DOMESTIC RAINWATER HARVESTING: Survey of Perceptions of Users in Kleinmond

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DOMESTIC RAINWATER HARVESTING: SURVEY OF PERCEPTIONS OF USERS IN KLEINMOND

Report
to the Water Research Commission

by

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This report emanates from the Water Research Commission project K5/2124, entitled: Point of use disinfections systems designed for domestic rainwater harvesting (DRWH) tanks for improved water quality in rural communities. Also available is *Quality of Harvested Rainwater and Application of Point of Use Treatment Systems* (**Report No. 2124/1/14**).

EXECUTIVE SUMMARY

A literature overview on domestic rainwater harvesting

Water scarcity due to severe drought in many regions of the world also represents a significant challenge to the availability of this resource. Domestic rainwater harvesting (DRWH), which involves the collection and storage of water from rooftops and diverse surfaces, is successfully implemented worldwide as a sustainable water supplement. The literature review on the social aspects of DRWH was done to assess the current state of the research field, as well as the strengths and weaknesses that exist within the published literature on the topic. Amongst numerous issues, topics such as the importance of DRWH, how it is applied in other countries, its limitations and disadvantages, how DRWH links in with the Millennium Development Goals (MDG), the perceptions of users on DRWH and the importance of community engagement were discussed in the literature review. While DRWH is a local intervention with primarily local benefits on ecosystems and human livelihoods, public participation is fundamental to the sustainability of DRWH projects such as the one in Kleinmond. With an insightful policy, DRWH can be promoted as a core adaptation strategy for achieving global security and access to water resources.

Domestic rainwater harvesting: Survey of perception of users in Kleinmond

The social research project was aimed at developing a better understanding of public perceptions, including the degree of acceptance of DRWH, and the way in which the harvested rainwater is utilised. More specifically, quantitative and qualitative data were collected in order to describe the following: (1) the condition of the tank; (2) the users' knowledge of the DRWH system, including its operation and maintenance; (3) whether the user would be willing to pay for repairs (if required); (4) perceived benefits and risks associated with DRWH; (5) level of satisfaction with DRWH; (6) and views on municipal water. In addition, demographic data on the respondents were gathered, *viz.* gender, age, highest level of education, household size and employment status, in order to provide a socio-economic background description of the study population. Ethical clearance (protocol number: HS850/2012) was obtained from Stellenbosch University's Research Ethics Committee: Human Research (Humanities) before fieldwork commenced. The face-to-face interviews (68 respondents) were guided by a semi-structured questionnaire (English/Afrikaans/Xhosa) and were conducted from 11–13 September 2012. The questionnaire was designed to gather primarily quantitative data, but included open-ended questions that delved deeper into the reasons for certain responses. The users in Kleinmond used the harvested rainwater for washing clothes, other cleaning activities and in a few cases for garden irrigation. This confirms the high level of acceptance of DRWH, as reported during the survey, among the community members of Kleinmond. Domestic rainwater harvesting offers numerous benefits, but unless the users' knowledge about these benefits and other aspects of DRWH

increases, its potential will not be fully realised. The success of DRWH depends on the interest, ownership and active support of the users.

National Conferences (Oral presentations)

1. DOBROWSKY PH, MANNEL D, PROZESKY H, DE KWAADSTENIET M, KHAN W and CLOETE, TE (2013) Microbial and chemical quality assessment and perception and primary uses of domestic harvested rainwater in Kleinmond, South Africa. 4TH Municipal Water Quality Conference, Sun City, South Africa, 7 – 10 July 2013.

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ACRONYMS & ABBREVIATIONS

CSIR	Council of Science and Industrial Research
DRWH	Domestic Rainwater Harvesting
DST	Department of Science and Technology
DWA	Department of Water Affairs
MDG	Millennium Development Goals
OM	Overstrand Municipality
RDP	Reconstruction and Development Programme
RWH	Rainwater Harvesting
SOPAC	South Pacific Applied Geoscience Commission

CHAPTER 1: BACKGROUND

1.1 INTRODUCTION

The Council for Scientific Industrial Research (CSIR), in collaboration with the Overstrand Municipality, the Department of Science and Technology (DST) and Eskom, rolled out a pilot project in Kleinmond, which involved the provision of 411 Breaking New Ground Houses (previously known as Reconstruction and Development Programme [RDP]) to households that formerly lived in informal dwellings. These 411 households moved into their new homes in October 2011. One of the additional features of these houses is that each was provided with a two thousand litre tank to harvest rainwater.

There are many cases where social development projects have failed due to the lack of understanding peoples' social behaviour (Lie, 2008; Parfitt, 2010). Social research is therefore important to understand what peoples' perceptions are regarding the water tanks and why certain individuals may sell the tank. Should the recipients of the tanks not accept the rainwater technology; the Government of South Africa can respond by exploring strategies to encourage the recipients to adopt Domestic Rainwater Harvesting (DRWH) as part of their lifestyle. Several sources of literature emphasise the importance of training to encourage the user's acceptance of DRWH (Raghavan, 2004; Mwenge Kahinda et al., 2007; He et al., 2007). Without acceptance and necessary training to maintain and use the tank, it is quite possible that projects such as the one in Kleinmond will not be sustainable.

This document reviews literature on DRWH, in order to assess the current state of the research field, as well as strengths and weaknesses that exist within the published literature on the topic. A questionnaire survey will be conducted in Kleinmond to describe and explain the perceptions of the recipients of the DRWH tanks.

1.2 A BRIEF HISTORY OF RAINWATER HARVESTING

The collecting and storing of rainwater in buckets, tanks, ponds and wells is commonly referred to as rainwater harvesting (RWH). Harvested rainwater can be used for multiple purposes, ranging from irrigating crops to washing, cooking and drinking (Ademun, 2009). Rainwater harvesting is an old technology that is gaining popularity in a new way. The history of RWH can be traced back to biblical times, as "extensive rainwater harvesting apparatus existed 4000 years ago in the Palestine and Greece" (Tamilnadu State Government, 2011). In ancient Rome, residences were built with individual cisterns and paved courtyards to capture rainwater to augment water from the city's aqueducts. As early as the third millennium BC, farming communities in Balochistan in Pakistan, and Kutch in India,

impounded rainwater and used it for irrigation dams (Tamilnadu State Government, 2011). In South Asia, RWH has a history of continuous practice for at least the last 8000 years (Pandey et al., 2003). One of the biggest challenges of the 21st century is to overcome a growing water shortage. Rainwater harvesting has thus regained its importance as a valuable alternative, or at least supplementary, water resource, along with more conventional water supply technologies (Worm and Van Hattum, 2006).

There are three major forms of RWH collection systems. One form is the in situ RWH which refers to precipitation of rainfall to the earths' surface, where after it is stored in the soil (Helmreich and Horn, 2009). The next form is external water harvesting which involves collecting runoff originating from rainfall over a surface and storing it off-site. In other words, overland flow or runoff is harvested from catchments of areas ranging from 0.1 to thousands of hectares (African Development Bank, 2002). It gets diverted from farmlands, hillsides, pastures, homes or even roads and the water is then stored in soil, ponds, tanks or groundwater aquifers (African Development Bank, 2002). The third form of RWH that will be discussed in detail in this document is domestic RWH (DRHW) which refers to water being collected from roofs, streets and courtyard runoffs (Helmreich and Horn, 2009).

1.3 WHAT IS DOMESTIC RAINWATER HARVESTING?

The most basic form of DRWH is when rainwater is collected in simple vessels at the edge of a roof. Variations on this basic approach include collection of rainwater in gutters which drain to the collection vessel through downpipes constructed for this purpose, and/or the diversion of rainwater from gutters to containers, before being conveyed to a storage container for domestic use (Gould, 1992). As the rooftop is the main catchment area, the amount and quality of rainwater collected depends on the area and type of roofing material (Gould, 1992).

In some cases, the tank is designed in order for the collected rainwater to pass through a simple filter to remove debris and to make it safer to drink. One could also harvest rainwater by using natural or artificial ponds and reservoirs (Helmreich and Horn, 2009). Harvested rainwater is usually collected in tanks which can be built underground or above ground. It can be used by households for the purposes of drinking (if it is properly treated), cooking and sanitation, as well as for small-scale productive use in agricultural activities (Helmreich and Horn, 2009).

Domestic rainwater harvesting is used in many countries throughout the world. In many areas, DRWH has now been introduced as part of an integrated water supply, where a town's water supply is unreliable, or where local water sources dry up for part of the year (Worm and Van Hattum, 2006). The technology is flexible and adaptable to a wide variety of conditions. It is used in the richest and poorest societies, as well as in the wettest and driest regions on our planet (Worm and Van Hattum, 2006).

1.4 WHY IS DOMESTIC RAINWATER OF MORE IMPORTANCE TODAY THAN BEFORE?

Millions of people throughout the world do not have access to clean water for domestic purposes. Two-and-a-half billion people have inadequate access to water for sanitation and waste disposal, while approximately 884 million people have inadequate access to safe drinking water (African Development Bank, 2002). Currently, groundwater is being used excessively, leading to diminished agricultural yields (Pandey et al., 2003). Regional conflicts over scarce water resources sometimes result in warfare, and due to the overuse and pollution of water resources, biodiversity is suffering (Pandey et al., 2003). Waterborne diseases as a result of the absence of sanitary domestic water are some of the leading causes of death worldwide. In addition, extreme climate events are being registered at a growing rate, while the world population continues to grow and will place additional stress on natural resources (Pandey et al., 2003). Under all of these circumstances, harvesting of rain is becoming crucial.

It is estimated that each year in sub-Saharan Africa, 200-500 million m^3 of rainfall is lost in the form of runoff, which could potentially irrigate substantial areas (African Development Bank, 2002). Even in locations with less serious water shortages, demand for additional water is dominant. The fact that RWH in general is widely under-utilised provides a further reason to focus and expand RWH in a more structured manner (African Development Bank, 2002). The overall objective of and reason for utilising concepts and techniques of RWH is to optimise the use of the available rainfall in any given location (African Development Bank, 2002).

