STUDY ON DOMESTIC WATER USE AND WATER USE EFFICIENCY: A CASE FOR CUVELAI- ETOSHA BASIN

BY

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CHAPTER 1

1.1 INTRODUCTION

Water is necessary for all human life. It is needed for personal sustenance as well as for agriculture and livestock. Namibia's primarily rural population relies on an adequate source of water for survival. Unfortunately, Namibia's extremely arid climate makes water resources both scarce and valuable. Careful water management is necessary to preserve Namibia's water sources for sustainable, long-term use.

In rural and peri-urban areas of developing countries, everyone uses water for various domestic purposes and many people use or could use water for 'productive' purposes to earn an income, such as gardening, field crops, livestock, brick making. Yet in most cases, water sources, uses and users are not well integrated, leaving much scope for improvements in water use efficiency, livelihood, and equitable water use.

The availability of and access to freshwater is an important determinant of patterns of economic growth and social development. This is particularly the case in Africa where most people live in rural areas and are still heavily dependent on agriculture for their livelihoods. Water is an essential resource for sustaining economic development in all sectors (Petersen & Beekman, 2002).

Water safety is affected by geogenic contamination of groundwater, pollution from industry and wastewater, poor sanitation, weak infrastructure, unreliable services, and the need for collection, transportation and storage in the home (UNICEF & WHO, 2011:10)

The tradition of having free or heavily subsidized water for livestock, irrigation and domestic use created the attitude that water is plentiful and of low value. This often

leads to great wastage. Even though it is the right of every Namibian to have reasonable access to clean water, there is a need to reduce excessive uses.

Water supplies are often short or expensive and become unreliable. This is especially true in Namibia due to the fact that Namibia is the most arid African country south of the Sahara with low and varied precipitation, from a maximum of ± 650mm in the north east to less than 50mm per year along the coast. Evaporation rates are very high and it is estimated that only 2% of the rainfall ends up as surface run-off and a mere 1% becomes available to recharge groundwater. The balance of 97% is lost through evaporation (83%) and evapotranspiration (14%). Namibia's international boundaries, both northern and southern are marked by the Kunene River in the northwest, the Okavango River in the central north and the Zambezi and Kwando Rivers in the northeast. The Orange River marks Namibia's southern border. It is only in these rivers that perennial surface water resources are found (MWAF, 2010).

Managing water resources in Namibia sustainably is therefore very important to ensure that water is utilized optimally. Based on the challenges faced with water resources in Namibia, the concept of managing water resources at basin levels was introduced to and accepted by stakeholders during the water sector review process in the late 1990s. The Water Resources Management Act makes provision for the establishment of basin management committees (BMCs) to make sure that integrated management and development takes place at the basin level. The role of the committees is to provide scope for addressing various issues affecting water resources in the basin, ranging from efficient water use to monitoring the health of the basin. The basin management committees are to equip basin communities to take full ownership of their own development with strong support from the relevant service providers. According to DRFN (2004), Basin management refers to the management of all activities aimed at enhanced functioning of a water basin.

The principles of integrated water resource management (IWRM), advocates for the efficient and equitable allocation to potential users and their rights to be looked at closely.

The Cuvelai-Etosha Basin was chosen as a second pilot of Basin Management Committee because of its dense, rural population, and because it is seen to experience water stress .The Cuvelai-Etosha basin (CEB) has been further sub-divided into four sub-basins with different characteristics to facilitate introduction of the basin management approach. Niipele Sub-basin (NsBMC) is one of these basins on the eastern part of the Cuvelai-Etosha basin. Water point committees were introduced in the basins to manage water resources at the basin levels.

The use of water from surface and underground source piped water is prioritized in Namibia. The first is water for domestic purposes (including livestock water for both subsistence and commercial farming) and the second is water for economic activities such as mining, industries and irrigation.

The challenge experienced in the basin is overusing of what seems an unlimited source of water and thus there is a great need to implement demand management measures more specifically to rural communities. The wise management of water is the responsibility of every person in Namibia. Through water awareness and appropriate regulations and incentives and a change of attitude at all levels of society, the social and economic benefits of water will be achieved. Efficient and effective use of water today will assure sustainable water supply well into the future.

Increasing water supply and water use efficiency has become a key challenge for future development in Namibia. Johansson *et al.* (2002) describe an efficient allocation of water resources as one that maximizes net benefits to society using existing technologies and water supplies at a short term perspective. Efficient water allocation maximizes net benefits over variable costs of supply, and results in equalizing the marginal benefits from resource use across sectors in order to maximize social welfare (Dinar *et al.*, 1997; Agudelo, 2001).

The demand for water in urban and rural areas is mainly influenced by:

- Population (including growth and density)
- Cost of water development and services
- Technological choices based on the socio-economic situation of water users

- Climate

Therefore the research aims at analyzing how communities of Niipele sub-basin use water and would like to improve the water use efficiency which is contributing to sustainable water use utilization in the sub-basin for rural development purposes. If the demand to increase water use efficiency in the Niipele sub-basin emerges from the data acquisition and analysis, recommendations will be forwarded to relevant institutions to develop awareness materials in order to promote public awareness on the benefit of efficient water use.

1.2 PROBLEM STATEMENT

Namibia is faced with the challenge of reducing water use each year. Water resources are unevenly distributed in the country and so is the demand for water. This situation is made worse by the fact that there are no perennial rivers flowing through the central regions, therefore people have to adopt to the water – saving lifestyles and for them to consider water as a scarce and precious resource to any nation.

There is a possibility that opinions differ between suppliers of water and consumers on how water should be managed, charged and used. This has leads to poor management of resources including the land closely associated with water infrastructures results in damage that is not easily reversed and can be a costly exercise. People have in many cases developed bad habits and are unaware of the importance of water conservation and water use efficiency. Simple and cheap steps such as fencing off water points, using clean containers for the transport and storage of water and use of pit latrines can go a long way to provide clean water for people without involving more costs.

Because water is supplied freely, people are sometimes leaving taps running to make drinking pools for livestock which is a wasteful practice. What communities do not realize is that standing pools of water encourage malaria carrying mosquitoes to breed and contamination of water by people and animal is real becoming a threat.

This study is therefore sought to document the opinions on these issues among local residents within the Niipele sub-basin.

1.3 RELEVANCE OF THE STUDY

The reason why efficiency is important is that water described by the first IWRM Dublin principle that is a finite and often scarce resource. Generally, efficiency measures how much one can do with one unit of water. Water use efficiency measures the amount of water actually used for a given use. This wider definition of efficiency calls for pricing arrangements that ensure cost recovery of water services. This will not only give the correct signal to water users, namely that water is valuable and should not be wasted, but will also lead to the sustainability of infrastructure and institutions. The wider definition of efficiency also calls for suitable legal arrangements that provide users with sufficient security of water tenure, such that they are willing to invest in water-related infrastructure.

Little research has been done on the domestic water use and water use efficiency mechanisms in rural areas in Namibia particularly in the Cuvelai-Etosha basin. There is also a need to get the views on the willingness and perception of community members on the payment for water services. The study also strive to look at the differences in water use and water demand between rural and urban households as well between communities that has been connected to pipeline water and those that recently connected or supplied with water and also those that still not having access to pipeline water. It is also important to observe how the socio-economic characteristics of households affect the accessibility, provision and payment for water services.

1.4 RESEARCH QUESTIONS

The study looks at the following questions:

1. What are the current main uses of water and water services in Niipele sub-basin and do these vary across household types?

2. What are the preferences of rural households and urban 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 in the Niipele sub-basin?

1.5 OBJECTIVES

The main objectives of the study are to elicit, assess and evaluate the level of domestic water use efficiency in the Niipele sub-basin.

Specific objectives were:

1. To identify the different water sources, uses and therefore build a scenario of water-related livelihood activities and a scenario 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. Identify best practices for water use efficiency at household levels.

1.6 STUDY AREA

1.6.1 Location

The research was done in Niipele Sub-Basin. Niipele sub-basin is located in the north-east and its boundaries are defined by the Angolan border in the north, the Kavango region in the east. It includes the following constituencies: Eenhana, Epembe, Okongo, Omundaungilo (Ohangwena region), Okankolo and Eengodi in Oshikoto region. The basin is characterised by the omiramba (rivers) namely Niipele and Odila that flow the southern direction towards the Etosha pan.

1.6.2 Population

The Cuvelai-Etosha basin is the most densely populated in the country, with an estimated urban population of 145 000 and a rural population of 680 000. As per the Namibia population and housing census of 2011, the population of Niipele sub-basin is about 108 400 people.

1.6.3 Soil and vegetation

The geology of the area is described as the Kalahari Formation, constituted mostly by sand and clay. The presence of relatively fertile soils and access to water in shallow wells initially attracted people to settle there.

Soil in many areas is characterised by a high level of salts, which are often concentrated below the surface. There are three soil types in the study area; sodic sands, deep Kalahari sands and clayey sodic sands (Oshikango). Soil at Oshikango has the highest potential for crop cultivation.

Vegetation in this area is used for various purposes such as firewood, fruits and thatching. Grasses also provide natural pasture for livestock, habitats for wildlife and add nutrients to soil. Plants are used for building houses, fences, palisade walls, and kraals for goats and cattle. They are also used for basket weaving, carving wooden utensils, furniture, toys, fish traps, mortars, pestles, preparing alcoholic beverages, making sledges and for decoration purposes. Plants also provide humans with fruits for consumption, remedies and in some cases are used for cosmetics such as body lotion.

1.6.4 People of the area

The people live in central northern Namibia and southern Angola. They originate from the great Bantu family, speak the languages of Oshiwambo and they make up the greatest population in Namibia. Communities develop where the water was most plentiful, and relied on shallow wells to retrieve water during dry periods

1.6.5 Water use activities

Livestock plays a central role in the livelihoods of both the rural and urban population of the basin. It is estimated that 25% of the cattle, 43 % of goats and 70% of donkeys in Namibia are found in this basin. The area mostly practice communal farming which includes both livestock and dry land crop farming with mahangu and sorghum as the main cereals supplemented with vegetables mainly beans , pumpkins and melons.

Some people in the basin specifically Niipele sub-basin are exposed to dirty unsafe water from open wells and oshanas. Dirty water can have a colour but it can also be clear and contain invisible bacteria or chemicals that are harmful to humans and animals.

1.6.6 Climate

The Cuvelai basin's climate is dominated by the movement of air controlled largely by high pressure systems. The south western part of the basin consequently receive an average only around 250 millimetres per annum while the north-east receive about 600 millimetres. Temperatures vary little across the basin where the average is greater than 22 ^{O}C in most areas. The southern-eastern and south western parts are slightly cooler than the northern area.

1.6.7 Land use activities in the basin

The land is mostly used for National park of which Etosha National park is the only park in the Cuvelai Etosha Basin. Niipele sub-basin is dominated by communal land.

