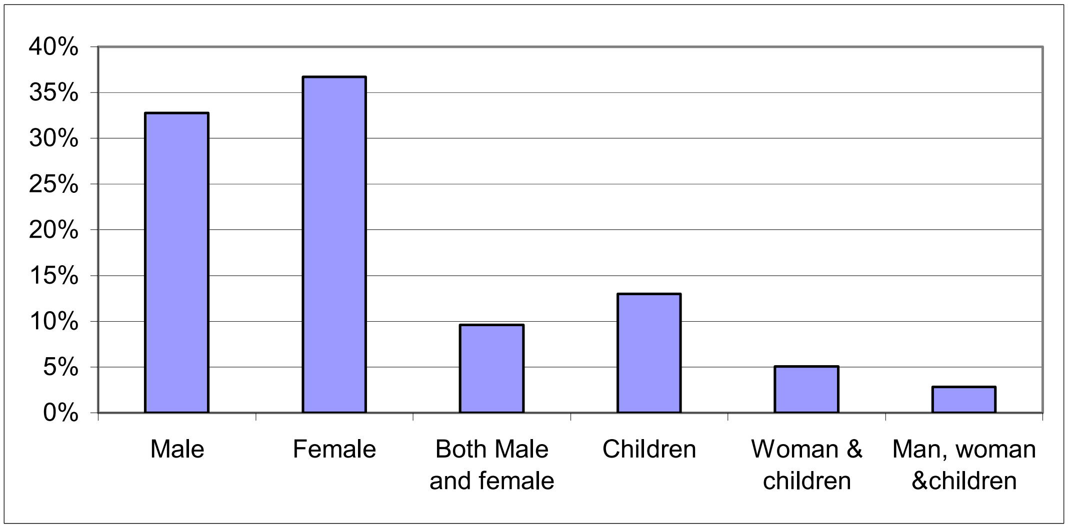



Figure 5. 4: Distribution of household by status of income earner
(Source: Survey data, 2007)

**Role of collecting water in the household**

Figure 5.5 shows that in almost a half of the households water collection is the role of women only. 32% of the households reported that even though both men and women collect water, women participate more actively in this role than men. Only 17% households reported that water collection is a men's responsibility. Given the current poor access to private taps and the unreliability and low frequency of water supply of the tap water and public standpipe water, women are the ones who bear the burden of collecting water from other sources which are far from their homestead. Improvement of water services in the rural areas is likely to benefit women in the sense that they will have more time to do other productive uses of their time as well as do their social roles of looking after the family.

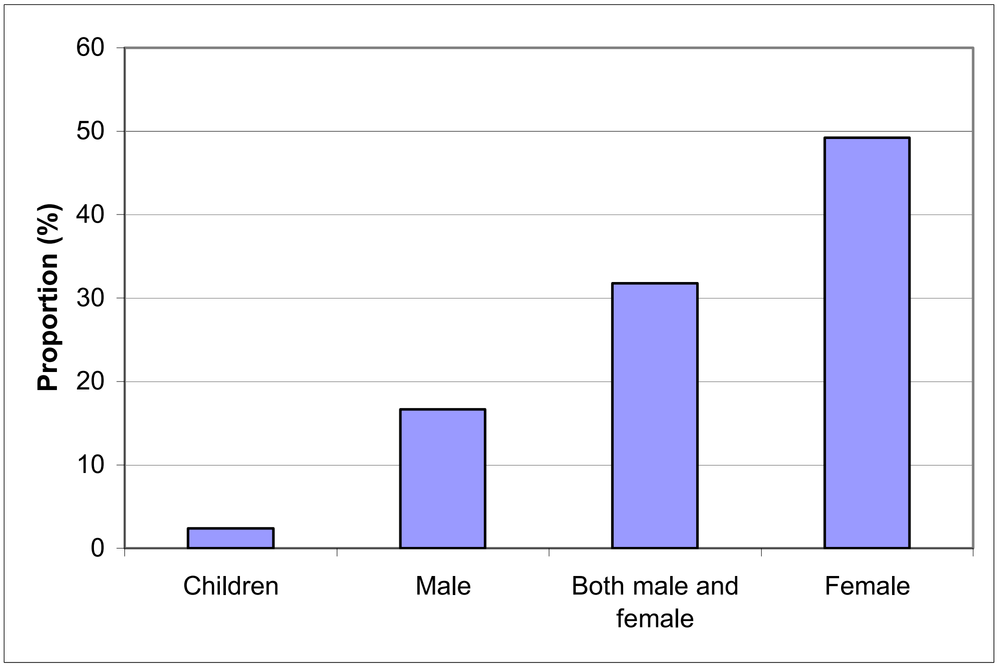



Figure 5. 5: Distribution of households per status of members collecting water[14]
(Source: Survey data, 2007)

[14] NB: Children were put only for households where they did not specify gender only [this note is not clear].

## 5.2 Characterisation of water uses and users

**Water access**

Only 51% of the sampled population have private taps. The proportion of the households having private taps within the premises is higher than the one provided by the 2001 census (38%), which indicate that over the past 6 years the number of people who had access to private taps increased significantly. The results show that in Metz, Makgaung, Ga-Sekororo and Turkey 2 more than 50% of the households have private taps. Turkey 1 and Enable have the worst access to private taps (20% and 31% of households respectively) (Figure 5.6). However, even though some of households in Sekororo-Letsoalo area have private taps, 24% of these taps are not working. The state of private taps is very uneven among villages: in Metz all the households have private taps running whilst in Ga-Sekororo and Turkey around 90% of households with private taps have running taps. On the contrary, in Enable and Turkey 1 only 20% and 33% of the piped households have running private taps.

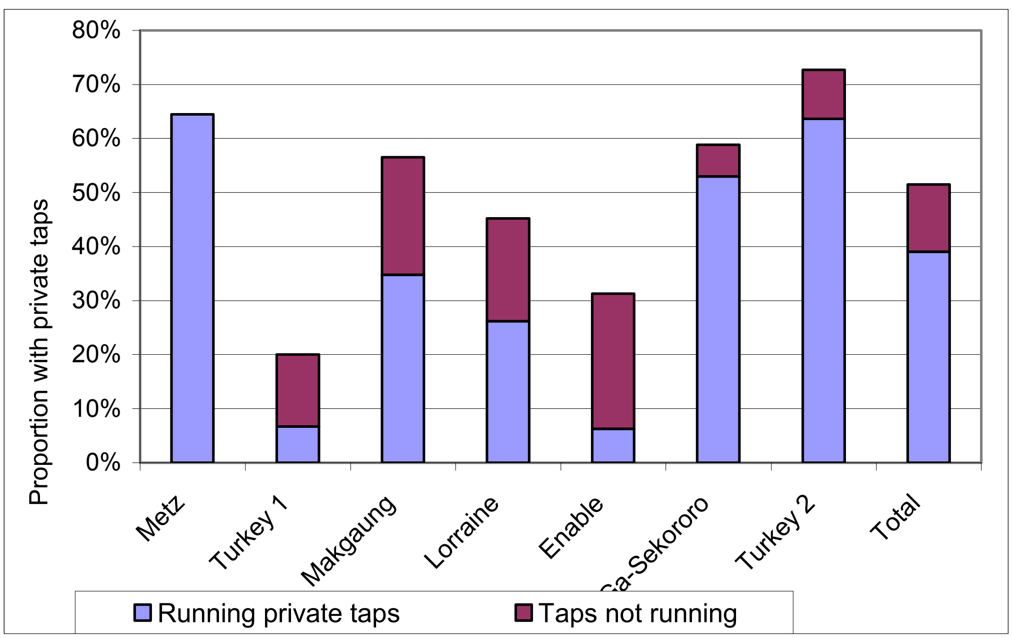



Figure 5. 6: Proportion of households with and without private taps in Sekororo-Letsoalo area
(Source: Survey data, 2007)

**Water sources**

The mean number of water sources in Sekororo-Letsoalo area is 2. Almost 50% of the households have more than one water source (see Figure 5.7). It is interesting to note that even households who have private taps or boreholes are using multiple sources of water (see Figure 5.8). The use of multiple sources is due to intermittency of water supply and low quantities of water. Only 18% of the households reported that they receive water at all times everyday whilst an additional 6% have water everyday but for limited times (see Table 5.12).

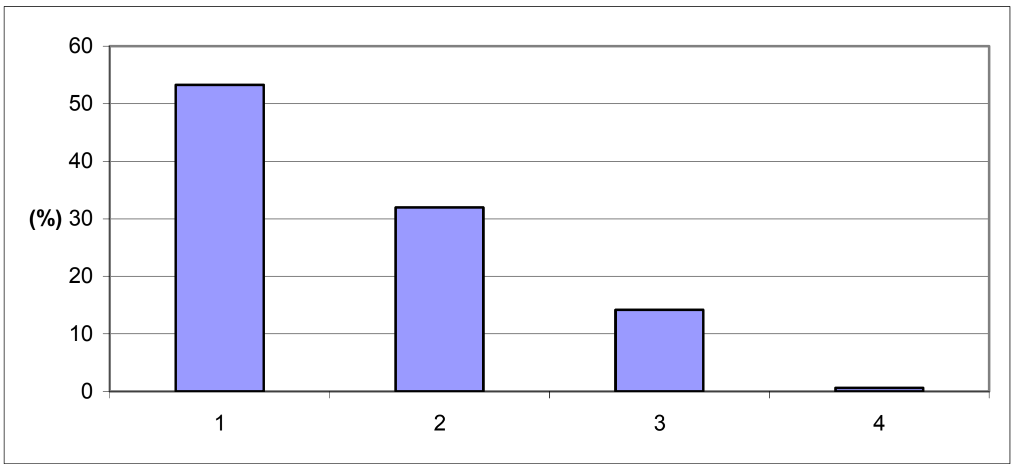



Figure 5. 7: Distribution of surveyed households per number of water sources
(Source: Survey data, 2007)

Figure 5.8 shows that a large proportion of the households have multiple sources of water. However these sources vary according to the village depending on the current frequency of supply of piped water (private taps and public standpipes) and other water services attributes. Table 5.10 shows the variability of water sources across villages. Most of the households in Metz, Makgaung and Turkey 1 rely mostly on one source whilst households in other villages rely on more than one source. Turkey 2 has the least percentage of households relying on one water source. In the other villages there are significant proportions of households that use more than one source. Ga-Sekororo has almost equal share between one source and more than one source. In Lorraine and Enable most of the people have more than one source.