1.5 APPLICATIONS OF DOMESTIC RAINWATER HARVESTING

1.5.1 China

China's local Government and research institutes carried out systematic experiments in 1993 in the country's Loess Plateau, by setting up numerous water catchments and irrigation projects (He et al., 2007). Results obtained from these experiments indicated that RWH was easy to establish and operate by individual farmers (He et al., 2007). These studies also provided the information needed to initiate extension programmes to teach farmers how to operate the RWH systems. However, in recent years, adoption rates have been far lower than predicted, because of a combination of ecological and socio-economic constraints that exist in the region (He et al., 2007).

It is important to take note of China's experience in this regard, because the country instituted extended teaching programmes to render DRWH sustainable in the long run. The Kleinmond recipients of the DRWH tanks are socio-economically disadvantaged, as many of them have very little or no education, the average income per household is R38 400 per annum, and there is a high

unemployment rate among the youth (Overstrand, 2012). If the Government of South Africa wants to render this pilot project a success, and sustainable, the recipients in Kleinmond have to receive training on DRWH. Such training should include the reasons why DRWH is important, the use of the water, and maintenance and operation of the tank.

1.5.2 Bangladesh

A large body of literature refers to gender roles and how women and young female children are not attending school, nor have the time to contribute towards the economy (Mwenge Kahinda et al., 2007; Moore and Mclean, 2008; Ademun, 2009). As women can potentially play a strong role in the agricultural process and in other forms of economic activity, this lost labour capacity must be factored into household economics when assessing the value of DRWH. Another factor for consideration is the loss in educational opportunities for young girls who carry water rather than attend school (Moore and Mclean, 2008).

This situation in Bangladesh relates to the South African context, where everyday people die (as in Bangladesh) from preventable waterborne diseases. As in Bangladesh, the women and young girls, especially in rural parts of South Africa, are often the ones in the household who are responsible for the collection of water. The result is loss of educational opportunities due to daily collection of water (Moore and Mclean, 2008). The research conducted in Bangladesh in addition highlights the need to be gender sensitive when conducting research on DRWH in South Africa (Moore and Mclean, 2008), as women and men differ in the way that they use water and in the way in which they are involved in water management. For example, it is mainly women and girls who use water for domestic purposes, while men and boys may compete for water from the same sources for farming and livestock (SOPAC, 2004).

1.5.3 India

Town planners and civic authorities in many cities in India are introducing by-laws that are rendering rainwater harvesting compulsory in all new structures. No water or sewage connection would be delivered if a new building did not have provisions for RWH (Tamilnadu State Government, 2011). Such legislation should also be implemented in all the other cities, to ensure a rise in the groundwater level. This information on RWH in India is important, as South Africa's water laws and policies stipulate that municipal water supplies should be utilised as the preferred, primary water source (Water Services Act, 1997).

1.5.4 Pacific Island Countries

In general, DRWH is considered one of the most appropriate solutions to improving potable water supplies in the Pacific. Rainwater catchment construction projects in rural areas have been the focus

of many aid projects in this region (SOPAC, 2004). These projects have been “implemented with funding from a large number of international and bilateral donors, NGOs and Community-Based Organisations” (SOPAC, 2004). Many involve the construction of ferrocement tanks which can be implemented in community-based construction schemes. In some island countries (e.g., the Cook Islands, Tuvalu, and the Maldives), plastic tanks are now becoming more popular than the previously used ferrocement or fibreglass tanks, because of the ease of installation, improved availability and pricing of plastic tanks (SOPAC, 2004). Various guidelines have been written, often in the local language, to assist in the training of persons to carry out construction work (SOPAC, 2004). A review of the literature on DRWH in the Pacific Islands is useful to the South African study, because it shows that DRWH is applied by, and possibly due to, aid projects (SOPAC, 2004). This is, however, not the case with Kleinmond, since the pilot project is mainly supported by the South African Government. South Africans are therefore privileged, in that the Government is making an effort to manage the country’s water resources more sufficiently, while improving the beneficiaries’ lives, by providing additional water to their households through DRWH systems. The initiative to promote DRWH is stronger if it is supported and driven by Government than by international and/or external organisations. It is possible that the perceptions and acceptance of DRWH tanks of the recipients may be influenced by the provider.

Four lessons are derived from the review of the literature on DRWH in Pacific Island countries: DRWH systems have a long history in the Pacific; DRWH is an appropriate technology for domestic water use (SOPAC, 2004); DRWH can be used as a primary water source as well as a secondary water source, and can reduce pressures on existing water resources (SOPAC, 2004); and participatory approaches aimed at engaging the community in all aspects of DRWH, should be encouraged (SOPAC, 2004).

1.5.5 Africa

Interest in DRWH is on the increase in many countries in eastern and southern Africa. National DRWH associations have also been formed in these regions. One of the first was the Kenya Rainwater Association, founded in 1995 (ERB, 1998). Three national associations were formed in 1998 alone, in Ethiopia, Uganda and Zimbabwe, respectively (ERB, 1998). The associations are usually initiated at national rainwater workshops, and they view their tasks to be mainly information dissemination, lobbying and networking. There are many networking organisations, research projects and other initiatives on the African continent which promote knowledge on DRWH and its implementation, for example, New Partnership for Africa’s Development, Southern African Network of Water Centres of Excellence (NEPAD, SANWATCE) and Waternet (Nepadwatercoe, 2012; Waternetonline, 2012). In West Africa, women groups and women departments of NGOs are much more interested in DRWH than are other general development departments of NGOs (where men are usually well represented) (ERB, 1998).

Many NGOs and donor organisations are in favour of DRWH and either specifically mention it as an "alternative water source", or imply it under "appropriate technologies" (ERB, 1998). Nongovernmental organisations in West Africa are starting to realise the potential of DRWH; however, some local cultural and socio-economic obstacles seem to exist (ERB, 1998). For example, rainwater is used in pagan cultures and is viewed as witchcraft, because it is used in spells and rituals, which leads to some people not wanting to utilise rainwater technology (ERB, 1998). In addition, socio-economically there is some cost involved in maintaining the tanks, which is not always a priority for households (ERB, 1998).

Several studies have been carried out with an aim of determining the potential of RWH to improve land productivity. Mugerwa's (2007) study investigated the potential of RWH for supplementary irrigation of cereal crops to overcome intra-seasonal dry-spells in the Sahel Region, which includes the countries of Senegal, southern Mauritania, Mali, Burkina Faso, southern Algeria, Niger, northern Nigeria, Chad, northern Cameroon, Sudan (including Darfur and the southern part of Sudan), and Eritrea (Fox and Rockström, 2000).

The study conducted by Fox and Rockström (2000) demonstrated that supplemental irrigation and RWH during dry-spells increased sorghum harvests by 41%. This quantitative evidence and farmers' opinions show that implementation of water conservation in the Central Plateau, Burkina Faso, has rehabilitated degraded land and increased cereal (i.e. sorghum and millet) yields, thus improving food security and household wealth (Mugerwa, 2007).

Botha et al. (2004) evaluated the agronomic sustainability of an infield-RWH technique in South Africa. It was concluded that this technique contributed to higher crop yields than normal conventional tillage, because it stops runoff and minimises soil evaporation losses. Soil evaporation implies a significant loss or depletion from the water balance. If the water table is very shallow (less than a meter), water will be continually supplied from the water table upward to the soil surface (Stormont and Coonrod, 2004). Soil evaporation is therefore controlled largely by climatic conditions at the soil surface (Stormont and Coonrod, 2004).

In addition to improving agricultural productivity, RWH in Africa is associated with other environmental and social benefits. Ngigi et al. (2003) reported that the construction of communal water pans to store water helps to reduce conflict over water resources among different clans in north-eastern Kenya. In addition, investment in the construction of water storage facilities has greatly improved crop and livestock production, leading to a higher standard of living in the area (Mugerwa, 2007).

1.6 LIMITATIONS AND DISADVANTAGES OF DRWH

Disadvantages of rainwater harvesting technologies are mainly due to the limited supply and uncertainty of rainfall (Table 1.1). Capital costs of DRWH are high, but neither operation nor

maintenance usually involves significant expenditure (Helmreich and Horn, 2009). The investment costs depend on the size of the tank, the material for the tank and whether a tank has to be built underground or above ground (Helmreich and Horn, 2009). In some cases there is a lack of acceptance, motivation and involvement among users (Helmreich and Horn, 2009). Additionally, insufficient attention is often devoted to social and economic aspects, such as land tenure and unemployment. Often people's knowledge of DRWH is inadequate and outdated, or DRWH is too expensive, which prevents capitalising on the benefits of rainwater resources. According to Mwenge Kahinda et al. (2007), DRWH is in fact illegal if water legislation is strictly applied. Therefore, more developmental work in terms of Government strategies and policies has to be done to address this matter. From an ecological perspective, it needs to be taken into account that RWH affects landscape water flows, and subsequently landscape ecosystem services.

1.7 ADVANTAGES OF DOMESTIC RAINWATER HARVESTING

Rainwater harvesting technologies are simple to install and operate. Local people can easily be trained to implement such technologies, and construction materials are also readily available (Ademun, 2009). Rainwater harvesting is convenient in the sense that it provides water at the point of consumption, and family members have full control of their own systems, which greatly reduces operation and maintenance problems (Ademun, 2009). Water collected from roof catchments is usually of acceptable quality for domestic purposes (Ademun, 2009). Although regional or other local factors may modify the local climatic conditions, rainwater can be a continuous source of water supply for both those in rural and urban areas. Depending upon household capacity and needs, both the water collection and storage capacity may be increased as needed within the available catchment area. Domestic rainwater harvesting is also advantageous because it reduces soil erosion, conserves surface water runoff during e.g. a monsoon, improves the groundwater table, is environmentally friendly, reduces flooding of roads and low-lying areas, is less expensive than buying water on a regular or daily bases, is easy to construct, operate and maintain, reduces the cost of pumping groundwater and rainwater, and is of a high quality, as it is soft and low in minerals (SOPAC, 2004; Ademun, 2009) (Table 1.1). In addition, DRWH inculcates a culture of water conservation (ERB, 1998).

Households in Uganda expressed a number of benefits that they expected from DRWH, i.e. that it saves the burden of carrying water on foot for long distances, improves the quality and quantity of water at the doorstep, helps to reduce risk of accidents, assaults and abuse, and the money used for buying water can be diverted to other needs (Ademun, 2009). Furthermore, DRWH serves as a solution to the problem of water shortage provides the possibility of additional water for household use, time spent on fetching water is saved, and it improves overall quality of life (Ademun, 2009).