Figure 1.1: Land use activities in the basin

(Source: Mendelsohn, 2013)

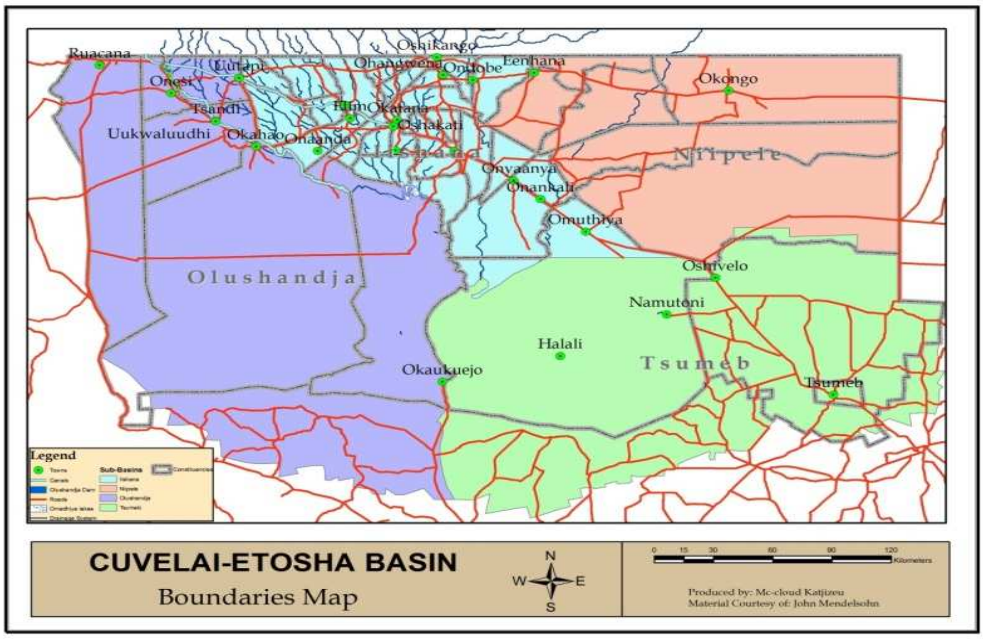

Figure 2: Map of CEB

(Source: MAWF, 2012)

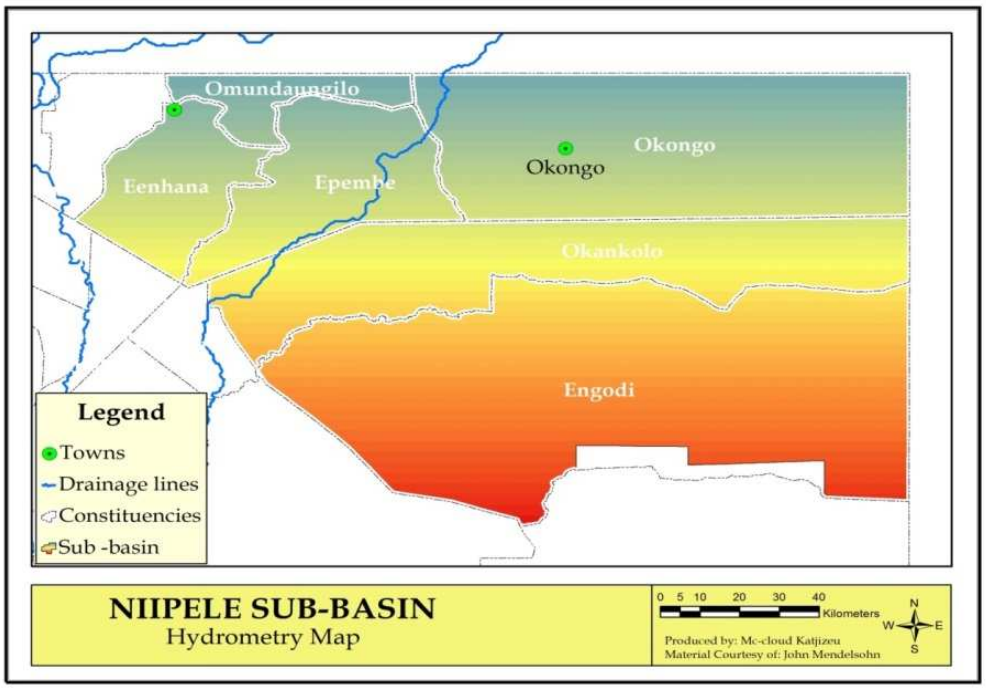

Figure 3: Map of Niipele Sub-basin
(Source: MAWF, 2012)

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In most developing countries, water use has increased over the last few decades due to population and economic growth. Changes in lifestyle and increasing affluence (water use per capita) increases water demand, a phenomenon which further deepens the water need deficit (Kluge and Moser-Norgaard, 2008).

Water use has grown at more than twice the growth rate of the world's population over the past century (World Bank, 2007a). Globally, there is enough water for basic human needs, but due to increasing affluence water resources are diminishing. Improved access to water, may lead to substantial increase in water use. Thus, there is a necessity to limit water use through efficiency policy interventions (Heita, 2010).

Examples of such improvements are: more accessible and cleaner water for households, expanded water services that allow productive uses, more reliable water supply through new institutions that enable effective interactions between end users and providers of water. Such improvements increase the ability of water users to pay for installation and maintenance of the systems, which in turn prepares the ground for accelerated up scaling and implementation of multiple-use systems (Marie Lefebvre, Sylvie Morardet, Marielle Montginoul, Stefano Farolfi, 2005).

Water is a key driver of economic and social development while it also has a basic function in maintaining the integrity of the natural environment. There is an increased water demand due to population growth and economic development, under the mounting investment costs of developing new water sources calls for efficient, equitable, and sustainable management of water resources in many developing countries. 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.

Some researchers have shown that even though Africa has 5 trillion cubic meters of fresh water resources available annually, only 3.8% of this supply has been developed, leaving 300 million African people without access to safe drinking water (Ford, 2008).

Water can also be a resource used in or necessary for productive activities and its collection is important in terms of time consumption (Makoni *et al.*, 2004; Soussan, 2003; Pollard *et al.*, 2002).

Competition among different sectors for scarce water resources and increasing public concern on water quality for human, animal and industrial consumption and recreational activities have focused more attention on water management in agriculture. As water resources shrink and competition from other sectors grows, agriculture faces a dual challenge: to produce more food with less water and to prevent the deterioration of water quality through contamination with soil runoff, nutrients and agrochemicals.

2.2 WAYS OF IMPROVING WATER USE EFFICIENCY

Maro (2005) defined water use efficiency as a measure of efficiency of water use for a defined user type with specified boundaries, and is expressed without units (i.e. as a percentage) requiring the formulation of the net and gross amount of water utilised for the activity under study.

Improving water efficiency allows countries to reduce water scarcity and maximize the benefits provided by existing water infrastructure (GWP, 2006). It also frees up water for other uses and reduces environmental degradation.

It is commonly intended that achieving water efficiency consists of optimizing water use. Indeed, different points of view should be considered when investigating water use efficiency. Absolute or physical efficiency means using the least possible amount of water for any activities.

2.3 PRODUCTIVE USES OF DOMESTIC WATER AND RURAL DOMESTIC WATER SOURCES

The water requirements of the poor always extend beyond domestic needs. Productive uses of water at the household level include a range of small-scale activities that enable poor men and women to grow subsistence food, fruit and vegetables, rear livestock and undertake informal microenterprises (Upadhyay, 2004).

Upadhyay (2004) further stated that in almost all rural communities in developing countries, it is primarily women and girls, who collect water, protect the water source and maintain the water systems, and store water. Women spend a significant amount of time with these activities. They also determine the use of water, and this decision-making has direct impact on the health of children and other family members.

In practice, the use of water for domestic purposes cannot easily be distinguished from productive use at the household level, particularly among poor urban communities. Domestic water use to sustain livelihoods among the poor forms an integral part of household coping strategies (Howard & Bartram, 2003).

One of the benefits of water use certainly not to be neglected is the positive impact on the livelihoods of the poor. Especially in the extensive semi-arid and arid areas of the developing world, rural livelihoods are strongly influenced by water use (Speelman , Haese , Ochieng & Vandermeulen , 2006).

Water can also be a resource used in or necessary for productive activities and its collection is important in terms of time consumption (Makoni *et al.*, 2004; Soussan, 2003; Pollard *et al.*, 2002). Following categories of water use by rural communities can be identified (Mokgope and Butterworth, 2001): 1) Water for basic human needs – these uses are focused on survival, providing water for drinking, cooking, sanitation and hygiene, with mainly health impacts and benefits; 2) Water for productive activities – these uses impact on food security or income. Output may

serve own consumption (subsistence production of vegetables, brick-making) or the market (sale of vegetables, fruits or ice blocks). Activities may also be associated with providing services (e.g. hair salons); 3) Water for other activities – these uses are not focused on production and mainly have religious or environmental significance (Speelman, Haese, Ochieng & Vandermeulen, 2006).

According to (Billi, Canitano & Quarto, 2007) most water planners assign priority to water use in the following hierarchical order: human consumption, food production and industrial production. However, this criterion has often caused conflicts because in many countries the priority of development strategies is not necessarily to improve the quality of life through sanitation and good health, but rather through the development of industry and exports (food and finished products).

Typical rural domestic water sources

In rural areas of southern Africa communities often rely upon a complex system of multiple sources, which are generally used for various activities. These often include non-potable sources of water where water quality is not the prime concern e.g. small dams and rivers are often used for washing of clothes. Typical sources of water in rural areas of southern Africa include:

- **Community tap.** A tap facility with communal access.
- **Homestead tap (yard).** This is a private water supply from a tap located in the yard of the homestead.
- **Homestead tap (inside).** This is a private water supply by tap located within one of the homestead buildings.
- **Community borehole.** A borehole with a hand driven pump for community access.
- **Private borehole.** This is similar to a community borehole but with the access limited to a select few.
- **Unprotected open well.** A well that is generally open to the environment and generally not very deep (e.g. 2 m to 10 m). The water is prone to contamination by pathogens. Water is collected using a bucket and rope.

- **Protected well.** A well that has been constructed with a cover, windlass/winch and bucket that protects against pathogens entering the water.
- **Protected/unprotected spring.** Similar to a protected/unprotected well, except the water wells up from the surrounding rock.
- **River or stream.** Water is accessed by direct collection from a watercourse.
- **Permanent dam.** Water is collected from the reservoir formed by the dam.
- **Rain water harvesting.** A method of collecting rainwater that runs off the roof of a building.

The seasonality of the regional rainfall in rural areas of southern African countries has a significant impact on the following:

The type of water source used e.g. in the rainy season rain water harvesting may be the main source of water, whereas in the dry season a deep borehole may be the only reliable source of water.

2.4 WATER USE AND WATER DEMAND MANAGEMENT

Water use in rural areas is dominated by agriculture. In fact, according to the 2003 FAO report, *unlocking the water potential of agriculture*, agricultural water use accounts for 70% of all water withdrawals globally. Industrial use accounts for another 20% and domestic use for the final 10%. With roughly half of the world's population now living in cities, domestic rural water withdrawals can thus be extrapolated to account for about 5% of the global total.