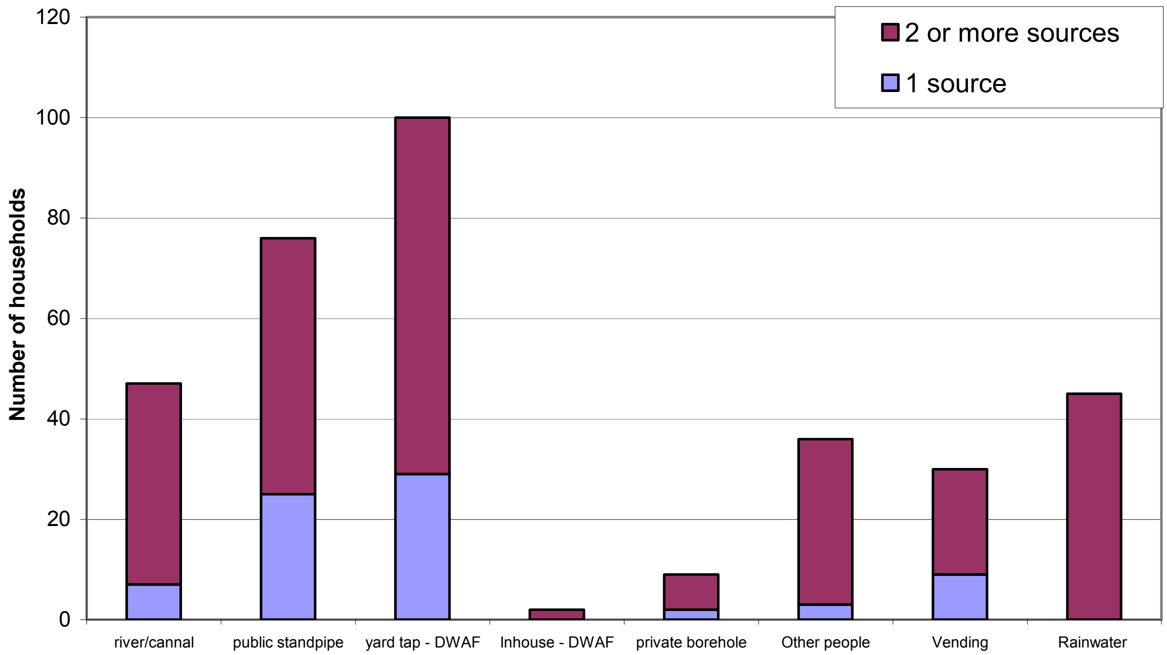



Figure 5. 8: Sources of water for households in Sekororo-Letsoalo area.
(Source: Survey data, 2007)

Table 5.9: Number of water services across villages

| **Number of sources** | **Metz** | **Turkey 1** | **Makgaung** | **Lorraine** | **Enable** | **Ga-Sekororo** | **Turkey 2** | **Total** |
|---|---|---|---|---|---|---|---|---|
| 1 source | **67%** | **80%** | **70%** | **40%** | **38%** | **47%** | 9% | 53% |
| 2 sources | 33% | 13% | 17% | **40%** | **31%** | 29% | **55%** | 32% |
| 3 sources | 0% | 7% | 9% | 19% | **31%** | 24% | 36% | 14% |
| 4 sources | 0% | 0% | 4% | 0% | 0% | 0% | 0% | 1% |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

(Source: Survey data, 2007)

Table 5.10 presents household water sources by village. The results show that the sources of water vary by village. A yard tap connected to the DWAF system is a common source in all villages except Turkey 1 and Enable. Public standpipe is the main source of water in Turkey 1 and Makgaung whilst the river is the mostly used source in Enable. A number of households in Metz, Lorraine and Ga-Sekororo ask for water from neighbours who in some cases sell this water to them. Water vendors and buying of water from neighbours are the most common source for households in Lorraine.

Water access is heterogeneous in all villages thereby making it possible for vending. In Lorraine villagers reported that they buy water for R0.50 for a 25 litres container and in some cases people pay R15 per 250 litres container. For 5% of the surveyed households, vending is their only source of water whilst 12% of the population reported that they use this source along with others. The water from private boreholes is normally connected to a tap (both in house and yard) though a single case was reported where the household collected water directly from the borehole.

Table 5.10: Number of surveyed household per water sources and village

| **Water source** | **Metz** | **Turkey 1** | **Makgaung** | **Lorraine** | **Enable** | **Ga-Sekororo** | **Turkey 2** |
|---|---|---|---|---|---|---|---|
| Borehole | 1 | | | 2 | | 2 | |
| In house tap -DWAF | 2 | | | 1 | | | |
| Yard tap connected to DWAF system | **26** | 2 | **10** | 10 | 4 | **9** | **8** |
| Rainwater | 6 | | 6 | 9 | **9** | **7** | **8** |
| Public standpipe | 5 | **14** | **13** | **13** | 1 | | 3 |
| Neighbours | 10 | | | **12** | | **10** | 3 |
| Vending | | | | **18** | 1 | 2 | |
| River/canal | 3 | 3 | 2 | 8 | **16** | | 3 |
| Total households | 45 | 15 | 23 | 42 | 16 | 17 | 11 |

(Source: Survey data, 2007)

**Frequency of supply**

As water is needed everyday for basic domestic consumption, frequency of supply is very important for households and a good indicator of the quality of water services. Supply of water determines how water is used and stored, affects the number of water sources and limits productive uses. Only 18% of the households reported that water is available to them everyday and at all times. 25% of the households have access to piped water every two days whilst 6% have access to water every day for limited hours. Most of the households have access to water less than 2 times per week and this water is mostly from the standpipe and private taps which are connected to the DWAF system (Table 5.12). As a coping strategy, these households store water and they use multiple sources of water like vending, neighbours and rivers. Based on the frequency of supply of taped water, Metz has the best water access whilst Turkey 2 has the worst.

Table 5.11: Distribution of surveyed households per frequency of water supply and village

| **Frequency of supply** | **Metz** | **Turkey 1** | **Makgaung** | **Lorraine** | **Enable (*)** | **Ga-Sekoror o** | **Turkey 2** | **Total** |
|---|---|---|---|---|---|---|---|---|
| everyday at all times | 0% | 0% | 0% | **26%** | **63%** | **53%** | 0% | 18% |
| everyday for limited hours | 4% | 0% | 0% | 14% | 6% | 0% | 0% | 5% |
| every 2 days | **73%** | 7% | 4% | 12% | 6% | 6% | 0% | 25% |
| 2 times per week | 7% | 20% | 9% | 12% | 6% | 12% | 9% | 10% |
| once in 2 weeks | 0% | 0% | 0% | 2% | 0% | 0% | 0% | 1% |
| less than 2 times per week | 16% | **73%** | **87%** | **33%** | 19% | 29% | **91%** | **41%** |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

(*) For households in Enable this shows frequency of supply of river water

(Source: Survey data, 2007)

**Storage of water**

95% of the surveyed households reported that they store water[15]. There is lack of water security, people are not certain about the times of water supply as households often go for some periods without piped water. Most people indicated that they use 25 litres and 250 litres containers to store water. A household has on average 6 small containers (20-25 litres) and 2 big containers (200-250 litres) for storing water (i.e., a storage capacity of 520 to 650 litres, hence 87 to 108 litres per capita -considering an average household of 6 members). This water is too little given that sometimes there is no water available for a week.  Only 7% of the population reported that they have Jojo[16] tanks (for rainwater harvesting and for storing borehole water). These tanks range from 1500 to 5000 litres of capacity.

[15] This is mainly because the frequency of supply of water is poor for most of the villages. Respondents say that this is sometimes due to bursting of pipe and breakdown of other infrastructure

[16] Jojo is the brand name for tanks that are used for rain harvesting and for storing borehole water.

Table 5.12: Distribution of surveyed households per frequency of filling containers with water

| How often are the containers filled | Frequency | Proportion (%) |
|---|---|---|
| Everyday | 24 | 14.8 |
| 3 times a week | 25 | 15.5 |
| 2 times a week | 11 | 6.8 |
| Once a week | 76 | 46.9 |
| Every 2 weeks | 8 | 4.9 |
| Every time after the rains | 14 | 8.6 |
| Once a month | 3 | 1.9 |
| Once in 3 months | 1 | 0.6 |
| **Total** | **162** | **100** |

(Source: Survey data, 2007)

47% of the households fill their containers with water every week (Table 5.12). The average number of days during which water is stored for use is 6 (standard deviation=3.68).

**Households' water consumption**

Figure 5.9 presents the water consumption of the sampled households, it shows that almost 50% of the households use between 75 and 150 litres per day. Using an average family size of 6, it means most people are using between 13 and 25 litres per capita per day. This quantity falls below the standard set by the 1997 Water Services Act of 25 litres per capita per day. In Enable around a half of the households use more than 300 litres per day (mainly from the river and used for multiple uses) whilst in some villages (Turkey 1, Turkey 2 and Ga-Sekororo) no household reaches this level of daily consumption. All households in Turkey 2 reported a daily consumption not exceeding 150 litres (see Table 5.13). Enable uses more water because it has the highest proportion of households using water for multiple uses. This could be attributed to World Vision and other NGOs' interventions through improvement of water access and introduction of community gardens in the village. Households' adoption of multiple uses is correlated with household water quantities.

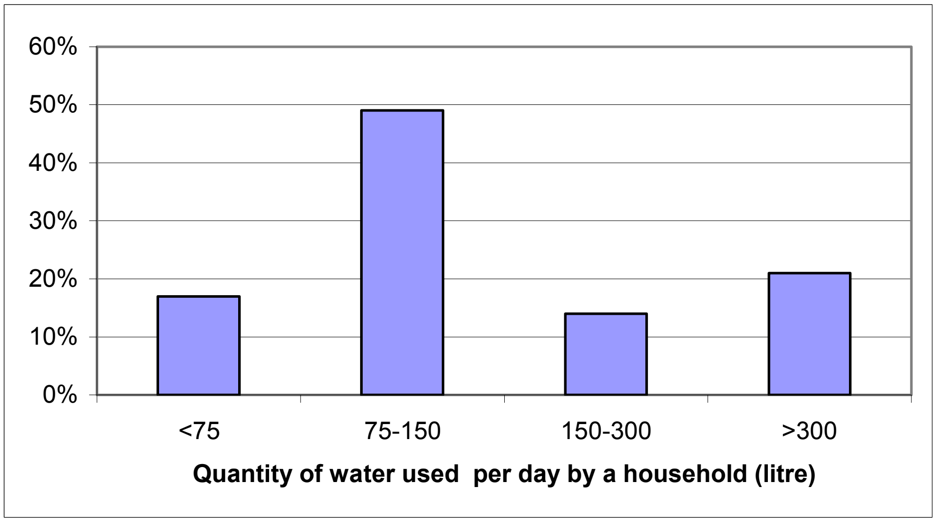



Figure 5. 9: Distribution of surveyed households per daily household water consumption
(Source: Survey data, 2007)

Table 5.13: Distribution of surveyed household per daily household water consumption and per village

| Quantity of water used per day (litres) | Metz (%) | Turkey 1 (%) | Makgaung (%) | Lorraine (%) | Enable (%) | Ga-Sekororo (%) | Turkey 2 (%) |
|---|---|---|---|---|---|---|---|
| <75 | 29 | 13 | 4 | 7 | 0 | 29 | 36 |
| 75-150 | 31 | **67** | **57** | **57** | 25 | **59** | **64** |
| 150-300 | 18 | 20 | 9 | 12 | 25 | 12 | 0 |
| >300 | 22 | 0 | 30 | 24 | **50** | 0 | 0 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

(Source: Survey data, 2007)

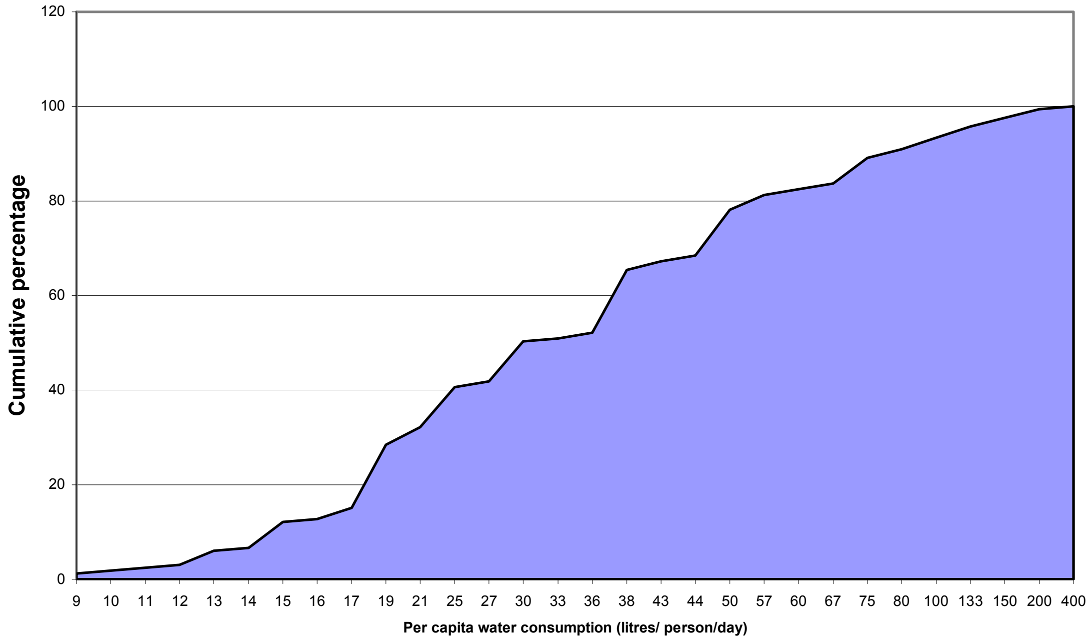



Figure 5. 10: Cumulative distribution of surveyed households by per capita daily water consumption
(Source: Survey data, 2007)

Figure 5.10 shows that about 41% of the population has water access below 25 litres per capita per day, which is the minimum free basic water that should be available to each individual. This shows that a lot needs to be done to ensure that all households in Sekororo-Letsoalo area have access to the minimum requirement of 25 litres/day standard set by the 1997 Water Services Act.