Domestic rainwater harvesting has superior qualities of being small-scale, simple to operate, highly adaptable, low cost and it is ideally suited to the socio-economic and biophysical conditions of any

area (He et al., 2007). “In most applications, one could meet over 50 per cent of household water demands with rainwater harvesting” (EBR, 1998). That is significant when one considers municipalities’ growing concerns about finding ways to supply water to their growing populations.

Mugerwa (2007) reported that successful adoption of RWH leads to higher agricultural productivity and household income, soil erosion control, revival of wetlands and improvement in pasture quality. In West Africa, the improvement of general living conditions through RWH was appreciated (EBR, 1998) as many people saw RWH as an ideal supplement to the public (and unreliable) water supply.

Rainwater harvesting has in many cases not only increased human well-being and ecosystem services, but also indirectly improves equality, especially in terms of gender, and strengthens social capital in a community. In many instances women have benefitted from having water for a small kitchen garden, thus improving diets and incomes (SEI-UNEP, 2009). These are important benefits which can further help individuals and communities to improve both ecosystem management as well as human well-being (SEI-UNEP, 2009). It is therefore advisable to consider rainfall as an important manageable resource in water management policies, strategies and plans (SEI-UNEP, 2009).

Table 1-1: Advantages and disadvantages for domestic water supply. Adopted from Harvesting the Heavens: Guidelines for rainwater harvesting in Pacific Islands. Compiled by the South Pacific Applied Geoscience Commission (SOPAC) for the United Nations Environment Programme (UNEP), p23. And adapted from (Practical Action Technical Brief, 2002).

ADVANTAGES OF DRWH	DISADVANTAGES OF DRWH
1. Convenience Provides a supply at the point of consumption.	**1. Expensive** When compared with alternative water sources, where these are available, the cost per litre of rainwater is frequently higher.
2. Good maintenance The operation and maintenance of household catchment systems are under sole control of the tank owner’s family.	**2. Supply is limited** Both by the amount of rainfall and size of the catchment area.
3. Low running costs These are almost negligible.	**3. High initial costs** The main cost of rainwater catchment systems is almost exclusively incurred during the initial construction, when a considerable capital outlay is required.
4. Relatively good water quality Better than traditional sources, especially for roof catchment	**4. Unattractive to policy makers** Rainwater projects are invariably far more cumbersome to administer than single large projects, e.g. a dam.
5. Low environment impact Rainwater is a renewable resource and through the introduction of DRWH no damage is done either to the environment or to future supplies.	**5. Supply is susceptible to droughts** Occurrence of long dry spells and droughts will adversely affect the performance of RWH systems, while insects, dirt and organic matter can also be a problem.

6. Ubiquitous supply Rainwater collection is always a water-supply alternative wherever rain falls.	**6. Water-quality vulnerable** The quality of rainwater may be affected by air pollution in the vicinity of certain industries. Contamination from animal or bird matter.
7. Simple construction The construction of rainwater catchment systems is simple and local people can easily be trained to build these by themselves; this reduces costs and encourages community participation.	
8. Flexible technology Systems can be built to almost any requirement. Poor households can start with a single, small tank and add more when they can afford it.	

1.8 QUALITY OF HARVESTED RAINWATER

Pure rainwater is mostly low in pollutants, depending on the quality of the atmosphere. Atmospheric pollutants including particles, microorganisms, heavy metals and organic substances, which accumulate on catchment areas as dry deposition, are washed out from the atmosphere during rainfall events (Helmreich and Horn, 2009). Rainwater in rural areas, being situated far from atmospheric and industrial pollution, is fairly clean, except for some dissolved gases (Helmreich and Horn, 2009). On the other hand, urban areas are characterised by high traffic volumes and industry impacts, and are therefore contaminated by particles, heavy metals and organic air pollutants (Helmreich and Horn, 2009). In addition, the catchment surfaces themselves may be a source of heavy metals and organic substances (Helmreich and Horn, 2009).

Similarly, zinc and copper roofs, or roofs with metallic paint or other coatings, are not recommended because of high heavy metal concentrations (Helmreich and Horn, 2009). Bacteria, viruses and protozoa may originate from faecal pollution by birds, mammals and reptiles that have access to catchments and rainwater storage tanks (Helmreich and Horn, 2009). Therefore, harvested rainwater that has not been treated is often unsuitable for drinking. Disinfection should therefore be applied to improve the microbiological quality of the harvested rainwater (Helmreich and Horn, 2009). Contaminants found in rainwater collection systems are presented in Table 1.2. The necessary maintenance and repair tasks for a given DRWH project are often much more obvious to designers and promoters than to the users. It is therefore essential to include education and training in operation and maintenance as part of any DRWH project. Table 1.2 was extracted from Harvesting the Heavens: Guidelines for rainwater harvesting in Pacific Islands. Compiled by the South Pacific Applied Geoscience Commission (SOPAC) for the United Nations Environment Programme (UNEP), p78.

Table 1-2: Contaminants found in rainwater collection

Contaminant	Source	Risk of entering the water
Dust and ash	Surrounding dirt and vegetation, volcanic activity	*Moderate*: Can be minimised by regular roof and gutter maintenance and use of a first-flush device.
Pathogenic bacteria	Bird and other animal faecal matter on roof, attached to dust	*Moderate*: Bacteria may be attached to dust or in animal faecal matter falling on the roof. Can be minimised by use of a first-flush device and good roof and tank maintenance.
Heavy metals dust	Particularly in urban and industrialised areas, as well as roof materials	*Low*: Unless downwind of industrial activity, such as a metal smelter, and/or rainfall is very acidic (this may occur in volcanic islands)
Other inorganic contaminants (e.g. salt from sea-spray)	Sea-spray, certain industrial discharges to air, use of unsuitable tank and/or roof materials	*Low*: Unless very close to the ocean or downwind of large-scale industrial activity
Mosquito larvae	Mosquitoes laying eggs in guttering and/or tank	*Moderate*: If tank inlet is screened and there are no gaps, risks can be minimised.

1.9 DOMESTIC RAINWATER HARVESTING AND THE MILLENNIUM DEVELOPMENT GOALS

One of the Millennium Development Goals (MDGs) is to halve the proportion of people without access to safe drinking water and sanitation by 2015 (SEI-UNEP, 2009). The provision of safe drinking water is currently a high priority for South Africa, one of the signatories of the MDG. Table 1.3 was extracted from the SEI-UNEP-publication called “Rainwater harvesting: A lifeline for human wellbeing”.

Table 1-3: Linking DRWH to Millennium Development Goals

Millennium Development Goal	Relevance of RWH intervention
1. End poverty and hunger	Primary: restoring and enhancing ecosystems’ productivity of food and other biomass produce
2. Universal education	Secondary
3. Gender equality	Primary: improving women’s health, time saving and income generating
4. Child health	Primary: improving health and sanitation
5. Maternal health	Secondary
6. Combat HIV/ AIDS	Secondary
7. Environmental sustainability	Primary: improving ecosystems services in landscape, enhance provision of water supply and sanitation conditions
8. Global partnership	Secondary

1.10 SOUTH AFRICAN WATER LEGISLATION RELATING TO DOMESTIC RAINWATER HARVESTING

The water legislation of South Africa is considered relevant for this study in Kleinmond, because South Africa has tried to incorporate present knowledge of water resources and their sustainable use into new legislation of 1997/1998. A review by Mwenge Kahinda et al. (2007) of the National Water Act (Act No. 36 of 1998) and the Water Services Act (Act No. 108 of 1997) indicates that current water legislation does not provide a clear legal framework for the adoption of DRWH, and if the law were strictly applied, the usage of DRWH would be illegal. If under the National Water Act, Section 22 (1) (c), DRWH is a permissible water use which does not require a license (Schedule 1), the Water Services Act, Section 6 (1) states that it will require an authorisation from the water services authority (Mwenge Kahinda et al., 2007). Users of rainwater can therefore come into conflict with the Water Services Act, if there is a nominated water services provider in the area. Clarification of this possible conflict will be sought, together with the new initiative of RWH in South Africa (ERB, 1998). “There is a need of a clear policy that will provide a framework which will enable the sustainable use and up scaling of DRWH” (Mwenge Kahinda et al, 2007). It is important that National Water Policies should recognise rainwater as a source of water for development and management (African Development Bank, 2002).

Water legislations should reflect the country policies for water resources development and should not contradict each other. Rights to develop ‘private water’ should be established (African Development Bank, 2002). The legislation is contradicting because RWH is illegal but at the same time Government supports the practice of RWH techniques. Development of National Water Resources policies under sector reforms should be consistent with other existing policies and repeal any objectionable clauses for development of DRWH (African Development Bank, 2002).

1.11 PERCEPTIONS OF THE USERS OF DOMESTICALLY HARVESTED RAINWATER

A further consideration with regard to RWH schemes, in addition to any national policies on DRWH, is the attitude of the potential users. A global survey of attitudes was commissioned by Warwick University, UK, to supply information to bodies involved in supplying aid for water supplies (ERB, 1998). These include the World Bank, UNICEF, Christian Aid, Oxfam and Aid America. The survey found that the greatest levels of interest was among females (ERB, 1998) and this could be as the task of carrying water home from remote sources usually falls to women. The survey also found a problem in some arid areas of the harvesting (particularly what was regarded as 'making' water) of rainwater being viewed as pagan practice, and was thus unacceptable (ERB, 1998). General conceptions are that rainwater is pure, a situation that may not prove to be true in polluted atmospheres (ERB, 1998). Attitudes to rainwater differ across the globe and a survey of acceptability of rainwater for drinking ranged from 94% in Uganda to 35% in Ethiopia (Ngigi, 2003).