In arid and semi-arid regions of Southern Africa water consumption is 10.1 litres against the recommended 50 litres per capita per day (Madebwe, 2011). Madebwe, (2011) further stated that conditions of water scarcity require efficient use of water which is a core characteristic of water demand management. Water demand management is defined as instituting strategies to influence demand in order to achieve efficient and sustainable use of scarce resources. Water demand management is a contending strategy to supply management. It places emphasis on

water use efficiency and is contrary to supply augmentation irrespective of demand. By adjusting and limiting demand to available resources, water demand management saves water without the need for bulk water investment. Consumers are persuaded to make realistic water demands and use water for desirable purposes. Southern Africa faces a serious water supply challenge driven by scarce and unevenly distributed water resources, rapid population growth and urbanization, and imperatives of development and social equity.

In the majority of rural areas of Africa domestic water use was found to vary from some 20 litres per person per day to 40 litres per person per day. However, the World Bank quotes a figure of 50 litres per person per day. The World Health Organization quotes a figure of 150 litres per household per day in order to provide adequate health and sanitation. It is important to note that both rural domestic water demand and use are affected by a number of complex factors. It is rarely possible to use one simple per capita figure on a catchment basis to assess the demand and use.

Water use or water consumption is defined as the actual quantity of water consumed by a consumer or at a Water Demand Centre (WDC). Water demand, on the other hand, is the quantity of water required to meet the needs of a WDC or other consumer. If either the yield from a Water Resource, or the supply capacity of the Water Infrastructure cannot meet the Water Demand, water consumption will be less than the demand.

In Namibia, almost half of all water consumed is used by irrigation, with another quarter consumed by urban consumers. Livestock account for all but the remaining 12% which is spread between mines, rural consumers and wildlife and tourism.

About 62.8% of the rural population and 97.7% of the urban population in 2011 have access to safe water supplies for domestic use. The country does not have heavy industries and the relatively small quantity of water consumed by the small service industries is therefore included in the urban domestic water consumption. Only 5% of the water supplied is used for mining, but it has always been subject to full cost recovery (Heyns, 2006).

Namibia as a country has an ever-increasing water demand to meet development needs and rapid population growth of 2.6% per annum (National Planning Commission, 2001).

Water Demand Management (WDM) is a relatively new concept in Namibia, currently only practiced in big urban centres. According to Nashipili & Schachtschneide (2008) due to its novelty, WDM has not been specifically addressed in rural water supply. Another reason is the lack of information on actual water use in rural areas. Due to the centralised, subsidised rural water supply structure in the past, water metering in rural areas was not considered important. Hence there is an information gap on rural water supply, actual water use and management.

Water demand aims to improve water use efficiency by reducing water losses or changing the wasteful way people use water. In many countries water demand management is an approach used to achieve water use efficiency.

In an arid country such as Namibia where water is scarce and water resources are costly to develop, it is important to prioritize the use of water. The prioritisation takes into consideration the economic outputs of each sector per m3 of water consumed, basic needs of humans and stock and numerous socio-economic aspects. According to the Water Supply and Sanitation Sector Policy (WSASP) of 2008, the first priority is water for domestic use. Agriculture is the highest water user in Namibia: 75% of water use in 2001/02 was for agriculture with about 23% in the communal sector and 52% in commercial agriculture. The remaining percentages were consumed by other sectors such as mining (3.3%), households (12.2%) etc. (GWP –DRFN, 2009).

Household demand for water is affected by a variety of factors, such as household size, households' distance from the source of water, how regularly water is accessible, and people's consumption patterns.

The figure below also illustrates the percentage of the population in Namibia that is using improved water sources in urban and rural areas.

2.5 IMPROVED WATER SOURCE; RURAL (% OF RURAL POPULATION WITH ACCESS) IN NAMIBIA

The Improved water source; rural (% of rural population with access) in Namibia was last reported at 90 in 2010, according to a World Bank report published in 2012. Access to an improved water source refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, and rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 liters a person a day from a source within one kilometre of the dwelling. This page includes a historical data chart, news and forecasts for Improved water source; rural (% of rural population with access) in Namibia.

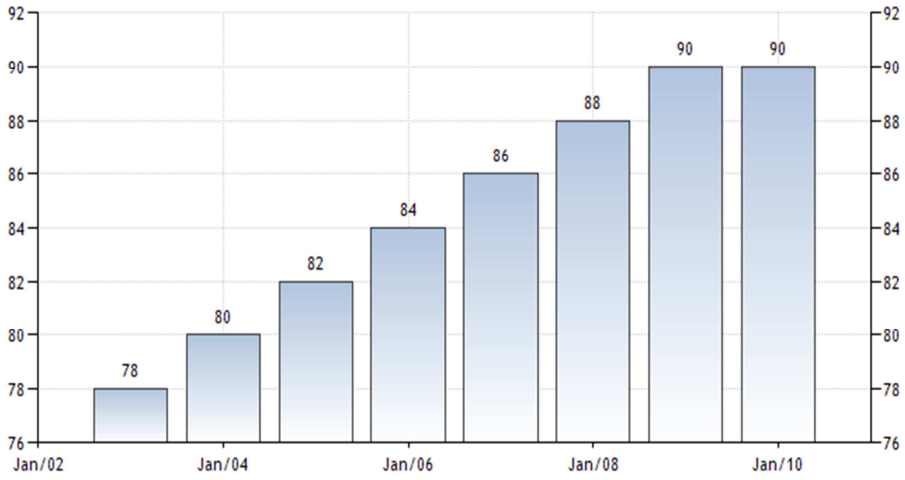

Figure 4: Improved water source; rural (% rural population with access) in Namibia

Source: http://www.tradingeconomics.com/namibia/improved-water-source-rural-percent-of-rural-population-with-access-wb-data.html

2.6 WATER SUPPLY IN THE CUVELAI-ETOSHA BASIN

The oshana system supports the highest density of people in Namibia resulting in a great demand for water. Unfortunately the area is arid and there is very little natural surface water that can provide rural communities and towns with a good supply of freshwater. The region is dependent on groundwater resources and water pumped from the Kunene river.

In the past people relied on omifima or wells to bring the groundwater to the surface . Even today, especially in areas away from the canal and pipelines , boreholes, omifima and hund dung wells remain popular, however the groundwater resources of the region are mostly salty, in fact they can be described as an underground salt marsh with several salt pans on the surface of the land. Freshwater groundwater is found only on the east and far east of the Cuvelai flood plains and throughout the region in small lenses below the sand which are tapped by omifima. Most of the water supplied in the region comes from the Kunene river by means of canals and pipelines. The raw water is purified at water purification plants . A network of taps and cattle water points provides rural people with purified water.

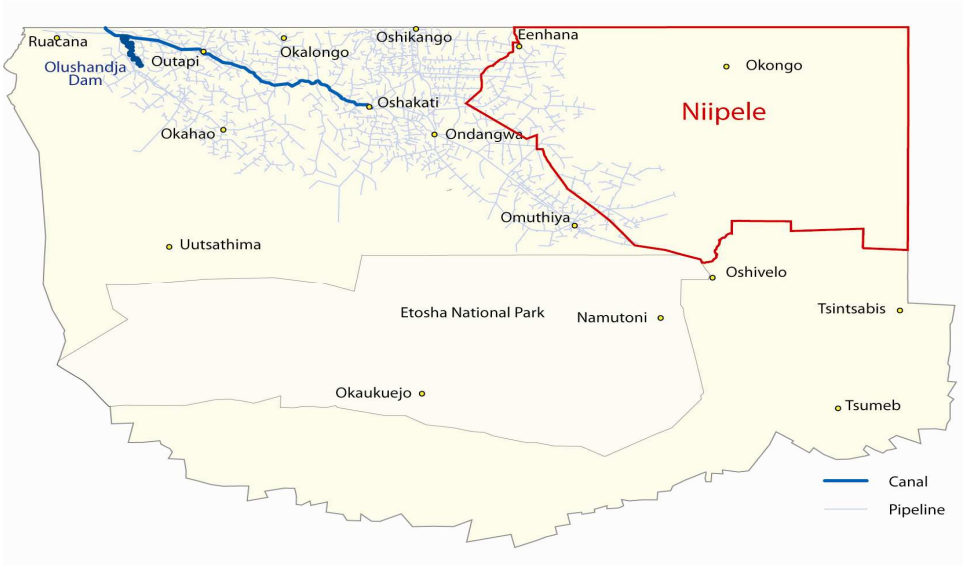

Figure 5 a): Water supply network for CEB

(Source: Mendelsohn, 2013)

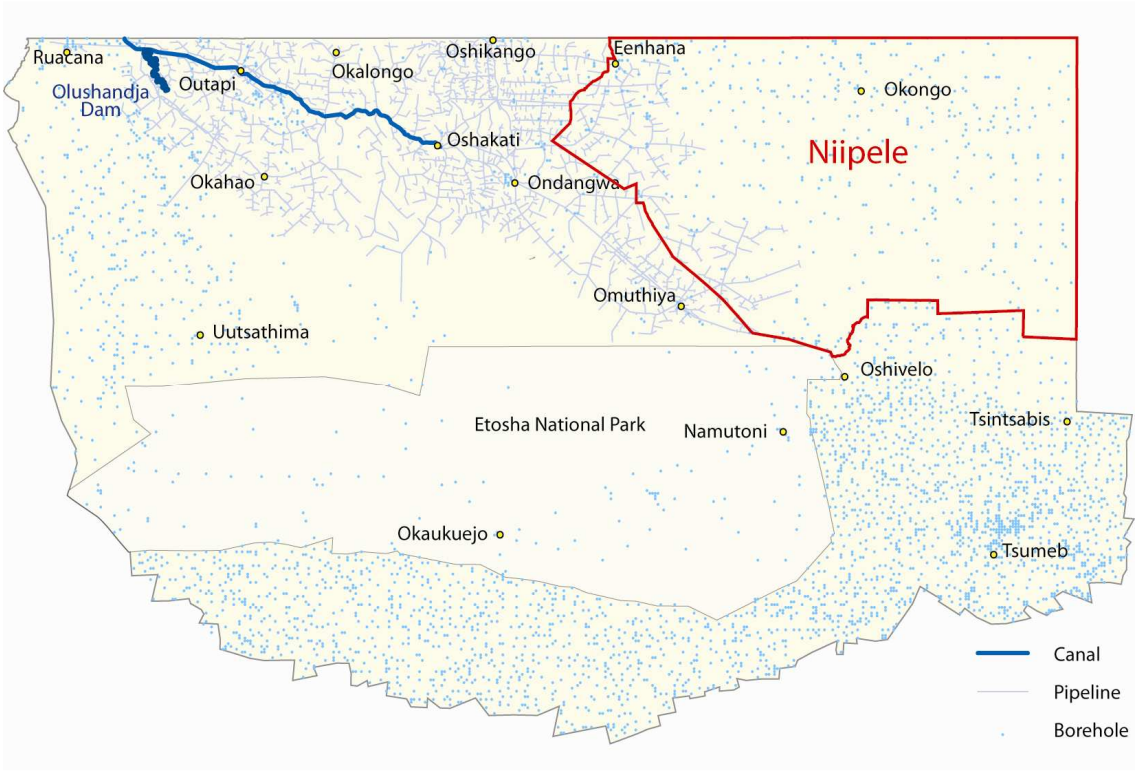

Figure 5 (b):

2.7 PERCEPTION ON PAYMENT FOR WATER SERVICES

In Namibia, water users do not pay for water per say but they pay for the supply services (DRWS, 2004). This practice means that anyone, anywhere can take a bucket and fill it with water for free; but if they want clean water delivered to their village or into their house they must pay for the supply service. However, investigations in central northern Namibia regarding people's perceptions about payment for water services have shown that many people in the rural parts of the Cuvelai basin have difficulties understanding the concept of cost recovery, and why and for what they are supposed to pay. For instance, many people think that water should be free as it is provided by God (Mazambani *et al.*, 2006). A common argument is: 'the government supplied free water before independence, why must people pay for water in a free Namibia?' (Klintenberg, Mazambani & Nantanga, 2007).