**Quality of water**

Figure 5.11 presents perceptions of surveyed households on current water quality in the Sekororo-Letsoalo area. Most of the respondents hinted that the water quality was not bad, whilst 24% reported that the water quality was poor or worse. More than 80% of the households in Enable reported that the quality of their water is poor and this could be attributed to the fact that they depend largely on river water. Main problems reported by those who perceived the water quality to be poor were that the water is saline, muddy, contaminated by living organisms, had an unusual colour or they are not happy that they drink the same water as animals or the water is simply not purified.

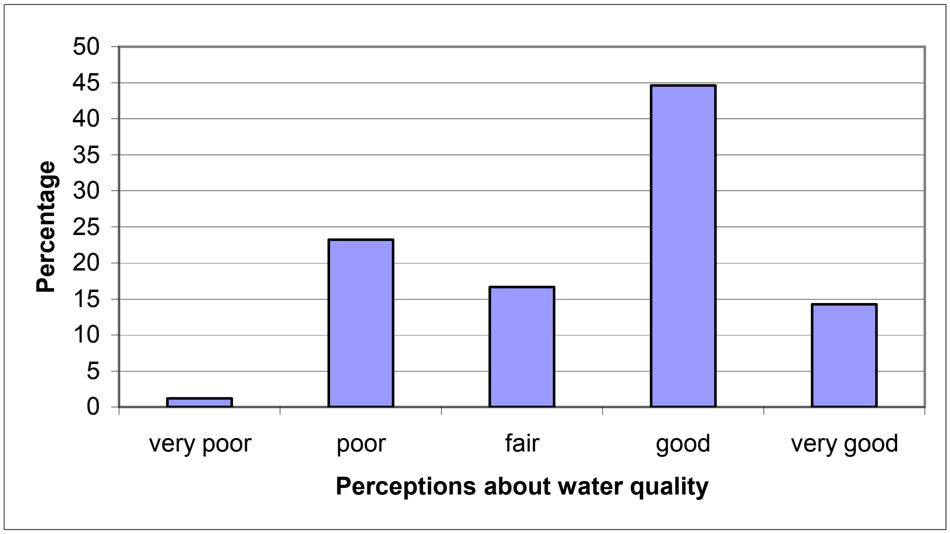



Figure 5. 11: Distribution of surveyed households according to their perception about water quality
(Source: Survey data, 2007)

**Multiple uses of water**

31% of the surveyed households reported that they are using water for non domestic uses. Turkey 2 (73%) and Enable (63%) had the highest proportion of households using water for multiple uses, whilst Turkey 1 and Makgaung had only 13% of households using their water for multiple uses (Figure 5.12). The results show that people who have the best frequency of supply of water (those who got water all times everyday) are more often using water for multiple uses (cf Figure 5.13). The quantity of water available to a household per day also determines what the household can use water for (Figure 5.14). There is a positive relationship between household daily water quantity and the use of water for multiple uses. Water consumption significantly affect engagement of households in multiple uses of water (F=2.6). Results show that 47% of the households using more than 300 litres per day use water for multiple uses whilst only 18% of those who get less than 75 litres per day use water for multiple uses. This shows that water quantity limits the use of water for productive uses and an improvement in water quantity for households could allow more households using water for multiple uses and hence improve the households' livelihood and ability to pay for water services.

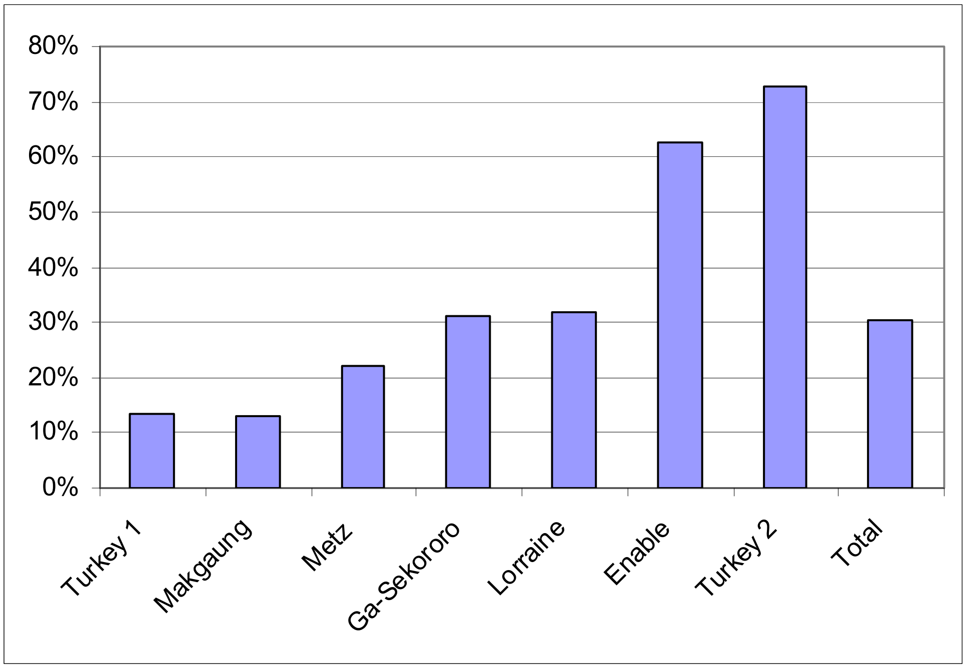



Figure 5. 12: Proportion of surveyed households using water for non domestic uses (Multiple uses) per village (Source: Own survey, 2007)

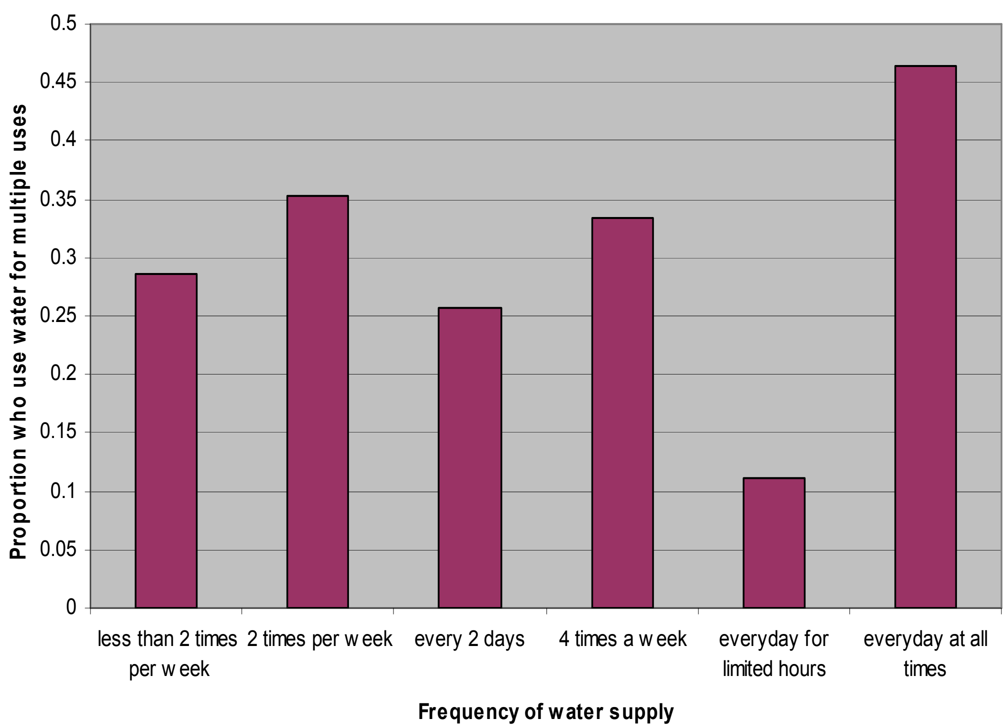



Figure 5. 13: Proportion of surveyed households using water for multiple uses according to their frequency of water supply
(Source: Survey data, 2007)

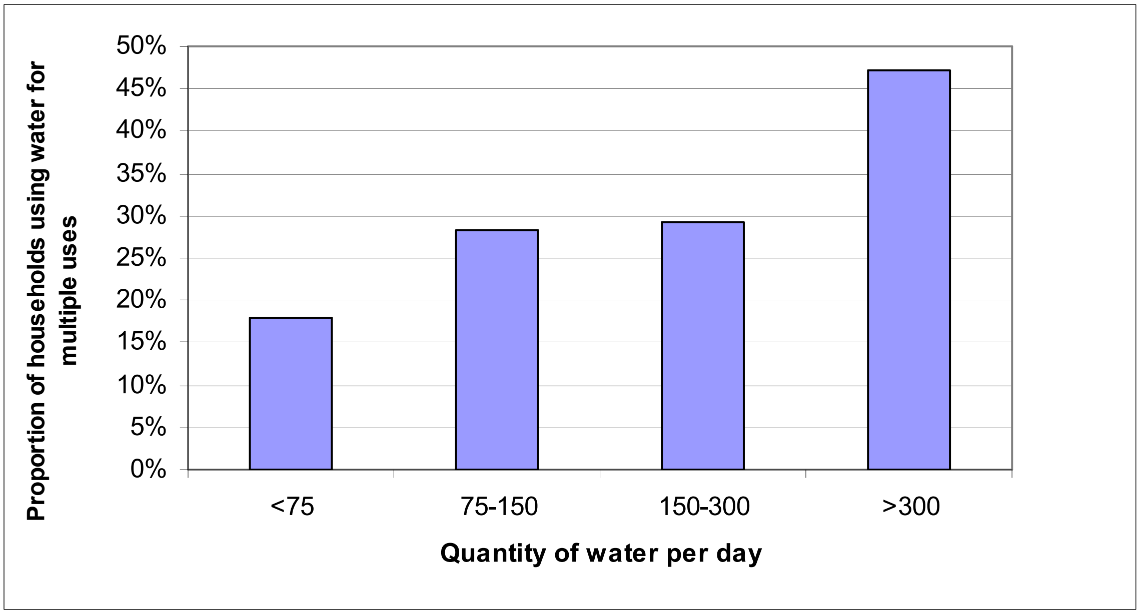



Figure 5. 14: Proportion of surveyed households using water for multiple uses according to their household daily water consumption
(Source: Survey data, 2007)

Figure 5.15 presents the type of non-domestic water uses for households in Sekororo-Letsoalo area. The most common productive uses of water in Sekororo-Letsoalo area are livestock watering and backyard gardening in summer and winter. There are however variations in the uses of water in different villages. In Turkey 2 more than 70% of households use water for livestock whilst more than 40% of households in Enable use water for backyard gardens all year round. Backyard gardens are also common in Metz, where 20 % of the households water their gardens all year round. Almost 20% of households in Ga-Sekororo use water for livestock. There are also significant proportions of households in Turkey 1 and Lorraine who use water for livestock as well.