Ngigi (2003) evaluated six RWH case studies selected from Ethiopia, Kenya, Uganda and Tanzania. He reported that despite the success of RWH systems, their impacts remain little owing to low levels of adoption. The report, however, does not provide reasons as to why the rate of adoption of on-farm RWH was low among farmers. Ngigi (2003) carried out an agro-hydrological evaluation of on-farm rainwater storage for supplemental irrigation in Laikipia District, Kenya. He reported that water losses through seepage and evaporation, may be partly responsible for low levels of adoption of water storage systems (Ngigi, 2003). Due to lack of labour, water distribution problems, risk of injury to humans and livestock as a result of using some RWH measures, can hinder adoption of the technology (Mugerwa, 2007). However, there appears to be no significant cultural problem regarding the acceptance of rainwater for drinking (Ngigi, 2003).

South Africa offers a special setting in which to examine public perceptions, awareness and behaviours. First is the historical context in which the reshaping of the South African political, economic and social systems is being carried out. South Africa can be viewed as a country containing two parallel societies (Anderson et al., 2007). One is comprised mostly of the African population which continues to live under circumstances comparable to those found in the developing world. The other, which includes the white population and many from the other race groups such as Indians and coloured population), enjoys economic and social amenities equal to those found in the developed world. Redressing these disparities that result from over 300 years of history requires substantial improvements not only in the economic status of those who are historically disadvantaged, but also in their social and political wellbeing (Anderson et al., 2007).

With the transition in 1994 the African population acquired, for the first time in over 300 years, responsibility for setting the agenda by which its hopes for this new society could become a reality (Anderson et al., 2007). Central to these expectations is the equal and equitable distribution of those services necessary for the well-being of all citizens. Key among these is access to safe drinking water and sanitation (Anderson et al., 2007).

Substantial efforts have been made since then to increase the availability of potable water supplies and basic sanitation services. By 2005, some 10 million households had access to safe water compared to less than 7.3 million with access to safe water in 1996 (Statistics South Africa, 2004). In 2005 basic sanitation services were available to 67% of the population in contrast to less than 50% of the population that had access to basic sanitation services in 1994 (DWAF, 2000). None of this is to argue that what is happening in South Africa is unique. Rather it is to observe that these aspects of the South African situation provide a special context in which to examine attitudes, awareness and behaviours regarding environmental issues and perceptions on DRWH (Anderson et al., 2007). Such information is a critical element in the identification and development of programs. How perceptions concerning environmental issues are formed, the relationship of these perceptions to behaviours to alleviate environmental problems and the relative influence that specific circumstances, social status and other factors have in the development of these perceptions (Anderson et al., 2007). There has,

however, been fairly little research explicitly about how the social-economic disadvantage user's perception and acceptance are towards DRWH (Anderson et al., 2007).

This brief review of the literature suggests a number of factors affecting perceptions of DRWH. In addition socioeconomic status and satisfaction with the neighbourhood in which one lives are alternatively seen as inhibiting or promoting recognition of environmental problems (Anderson et al., 2007).

Another question is whether urban and rural Africans differ regarding the perception of DRWH. Other studies have suggested that the educational background of the respondent is an important factor in forming perceptions of the presence or absence of environmental contamination, with those having a higher level of educational attainment more likely to be aware of environmental problems (White and Hunter, 2005). Water-related behaviours include the treatment of drinking water and water for food preparation. It is important to determine how important perception of water pollution as a problem is in influencing whether households treat their water (White and Hunter, 2005).

It should be noted however, that the major problem with involving communities in projects is that it can take a long time for a community to make the necessary commitments and decisions and that time does not normally tie in with budgeting and planning constraints of supporting agencies (SOPAC, 2004). Project plans commonly refer to community participation but very often the overall form of the project has already been decided by the time consultation with the community occurs and therefore consultation and participation will only have limited effect. Projects should therefore be implemented over a much longer time-span to allow participatory approaches to take effect and create full ownership by communities (SOPAC, 2004).

Based on a survey of 218 farmers in the semi-arid areas of Loess Plateau in China in 2005 results indicate that several variables are significant in explaining farmers' adoption decisions (He et al., 2007). Farmers' educational background, active labour force size, and positive attitudes towards RWH are some of the variables that have significantly positive effects on the adoption of RWH. The probability of adoption also increases with increased targeting of institutional variables: credit obtained, assistance obtained, and technical training received (He et al., 2007). Variables such as family size, off-farm activity, level of family income, risk preference, and land tenure do not significantly influence adoption (He et al., 2007). This information will help prioritise the factors that affect adoption decisions and provide insight on pathways to increase the adoption.

1.11.1 Farmers' perception

As hypothesised, the likelihood of a farmer who has a positive attitude towards adopting RWH is 8 times higher than of a farmer who has a negative attitude towards utilising RWH (He et al., 2007).

1.11.2 Community Engagement

Engaging communities and fostering a sense of ownership is vital in development projects, especially in developing countries and poorer areas. This is done through utilising participatory research techniques to involve community members in identifying problems and creating solutions. Participatory research has two main goals: to “uncover or produce information and knowledge that will be directly useful to a group of people” and to “enlighten and empower the average person in the group, motivating each other to take up and use the information gathered in the research” (Ward, 2007).

Community participation and involvement can also influence Government agencies and the policy making process. Participatory development can “reduce information problems for development planners and beneficiaries, increase the resources available to poor people, and strengthen the capacity for collective action among poor and other marginalised societal groups” (Ward, 2007). This is beneficial for both communities and agencies since greater participation can determine policy deficiencies and shortcomings quickly and allow for greater influence on possible solutions (Ward, 2007). Addressing people’s needs requires involving them in the process of project preparation, decision-making, choice, implementation, monitoring and evaluation. This is a pre-requisite to sustainability, replicability and proper management of a project.

1.12 RECOMMENDATIONS

Education and Awareness on DRWH should be taken as priority for all water professionals (African Development Bank, 2002; He et al., 2007). Household water supply through multiple water sources should be encouraged (African Development Bank, 2002). To build capacity for large-scale RWH in South Africa, one needs to “determine what the appropriate technologies are, what policies, regulations and building codes are required and what needs to be done to make it economically viable and publicly accepted “ (ERB, 1998).

Table 1.4. outlines the desirable pre-conditions for RWH projects and briefly explains in the left column of the Table the technical feasibility, social and economic feasibility and environment and health feasibility. In the right column of Table 1.4, DRWH supports institutional arrangements and traditional practices of RWH. Table 1.4 is adopted from Harvesting the Heavens: Guidelines for RWH in Pacific Islands. Compiled by the South Pacific Applied Geoscience Commission (SOPAC) for the United Nations Environment Programme (UNEP).

Table 1.4. Checklist for assessing appropriateness and viability of RWH systems

Technical feasibility • Rainfall and catchment area must be sufficient to meet demand • Design should be appropriate • Skills or training potential must be available locally	**Alternatives considered** • All reasonable alternative means of water provision should be investigated • Consideration should be given to using more than one alternative in combination
Social and economic feasibility • A real felt need in the community for better water provision • Designs should be affordable and cost-effective • The community should be enthusiastic and fully involved • Existence of social cohesion (not conflict) essential	**Institutional arrangements** • The community should have the institutional capacity to manage the development and operation of the system • Local human resources should be available to ensure the institutions continue to function effectively once any external agency assistance is withdrawn
Environmental feasibility and health • The project should have an acceptable level of environmental impact • The project should be designed to enhance the environment The project should improve both the quantity and quality of water available and should have a positive impact on the health of the community	**Traditional and current practices** • Consideration should be given to traditional RWH practices • Existing approaches to rainwater utilisation and possible upgrading should be investigated

1.13 SUMMARY

Rainwater harvesting has been applied as an alternative water resource for thousands of years. Over the years rising populations, growing industrialisation, and expanding agriculture have pushed up the demand for water. Efforts have been made to collect water by building dams and reservoirs and digging wells; some countries have also tried to recycle and desalinate (remove salts) water. Water conservation has become the need of the day and DRWH seems to be a beneficial method for minimizing water scarcity in developing countries.

The feasibility of RWH in a particular locality is highly dependent upon the amount and intensity of rainfall. Accounts of serious illness linked to rainwater supplies are few, suggesting that RWH technologies are effective sources of water supply for many household purposes. Rainwater

harvested for domestic use may be polluted by bacteria and hazardous substances therefor treatment of the water is a pre-requisite should one choose to use it for drinking water and water to prepare food.

Increasing interest and formation of national rainwater associations in East and Southern Africa and NGOs in West Africa is starting to realise the potential of RWH (ERB, 1998). Potentials of RWH are seen in areas that cannot be served by standard technologies such as groundwater and hand-pumps or have contaminated/unusable groundwater.

The Water legislation in South Africa specifically mentions rainwater as a permissible source of water, and to use water only from an authorised service provider (Water Service Act, 1997). Water legislations should reflect the country policies for water resources development and should not contradict each other.

Rainwater harvesting is a local intervention with primarily local benefits on ecosystems and human livelihoods. Public participation is fundamental to the sustainability of DRWH projects such as the one in Kleinmond. We should consider rainfall as an important manageable resource in water management policies, strategies and plans. Domestic RWH is an alternative solution and one that makes a lot of sense. With an insightful policy, DRWH can be promoted as a core adaptation strategy for achieving global security, the MDGs and sustainability of water resources.

CHAPTER 2: DOMESTIC RAINWATER HARVESTING: SURVEY OF PERCEPTIONS OF USERS IN KLEINMOND

2.1 INTRODUCTION

The Council for Scientific Industrial Research (CSIR), in collaboration with the Overstrand Municipality (OM), the Department of Science and Technology and Eskom, rolled out a pilot project in Kleinmond, which involved the provision of 411 Breaking New Ground Houses (previously known as Reconstruction and Development Programme) to households that formerly resided in informal dwellings. These 411 households occupied their new homes in October 2011. One of the additional features of these houses is the provision of a 2 000 litre Domestic Rainwater Harvesting (DRWH) tank (CSIR, 2010).

The research team that conducted the study at Kleinmond consists of seven researchers, all affiliated with Stellenbosch University. Five are affiliated with the Microbiology Department, while one researcher who is employed at the Water Institute (henceforth referred to as "the researcher") conducted the social research in collaboration with a senior lecturer from the Department of Sociology and Anthropology. The microbiology researchers investigated the microbial and chemical quality of the harvested rainwater to ascertain its suitability for certain domestic purposes, while the social research focused on public perceptions, including acceptance, of domestic rainwater harvesting (DRWH), and the way in which the harvested rainwater is utilised. The microbiology research team collected samples from specific DRWH tanks over a period of six months (March–August 2012). The people living at the houses, from which these water samples were collected, as well as an additional 39 households, were interviewed for the current study.