Much of the confusion seems to stem from the fact that many people do not understand what it takes to supply water; and therefore an effort must be made to explain the difference between purified, piped water and water that is freely available in the oshanas. One step towards improving this understanding among the water users has been to arrange tours of influential people to the NamWater facility in Oshakati, which have clearly improved understanding among water users.

Another way to improve willingness to pay is to improve relationships between consumers and the organisation managing the water supply service. Increased mutual trust and confidence that the service will be delivered as promised can be achieved through better information and communication. This often has a positive influence on a user's satisfaction and willingness to pay, as is found by numerous urban utilities. There have been several studies into the extent of willingness to pay for water supply in rural areas. On average the willingness to contribute towards water as a % of all households was 78.6%. However, the ability to pay, as measured by the 5% of income rule of thumb, suggests that many families may not be able to afford to maintain the community water supply. Willingness to pay is affected by unclear stipulation of water point responsibilities in some areas. Willingness to pay is reduced as the quality of the service is reduced meaning that careful monitoring of the quality of service the water point provides is required for institutional sustainability.

A study done by Engel, Iskandarani & Pilar Useche (2005) revealed that the share of income that a household is willing to pay for water can vary widely – from 0.5% to 10%. Furthermore, empirical analysis showed that more educated households are willing to pay more for improved water supplies.

CHAPTER 3

METHODOLOGY

3.1 DATA SOURCES AND DATA COLLECTION

This study is based on both primary and secondary data. The secondary data were drawn from government (MAWF) and other research publications as well as from students' dissertations more particularly for the water use and demand. Primary data came from focus groups conducted with local stakeholders and household surveys. Community meetings were done at different sites to get the perception of the community members on water use and perceptions on water payment.

A structured questionnaire was used to collect quantitative data about the household's water use patterns. The content of the questionnaire on household targeted the socio-economic factors of households in the study area. Since the study area is quite big and varsity, a random sampling method was used to identify households to take part in the research. The questionnaires had different components. The research looked at four sample areas which are: rural areas that has piped water for more than five years, rural areas without piped water, urban areas with piped water and urban areas without piped water. A sample of 15 households for each sample area was interviewed. In total 60 households were interviewed. The questionnaires comprises of four parts namely: 1) Household Socio economic data, 2) Water sources and water use, 3) Water infrastructure, use and conditions, 4) Water Management. See annexure for the sample questionnaire. The urban without piped looked at the informal settlements that are in the boundaries of the towns but they are not yet serviced to have water and sewerage systems in place.

Figure 6: Individual interview

Figure 7: Focus group discussions

3.2 STATISTICAL ANALYSIS

Descriptive statistics was used to characterize the different water sources, socioeconomic characteristics of households, as well as household's willingness to pay for water services and desired improvement for water services.

CHAPTER 4

RESULTS

4.1 HOUSEHOLD AND SOCIO ECONOMIC DATA

4.1.1 Household composition and size

The household size of the sample ranged from 1 to 28 with the households in rural areas having more people than households in urban areas. The sample size of rural population with piped water has a highest average of 13 and the urban without piped water with the least average of 5 as it is indicated on figure 8.

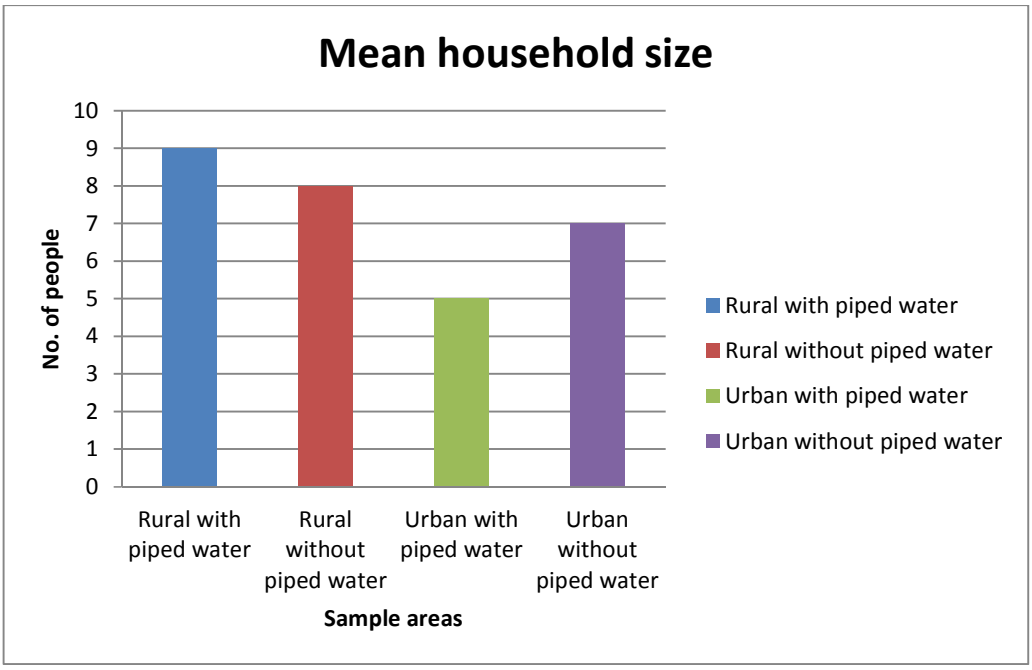

Figure 8: Mean household size in each sample area
(Source: Survey data: 2014)

4.1.2 Age composition of the households

Table 1 show that most of the households in each sample area have more people who are above 15 years, but there is not much difference with those that are younger than 15 years (0-14) years.

Table 1: Age composition for households in each sample area
(Source: Survey Data, 2014)

SAMPLE AREA	0-14 years	15 years or older	Total
Rural with piped water	82	105	187
Rural without piped water	67	101	168
Urban with piped water	30	39	69
Urban without piped water	43	56	99

4.1.3 Employment and sources of income for the households

Figure 9 shows that in rural households with piped water 10 households have employed members in the household (earn a salary). The questionnaire only asked whether there is anybody in the household who is employed but not necessarily asked the occupation of the head of the household. This means that even if the head of the household is not working there might be others in the household that have income. Generally it can be concluded that most households have an income from employment and on small businesses and it can be seen that there is no much of a difference in terms of unemployment for households in different sample areas.

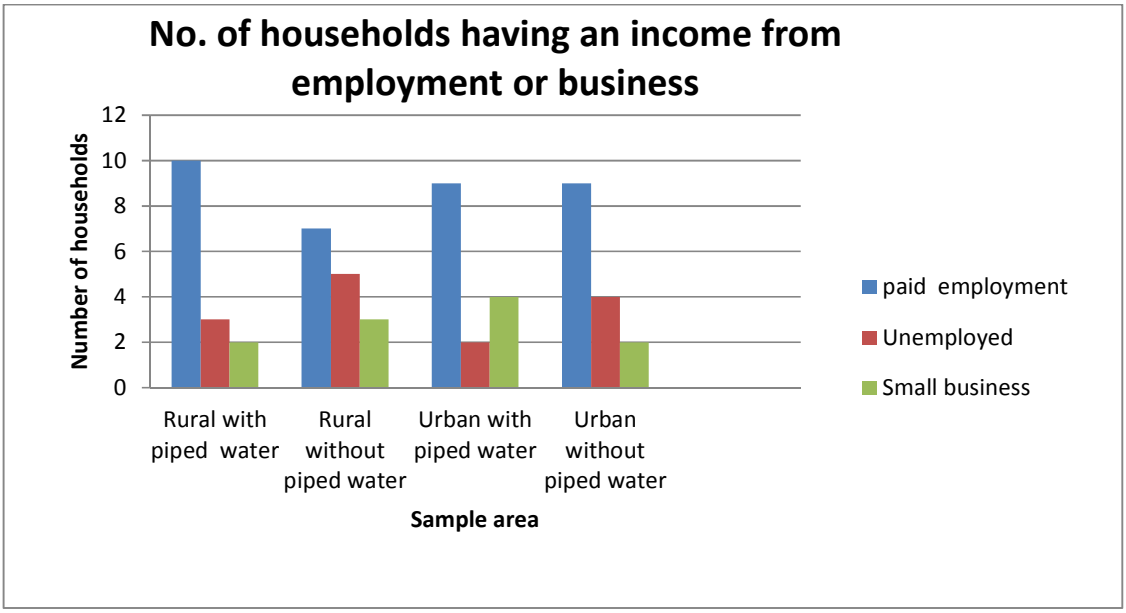

Figure 9: Employment status of the households in each sample area (Source: Survey data 2014)

4.1.4 Main sources of energy used for cooking in the household

Figure 10 below shows the type of energy source, households use for cooking. Majority of households in rural with and without piped water use firewood for cooking and only one household in rural area uses electricity for cooking. Due to the increase in prices of electricity there are some households in urban areas that use gas and two households use firewood for cooking to save the electricity units for other household's appliances.