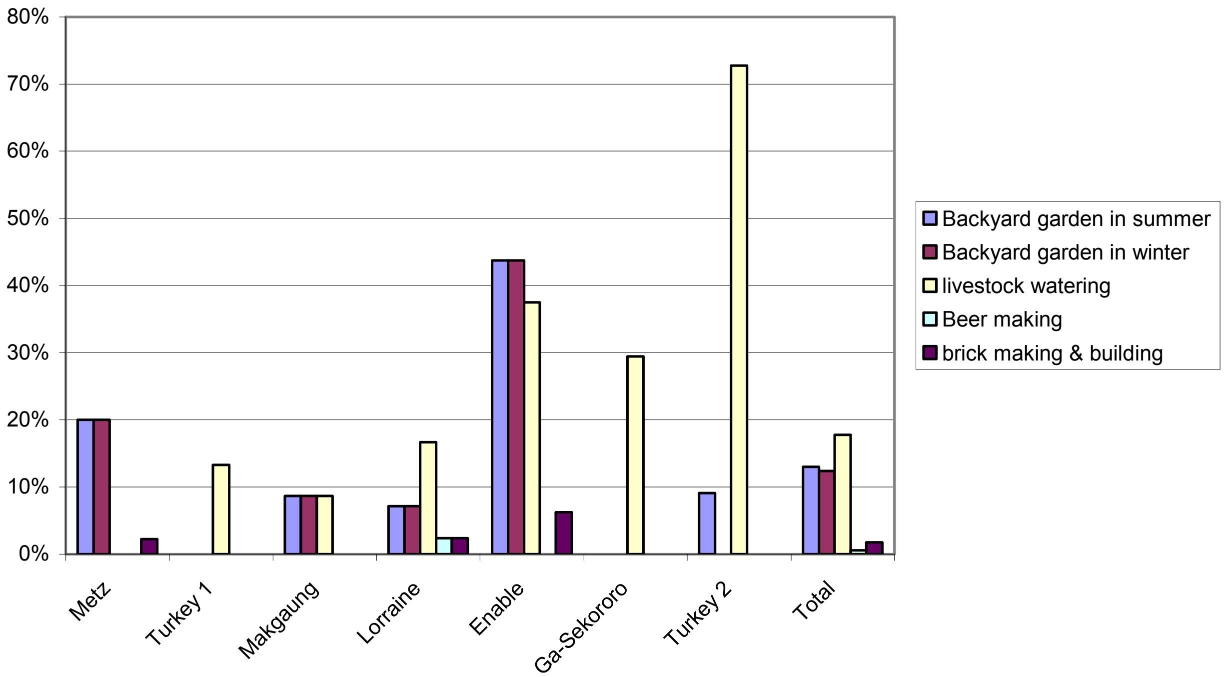



Figure 5. 15: Proportion of surveyed households per types of productive uses of water and villages
(Source: Survey data, 2007)

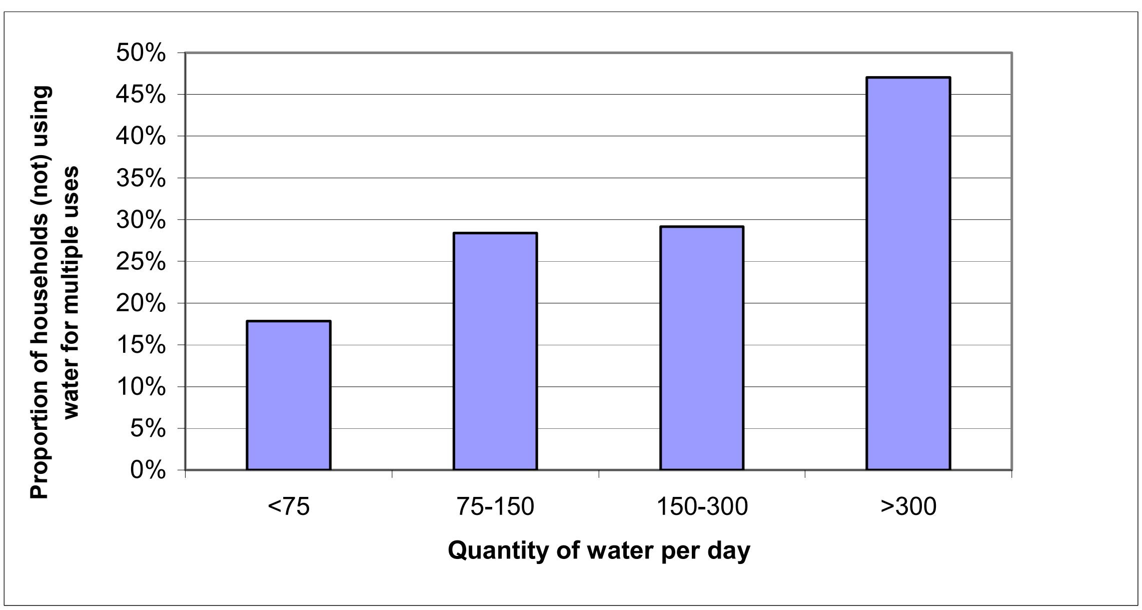



Figure 5. 16: Households using water for multiple uses by water consumption
Source: own survey data

Only 12% of the households has plots in irrigation schemes and communal gardens (see Table 5.14 below). Turkey 2 has the highest proportion of households having plots or using communal gardens in the irrigation scheme (54%). There are no communal gardens or irrigation plots in Turkey 1 and Makgaung.

Table 5.14: Proportion of surveyed households with irrigation plots or communal gardens by village

| Village | Proportion of households which have plots in an irrigation scheme |
|---|---|
| Metz | 9% |
| Enable | 31% |
| Lorraine | 8% |
| Ga-Sekororo | 12% |
| Turkey 2 | 54% |
| **Total sample** | **12%** |

(Source: Survey data, 2007)

### Payment for water

Water is considered a basic commodity and in Sekororo-Letsoalo area, people are not paying a monthly bill for water. However, in the study area 40% of the households reported that they are paying a fixed amount, less than R10 every month, for the operation and maintenance of the water infrastructure. Some people are buying water from neighbours or water vendors. People also paid for their storage containers, and sometimes for being connected to the water network.

Table 5.15: Proportion of surveyed households paying for maintenance of water system by village

| Village | Households who pay for water |
|---|---|
| Metz | 75% |
| Turkey 1 | 8% |
| Makgaung | 52% |
| Lorraine | 25% |
| Enable | 0 |
| Ga-Sekororo | 0 |
| Turkey 2 | 73% |
| **Total** | **40%** |

(Source: Survey data, 2007)

Table 5.15 shows that in all the surveyed villages except Enable and Turkey 2 households pay for water. The payment for water is irrespective of whether a household has a private tap or not because even those households collecting water from the river are paying for maintenance of water infrastructure. This payment fee is for private taps and public standpipe infrastructure maintenance. Public standpipes are a public good which is difficult to determine and regulate users. It is difficult and expensive to regulate use of standpipes hence it is basically assumed that those who do not have private taps and are close to public standpipes use water from standpipes.

Table 5.16: Average payment for private connection to public water network for connected households

| **Village** | **Humber of households connected to private taps** | **Mean private tap connection fee (Rands)** |
|---|---|---|
| Metz | 29 | 131.67 |
| Turkey 1 | 3 | 107.83 |
| Makgaung | 13 | 120.00 |
| Lorraine | 19 | 74.38 |
| Enable | 5 | 280.00 |
| Ga-Sekororo | 10 | 32.50 |
| Turkey 2 | 8 | 66.67 |
| Total | 87 | 115.00 |

(Source: Survey data, 2007)

51% of the households in Sekororo-Letsoalo area are connected to private taps. Households paid on average R115 once-off for connection to the DWAF or municipal water system (calculated only for those who are connected and those who responded to the question) (standard deviation is 134). The amount ranges from R0 to R500 as a once-off payment for the private tap. 70 % of the households reported that they paid less than R100 to be connected to the public water network. The variation in connection fee is positively related to the age of the connection for these households. The study showed that only 13% of all sampled households had access to private taps before 1994. During apartheid, water services provided by the government of homelands were limited; when they existed water services mostly consisted of rudimentary networks of public standpipes. Most of the existing networks in the area were built during the 1980's, some improvements (weirs, reservoirs) and extensions being added after 1994 (see Table 5.18).

Currently the proportion of households being connected has risen to 51% of the households. 25 % of households which have private taps were connected before 1994 whilst 50% were connected in the period between 2001 and 2007. Despite the fact that there were no investments in water infrastructure, there has been an increase in number of households connected to the public water network. This has therefore resulted in the problems of breakdown and poor quality of current piped water service.

Though the Free Basic Water (FBW) policy was officially launched in July 2001, the pace of implementation in rural areas has been slow due to varying technical, financial, political and logistical problems at local and municipal levels (Balfour *et al.*, 2004). The only interventions done so far were that by non governmental organisations like Mvula Trust and World Vision. Surveyed households reported that they do not get water from their taps. In addition, the supply of this water is not reliable and in some cases households go for days without piped water.

Table 5.17: Date of construction of main water infrastructures in sampled villages

| Villages | Reservoir | Reticulation |
|---|---|---|
| Metz | 1982- 1984 - 2001 | 1984 |
| Turkey 1 | 1984 | 1984 |
| Turkey 2 | 1984 | 1984 |
| Makgaung | 1980 | 1980 |
| Lorraine | 1983-1998 | 1983 |
| Enable | 1987 | 1987 |
| Ga-Sekororo | 1979 – 1983 - 1990 | 1980 |

Source: DWAF Functional Assessment, 2003

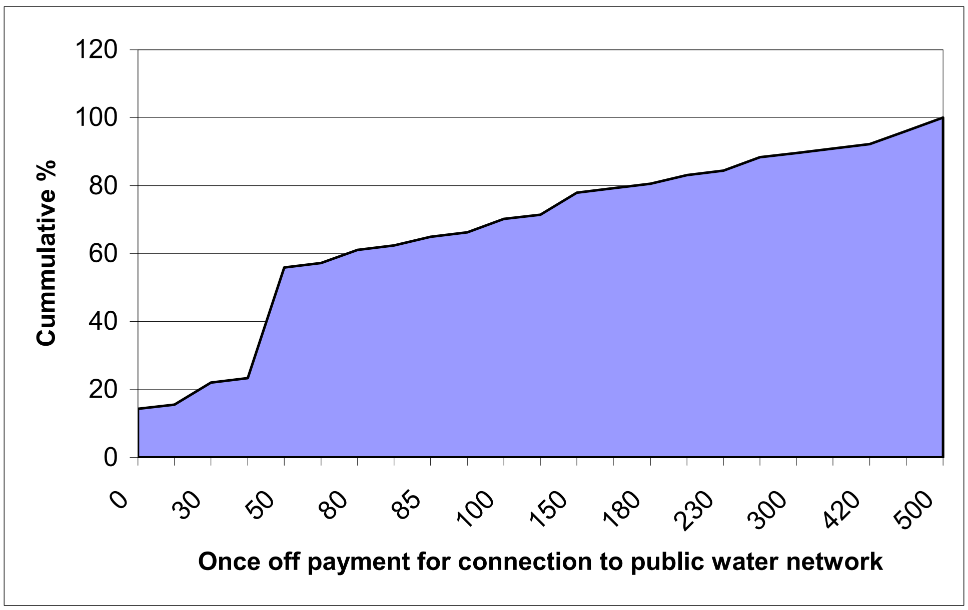



Figure 5. 17: Cumulative distribution of surveyed households according to amount paid for connection to the DWAF/Municipal water network
(Source: Survey data, 2007)

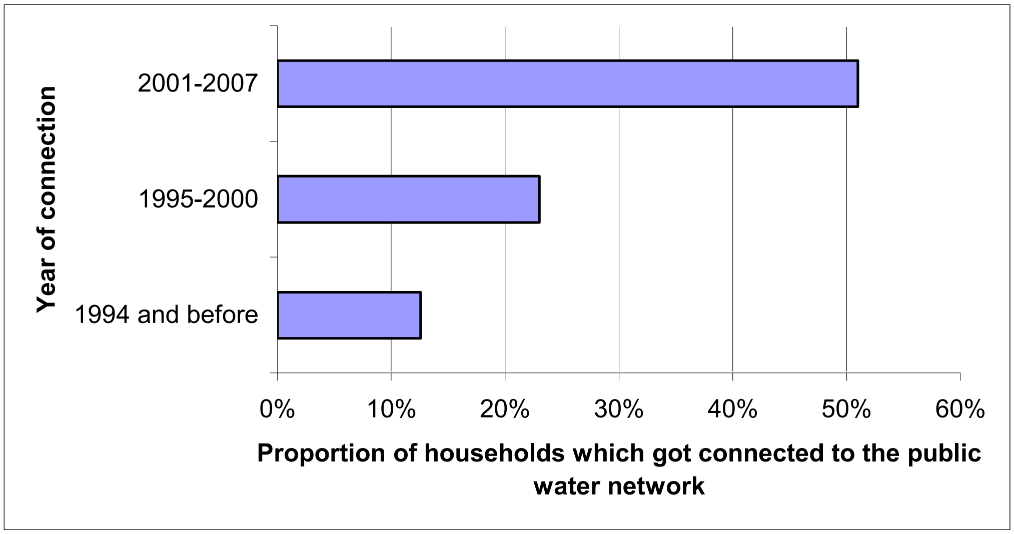



Figure 5. 18: Proportion of surveyed households privately connected to the DWAF/Municipal network per period of connection
(Source: Survey data, 2007)

**Willingness to pay for connection fee**

When asked about willingness to pay for a new refurbished water network, about 29% of the respondents (both those with taps and those without) were not willing to pay. About 65% reported that they would be willing to pay an amount up to R100 as once-off connection fee. 5% indicated that they would be willing to pay an amount between R100 and R500. Only 1% (from Metz village) would finally be willing to pay more than R500 for connection to the improved water network. The amount that most households are willing to pay (R0-R100) corresponds to the amount that most households paid to be connected to the current water network.