There are many examples of social development projects that have failed due to a lack of understanding of people's social behaviour (Lie, 2008; Parfitt, 2010). This survey of DRWH users in Kleinmond was therefore aimed at gaining insight into people's perceptions and uses of DRWH. Should the recipients of the water tanks not accept the DRWH technology, for example, the Government of South Africa can respond by exploring strategies to encourage the recipients to adopt DRWH as part of their lifestyle.

2.2 RESEARCH PROBLEM AND OBJECTIVES

Domestic rainwater harvesting is a technology and a method aimed at mitigating the scarcity of water and to support social development. This technology can only be implemented when people are willing to use it. This social research project was therefore aimed at developing a better understanding of public perceptions, including degree of acceptance of DRWH, and the way in which the harvested

rainwater is put to use. More specifically, quantitative and qualitative data were collected in order to describe the following: (1) the condition of the tank; (2) the users' knowledge of the DRWH system, including its operation and maintenance; (3) whether the user would be willing to pay for repairs should the tank break; (4) perceived benefits and risks associated with DRWH; (5) level of satisfaction with DRWH; (6) views on municipal water; and (7) the purposes for which the rainwater is utilised. In addition, demographic data on the respondents were gathered, *viz.* gender, age, highest level of education, household size and employment status, in order to provide a socio-economic background description of the study population.

2.3 FIELD SITE

Kleinmond is a small coastal town in the Overberg region of the Western Cape Province in South Africa. The site where the study was conducted is a newly developed residential area in Kleinmond, consisting of 411 houses in total, which are clustered into 3 areas (Figure 2.1). The first, indicated by the black circle on the left, consists of 25 houses; the second black circle comprises of 32 houses; and the largest cluster, which is circled in red, contains 354 houses. The study was conducted in the largest cluster, where 68 interviews were carried out, covering approximately a fifth of the houses (Figure 2.2 and Figure 2.3).

Figure 2-1: Aerial view of the Kleinmond region, Western Cape. The locations of the Breaking New Ground Houses are indicated by the circles, with the red circle indicating the area included in the current investigation.

Figure 2-2: A street view of the houses in the Kleinmond area investigated.

Figure 2-3: The water tanks are situated either in front or at the back of the house.

2.4 METHODOLOGY

2.4.1 Preparing for the Field

The local municipality in Kleinmond was approached to assist the researcher in gaining access to the community. Prior to data collection, the community was visited in order to gain familiarity with the area and to build a rapport with the municipal staff. Some qualitative data was also collected through observation during the field visit.

The municipal manager provided the researcher with useful information, such as the fact that the community is equally divided between Afrikaans- and Xhosa-speakers. The assistance of a social anthropology student from Stellenbosch University was therefore enlisted during interviews with the Xhosa-speaking respondents. The translator was selected on the basis of her understanding of isiXhosa and her fieldwork experience as a senior undergraduate (third-year) student in social anthropology at Stellenbosch University.

The research was conducted in accordance with the 2009 Framework Policy for the Assurance and Promotion of Ethically Accountable Research at Stellenbosch University. The researcher applied to Stellenbosch University's Research Ethics Committee: Human Research (Humanities) for ethical clearance (protocol number: HS850/2012), which was provided before fieldwork commenced. Post-fieldwork confidentiality is maintained by means of safeguarding the questionnaires at the AI Perold building at Stellenbosch University. Only the researcher and supervisors have direct access to the questionnaires. Each questionnaire was assigned a unique questionnaire number; however, these numbers are not linked to the home addresses of respondents, and identifiable personal details of respondents were not collected during the study.

2.4.2 Sampling Method

A sampling frame was constructed from a map of the study area which was provided by the municipality. Every house on the map was numbered, and a systematic random sampling technique was applied to select every fifth house on the sampling frame. As mentioned previously, another part of the broader study involved collecting rainwater samples from houses in order to determine whether an association exists between the microbial and chemical quality of the rainwater and the way in which people use the tanks and/or the rainwater. It was therefore important that those 29 houses, from which rainwater was collected by the microbiology research team, were also included in the social research sample. Most of these houses fell into the random sample, but eleven did not and were therefore selected purposively. A total of 68 households were therefore sampled with the objective of interviewing one respondent per household.

2.4.3 Data Collection

Data were gathered by means of face-to-face interviews with 68 respondents. The interviews were guided by a semi-structured questionnaire (see Appendices 1–3), and were conducted over a period of three days (11–13 September 2012) by the researcher, with the help of a translator. Although self-administered questionnaires would have been less time-consuming, administering the questionnaire during interviews ensured that the questions were understood by the respondents and thereby increased the accuracy and reliability of the data collected.

2.4.3.1 Questionnaire design

The questionnaire was designed to gather primarily quantitative data, but included open-ended questions that delved deeper into the reasons for certain responses. A literature review was conducted before designing the questionnaire, and some questionnaire items were incorporated from this literature after adapting them to the context of the study. Numerical codes were assigned to the response options for closed-ended questions to simplify data entry and analysis (Appendix A).

The questionnaire was originally designed in English, where after it was translated into Afrikaans and Xhosa. In the field, the Xhosa questionnaire was used by a translator to ask the questions in Xhosa, and the translator then translated the responses to the researcher, who completed an English version of the questionnaire accordingly. The translator's involvement increased the isiXhosa-speaking respondents' willingness to participate, and facilitated the accurate and reliable administration of questionnaires to these respondents (Appendix A).

The aim of the first section of the questionnaire was to gain an overview of the tanks' condition, the respondents' knowledge on maintenance, and whether they would be willing to pay for repairs should the tank break. The second part of the questionnaire was aimed at understanding what the respondents are using the harvested water for, and to elicit their opinion on municipal water. The last section focused on demographic details of the respondents, in order to construct a socio-economic profile of the sample (Appendix A).

2.4.3.2 Pilot study

Prior to data collection, a pilot study was conducted to test both the Afrikaans and Xhosa versions of the questionnaires. The questions were well received by the pilot respondents and after the pilot study only minor changes were made to the questionnaire.

2.4.3.3 Data analysis

The collected data were captured, processed and analysed with IBM SPSS Statistics (v. 19).

2.5 RESULTS AND DISCUSSION

2.5.1 Socio-demographic Profile

Of the 68 respondents interviewed, the majority (52 respondents, or 76%) are female, while the remaining 16 respondents are male. In terms of racial demographics, 36% of the population of the broader Overstrand region, within which Kleinmond is located, consists of coloureds, while 33% are

white, 30% are African and only approximately 1% are Indian (Overstrand Municipality, 2012a). The Kleinmond recipients of the DRWH tanks consist predominantly of coloured and black Africans.

2.5.1.1 Level of Education

It is imperative that the highest level of education is taken into consideration when implementing social development programmes, and in the specific case of DRWH, it could influence how a user understands and interacts with the new technology. As Figure 2.4 shows, approximately 12% of the respondents reported having no schooling, while three-quarters (75%) of the respondents reported a highest level of education of Grade 7 or lower, i.e. primary school.

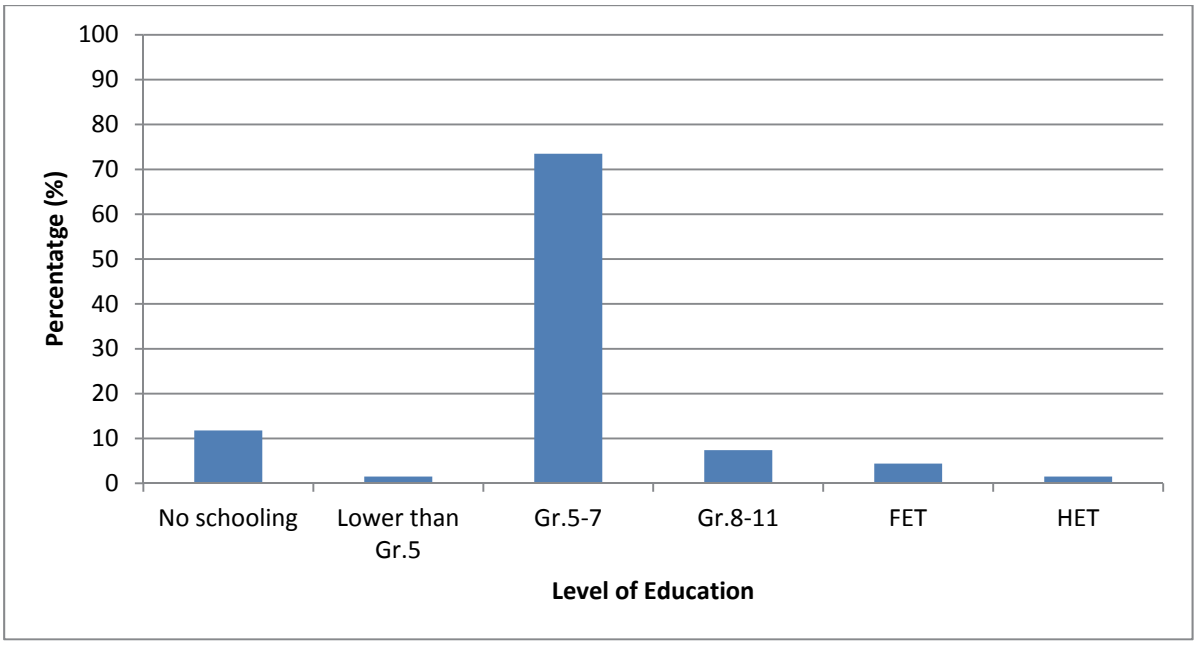

Figure 2-4: Distribution in terms of highest level of education attained. Further Education and Training (FET). Higher Education and Training (HET). The percentage total does not add to exactly 100 because of rounding effects.

2.5.1.2 Age distribution

An analysis in terms of age shows that almost 50% of the respondents were in their thirties, while the second largest group (27%) was in their twenties (Table 2.1), i.e. three-quarters were younger than 40. Observations during interviews support these findings. In South Africa, the term “youth” is defined as ranging from 14–35 years (National Youth Policy, 2009). Therefore, by far the majority of the DRWH users in Kleinmond can be categorized as “youth”.