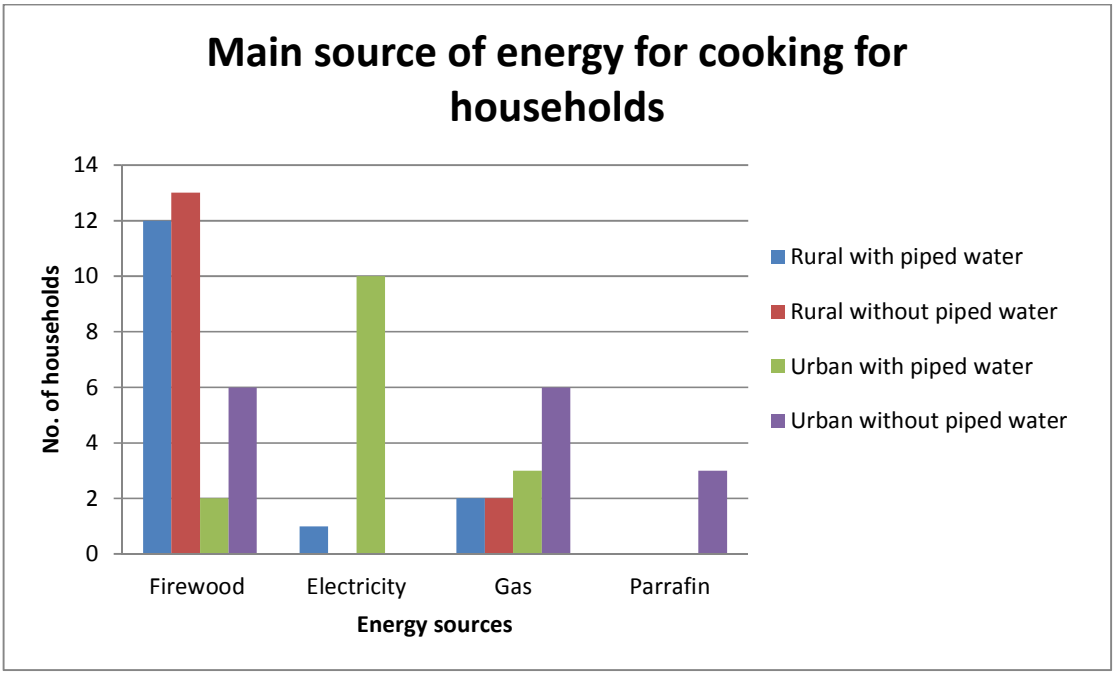

Figure 10: Main source of energy for cooking by households in each sample area (Source: Survey data, 2014)

4.2 WATER SOURCES AND WATER USE

People in rural areas depends mostly in boreholes, wells, oshanas and tap water as the sources on water while in urban areas people rely more on tap water. Also in rural areas people use water from different water sources for different purposes for example during the rainy season rural household with piped water only use tap water for drinking and cooking. For other purposes they use water from oshanas, wells and sometimes harvest water from the corrugated iron structures in buckets that can be used for laundry and watering of vegetables. As it can be seen from figure 11, each sample area has different number of sources of water which are used for multiple uses.

All urban households had only one source, piped water which is either supplied to their neighbourhood or houses or pay elsewhere from which they obtained water.

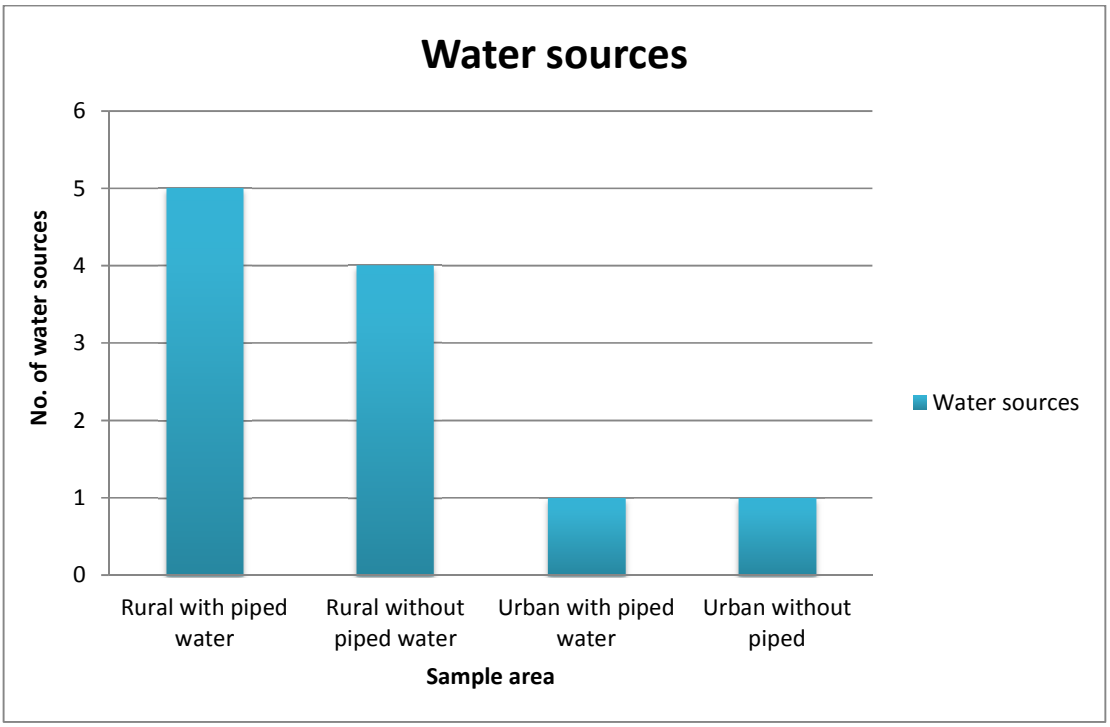

Figure 11: Number of water sources in each sample area
(Source: Survey data: 2014)

Each sample area has different types of water sources. For example in some households in rural areas with piped water, the piped water is only used for drinking and cooking but other uses like laundry and livestock watering use water from wells , dams and Oshana. Figure 12 has clearly indicated the types of water sources available in each sample area.

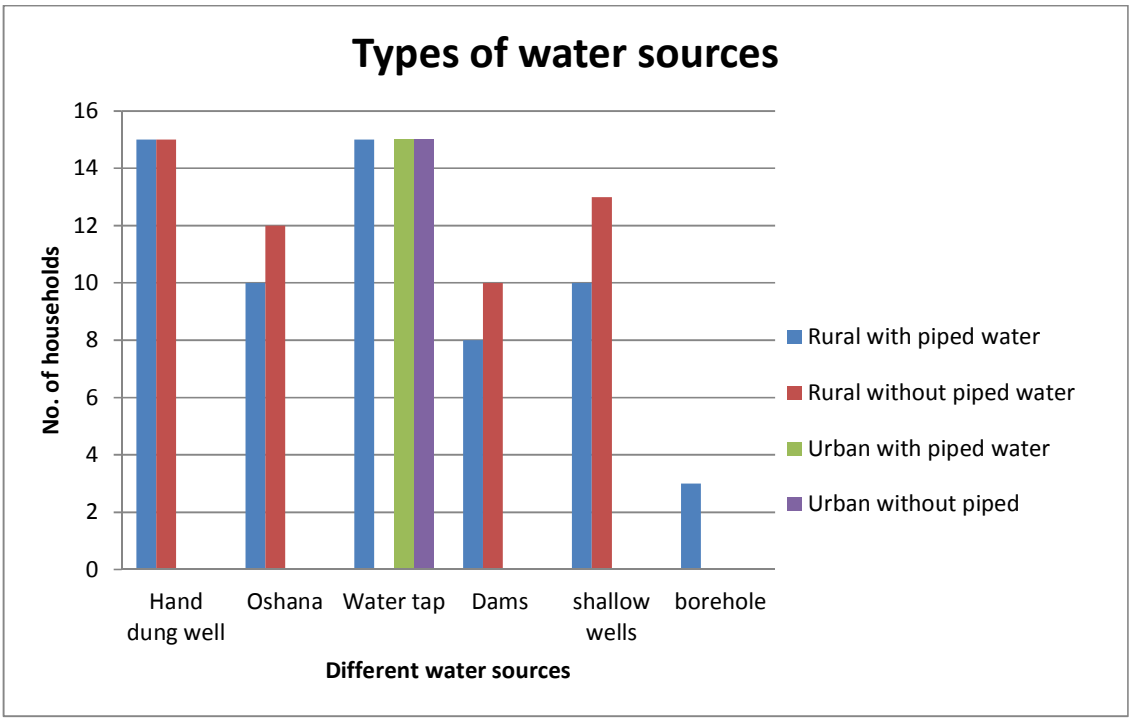

Figure 12: Types of water sources in each sample area
(Source: Survey data, 2014)

The below pictures are showing some of the water sources found in the sample areas.

Figure 13: Oshana as a source of water

This is mostly a main water source for livestock during the rainy season both rural areas with piped water and rural areas without piped water.

Figure 14: A shallow hand dug well

This is a water source most commonly in rural areas. In areas with piped water this is only used for other livestock watering, bricks making and gardening. In rural areas without piped water, the households depend entirely on this water source.

Figure 15: A community water point

This is a source which is used by households without private taps in the households. This water sources are being managed by water point committees elected by community members.

Figure 16: A shallow well as a water source

This is also a traditional shallow well that is also a water sources for households in rural areas without piped water.

4.3 WATER CONSUMPTION AND DEMAND IN RURAL WITH AND WITHOUT PIPED WATER

All respondents in the four sample areas have indicated that they use water for domestic uses mainly for domestic purposes but the quantities of water used across households. Generally, quantities used for domestic purposes range from 75 to 200 litres per household per day. The differences in water consumption are determined by a number of factors ranging from the type of water source, distance to the source or point of collection, household size and reliability of water supply. People tend that are far away from the water sources use less water compared to those that are closer to the water sources. In urban areas most of the town councils only allows

people to use piped water for domestic purposes and industrial use and in most cases harvesting of rainwater is prohibited in towns.

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 and nurseries). Currently most households have backyard gardens for subsistence purposes only. Households reported that they only 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.

Dry season for rural household with piped water

Table 2: Water uses during the dry season
(Source: Survey Data, 2014)

Uses	Water tap	Hand-dug well	Oshana	Dams	Others
Drinking	√				
Cooking	√				
Personal hygiene	√	√			
Laundry	√	√			
Watering livestock		√	√	√	
Gardening		√	√	√	
Beer making	√	√			
Cooking food to sell	√	√			
Brick making/ building	√	√	√		

Rainy season for households with piped water

Table 3: Water use during the rainy season
(Source: Survey Data, 2014)

Uses	Water tap	Hand-dug well	Oshana	Dams	Others
Drinking	√				
Cooking	√				
Personal hygiene	√	√	√	√	
Laundry		√	√	√	√
Watering livestock			√	√	
Gardening			√	√	
Beer making	√	√			
Cooking food to sell	√	√			
Brick making/building		√	√	√	

4.4 DISTANCE TO THE WATER SOURCES

The people in households in rural areas without piped water travel more than 1000m to collect water from the water sources. Figure 4.8 indicates that the water sources in urban with piped is less compared to other sample areas. This is because most of the taps in urban areas are located within the household yards and only few people collect water from outside.