The high proportion of respondents not willing to pay could be because they consider water to be a free good. Households might also not be willing to pay for connection because they once paid and they are experiencing bad maintenance and management of water service. Now they are not ready to pay because they are not happy with the water authority (DWAF/ Municipality). This is consistent with findings from other studies. Faith in the current service provider and social value of the current service has positive relationship with households' WTP for water service (Raje *et al.*, 2002, Ntengwe, 2004).

Some household variables can explain the households' willingness to pay for water connection. F-test results show that there is a positive relationship between education and willingness to pay for water connection to a refurbished system ($F=2.35$, $p=0.044$). This can be attributed to the fact that educated household heads have a higher probability to have access to permanent jobs and get higher incomes hence can afford to pay for private connection. The t-test results show that the mean quantity of water per household per day is higher for households which are willing to pay for water (220 litres/household/day) compared to households not willing to pay for water connection (184 litres/household/day). This could be because households which consume more could be more willing to pay for a private connection because the water duty is more tedious. Households consuming more water could also be wealthier than the others. In addition, the households which have higher water quantities know the benefits of having more water; they are willing to pay to enjoy more benefits. The F-test shows that there is a positive correlation between income per capita and household willingness to pay for connection to a refurbished water network ($F=3.94$, $p=0.002$).

The t-test results showed that women were willing to pay more for water connection compared to men ($p=0.05$). Men on average are not willing to pay for water connection whilst women on average are willing to pay up to R100 as a connection fee to a refurbished water network. This is due to the fact that water collection is considered a woman's role; men experience less than women the inconvenience of poor water services.

**Households with electricity**

Although most of these households are poor, 94% have electricity connected to their homes and they can afford to pay for their consumption. These households have prepaid electricity whose use is based on how much they can afford. Most households use electricity mostly for lighting and for other households' appliances which do not consume much electricity. On average, a household pays R74 per month for electricity (Standard deviation of 64.25) (See Table 5.19). This ability to pay for electricity could be used as an argument in favour of the capacity by most households to pay for water (both connection and the monthly bill). However on the other hand, this payment for electricity only shows that households are used to pay for service. This cannot be used as an argument that they can afford paying for water since these households can control their use of electricity. With a private tap at home it would be difficult to control. In addition payment for electricity does not show whether the households would be able to afford both water and electricity.

During the focus group discussion some groups of women proposed that people should have metered water and pay for use so as to ensure that they use water responsibly, they said people can afford because they are paying for electricity and they can afford to buy prepaid electricity for the whole month.

Table 5.18: Descriptive Statistics for monthly electricity bill (in Rands)

| Number of observations | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| 157 | 10.00 | 400.00 | 75.19108 | 64.04847 |

(Source: Survey data, 2007)

**Relationships between characteristics of water services and water use**

The attributes for water services are so correlated such that it is difficult to attribute any observation to only one characteristic of the service. It can be seen that the quantity of water used by a household is related to number of water sources, sources of water, and that there is a positive relationship between quantity of water and the households' use of water for multiple uses. There are positive relationships between households' use of water for multiple purposes and water source, access to private taps, and quantity of water. This makes it difficult to show which of these attributes affect the households' use of water for productive purposes since most of the characteristics are correlated to each other (see Table 5.20).

Number of water sources seems to be positively and significantly related to type of water source, access to private tap, and multiple uses of water. This is because almost all the water sources are considered to be unreliable; even households with private taps cannot have water supply at all the times hence they rely on multiple sources for water. This also implies that households collect water from multiple sources so they can have more water to use for multiple uses. There is a negative and significant relationship between number of water sources and quality of water. Households with improved water quality tend to have few sources. Sources of water were ranked from the worst to the best based on quality and distance to the source. The source of water is positively and significantly related to the water quantity and multiple uses. There is negative and significant relationship between quality of water and the type of source of water. There is a positive relationship between household income and access to private taps, water quantity, and multiple uses. Households that have higher incomes can afford to have private taps and hence have higher water consumption.

Household water quantity has positive and significant relationship with multiple uses of water, income per capita and household income. Households with higher water consumption meet their basic needs of water hence can use additional water above basic requirement for productive purposes. Frequency of supply of water has no significant relationship with any other variable. There is a negative and significant relationship between water quality and multiple uses of water. Most of the productive uses can use water which is considered to be unsafe for consumption. The results also showed that most households which use water for productive uses are in Enable where the majority uses river water. There is a positive and significant relationship between water quality and income per capita. This is so because households which have higher income can afford to have piped water and hence have access to water of good quality. There is a positive relationship between household income and multiple uses. Households with higher incomes can afford to have better access to water and as a result can use water for multiple uses.

**Table 5.19: Correlation matrix**

| | Number of water sources | Source of water | Access to private tap | Water quantity | Frequency of supply-ranked | Quality of water | Multiple uses of water | Income per capita | Household income |
|---|---|---|---|---|---|---|---|---|---|
| Number of water sources | 1.000 | 0.774*** | 0.174** | 0.228*** | -0.058 | -0.301*** | 0.347*** | -0.096 | 0.054 |
| Source of water | 0.774*** | 1.000 | -0.047 | 0.308*** | -0.071 | -0.191** | 0.320*** | -0.058 | -0.032 |
| Access to private tap | 0.174** | -0.047 | 1.000 | -0.012 | 0.096 | -0.011 | 0.175** | 0.176** | 0.218*** |
| Water quantity | 0.228*** | 0.308*** | -0.012 | 1.000 | 0.004 | -0.375*** | 0.189** | 0.161** | 0.182** |
| Frequency of supply-ranked | -0.058 | -0.071 | 0.096 | 0.004 | 1.000 | -0.021 | 0.071 | -0.031 | -0.062 |
| Quality of water | -0.301*** | -0.191** | -0.011 | -0.375*** | -0.021 | 1.000 | -0.160** | 0.129* | -0.035 |
| Multiple uses of water | 0.347*** | 0.320*** | 0.175** | 0.189** | 0.071 | -0.160** | 1.000 | 0.074 | 0.208*** |
| Income per capita | -0.096 | -0.058 | 0.176** | 0.161** | -0.031 | 0.129* | 0.074 | 1.000 | 0.552*** |
| Household income | 0.054 | -0.032 | 0.218*** | 0.182** | -0.062 | -0.035 | 0.208*** | 0.552*** | 1.000 |

*** Significant at 1% level ** Significant at 5% level * Significant at 10% level

(Source: Survey data, 2007)

## 5.3 Summary of findings

The results presented in this chapter show that there are variations in household characteristics and water services across villages, gender and livelihood activities. Most of the respondents were female and this was an advantage as women are the ones who are more aware of household water use and sources. Respondents' educational level was very low, many did not reach secondary school and some did not receive any formal education. Unemployment is very high, many household heads are not employed and dependence on pension and social grants is still very high in the area.

Though generally a significant number of households has access to private taps, quite a number of taps are not working. This is because there was no major improvement of water infrastructure to match this increase in number of households connected to private taps. The proportion of households with private taps has increased since 1994 but the frequency of supply of water to households is poor because there is poor maintenance of infrastructure. Per capita water consumption is below the RDP standard (25litre/capita/day) for 41% of the households. Water supply frequency and reliability are a major problem: only 18% of respondents declared to have access to a source of water everyday at any time. Most of the respondents seemed to prioritize water for domestic purposes before they can engage into productive uses. Households often resort to several water sources to meet their needs and have invested in storage capacity to cope with unreliability of water supply. Only a small proportion of households (which consume higher quantities of water) are engaged in multiple uses of water because of the current low average water consumption. As a result 71% of households were willing to pay for an improved water network. Households which were not willing to pay were characterised by low water consumption, low education level of household head, low per capita income. Gender of the respondent also had an impact on the willingness to pay for refurbishment as a higher proportion of men were not willing to pay for water refurbishment.

# Chapter 6

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

## 6.0 Introduction

This chapter presents and discusses the determinants of water demand; water services preferences, trade-off among preferences and willingness to pay for water by rural households. The chapter is divided into three sections. The first section presents results of the econometric analysis (Conditional Logit Model - CLM) conducted on the results of the choice experiment run in Sekororo-Letsoalo area to elicit the determinants of water demand by households, preferences of water alternatives, willingness to pay for water services shown by implicit price. The second section explores the determinants of service preferences by focusing on the attributes that households reported to be important. Cross tabulations and chi-square tests are used to compare differences in water service preferences across households. The last section presents the summary of findings in this chapter.

## 6.1 Conditional Logit Model (CLM) Results

As justified in chapter 4, a Conditional Logit Model (CLM) was adopted to interpret the data collected through the choice experiment. As indicated in chapter four, the sample was originally split into two strata (stratum 1: households without private taps; and stratum 2: households with private taps). In the choice experiment, 24 water alternatives were generated for stratum 1 (18 for stratum 2) through the experimental design applied to the 6 (5 for stratum 2) attributes with different levels (cf. chapter four). These water alternatives were put into pairs to form 12 and 9 choice cards for households without private taps and households with private taps respectively. At least 3 cards (one at a time) were presented to each surveyed household. The dependent variable for the CLM was the choice of water alternatives whilst the explanatory variables were represented by the following attributes of water service: water quantity, water quality, water source, price, frequency of supply and possibility of productive uses of water.

During the data processing, the sample was further sub-stratified on the basis of household's water consumption and household's income. This sub-stratification led to the typology of households described in the following paragraphs.

Tables 6.2 to 6.10 present the results of the CLM for the different strata and sub-strata of the sample. The columns of each table report, for each attribute (variable), the estimated coefficient of the CLM regression, the antilog of the coefficient, the implicit price and the significance of the coefficient. (Implicit price= attribute coefficient/price coefficient). The coefficient of the variables shows, for each variable, the relationship between the household choice and that specific variable. A positive coefficient indicates that households prefer a quantitative increase or a qualitative improvement (shift to an upper level) of the attribute; in other words, there is household's gain of utility from an improved attribute. On the other hand households suffer negative utility from an increase of a variable with a negative sign. The sign of an attribute is used to test whether the relationship between variables conforms to micro-economic theory. Calculating the antilog of the CLM coefficient allows odds interpretation (Logit (P)=log (odds)=ln(P/1-P). Odds interpretation shows how an increase (or decrease) of attribute levels would result in a change in the probability of choosing a water service alternative including this increase (or decrease) (Greene, 2007). Implicit prices show the respondents' willingness to pay for improvement of the attributes. (Greene, 2007; Snowball, et al., 2007; Morrison et al., 2002). Probability value (p value) measures the fitness of each of the attributes in the model. P value is the lowest level at which the null hypothesis (coefficient is equal to zero) can be rejected. This p value should be smaller than the fixed level of 1%, 5% and 10% for the variable coefficient to be significantly different from zero (Gujarati, 2003).

The overall performance of the regression can be assessed by looking at the McFadden R2 value. The McFadden value corresponds to the proportion of the variance of the dependent variable explained by the variance in the independent variables. This McFadden R2 is a comparison of the likelihood ratios of an estimated model with that of the constant-only model (where there are no explanatory variables). The constant-only model is used as a base case because variation in the dependent variable is not expected because of the absence of explanatory variables. This value is a scalar measure between 0 and 1. A model would be acceptable if its McFadden R2 value is between 0.2 and 0.4 (Koutsoyannis, 1996).

### 6.1.1 Preferences for water services of households with and without private tap

There are differences in current water services between households with private taps and households without private taps. Table 6.1 presents the socio-economic factors and water source for households with and without private taps.