Table 2-1: Distribution in terms of age.

Age	n	%
20s	19	27
30s	33	49
40s	11	16
50s	2	3
60s	2	3
Older than 69	1	2
Total	**68**	**100.0**

2.5.1.3 Household size

Determining household size is important to understand what the monthly water needs and expenditures are per household (Ademun, 2009). Respondents were therefore asked how many people lived on the premises. In one extreme case nine people were living in a house (see Table 2.2), and the respondent relied immensely on the water tank because according to her, household members use a lot of water and have to use the rainwater sparingly when there is no municipal water. Table 2.2 further shows that the average household consists of approximately four members, as indicated by the mean, the median and the mode. In terms of distribution, 19 respondents (28%) reported that three people live on their premises, while 16 (or 24%) reported a household size of four, and 13 (19%) of respondents' households consisted of five people.

Table 2-2: Household size

Number of people that live on respondent's premises	
Minimum	1.0
Maximum	9.0
Mean	3.7
Median	4.0
Mode	3.0

2.5.1.4 Employment status

The issue of employment was considered important on the basis of the results of previous studies (He et al., 2007; Ademun, 2009), because it indicates financial stability or instability. In Kleinmond, one may assume that financial strain, because of unemployment, increases the incentive to save water (and thereby money) by using the tank more effectively, and increases the acceptability of the tank. Table 2.3 reveals that nearly 60% of the respondents are unemployed.

Table 2-3: Distribution in terms of employment status.

Are you currently employed?	n	%
Yes	28	42
No	40	58
Total	**68**	**100.0**

2.5.1.5 Summary

An analysis of the socio-demographic data shows that the majority of DRWH users are young (under 35 years of age) and socio-economically disadvantaged, as the majority have attained very little or no education, are unemployed and tend to survive on government grants. Although questions on government grants were not included in the questionnaire, during the interviews respondents often referred to receiving "indigent support" ("deernishulp" in Afrikaans) from the local municipality. They also frequently volunteered their unemployed status and lack of money to maintain the tank or to pay for municipal water. This will be further discussed in section 2.5.6, which describes respondents' perceptions on municipal water.

2.5.2 The Water Tank: Condition, Operation and Value

Based on the researcher's observations, it seemed that at the time of data collection the majority of the tanks were in a good condition. This is supported by the interview data as 78% of the respondents reported that their tanks are in what they perceive to be a good condition.

Table 2.4 shows that the majority of the remaining 22% of the respondents experienced problems related to leaking tanks (eight respondents), or missing lids (six respondents), while two respondents reported broken pipes or taps. It is important to note that at least two respondents reported that the tank had been leaking ever since they moved in. It is possible that a manufacturing problem may be to blame, or that the tanks may have been damaged during installation. Figure 2.5 depicts a bucket positioned underneath the leaking tank, indicating that the tank owner implemented measures to prevent water wastage.

Table 2-4: Detail on the type of tank damage.

If tank is broken, please specify	n	%
It leaks / leaking / squirts out water	8	50
Lid is gone	6	38
Pipe(s)/tap broken	2	12
Total	**16**	**100.0**

Figure 2-5: Measures implemented to prevent water wastage, where DRWH tank taps were leaking.

With the exception of one respondent, all users preferred to retain the tank. They motivated their preference by referring to benefits associated with the tank, particularly in terms of saving money (22 respondents), as municipal water is expensive and they are saving money by using the rainwater in the tank (see Table 2.5). The second most common reason for wanting to keep the tank relates to their experience of not receiving municipal tap water due to maintenance and repairs (16 respondents) (which was the case during the data collection period). In particular during such disruptions in municipal water provision, the tank becomes a convenient asset. Saving water (probably linked to cost-saving mentioned above) was mentioned by a further nine respondents as a reason why they wanted the tank to remain in their possession.

Table 2-5: Reasons for retaining the tank.

Why would you like to keep the tank	**n**	**%**
Water is expensive / we save money	22	32
Very useful during water shortages	16	24
To save water	9	14
Generally useful	21	30
Total	**68**	**100.0**

Table 2.6 was adopted from the Integrated Development Plan (IDP) 2012-2017, to indicate the tarrif and charges for water at OM. This information is particularly relevant to understand the financial challenges the community faces in paying for municipal water, and to provide an objective measure of what respondents mean when they report that “water is expensive”. Table 2.6 provides an overview of the block-step water tariffs of OM (VAT excluded) with some comments on the specific block (Overstrand Municipality, 2012a). The first six kL of water is provided free to all consumers. Free

basic water and sanitation services are linked to OM's Indigent Policy; hence all indigent households receive free basic water and sanitation services (Overstrand Municipality, 2012b). As mentioned in the socio-demographic profile, many respondents verbalised that they are receiving indigent support. The next two blocks in Table 2.6 indicate that, in 2011 and 2012, 7–30 kL was charged at R7.02 per kL. A household receiving indigent support is not allowed to exceed 18 kL per month (Overstrand Municipality, 2012b).

Table 2-6: Tariff and charges for water at Overstrand Municipality (OM). Adapted from (Overstrand Municipality, 2012b).

Block kL/month	**11/12**	**10/11**	**09/10**	**Comments**
0–6	R 0-00	R 0-00	R 0-00	Free basic water
7–15	R 7-02	R 6-48	R 6-00	Low volume use
16–30				Typical use volume, including garden irrigation
31–60	R 17-55	R 16-20	R 15-00	Above average use, including garden irrigation
61–100	R 23-69	R 21-60	R 20-00	Wasteful use and/or severe garden irrigation
>100				Significant waste and/or unnecessary garden irrigation

Approximately 90% of the respondents would not consider selling the tank (Table 2.7). Only one respondent definitely considered selling the tank, while 9% of respondents' decision to sell the tank would be contingent on other factors. The reasons why respondents were not contemplating selling the tank were similar to those that explained why they wanted to keep the tank, i.e. the saving of costs, especially since municipal water is expensive, and a perception that the tank is generally very useful to them. One of the respondents commented: "I will not sell it for a million dollars". Even within a context of harsh poverty, it seems the benefits of the tanks outweigh the once-off gain that would be made from selling the tank.

Table 2-7: Willingness to consider selling the tank.

Would you consider selling the tank?	**n**	**%**
Yes, definitely	1	1
It depends	6	9
No, definitely not	61	90
Total	**68**	**100.0**

In order to determine the extent to which the users are taking ownership of their tanks, two questions were asked: "what would you do should the tank break", and secondly, "would you be willing to pay for the repairs of the tank should it break". These questions were adapted from those used in a pilot study on attitudes towards and perceptions on rainwater harvesting in the United Kingdom (Ward et

al., 2008). As Ward et al. (2008) highlight, 'rainwater harvesting is not a 'fit and forget technology' and people often realize after instalment that maintenance is required. Their study found that respondents underestimated how frequently they had to conduct four maintenance activities, i.e. cleaning the surface, cleaning the filters, replacing the UV lamp and checking the pump, and they underestimated the costs incurred by the same four activities.

In Kleinmond, approximately half of the respondents acknowledged that they would not know what to do if the tank breaks. One third (24%) reported that they would attempt to repair it, and the remaining minority of respondents said that they would report it to the municipality, with the expectation that the municipality would either repair or replace the tank. This question prompted many of the respondents to complain of leaking taps and broken pipes (the latter causing damp walls) inside their houses. Some respondents mentioned that they had reported the housing problems to the municipality, but received no response. This is relevant, as the leaking taps are increasing their water use and therefore expenditure. This issue will be further discussed in section 2.5.6 concerning respondents' views on municipal water. According to the IDP 2012-2017, The Local Labour Promotion Project (LLPP) of the OM was initiated with the aim to reduce unpaid municipal debt which provides income opportunities to communities with high unemployment and poverty levels (Overstrand Municipality, 2012a). Part of the programme involves repairing water leakages at indigent households to prevent high water accounts (Overstrand Municipality, 2012a). Based on the LLPP, it seems as if the municipality is aware of the water leakage problems in the area and they will probably be addressed in the near future.

However, it was evident that maintenance of the houses and water tanks was perceived as a municipal problem, and that the municipality was expected to take responsibility for repairs. Of those 15 (23%) respondents who reported that the tank was broken, three respondents did report it to the municipality, while two tried to fix it themselves and the other two respondents did not know what to do. On a positive note, two-thirds (45) of the respondents were willing to pay to repair the tank should it break (Table 2.8). The remaining 23 respondents who were either unwilling to pay for the repair of their tank or unsure in this regard, cited financial constraints as a reason. Adenum (2009), who posed a similar question in a study in Uganda, found that the community members were not willing to pay for the repair of the tanks.

Table 2-8: Willingness to fund reparation of tank.

Would you pay money to fix your tank should it break?	**n**	**%**
Yes	45	66
No	12	18
Maybe/Unsure	11	16
Total	**68**	**100.0**

It would therefore be important to communicate to users the fact that the tanks require very little maintenance, and that they would be able to conduct such maintenance themselves. In this regard it is encouraging to note that approximately 90% of the respondents expressed a willingness to learn how to maintain the tanks (Table 2.9).

Table 2-9: Preference for training in maintaining tank.

Would you like to learn how to maintain the tank?	**n**	**%**
Yes	61	90
No	7	10
Total	**68**	**100.0**

One of the open-ended questions asked respondents why they think the government provided houses with tanks. The question was asked to determine whether the respondents are aware of the reasons why government initiates social development programmes such as the one in Kleinmond, and how people experience and perceive these actions by the government. Thirty (44%) of the respondents were of the opinion that they received the tanks because it assists them, as a community, in saving water, and approximately one third (22 respondents) understood it as an attempt to save money. However, some of the comments included, “I don’t know, they never told us”, and ‘I have never thought of it’, which are notable, as this reflects a lack of understanding of what the government aims to accomplish with the development in Kleinmond.

One can argue that the water tanks were valued by the users and that the users were gaining benefits from them. Nonetheless, it is unfair to expect that the user is aware of all the pros and cons of using DRWH technology. Even though many said they were willing to pay for repairing the tank, this does not mean that they are able to pay for it. A high incidence of poverty and unemployment means that other, survival-related priorities (e.g. feeding oneself and one’s dependents) overshadow maintaining or fixing a water tank, especially if one has access to municipal water. Training is needed and more importantly, was welcomed by the community members who are eager to learn about the maintenance of the tank.