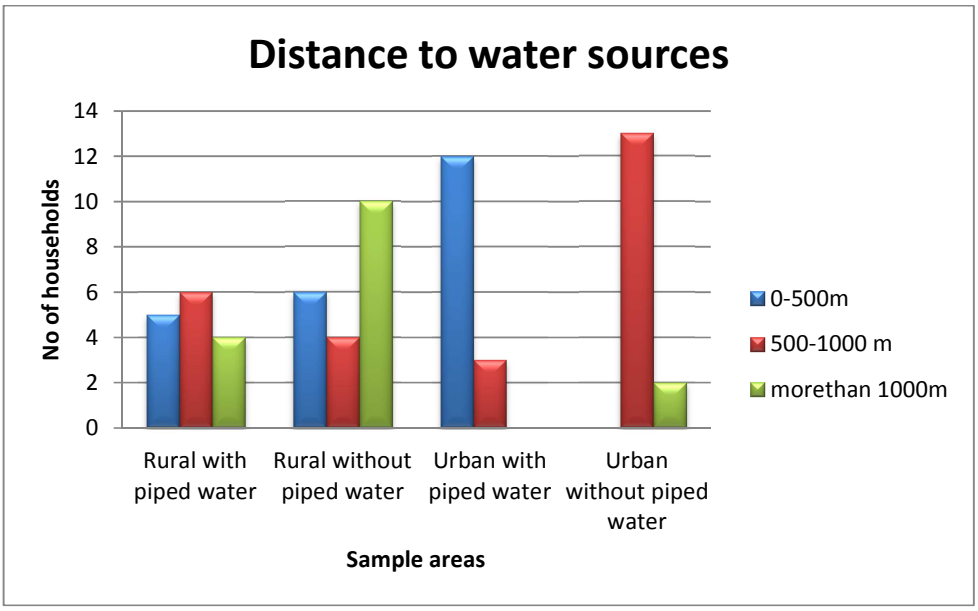

Figure 17: Maximum distance to the nearest water sources in each sample area (Source: Survey data, 2014)

4.5 DESIRED IMPROVEMENT IN WATER SUPPLY

The respondents proposed what they desire to be improved in terms of water supply in the area. This was done to help the rural water supply and Namwater to plan better whenever there is a plan in improving the existing water supply or new water points. The results are illustrated in the following figure:

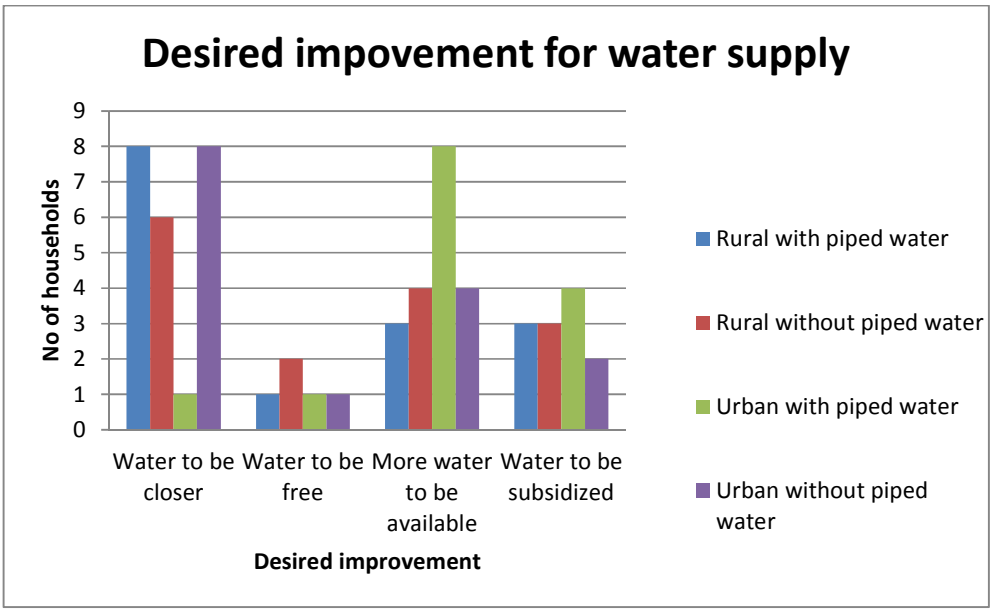

Figure 18: Desired improvement for water supply by households (Source: Survey data, 2014)

As it can be seen in the above figure more respondents in rural with piped water and rural without piped water need water to be closer while respondents in urban with piped water desire more water to be available. In the whole sample areas, even though the households see the need for paying for water services, they still feel that the payment of water is still high and therefore they desire the water to be subsidized. The good thing is also that only few households in both sample areas that stated that water should be free. There are some households who are in the areas where there is piped water but they are still using water from wells, oshanas and other sources since they cannot afford to pay for water services.

From the focused group discussions, most community members stated that they need earth dams to be excavated or old ones to be rehabilitated. The earth dams are being used as a major source of water for livestock in rural areas. The community also want relevant authorities to look for possible ways of harvesting rainwater during flood years so that it can be used during the drought season like the drought the country experienced last year (2013).

4.6 PERCEPTION OF HOUSEHOLDS FOR THE PAYMENT OF WATER

The questionnaire also looked at the aspects of how the community members perceive the cost of water that is charged currently either for private taps or community taps. The issue that has emerged from the discussions with water users in central northern Namibia is that in general, people in the past use to think that water is supplied freely without considering the processes involved in the treatment and maintenance of water infrastructures. This commonly results in low acceptance rates of initiatives that are different from what people are used to or what they see other people having.

Households in rural areas without piped water did not comment much on this matter since they are not aware of the prices yet. In general, 90% of the respondents concluded that the contributions towards water payments are fair and people can afford to pay for water services. And even household that does not have piped water currently; most of them indicated that they are willing to pay for water services once it is made available to them. The other issue with payments especially for people who use community water points is that, they do not really understand what are they paying for and they feel like water from the community water points are not to be paid for but only those with taps inside the households can pay. It is not really that all households cannot afford to pay but it is just the attitudes and influence from others but awareness and education on the importance of the payment of water is needed particularly in rural areas.

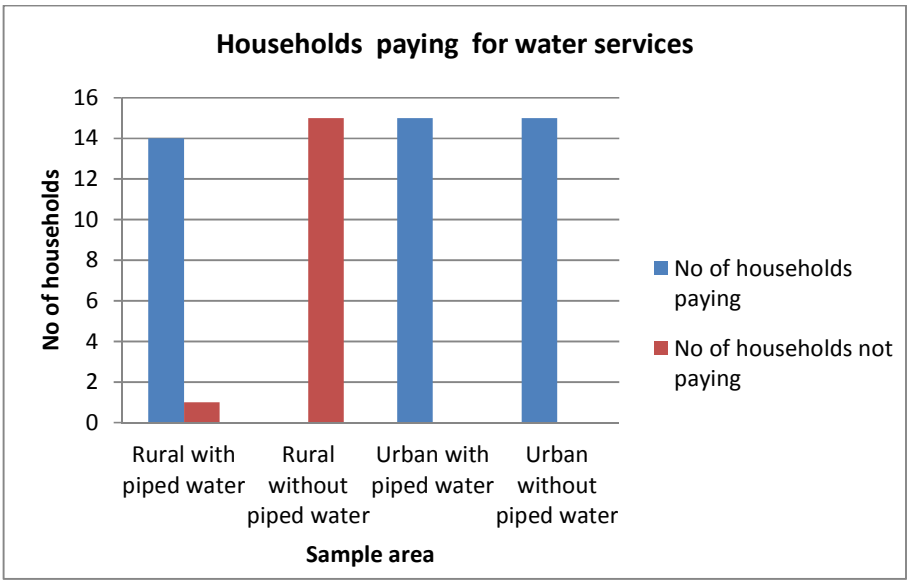

Figure 19: Households paying for water services (Source: Survey data, 2013)

The households in urban areas without water are also paying for water services in the absence of piped water at their places. This is because these areas are currently called informal settlement areas that are within the borders of towns. The plans are still underway to service the land and provide water services to the households. Since other sources of water such as hand dug wells, dams, and lakes are not readily available, these people have to walk for some kilometres to get water from the urban area with piped water.

4.6.1 Household's perception on the current prices of water

The study also looked into the aspect of how the community perceive the current price they are paying for water services. 70% of the households reported that the price is fair especially the households with private taps that are on the Namwater pipelines since they said they pay less than those that are on the Rural water supply network. 20% of the respondents view the price as appropriate even though some think that some months they are charged more. The 10% that reported that the price of water is unfair is mostly households that use community water points that pay a fixed amount per month e.g. N$ 10/per month for each household. Some households reported that they have few people in the houses, some do not have livestock and yet they have to pay the same amount.

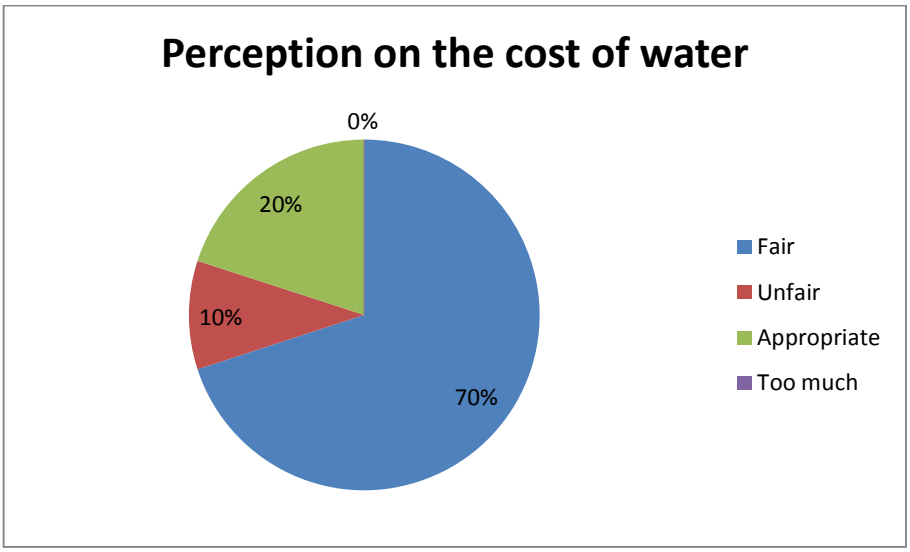

Figure 20: Perception on the cost of water
(Source: Survey data, 2014)

4.6.2 Willingness to pay for water services

The community members especially in rural household with piped water seems to know less about the cost recovery involved in water and therefore most of them proposed that the water bill per month should not exceed N$ 50.00 regardless of how many cubic meters are used. This is almost similar to rural household without piped water. Currently the households in this sample size are not paying for water services but they also indicated that if they happen to have piped water then majority are willing to pay in the range of N$ 5-50.00 and very few are willing to pay between N$ 50-100. This gives an indication that community members still need to be made aware of the importance of paying for water.