Table 6. 1: Comparison of households with and without private taps[17]

| | **Households without private taps (n=82)** | **Households with private taps (n=87)** | **P-value** |
|---|---|---|---|
| Number of water sources | 1** | 2 | 0.022 |
| Electricity bill | 60*** | 86 | 0.010 |
| Total household monthly income (Rands) | 1359* | 1931 | 0.074 |
| Monthly income per capita (Rands) | 248** | 462 | 0.024 |

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

[17] Results presented in Table 6.1 are for significant variables only

### 6.1.2 Preferences for water services of households with and without private taps

Results for stratum 1 (households without private taps) are presented in Table 6.2. All coefficients except "productive uses" are significant and, with the exception of "price", positive, implying that increases in each of these attributes are desirable to the respondents. All the signs of attributes' coefficients are, therefore, in line with micro-economic theory hypotheses. Analysing the antilog of coefficients, an increase in the quantity of water per day from one level to the next would result in a 1.01% increase in the respondent's probability of choosing an alternative (i.e. a set of attributes' levels) including this shift of level in the attribute "water quantity". Similarly, an increase by one level 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 by one level would 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 would 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 an increase by one litre/day was estimated. This implies that WTP of these households is R0.10 for 30 additional litres/month, or R3.33/$m^3$/month (which is lower than the estimated cost of recovery of R10/$m^3$ in the area (DWAF personal communication, 2007). This is comparable to the rate which was charged to household for water in Polokwane in 2005 (Lefebvre, 2005). Similarly, a WTP of R14.63/month was observed for an improvement in the frequency of supply from one level to the next. This WTP value is comparable to that by Banda *et al.* (2006 and 2007) estimated using the CVM approach. Quality of water is also an important determinant for 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. The connection fee considered by the Maruleng district municipality for the new water supply project is R920. If we deduct from this what most people are willing to pay as a once-off connection (R100), the balance is R820. If people can access to a loan at 20%

annual interest rate over 42 months, the monthly instalments would be R27.30, which corresponds to the WTP of households.

Table 6.2: 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 | 0.005 |
| Frequency of supply | 0.563*** | 3.66 | 14.63 | 0.000 |
| Quality | 0.749** | 5.61 | 19.44 | 0.023 |
| Price | -0.039*** | 1.09 | 1.00 | 0.000 |
| Productive uses | 0.071 | - | - | 0.756 |
| Water source | 1.065*** | 11.61 | 27.67 | 0.000 |

Number of households = 82 ; 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 6.3. The same attributes used for stratum 1, with the exception of “source of water”, were included in the choice experiment for this stratum. All the coefficients were significant with the exception of “productive uses”. All the signs of coefficients were found in line with micro-economic theory predictions. 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 6.3.

Table 6.3: CLM Results of Stratum 2. Households with private taps

| Variable | Coefficient | Antilog of the coefficient | Implicit Price | P[\|Z\|>z]\| |
|---|---|---|---|---|
| Quantity | 0.002** | 1.00 | 0.06 | 0.004 |
| Frequency of supply | 0.192* | 1.56 | 6.60 | 0.071 |
| Quality | 0.341** | 2.19 | 11.74 | 0.046 |
| Price | -0.030*** | 1.07 | 1.00 | 0.000 |
| Productive uses | 0.362 | - | - | 0.164 |

McFadden $R^2$ = 0.21
Number of households = 87

The price elasticity of demand for water (the price coefficient) is higher for households without private taps compared to households with private taps. This can be due to the fact that the former households are poorer than the latter, and therefore more sensitive to the economic variable. Mean monthly per capita income for households without private taps is R248, compared to R462 for households with private taps (see Table 6.1). Farolfi *et al.*, 2006; Mbata, 2006; Davis, 2004; Whittington *et al.*, 1990 also found a negative relationship between income and WTP for water services. For the two strata, estimations are significant and consistent with the findings of Snowball *et al*. (2007), who found that water price was very significant for households living in an urban area of South Africa (Grahamstown).

The implicit prices show that households without private taps are willing to pay more (for quantity, quality and frequency of supply) than households with private taps. The household's current water source is correlated with WTP for improved water services. Households with private taps have a higher preference for productive uses. This could be due to the fact that, contrary to households without private taps who are still worried about meeting their basic water needs, their water supply is sufficient in terms of quantity and reliability, to engage in non domestic water uses.

An improvement in the quantity of water available has almost the same impact on preferences of the two groups of households. 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 more linked to the access to the water source and to its reliability rather than to the quantity of water available. Unreliability of water source is also probably more difficult to bear when you have to walk long distance to fetch water than when water is supplied at home. 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 homestead in terms of preferences for the 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. However, because of the miserable quality conditions of water collected from the rivers/streams and sometimes even from collective taps, households without private taps allocate even higher importance to this attribute (0.749) than households with private taps (0.341). This could be because of compensation between quantity and quality for households with private taps who have generally access to more water.

WTP for the different attributes follows logically the stated preferences explained above. For households without private taps, however, it is negatively influenced by the higher price coefficient.

### 6.1.3 Household's water consumption and preferences for water services

In order to interpret more precisely the results from the two strata illustrated above, it appeared worthwhile to cross the character "availability (or not) of a private tap" used to define the two main strata, presented in the previous section, 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 "households with lower water consumption" those consuming less than 150 litres per day and "households with higher water consumption" the remaining ones.

The introduction of this new variable allowed splitting the whole sample into four groups (sub-strata): "households without private tap and lower water consumption" (sub-stratum 1a); "household without private tap and higher water consumption" (sub-stratum 1b); "households with private tap and lower water consumption" (sub-stratum 2a); "households with private tap and higher water consumption" (sub-stratum 2b). Tables 6.4 to 6.7 present the results of a CLM applied to the four sub-groups of households.

Results show that the signs of all the attributes except the one of "productive uses" for households without private tap consuming less water (which is also the only non significant coefficient) are still in line with economic theory hypotheses.

In the groups without private taps (Tables 6.4 and 6.5), the higher coefficients shown by the households consuming more water for "frequency of supply" and "water source" indicate that the requirement of a closer and more reliable source of water supply is stronger in households where water consumption is higher. For households consuming more water, the coefficient of the attribute "productive uses" (even if not significant) is positive and higher than the one observed in stratum 1, confirming that higher water consumption and therefore availability induces more interest in non domestic water uses. Households without private taps consuming more water are less concerned with water quality but more concerned with water price than households consuming little water, as their high consumption of a more expensive resource would have a negative influence in their family budget.

Table 6.4: Sub-stratum 1a. Households without private tap and lower water consumption

| **Variable** | **Coefficient** | **Antilog of coefficient** | **Implicit Price** | **P[\|Z\|>z]** |
|---|---|---|---|---|
| Quantity | 0.004** | 1.01 | 0.10 | 0.011 |
| Frequency of supply | 0.422*** | 2.64 | 11.63 | 0.003 |
| Quality | 0.716** | 5.20 | 19.73 | 0.046 |
| Price | -0.036*** | 1.09 | 1 | 0.000 |
| Productive uses | -0.039 | - | - | 0.879 |
| Water source | 1.006*** | 10.14 | 27.71 | 0.001 |

McFadden $R^2$ = 0.28; Number of households=29

Table 6.5: Sub-stratum 1b. Households without private tap and higher water consumption

| **Variable** | **Coefficient** | **Antilog of coefficient** | **Implicit Price** | **P[\|Z\|>z]** |
|---|---|---|---|---|
| Quantity | 0.004 | - | - | 0.272 |
| Frequency of supply | 1.251*** | 17.82 | 24.80 | 0.003 |
| Quality | 0.548 | - | - | 0.614 |
| Price | -0.050*** | 1.12% | 1 | 0.002 |
| Productive uses | 1.011 | - | - | 0.191 |
| Water source | 1.779** | 60.12 | 35.27 | 0.026 |

McFadden $R^2$ = 0.34; Number of households = 53

Interestingly, when private taps are available (Tables 6.6 and 6.7), the frequency of supply is less important for households consuming more water than for households consuming less. This is because water consumption is correlated with frequency of supply. The higher coefficient for the attribute "productive uses" when consumption is higher seems to confirm the findings about the emergence of the interest for multiple uses once basic needs are satisfied.

Table 6.6: Sub-Stratum 2a. Households with private tap and lower water consumption

| Variable | Coefficient | Antilog of the coefficient | Implicit Price | P[\|Z\|>z] |
|---|---|---|---|---|
| Quantity | 0.002* | 1.00 | 0.057 | 0.050 |
| Frequency of supply | 0.243* | 1.75 | 9.02 | 0.078 |
| Quality | 0.209 | - | - | 0.335 |
| Price | -0.027*** | 1.06 | 1 | 0.000 |
| Productive uses | 0.102 | - | - | 0.743 |

McFadden $R^2$ = 0.17; Number of households = 30

Table 6.7: Sub-stratum 2b. Households with private tap and higher water consumption

| Variable | Coefficient | Antilog of coefficient | Implicit Price | P[\|Z\|>z] |
|---|---|---|---|---|
| Quantity | 0.003** | 1.01 | 0.071 | 0.0267 |
| Frequency of supply | 0.101 | - | - | 0.552 |
| Quality | 0.620** | 4.17 | 17.24 | 0.037 |
| Price | -0.036*** | 1.09 | 1 | 0.000 |
| Productive uses | 0.935* | 8.61 | 26.02 | 0.063 |

McFadden $R^2$ = 0.24; Number of households = 57

### 6.1.4 Household's income and preferences for water services

Table 6.8: Water source and socio-economic factors for poor and non poor households

| | Poor | Non poor | p-value |
|---|---|---|---|
| Number of water sources | 1 | 2 | 0.001 |
| Monthly electricity bill (Rands) | 57 | 103 | 0.000 |
| Education level | 2 | 3 | 0.033 |
| Household monthly income (Rands) | 688 | 3319 | 0.000 |
| Monthly income per capita (Rands) | 158 | 709 | 0.000 |

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 and willingness to pay for water service improvements. Households were therefore split in two groups on the basis of per capita monthly income. The income character was crossed with the "availability of private tap" to obtain four sub-strata: "households without private tap and lower income" (sub-stratum 1c); "household without private tap and higher income" (sub-stratum 1d); "households with private tap and lower income" (sub-stratum 2c); and "households with private tap and higher income" (sub-stratum 2d). Median income in the whole sample was calculated at R 8.04/capita/day. It was therefore decided to consider "poor households" those earning less than the median income per capita, corresponding, for a family of 6 members, to R1450/month. Due to the few observations available for poor households having private taps, CLM was applied only to the two sub-strata referring to households without private taps. Tables 6.9 and 6.10 show the results of CLM applied to these sub-strata.

Table 6.9: Sub-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; Households number =27

Table 6.10: Sub-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; Households number=56

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. An access to private tap is the most sensitive attribute for both sub-strata, while frequency of supply seems to be the second priority for relatively wealthier households and water quality is the second highest concern for poorer households.

## 6.2 Determinants of household water services choice

As a follow-up to the choice experiment, households were asked how they made their choices and to select the two most important attributes to them. Frequency results and chi-square tests were used to assess and compare preferences of attributes across different households' strata. Respondents reported that they looked at all attributes when making their choice of water alternative. Fig. 6.1 presents for each attribute the frequencies of households having considered this attribute as important. The results show that the most important water service attributes for most of the households in the sample were the price of water, the frequency of supply of water and the quality of water. Figure 6.1 also shows that quantity and productive uses were important to only 20% and 5% of respondents respectively.