2.5.3 The Use of Rainwater

Two of the 68 respondents reported that they are not using the water in their tanks. One household did not have a tank because, according to the respondent, it was not attached to the house and was blown away by the wind. The other respondent could not use the tank because the tap was broken. The fact that almost all of the respondents used the water in their tanks should, however, be interpreted against the background that, during the week in which the data were collected, the community experienced three days without municipal water, due to maintenance that was conducted on the water pipes. During that week, the water tanks proved particularly useful, convenient and valuable to the respondents, as indicated by Figure 2.6.

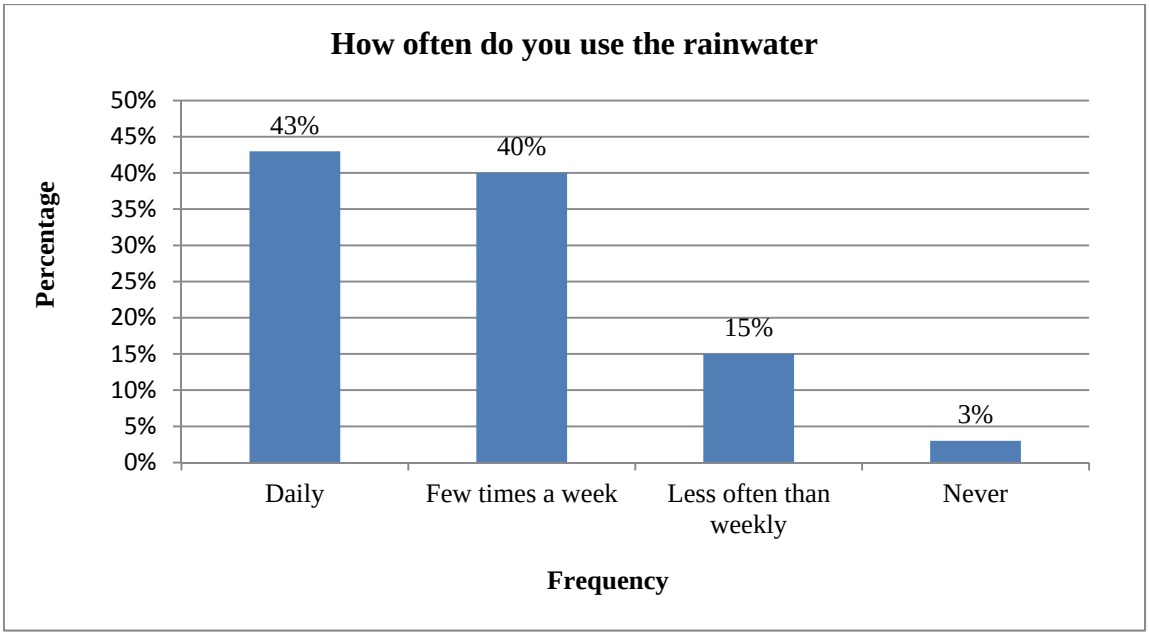

Figure 2-6: Frequency of rainwater use.

Rainwater harvested and stored in the tanks has several potential applications, such as drinking, cooking, washing clothes, cleaning, personal hygiene such as bathing, and other activities such as watering plants, washing cars and providing drinking water to pets. A question on usage of water was adapted from Karim et al.'s study that investigated people's perception and acceptance of rainwater harvesting in Bangladesh (Karim et al., 2005). The question asked respondents in Kleinmond specifically whether they use the harvested rainwater for gardening, cooking, drinking, washing clothes, cleaning the house and/or bathing. In answering this question, the respondents could choose more than one option (i.e. as many as apply). The results represented in Table 2.10 indicate that nearly all the respondents use the rainwater to wash their clothes. The second most common purpose for which the rainwater is used is general cleaning, such as cleaning the house (especially floors), cars, etc. A few gardens were watered with the rainwater (Figure 2.7), and in cases where these gardens are a source of food, the water tank can be very beneficial to poor households.

Table 2-10: Purposes for which rainwater is used.

Do you use the rainwater for the following?	**n**	**%**
Laundry	62	92
Cleaning	47	70
Gardening	31	46
Bathing	30	44
Drinking	16	24
Cooking	13	19

Figure 2-7: Photograph of two food gardens watered by harvested rainwater in Kleinmond.

2.5.4 Potential Health Risks Associated with the Use of Rainwater

In addition to questioning the respondents about what they use the rainwater for, other items focused in more detail on the respondents' use of the water for drinking, in part also to examine if the respondents are aware of the potential risks associated with DRWH, and the need for pre-treating the harvested rainwater.

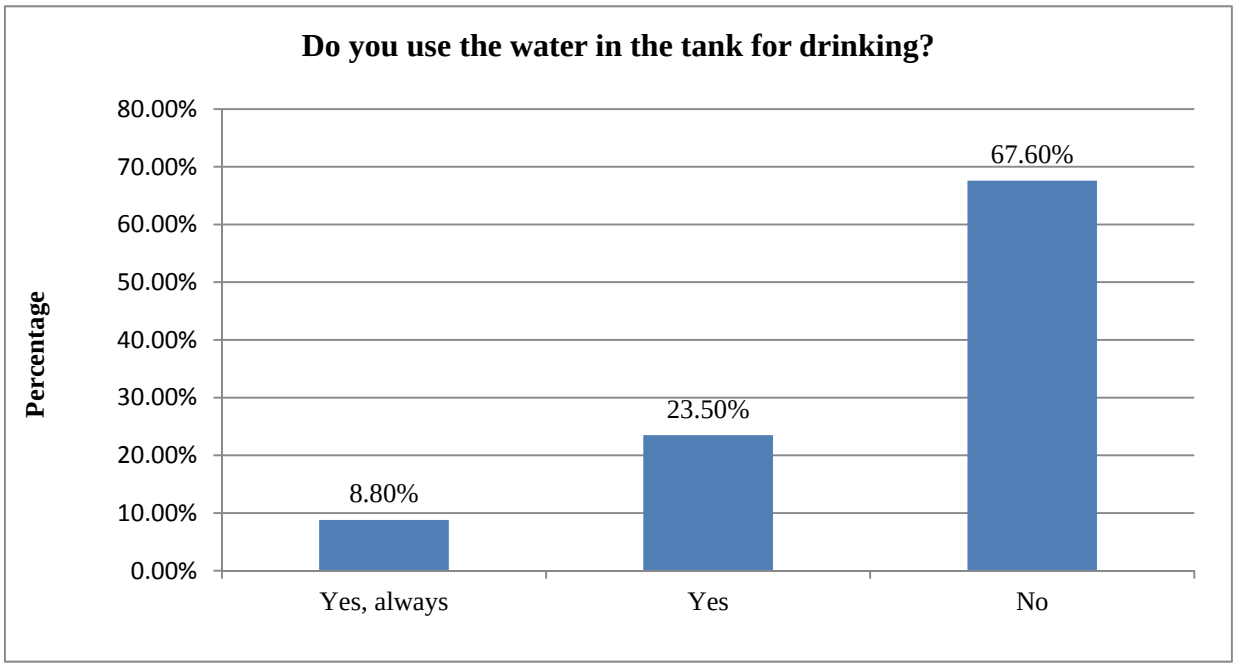

Figure 2-8: Use of tank for drinking water.

Approximately two-thirds (68%) of the respondents do not use the water in the tank for drinking, while by far the majority of those who use it for drinking, do so only sometimes (24%) (Figure 2.8). Worm and Van Hattum (2006) who assembled a booklet on how to collect, store and purify rainwater, strongly advise boiling the rainwater 2–3 minutes before drinking it, and discuss alternative methods for pre-treating the rainwater (Worm and Van Hattum, 2006).

Responses to a question adapted from these authors show that the majority (19) of the 22 respondents who do drink the tank water pre-treat it first, but only six of them always do so, while the remaining 13 only sometimes pre-treat the water (Table 2.11).

Table 2-11: Tendency to pre-treat water before drinking.

Do you pre-treat the water first before drinking?	**n**	**%**
Yes, always	6	26
Yes, sometimes	13	57
No	4	17
Total	**23***	**100.0**

*This question only applied to the 23 respondents who reported drinking the tank water

One of the questions asked whether respondents have experienced any problems using the water in the tank. By far the majority (61 respondents, or 90%) of the respondents had not experienced any such problems. However, the minority who answered in the affirmative provided noteworthy responses. A mother mentioned that her baby developed a rash after she used the rainwater to bath him. Others mentioned that rainwater is “bad for your stomach”, as it causes nausea. Two respondents reported having seen worms in the water. Some of the respondents who had not experienced any problems using the water in the tank elaborated on their response by stating that rainwater is clean and it tastes good.

It is possible that these users are not aware of the extent to which common sources of rainwater contamination, such as “dirt and faeces which comes mainly from birds and small animals on the roof surface” (Worm and Van Hattum, 2006) and that fall into the tank, may pollute the water. Thus, respondents were asked whether they have noticed animals on the roofs of the houses (Figure 2.9). Some respondents answered in the affirmative, but this does not indicate that they are aware of the health risks that the animals pose to them. Other sources of rainwater contamination include “leaf debris and organic material washed into the tank, animals, insects and birds that have drowned in the water and breeding mosquitoes” (Worm and Van Hattum, 2006).

In this particular community, many of the households place their garbage bags on top of the tank (see Figure 2.10) instead of on the ground, in order to prevent dogs in search of food from gaining access to and ripping the bags open. These garbage bags could easily contaminate the rainwater, especially if they are leaking or broken, and/or the lid of the tank is absent (as indicated by six of the

respondents – see Table 2.11). This highlights once again the importance of training and knowledge-sharing, not only for maintaining the tanks, but also to be informed on potential health risks related to the tanks. The users need to be informed that the installation of first flush diverters, regular cleaning of the gutters and roof maintenance will improve the quality of the harvested rainwater.