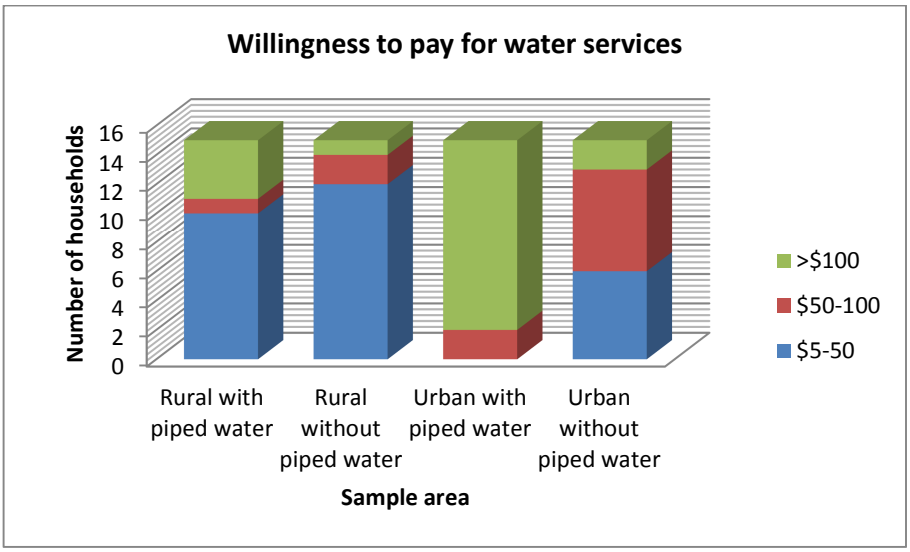

Figure 21: Households willingness to pay for improved water services (Source: Survey data, 2014)

As for urban houses with piped water, most respondents are willing to pay more than N$ 100.00 and only two households that have indicated they are willing to pay between N$ 50-100. In urban areas there are no other sources of water and people have no option not to pay otherwise their water will be cut off unlike in rural areas where people can opt to others sources when their water points are closed.

4.7 THE QUALITY OF WATER

Water quality seems not be a major concern in areas with piped water but in areas without piped water is a big challenge. Rural households use the taste and smell and smell to determine the quality of water. Figure 4.11presents the perceptions of the sampled households on the water quality they use for drinking. Most of the respondents in areas with piped water reported that the water quality is very good while respondents in rural without piped water stated that some water have poor or very poor quality. This could have caused by the fact that water is in some areas are either saline, muddy, polluted by living organisms since most of the water sources are not covered and this gives an unusual colour and unpleasant smell or they are not happy that they drink the same water as animals or the water is simply not purified. These respondents reported that they boil the water or use water purification tablets before the water can be consumed by human beings. Livestock

are left with no other alternative but to drink the water regardless of how the quality is. Also the study was done during the time when many shallow wells (omifima) contained little water which would have been more contaminated during the rainy season and this could have affected the water quality.

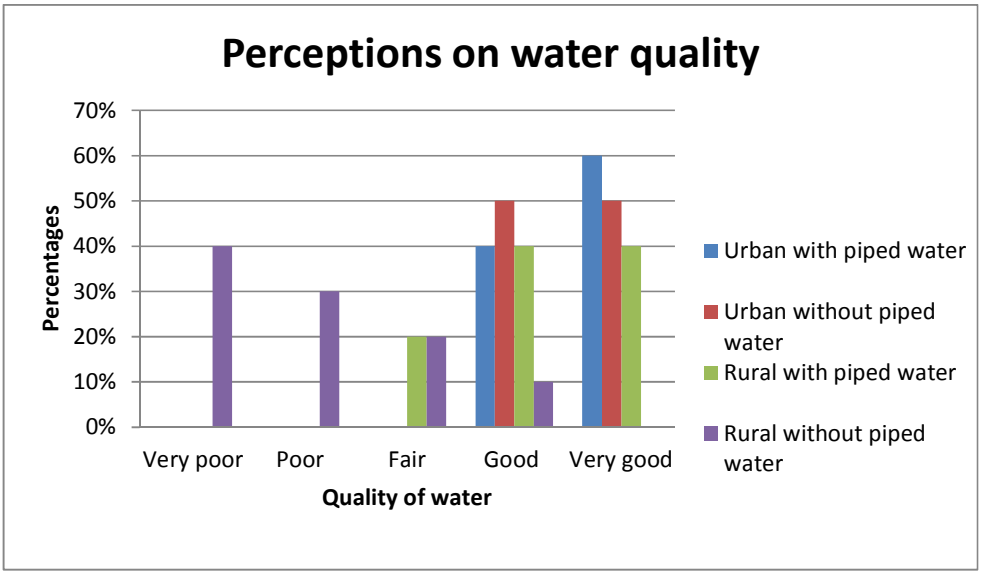

Figure 22: Perceptions on water quality
(Source: Survey Data, 2014)

4.8 WATER INFRASTRUCTURE, USE AND CONDITIONS

Respondents were asked to state the major water using appliances in their households. In rural areas either with piped or without piped water, the major appliances are water taps and washing basins. Only two households in rural areas have flushing toilets. In urban areas with piped water the appliances range from water tap, showers, some households have washing machines, flushing toilets and others.

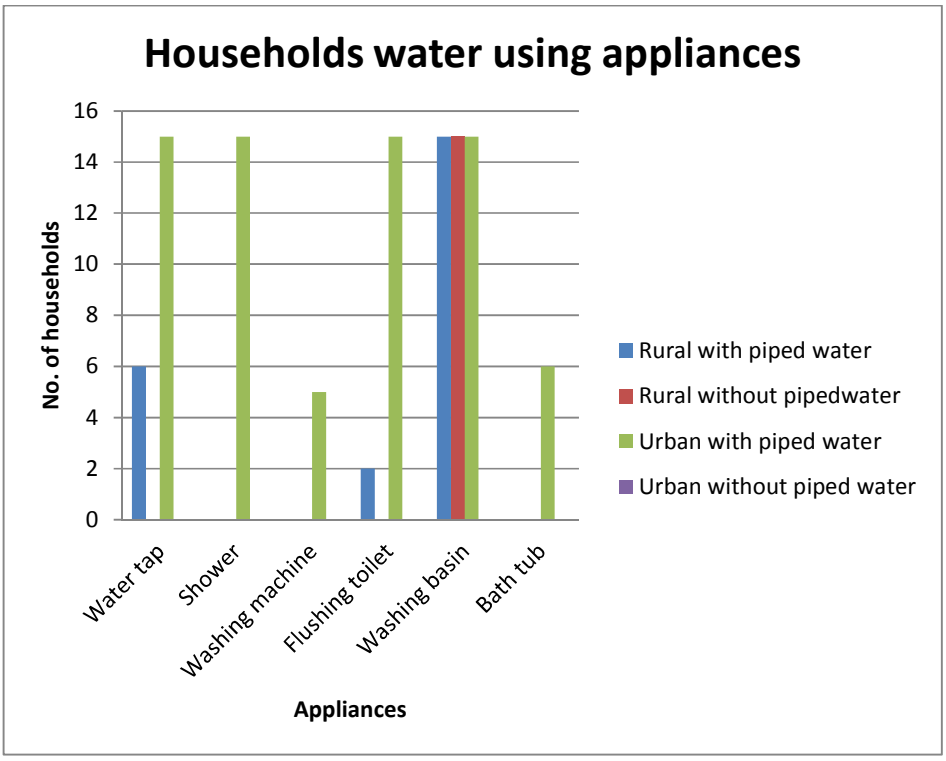

Figure 23: Water using appliances in each sample area
(Source: Survey Data, 2014)

4.8.1 Toilet arrangements for the households

Sanitation and water goes hand in hand, that is why a questionnaire also looked at the toilet arrangements of the households. Figure 4.13 shows that out of 60 households that were interviewed, 20 households use outside toilets and this are mainly in rural areas. The people in rural areas set up these toilets without taking into consideration of the nearby water sources; they are being located wherever the household find a space to put up a toilet. 15 households have flushing toilets and this are mainly in urban areas. There are about 10 households that reported that they do not have any toilet in their households at all and still doing open defecation which is posing danger to the environment and the water sources especially in flood areas.

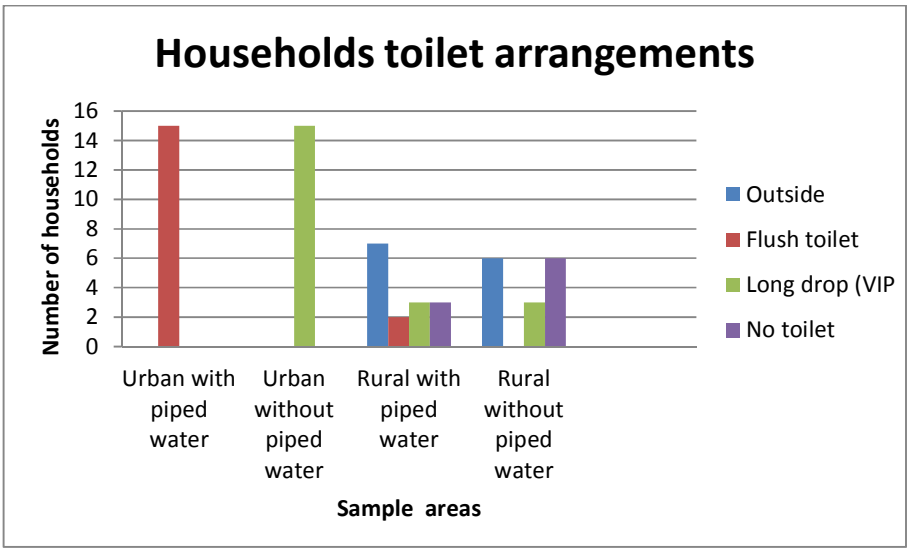

Figure 24: Households toilet arrangements in each sample area (Source: Survey Data, 2014)

4.9 BEST PRACTICES FOR WATER USE EFFICIENCY AT HOUSEHOLD LEVEL

As per the objective four of the thesis, several literatures have been consulted and during the focus group discussion some ways to improve or reduce water use were identified. Below are highlighted tips in reducing water use.

4.9.1 Toilets

There is no need to flush the toilet every time it is used. People in the house should not throw anything on the toilet that can be thrown in the rubbish bin. Rubbish such as piece of cotton wool or cigarette stompies are not supposed to go into the sewerage treatment and using 12 litres of water to get rid of such small pieces of rubbish is very wasteful.

4.9.2. Showers

Keep showers short. Turn the taps off when applying soap on the body. If possible, use low-flow shower heads. Most of the respondents have stated that using a washing basin is a best way to save water.

4.9.3 Washing cars

Wash the car with a bucket of water rather than using a hose pipe. It is not necessary to wash cars every day, therefore households should minimise the washing of cars to reduce water use. People should avoid washing the cars in the oshanas or open canals as this will pollute water and pose health hazards to livestock and people.

4.9.4 Watering gardens

Water gardens early in the morning before 10:00 or in the late afternoon after 16:00. If the garden is watered at midday most of the water will evaporate and very little will go to the plants due to the high evaporation rate the country is facing.

4.9.5. Re-use

Re-use water from washing and rinsing dishes for the garden or pot plants. Water that is left after bathing or laundry can be used to water bricks.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter summary the findings of the study that will therefore present the conclusions and recommendations derived from the literature review and the results of the actual study. The recommendations will also include some proposed ways that households can use to improve water efficiency.

5.2 SUMMARY OF FINDINGS

The study concludes that households use water for multiple purposes and also water from different sources. The uses of water includes; cooking, livestock watering, gardening, bricks making or buildings, laundry, personal hygiene (bathing). This makes it significant that water has an economic good as well as social good. Households in rural areas with piped water prefer to use tap water only for cooking during the rainy season and use water from the other sources like oshanas, wells etc. for other purposes. Since some other water sources may get dry during the dry season some households use tap water even for bricks making. Households in rural areas without piped water also use water for multiple uses but have to make sure that the water for drinking is boiled before drinking.