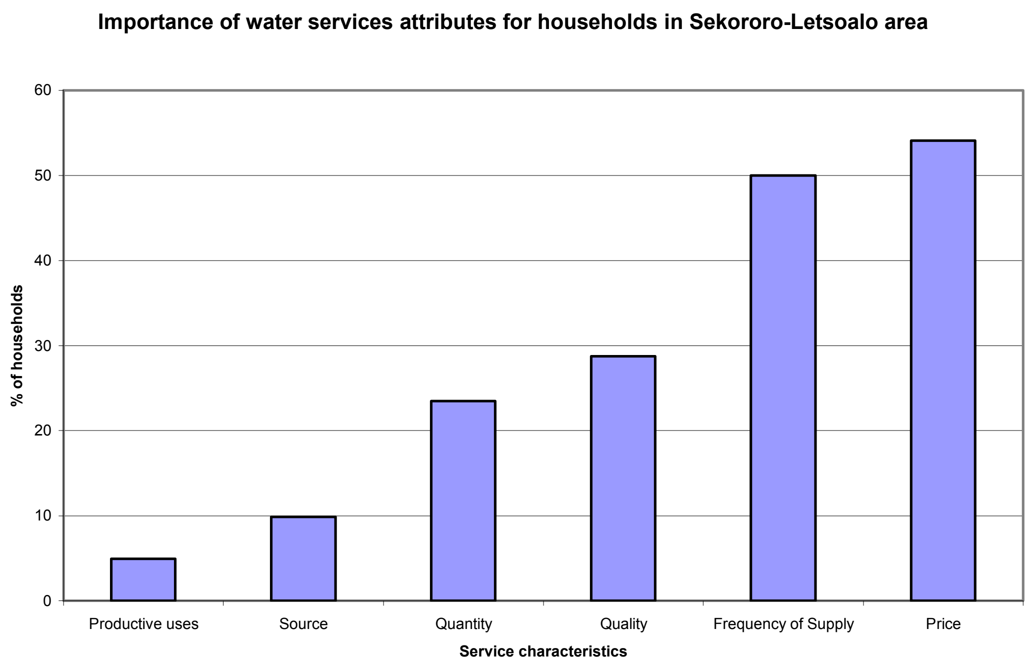



Figure 6. 1: Importance of water services attributes to households in Letsoalo-Sekororo area
Source: Survey data 2007

Cross tabulations and chi-square tests were applied to show the differences in importance of attributes across households' strata and villages. Importance placed on the attributes differs across villages, gender and between households with and without private taps. Results for significantly different attributes are presented in Tables 6.11 to 6.13. Households without private taps place more emphasis on source of water and price and less on water quality compared to households with private taps. This is consistent with the results of the choice experiment, except for water quality.

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Table 6.11: Importance of water service attributes across household strata based on water source (proportion of households in each stratum considering the attribute as important)

| | **No private tap** | **Private tap** | **P[\|Z\|>z]** |
|---|---|---|---|
| **Quality** | 16%*** | 41% | 0.000 |
| **Price** | 73%*** | 37% | 0.000 |

There were variations in quality and prices across villages (c.f.Table 6.12).

Table 6.12: Importance of water service attributes across villages (proportion of households in each village considering the attribute as important)

| | **Metz** | **Turkey 1** | **Makgaung** | **Lorraine** | **Enable** | **Ga-Sekororo** | **Turkey 2** | **P[\|Z\|>z]** |
|---|---|---|---|---|---|---|---|---|
| **Quality** | 19% | 14% | **48%** | 29% | 19% | **50%** | 29% | 0.062 |
| **Price** | 52% | **60%** | **64%** | **60%** | **60%** | 44% | - | 0.095 |

The importance of the different attributes also varies according to respondent's gender. Quality is much more important to women than men. Price is more important to men than to women (see Table 6.13).

Table 6. 13: Importance of water services attributes across gender (proportion of respondents considering the attribute as important)

| | **Male** | **Female** | **P[|Z|>z]** |
|---|---|---|---|
| **Quality** | 10% | **35%** | 0.003 |
| **Price** | **66%** | 50% | 0.097 |

## 6.3 Summary of results

Results of the CLM are presented in this chapter. Results show that households in Sekororo-Letsoalo area are willing to pay for improvement of water services. The CLM had very good McFadden $R^2$, most of the attributes were significant. Results show that different groups of households have differences in preferences for water services and different willingness to pay for different water services improvement. These differences in WTP and preferences are due to variations in household income and current water source. Access to water from private tap is a very important improvement to households which do not have private taps whilst purification of water to improve quality was the most important improvement to households with private taps. Households' price elasticity of water demand was almost the same for all strata, but slightly higher for household without private tap compared to those with private tap. Increase of number of productive uses was only important to households connected to a private tap and with higher water consumption. Frequency results show that the most important attributes that determined households choice of water service in the choice experiment are price and frequency of supply. Cross Tables and chi-square results show that there are significant differences in importance of attributes across households' strata, gender, villages and household incomes.

# Chapter 7

# Conclusions, Policy Implications and Recommendations

## 7.0 Introduction

This chapter reviews principal findings in the study and presents conclusions and recommendations drawn from the results. The first section of the chapter revisits the objectives that guided this study and summarises the major findings related to each objective. The second section explores the policy insights and implications drawn from the findings in this study will follow. The last section presents potential areas for further research.

## 7.1 Summary of findings

The first objective of this study was to characterise households in the study area in terms of household demographics, livelihood strategies and water uses. Results of this study show that there is a diversity of water sources and these vary with household types and location. However, most households rely on multiple water sources as most of the sources are unreliable.

In general domestic water delivery service in the study area is poor. A significant proportion of households consume less than the recommended RDP standard. Household engagement in water use for productive purposes is limited by scarcity of water resource. The study showed that households with better water access (good frequency of supply and higher water consumption) are using water for multiple uses. The implication of this finding is that an improvement in water services would allow households to use water for multiple uses and hence has the potential to improve their incomes and livelihood and reduce poverty.

The second objective of this study was to identify water service improvements that are desired by the households. The study found out that the desired improvements in water service will be those that improve water availability, shorten distance and time to water source (preferably by improving access to in-yard water), improve water quantity, water quality, reliability and frequency of supply. The choice experiment showed that water quantity, water quality and water source are the most important improvements required by households. These service improvements can allow households to use water for multiple uses. Focus group discussions (done in June, 2007) shows that regulation of water either through use of meters or quota were also some of the water service improvements desired by households. Improving water infrastructure would improve the current water service; currently the main problem is that the infrastructure cannot reliably supply water to all households.

The third objective of this study was to estimate households' WTP for improved water services (including services for multiple uses). Findings of this study showed that households are willing to pay for improved water services. The estimated WTP value per household for water service improvement is consistent with those observed in other studies done in rural settings in South Africa (Banda *et al*., 2006). This study showed that multiple uses of water are not common in the studied area. The main reason is that because of the general scarcity of water, households are primarily concerned with meeting their basic domestic water requirements. A clear interest to engage in multiple uses was observed only in those households that already have enough water to satisfy basic domestic needs.

The last objective of this study was to assess determinants of WTP for improved water services. Findings show that household water demand is determined by water quality, water source and water quantity and household income (as can be shown by the significance of these variables in the econometric analysis which was conducted).

## 7.2 Conclusions, Policy Insights and Recommendations

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. As a result, households are willing to pay for improved water supply and services.

Households' WTP demonstrates that there is room for policies aimed at improving rural domestic water infrastructures and services through cost-recovery mechanisms, providing that the services proposed respond to users' demand. Partial recovery of the investment and operating costs required for water service provision and improvement could be achieved, for instance, through the introduction of water tariffs based on the quantity consumed but targeted subsidy should be offered to the poor.

Integrated Water Resources Management (IWRM) in developing countries also includes the efficient and equitable allocation of water to rural domestic users. The lack of equity in the provision of water services in these areas today is flagrant. A minimum amount of water must therefore be supplied free of charge and in a reliable way (collective taps, private taps) to all rural households. These households demonstrate to be willing to pay, accordingly to their low income, for additional amounts of water. These additional amounts would improve further the quality of life of rural households and can be used for non domestic uses such as backyard garden irrigation, beer production, etc., which are likely to foster local economies and improve local livelihood and reduce rural poverty.

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 calculated. Alternatively, offering a menu of water services with different prices for households to choose from would be appropriate. In summary cost-recovery is possible but the level and structure of tariffs and the technological options chosen to implement them are very important for the success of cost-recovery program.

The study revealed that households which currently consume more water and have in-yard taps are willing to use water for multiple uses. This confirms 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 non domestic water uses that could enhance the economic conditions of the family.

## 7.3 Areas for Further Research

CM application 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 and uses. However, the combined use of various economic methods in addition to the CM (for instance revealed preferences methods such as the travel cost or a dichotomous choice method such as the CVM) would certainly improve the accuracy of the results and increase their robustness.

Further studies on feasibility of water service improvements in rural communities would be important as this would reveal if such projects are sustainable. Studies that focus on water availability and cost-benefit analysis (which was done only to a limited extent in this study) of water services improvements would add value to this study.

In future, valuation of water productivity (using a production function) on each of the observed multiple uses is likely to improve the soundness of findings of this study. This method would provide insights on the marginal benefits of each of the desired productive uses of domestic water and their relative impact on livelihood of rural households.

A further study to assess if provision of information and training in using water for productive uses could increase WTP for productive uses and significance of this attribute.

Also a future research on the impact of better storage of water on the households' WTP for water.

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# Annex 1: Efficiency of the orthogonal design

Table A1: Efficiency for strata 1

| Design Number | D-Efficiency | A-Efficiency | G-Efficiency | Average Prediction Standard Error |
|---|---|---|---|---|
| 12 | 91.0627 | 81.6327 | 100.0000 | 1.0000 |
| 16 | 98.5942 | 97.2973 | 96.0769 | 0.8660 |
| 18 | 96.7613 | 94.0386 | 91.8354 | 0.8165 |
| 24 | 99.0519 | 98.0769 | 96.2950 | 0.7071 |
| 30 | 98.6994 | 97.3636 | 89.8621 | 0.6325 |
| 36 | 99.2229 | 98.4469 | 95.4735 | 0.5774 |
| 42 | 99.3270 | 98.6666 | 94.9967 | 0.5345 |
| 48 | 100.0000 | 100.0000 | 100.0000 | 0.5000 |
| 54 | 99.5980 | 99.2066 | 96.6221 | 0.4714 |
| 60 | 99.7215 | 99.4432 | 96.4683 | 0.4472 |
| 66 | 99.7466 | 99.5000 | 97.3349 | 0.4264 |
| 72 | 99.8969 | 99.7934 | 98.9806 | 0.4082 |
| 78 | 99.8123 | 99.6234 | 96.3519 | 0.3922 |

Table A2: Efficiency for strata 2

| Design Number | D-Efficiency | A-Efficiency | G-Efficiency | Average Prediction Standard Error |
|---|---|---|---|---|
| 12 | 93.6813 | 88.3534 | 87.4007 | 1.0186 |
| 18 | 100.0000 | 100.0000 | 95.7427 | 0.9574 |
| 24 | 100.0000 | 100.0000 | 95.9782 | 0.6770 |
| 30 | 100.0000 | 100.0000 | 91.6393 | 0.6055 |
| 36 | 100.0000 | 100.0000 | 96.8453 | 0.5528 |
| 42 | 100.0000 | 100.0000 | 94.5949 | 0.5118 |
| 48 | 100.0000 | 100.0000 | 100.0000 | 0.4787 |
| 54 | 100.0000 | 100.0000 | 96.3425 | 0.4513 |
| 60 | 100.0000 | 100.0000 | 96.2533 | 0.4282 |

# **Annex 2a:** Choice cards for stratum 1

**Card Number 1 for Strata 1**

| **Attribute** | **1** | **2** |
|---|---|---|
| Quantity per day in litres | 300 | 75 |
| Frequency of Supply | Current | All times |
| Quality | Purified | Current |
| Price | R50 | R0 |
| Productive uses | More | Current |
| Source | Private tap | Current |
| | | |

**Card Number 2 for Strata 1**

| **Attribute** | **3** | **4** |
|---|---|---|
| Quantity per day in litres | 150 | 75 |
| Frequency of Supply | Current | Limited hours per day |
| Quality | Current | Purified |
| Price | R100 | 50 |
| Productive uses | Current | More |
| Source | Private tap | Private tap |
| | | |

**Card Number 3 for Strata 1**

| **Attribute** | **5** | **6** |
|---|---|---|
| Quantity per day in litres | 150 | >300 |
| Frequency of Supply | Current | All times |
| Quality | Current | Current |
| Price | 50 | 10 |
| Productive uses | Current | More |
| Source | Current | Private tap |
| | | |

**Card Number 4 for Strata 1**

| **Attribute** | **7** | **8** |
|---|---|---|
| Quantity per day in litres | 75 | 300 |
| Frequency of Supply | Current | All times |
| Quality | Purified | Current |
| Price | 10 | 50 |
| Productive uses | More | Current |
| Source | Current | Current |
| | | |

**Card Number 5 for Strata 1**

| **Attribute** | **9** | **10** |
|---|---|---|
| Quantity per day in litres | >300 | 150 |
| Frequency of Supply | Limited hours | All times |
| Quality | Current | Purified |
| Price | 10 | 0 |
| Productive uses | Current | Current |
| Source | Current | Private tap |
| | | |

**Card Number 6 for Strata 1**

| **Attribute** | **11** | **12** |
|---|---|---|
| Quantity per day in litres | 300 | 75 |
| Frequency of Supply | All times | All times |
| Quality | Purified | Purified |
| Price | 0 | 10 |
| Productive uses | Current | Current |
| Source | Private tap | Private tap |
| | | |

**Card Number 7 for Strata 1**

| **Attribute** | **13** | **14** |
|---|---|---|
| Quantity per day in litres | >300 | 300 |
| Frequency of Supply | Current | Limited hours |
| Quality | Current | Current |
| Price | 0 | 100 |
| Productive uses | More | More |
| Source | Private tap | Current |
| | | |

**Card Number 8 for Strata** 1

| **Attribute** | **15** | **16** |
|---|---|---|
| Quantity per day in litres | >300 | 300 |
| Frequency of Supply | Limited hours | Current |
| Quality | Purified | Current |
| Price | 100 | 0 |
| Productive uses | Current | More |
| Source | Current | Current |
| | | |

**Card Number 9 for Strata 1**

| **Attribute** | **17** | **18** |
|---|---|---|
| Quantity per day in litres | >300 | 300 |
| Frequency of Supply | All times | Limited hours |
| Quality | Purified | Purified |
| Price | 50 | 0 |
| Productive uses | More | Current |
| Source | Current | Private tap |
| | | |

**Card Number 10 for Strata 1**

| **Attribute** | **19** | **20** |
|---|---|---|
| Quantity per day in litres | >300 | 150 |
| Frequency of Supply | Current | Limited hours |
| Quality | Purified | Current |
| Price | 100 | 10 |
| Productive uses | Current | More |
| Source | Private tap | Private tap |
| | | |

**Card Number 11 for Strata 1**

| **Attribute** | **21** | **22** |
|---|---|---|
| Quantity per day in litres | 75 | 150 |
| Frequency of Supply | Current | Limited hours |
| Quality | Purified | Purified |
| Price | 10 | 0 |
| Productive uses | Current | More |
| Source | Current | Current |
| | | |

**Card Number 12 for Strata 1**

| **Attribute** | **23** | **24** |
|---|---|---|
| Quantity per day in litres | 75 | 150 |
| Frequency of Supply | Limited hours | All times |
| Quality | Current | Purified |
| Price | 50 | 100 |
| Productive uses | Current | More |
| Source | Private tap | Current |
| | | |

# Annex 2b: Choice cards for stratum 2

**Choice card 1 for strata 2**

| **Attribute** | **1** | **2** |
|---|---|---|
| Quantity per day in litres | 300 | 75 |
| Frequency of Supply | All times | All times |
| Quality | Purified | Current |
| Price | R10 | R50 |
| Productive uses | Current | More |
| | | |

**Choice card 2 for strata 2**

| **Attribute** | **3** | **4** |
|---|---|---|
| Quantity per day in litres | >300 | 300 |
| Frequency of Supply | All times | Current |
| Quality | Purified | Current |
| Price | R100 | R100 |
| Productive uses | Current | More |
| | | |

**Choice card 3 for strata 2**

| **Attribute** | **5** | **6** |
|---|---|---|
| Quantity per day in litres | >300 | >300 |
| Frequency of Supply | Current | All times |
| Quality | Current | Purified |
| Price | R50 | R10 |
| Productive uses | Current | More |
| | | |

**Choice card 4 for strata 2**

| **Attribute** | **7** | **8** |
|---|---|---|
| Quantity per day in litres | 300 | 75 |
| Frequency of Supply | All times | Limited hours per day |
| Quality | Current | Purified |
| Price | R100 | R0 |
| Productive uses | Current | Current |
| | | |

**Choice card 5 for strata 2**

| **Attribute** | **9** | **10** |
|---|---|---|
| Quantity per day in litres | 75 | >300 |
| Frequency of Supply | Current | Current |
| Quality | Purified | Current |
| Price | R100 | R50 |
| Productive uses | More | More |
| | | |

**Choice card 6 for strata 2**

| **Attribute** | **11** | **12** |
|---|---|---|
| Quantity per day in litres | 300 | 75 |
| Frequency of Supply | Current | Limited hours per day |
| Quality | Current | Purified |
| Price | R0 | R10 |
| Productive uses | Current | Current |
| | | |

**Choice card 7 for strata 2**

| **Attribute** | **13** | **14** |
|---|---|---|
| Quantity per day in litres | 75 | 300 |
| Frequency of Supply | Current | Limited hours per day |
| Quality | Current | Purified |
| Price | R50 | R100 |
| Productive uses | More | More |
| | | |

Choice card 8 for strata 2

| Attribute | 15 | 16 |
|---|---|---|
| Quantity per day in litres | >300 | 300 |
| Frequency of Supply | Limited hours per day | Limited hours per day |
| Quality | Current | Purified |
| Price | R10 | R0 |
| Productive uses | More | More |
| | | |

Choice card 9 for strata 2

| Attribute | 17 | 18 |
|---|---|---|
| Quantity per day in litres | 75 | >300 |
| Frequency of Supply | All times | Limited hours per day |
| Quality | Current | Purified |
| Price | R0 | R10 |
| Productive uses | More | Current |
| | | |

# Annex 3: Questionnaire used for household survey

## SECTION 1: Water Use and consumption

SOURCE OF WATER:
1.1 From where do you get your water? (can be more than 1 source)

- ☐River / canal
- ☐Public standpipe
- ☐Yard tap connected to DWAF / municipal system
- ☐Yard tap connected to community system
- ☐Yard tap connected to a private borehole
- ☐In house tap connected to DWAF / municipal system
- ☐In house tap connected to private borehole
- ☐Rainwater
- ☐Other (specify) ________________

1.2 Do you have a private tap?
- ☐Yes
- ☐No

1.3 If yes, do you get water from this tap?
- ☐Yes
- ☐No

STORAGE
1.4 Do you store water?
- ☐Yes
- ☐No

QUANTITY:
How much water is your household currently using per day?

| In Number of 25 litres containers | In litres |
|---|---|
| ☐ Less than 3 | *1.5* ☐ Less than 75 |
| ☐ 3-6 | ☐ 75-150 |
| ☐ 6-12 | ☐ 150-300 |
| ☐ More than 12 | ☐ More than 300 |

FREQUENCY OF WATER SUPPLY:
1.6 How often do you have access to water?
- ☐Less than 2 times per week
- ☐2 times per week
- ☐Every 2 days
- ☐Everyday for limited hours
- ☐Everyday at all times

QUALITY:
1.7 How do you rate the quality of your water?

- ☐Very poor
- ☐Poor
- ☐Fair
- ☐Good
- ☐Very good

1.8 What are the main problems of water quality?

☐Salinity ☐Mud ☐Colour
☐Pollution ☐Other (specify)________________________

PRICE:

1.9 Are you currently paying a monthly bill for water?

- ☐Yes
- ☐No

1.10 If yes, how much do you pay per month?

- ☐Less than R10
- ☐R11-R50
- ☐R51-100
- ☐More than R100

1.11 If you are connected to the public (or community) water network, how much did you pay for the connection?

_______________________

1.12When were you connected?_______________

1.13 If you are currently not connected to the public water network, or if the system you are connected with must be refurbished, how much would you be willing to pay as fee (once-off payment) to be connected to the new/refurbished network?

- ☐R0
- ☐Less than R100
- ☐R101-R300
- ☐R301-R500
- ☐More than R500

MULTIPLE USES:

1.14 Are you using water for uses other than domestic ones (such as drinking, cooking, washing, bathing, etc.) ?

- ☐Yes
- ☐No

1.15 If yes, what are these uses? (can be more than one use)

- ☐Backyard garden watering in summer
- ☐Backyard garden watering in winter
- ☐Livestock watering
- ☐Beer making
- ☐Cooking to sell food
- ☐Brick making / building
- ☐Other (specify)_________________________

1.16For these uses do you use the same sources of water as for domestic uses? ☐Yes ☐No

1.17 If no which sources of water do you use?______________________________________

1.18 Do you have a plot in an irrigation scheme?
- ☐Yes
- ☐No

1.19 Do you have a plot in a communal garden?
- ☐Yes
- ☐No

ADDITIONAL QUESTIONS:

ELECTRICITY:
1.20 Are you connected to electricity
- ☐Yes
- ☐No

1.14b How much do you pay per month?_______________________

STORAGE:
1.21If yes, what type of containers do you use to store water?
- ☐ small containers (20-25 l) how many of them do you have?_______
- ☐ big containers (200-250 l) how many of them do you have?_______
- ☐ Jojo tanks (specify volume) how many of them do you have?_______
- ☐ other (specify volume) how many of them do you have?

1.14b) How many of them do you use?____________________
1.4c) How often do you fill them up? ____________________
1.4d) How long does this water last?_____________________

1.22 Who collects water?

SOURCE: CANAL OR RIVER

1.23 .If you collect water from a canal or a river
a) How many times per day do you collect water?____________________
b) Which type of containers do you use?___________________________
c) How many containers of this type do you fill at each time?____________________
d) How long (how many days) does this water last?
[Quantity = times of collection per day * number of containers at each time * size of containers / how many days]
_________________________________________________________

SOURCE: STANDPIPE OR OTHER PEOPLE

1.24 If you collect water from a standpipe or from other people
a) How many days per week do you go collect water? ______________________
b) How many times per day of collection? ______________________________
c) Which type of containers do you use? _______________________________
d) How many containers of this type do you fill at each time? _________________
e) How long (how many days) does this water last? ________________________

SOURCE: PRIVATE BOREHOLE

1.25 How much did you pay for drilling the borehole?_________________

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## SECTION 2:Household socio-economic characteristics

2.0. Are you the head of the household? ☐Yes ☐No

2.1. How old are you (years) ____________________

2.2. Are you :
☐Female
☐Male

2.3. What is your education level?

☐None ☐Primary ☐Secondary ☐Diploma ☐Degree

2.4. How many people live permanently in your household? _________

2.5. What is the occupation of the head of the household?

☐Farmer ☐Farm worker
☐Pensioner ☐Domestic worker
☐Public sector employee ☐Mining/Industrial worker
☐Unemployed ☐Unemployed
☐Self employed ☐Other (Specify) ___________

2.6. How much is the household earning per month? (Indicate in which category does the household's income fall)

☐<R400 ☐R400-R800 ☐R800-R1600
☐R1600-R3200 ☐R3200-R6400 ☐> R6400

2.7. State the amount your household is earning monthly from each source

| Source | Amount per month | Who earns this income? |
|---|---|---|
| Farm income (crop and livestock)(per year) | | |
| Salaries (permanent jobs) | | |
| Pension and other social grants | | |
| Other income (specify) | | |
| | | |
| TOTAL | | |

Note: the total must be in the range stated above

2.8. Name of the village ___________________

2.9. Name of interviewer ________________

2.10. Date of interview _________________

2.11. Name of respondent ___________________2.12 Telephone number _________________

## SECTION 3: Choice Experiment

**Strata Number**______________________________

3.1

| | Card Number | Chosen water service | |
|---|---|---|---|
| 1 | | ☐ 1 | ☐2 |
| 2 | | ☐ 1 | ☐2 |
| 3 | | ☐ 1 | ☐2 |
| 4 | | ☐ 1 | ☐2 |
| 5 | | ☐ 1 | ☐2 |
| 6 | | ☐ 1 | ☐2 |

3. 2 Did you look at all the attributes?

- ☐ Yes
- ☐ No

.3.3a Which attributes did you look at? (can be more than one attribute)

- ☐ Quantity of water
- ☐ Availability
- ☐ Quality
- ☐ Price
- ☐ Productive uses
- ☐ Water source

3.3b Which 2 attributes are the most important to you? (select 2 only)

- ☐ Quantity of water
- ☐ Availability
- ☐ Quality
- ☐ Price
- ☐ Productive uses
- ☐ Water source

3.4 Why?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

3.5 Did you understand everything in this exercise?

- ☐ Yes
- ☐ No

3.5b)If No, what didn't you understand?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**Thank You**