The results also highlighted that there is a diversity of water sources and these vary with household types and location. Even households with piped water especially in rural areas cannot only rely on tap water since sometimes water are being cut off or fixed and they have to use water from the other sources. Most households in both rural and urban areas use containers to store water in case the water supply is being disturbed but sometimes the containers cannot secure water for many days.

As for the second objective of the study which 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 some households want the water to be closer, some need water to be available, some want water to be subsidised and very few feels that they cannot afford to pay for water services and hence they want the water to be free. The summary from the focused group discussions, most community members stated that they need earth dams to be excavated or old ones to be rehabilitated. Rainwater harvesting was also mentioned in most of the sample areas.

For the third objective on the household's willingness to pay for water services, the study found out that different households are willing to pay for water services. Households also gave their perceptions on the current charges for water of which some think it is fair, some think it's appropriate and the rest said it is unfair but none of the households really say it is too high. On the payment for water services more households in urban and rural areas with piped water are paying for the tap water they use and non-piped water do not pay since they only use water from other sources where the water is not purified. The study also found out that some have indicated the amount of money they are willing to pay in case the water services are to be improved in their areas. This ranges from N$ 5- more than 100 per month.

The fourth objective of the study was to identify best practices for water use efficiency at households' level. This was done through secondary data of other research publications and focus group discussions. The study found the following practices that households can use for water efficiency.

- Wash the cars with water in the basin or bucket instead of using a hose pipe
- Water the plants in the morning
- Report any case of leaking pipes
- Leave the taps closed all the time
- Reuse water for different purposes.

5.3 RECOMMENDATIONS

It is important that awareness and trainings to be provided to the community members on the importance of paying for water services. It is also necessary that people are made aware on the protecting of water sources especially those that does not have access to piped water. And for those that have piped water still to take care of the other water sources as the scarcity of water in the country as whole is crucial.

Beside the fact that every Namibian has the right to have a reasonable access to clear water, it is very important to reduce the demand for excessive water and this can only be achieved by promoting awareness campaigns on water conservation. Basin Management committees (BMCs) can take a lead in this regard. There is also a need to ensure that proper land use, planning and management of livestock in rural areas are taken into consideration all the times.

Further research can be done to compare the actual water consumption (the quantity of water use per day) of households in different sample areas as this was not much covered in this study.

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ABSTRACT

Water is the basis of life and forms the fundamental resource base for human well-being. In the dry and arid countries such as Namibia water scarcity is a major concern and hence water use efficiency measures are crucial. Poor access to water has a profound influence on human well-being. Communities may be water poor simply because water is not available or because they have to cover long distances to reach the nearest water source.

In many countries and specifically in Namibia, water consumption, use and disposal are often taken for granted as essential services with required levels of service quality, yet little is known about how much consumers are willing to pay for specific service levels. The study looked at the different water sources available within Niipele sub-basin and the uses for thereof. It also looked at the desired improvement of water services by community members as well as to share best practices for water use efficiency at household level.

A total of 60 interviews were conducted within Niipele sub-basin which is one of the sub-basin in Cuvelai-Etosha basin in Namibia. There were four sample areas namely: rural with piped water, rural without piped water, urban with pipe water and urban without piped water. Quantitative and qualitative methods were used in the study.

Results show that water is used for multiple uses ranging from domestic to other uses like bricks making and others. Rural households both with piped and without piped water use water from different sources for different uses and this also depend on the seasons. Households require water to be closer, some need water to be subsidized and some households responded that they want more water to be available all the time.

The results also shows that households in all sample areas are willing to pay for water services and most of the respondents indicated that the current price for water is fair even though there are those that reported that it is unfair.

ANNEXURE 1

DOMESTIC WATER USE QUESTIONNAIRE

Domestic Water Use Questionnaire

Ms. Anna T. Haufiku is an MSA student at the University of Free State (Centre for Sustainable Agriculture, Rural Development and Extension) in South Africa. The student is conducting a survey concerning domestic water use issues in your neighborhood for the Niipele Sub-Basin on *Sustainable Water Resource Management in the Cuvelai Etosha Basin.* The information gathered will be used to identify water use patterns. All the specific information you provide will be treated confidentially. We hope that you will be willing to help us with this study.

For office use only

1-3

1. Date of survey:

_____/_____/_____

4-5

2. Interviewer:

_____

6-7

3. Region:

(a)	Rural	1
(b)	Urban	2
(c)	Peri-urban	3

8

4. Constituency:

_____

9-10

5. Village name:

_____

11-12

PART 1: HOUSEHOLD SOCIO-ECONOMIC DATA

For office use only

1. What type of building do you live in?

_____ 13-14

1.1 The main materials used for the roof:

(a)	Corrugated iron or Asbestos sheets	1
(b)	Thatch grass	2

15

1.2 Main material used for walls:

(a)	Bricks or blocks	1
(b)	Corrugated iron or Asbestos sheets	2
(c)	Wood and mud	3
(d)	Sticks	4

16

1.3 Main material used for floors:

(a)	Cement	1
(b)	Mud and dung	2
(c)	Tiles	3
(d)	Sand	4

17

2. How many people live in your household?

_____ 18-19

3. How many are younger than 15 (0-14) years?

_____ 20-21

4. How many are 15 years or older?

_____ 22-23

5. Does anyone in your household have a paid employment, earn a salary or have a business?

_____ 24-25

For office use only

6. Does anyone in your household own a car?

(a)	Yes	1	
(b)	No	2	26

7. Does anyone in your household own a radio?

(a)	Yes	1	
(b)	No	2	27

8. What kind of energy source do you use for cooking in your household?

_____ 28-29

9. How many people in the household have cell phones?

_____ 30-31

10. How many livestock do your household own?

(a)	Cattle	1	32
(b)	Goats	2	33
(c)	Donkeys	3	34
(d)	Sheep	4	35

PART 2: WATER SOURCES AND WATER USES

For office use only

1. What is the different water sources used for the different purposes in your household?

1.1 Dry Season:

		Water tap	Hand-dug well	Oshana	Dams	Bottled water	Others		
(a)	Drinking								36
(b)	Cooking								37
(c)	Personal Hygiene								38
(d)	Laundry								39
(e)	Watering Livestock								40
(f)	Gardening								41
(g)	Beer Making								42
(h)	Cooking to sell food								43
(i)	Brick making/building								44
(j)	Other: Specify								45

1.2 Rainy Season:

		Water tap	Hand-dug well	Oshana	Dams	Bottled water	Others		
(a)	Drinking								46
(b)	Cooking								47
(c)	Personal Hygiene								48
(d)	Laundry								49
(e)	Watering Livestock								50
(f)	Gardening								51
(g)	Beer Making								52
(h)	Cooking to sell food								53
(i)	Brick making/building								54
(j)	Other: Specify								55

For office use only

2. If water is also collected from outside:

2.1 How far is the nearest water source/point from your residence?

(a)	0 – 500m	1	
(b)	500 – 1 000m	2	
(c)	More than 1 000m	3	56

2.2 How do you collect water?

(a)	By walking	1	
(b)	By animal drawn cart	2	
(c)	By wheelbarrow	3	
(d)	By car	4	
(e)	Others	5	57

2.2.1 If others, please specify:

_____ 58-59

2.2.2 How long in terms of minutes/hours does it take to walk to the nearest water supply point?

_____ 60-61

2.2.3 How many times do you collected water in a day?

_____ 62-63

3. Do you pay for water you use?

(a)	Yes	1	
(b)	No	2	64

3.1 If yes, which payment system applies to your household?

(a)	Own water meter	1	65
(b)	Shared water meter	2	66
(c)	Direct payment at the water point	3	67
(d)	Others:	4	68

For office use only

4. How does the community perceive water contributions?

(a)	Fair	1
(b)	Unfair	2
(c)	Appropriate	3
(d)	Too much	4

69

5. Can people in this area generally afford to pay for water?

(a)	Yes	1
(b)	No	2

70

5.1 If no, what could be the reasons?

_____

_____

_____

71-72

6. What would be the most important improvement to your water supply? Choose one option.

(a)	Water to be closer	1
(b)	Water to be costless	2
(c)	Water to be cleaner	3
(d)	More water to be available	4
(e)	Water to be subsidized	5

73

7. If the water supply is to be improved in your area, how much more would you be willing to spend on water per month?

_____

74-75

8. How do you rate the quality of water in your area?

(a)	Very poor	1
(b)	Poor	2
(c)	Fair	3
(d)	Good	4
(e)	Very good	5

76

For office use only

9. What are the main problems of water quality?

(a)	Salinity	1	
(b)	Mud	2	
(c)	Pollution	3	
(d)	Colour	4	
(e)	Others: Specify _____	5	77

PART 3: WATER INFRASTRUCTURE, ACCESS AND CONDITIONS OF WATER INFRASTRUCTURE

1. What are the major water using appliances in your household?

	Water using appliances	Number of appliances		
(a)	Water tap		1	78
(b)	Shower		2	79
(c)	Washing machine		3	80
(d)	Flushing toilet		4	81
(e)	Washing basin		5	82
(f)	Bath tub		6	83
(g)	Water heater		7	84
(h)	Other		8	85

2. What is the household toilet arrangement in your household?

(a)	Outside	1	
(b)	Flush toilet	2	
(c)	Long drop (VIP)	3	
(d)	Shared community toilet	4	
(e)	Other	5	86

3. For personal hygiene, which of the following do household members use most frequently?

(a)	Shower	1	
(b)	Tub bathing	2	
(c)	Washing basin	3	
(d)	Other: Specify _____	4	87

For office use only

4. In a typical week, how often does your household do laundry?

(a)	Everyday	1
(b)	Every three days	2
(c)	Once a week	3
(d)	Others: Specify _____	4

88

5. Do you store water?

(a)	Yes	1
(b)	No	2

89

6. What types of water containers do you use to store water?

_____

90-91

7. Do you serve in any water management committee?

(a)	Yes	1
(b)	No	2

92

8. Have you ever noticed any public information program on water conservation?

(a)	Yes	1
(b)	No	2

93

8.1 If yes, please specify:

_____

94-95

Thank you very much for taking part in the survey. Have a good day.

DECLARATION

I, Anna Tuyenikelao Haufiku, declare that this thesis/ dissertation, which I hereby submit for the degree MSA: Sustainable Agriculture at the University of Free State, is my own work and has not been previously submitted by me for a degree at this or any other tertiary institution.

SIGNATURE **DATE**

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Last but not least, I would like to extend my gratitude to my family and friends for their encouragement and moral support.

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TABLE OF CONTENTS

PAGE

PAGE

LIST OF FIGURES

PAGE

LIST OF TABLES

ACRONYMS

BMC	Basin Management committees
IWRM	Integrated Water Resources Management
MAWF	Ministry of Agriculture, Water and Forestry
NsBMC	Niipele sub-basin management committee
WDM	Water Demand Management