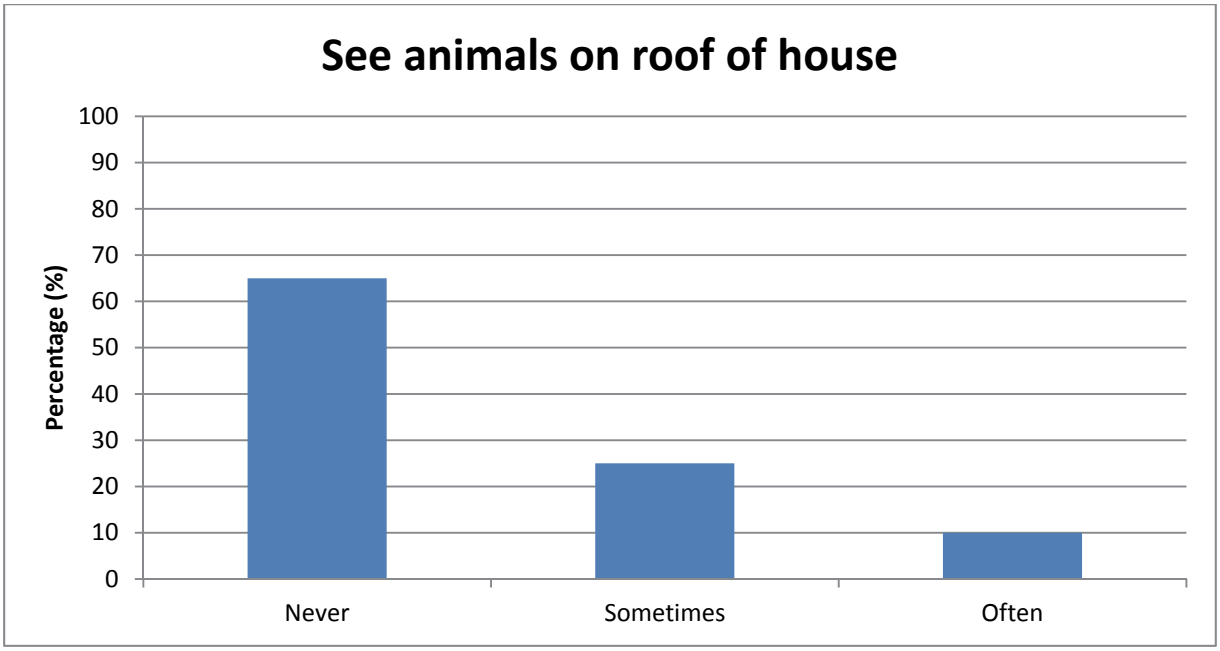

Figure 2-9: Frequency with which animals are noticed on roofs of the houses.

Figure 2-10: Photograph of garbage bags on top of the tank.

2.5.5 Concern About and Reuse of Water

Respondents' level of concern about water availability was also measured. When interpreting the results, it is important to take into account that, at the time of data collection, respondents were not receiving running water from the municipality, which could have increased their level of concern about a lack of water. The two households who did not have a tank both confirmed that they had to ask their neighbours for some rainwater, and expressed concern about the length of time it would take the municipality to restore tap water provision. The municipality was accused for not warning them about the disruption in tap water provision, which lasted for three days, as this made them feel unprepared and anxious. The results for the sample as a whole, as depicted in Figure 2.11, show that more than one-third (35%) of the respondents are often concerned about water, and approximately a quarter (26%) are sometimes concerned about water.

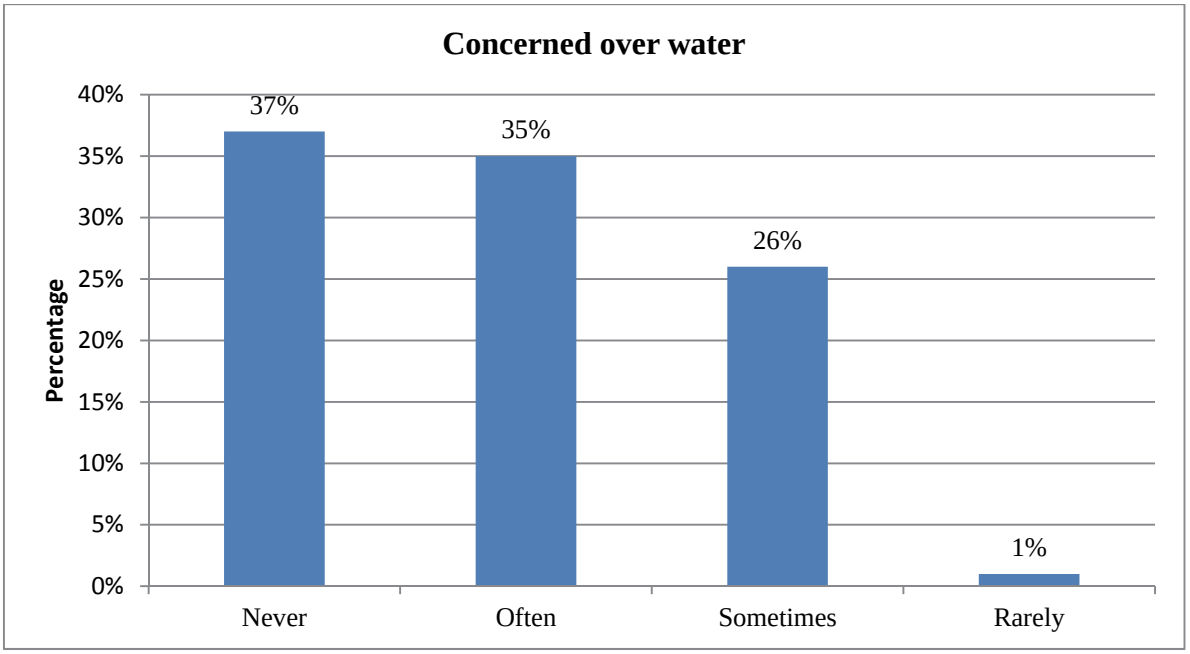

Figure 2-11: Level of concern about water.

Although the majority of the respondents are at least sometimes concerned about water, the community is not familiar with reusing water, as 78% of respondents never do so. This counteracts the general assumption that concern about water would lead one to search for alternative methods to save water by reusing it. It did, however, transpire during the interviews that the meaning of "reuse" was not clear to the respondents, and therefore required some explanation, which was offered by informing the respondents that reuse refers to using water more than once. Two examples were always provided in conjunction with the explanation, i.e.: "Do you use the bath water to water the garden or flush the toilet?" and "Do you cook rice and then use the same water to cook other vegetables?" Those who did mention reusing water were also requested to provide an example, in order ensure they understood the question. These examples included using bath water to wash floors

or water plants (see Figure 2.12). On the basis of these findings, it is therefore recommended that transfer of information on water reuse be included in training.

Figure 2-12: Photograph of bath water being reused to clean the house.

It is evident from the results that the respondents are in favour of DRWH, which provides a supply of water preferred especially for washing clothes and cleaning. However, not many of the respondents are using the water for drinking, which is fortunate because many of the respondents place their garbage bags on top of the tank, which poses a high risk for contamination of the rainwater. Moreover, the results reveal a general lack of awareness of the risk of contamination from this and/or other sources, as some of the respondents who drink the water do not pre-treat it. Respondents expressed a measure of concern regarding water availability, especially because they did not have access to municipal water for three days. During this time, the water tanks became a reliable substitute which enabled them to function without experiencing a high level of water stress. The reuse of water would also have been useful in these circumstances. However, the survey revealed that a large majority of the respondents do not reuse their water.

2.5.6 Municipal Water

In Kleinmond municipal water is not free of charge. Many respondents reported that, since receiving “indigent support”, their water bills are much lower and they can afford to pay for municipal water. According to some of the respondents, their water bill ranged from R 100–R 200 per month, but with the indigent grant, they only pay R 46 per month. The data was verified with reference to documentation available on the OM’s website, which explains the operation of the policy on the indigent grant. In order to qualify for the grant, an applicant should not earn more than R 4800 per month, his/her household should not use more than 500 kWh of electricity and more than 18 kL of water per month, and he/she must be a permanent resident of the Overstrand region, as well as a South African citizen (Overstrand Municipality, 2012b). The grant covers municipal services, including

water and electricity, requiring the recipients of the grant to only pay a minimum flat rate of R 46 per month, which is spent on maintaining and upgrading municipal infrastructure in Kleinmond.

Should recipients of the grant use more water or electricity than stipulated, the municipality sends them a bill to pay the difference and to warn them against using more water and electricity than stipulated by the conditions of the grant. Should the user continue to overspend on water and electricity, the municipality has the right to disqualify him/her from receiving indigent support. Apart from the households who receive indigent support, every household in the Overstrand region receives 6 kL of free water each month. Once households exceed 6 kL of water, they have to pay the difference (Table 2.6).

Five questions were asked to measure respondents' opinions on municipal water, as these opinions (which are usually based on positive or negative experiences with municipal water) may have an effect on users' perceptions toward DRWH. First, respondents were asked whether they think water should be free of charge, and their responses indicate that users are almost equally divided on this issue: 35 (52%) respondents agreed that water should be free while 30 (44%) disagreed, and the remaining three were unsure.

In a related question, respondents were asked whether everybody should pay for the municipal water that they use. The majority (72%) of respondents agreed (Table 2.12), and some elucidated their response by stating that "one can't get everything for free".

Table 2-12: Opinion on paying for municipal water.

Everybody should pay for the municipal water they use	**n**	**%**
Agree	49	72
Disagree	16	24
Don't know	3	4
Total	**68**	**100.0**

It is unclear why 14 of the respondents who were of the opinion that water should be free (see above), now agreed that one should also pay for water. One possible reason is that it is perceived as fair that everybody should pay for the municipal water that they use, since most of the community members are paying for water (with or without the compassionate support). Another reason could be that, while the notion of free water is appealing, there is recognition of the fact that it would be not possible for the municipality to provide water free of charge. Some respondents did complain that numerous community members are not paying for municipal water. This was confirmed by a respondent who acknowledged that she has not paid for municipal water since moving into the house, although her household's monthly water use exceeds the amount of water they get for free each month. She simply

cannot pay for the water because she and her husband are both unemployed and are using the little money they have to pay for basic necessities (e.g. food) for themselves and their two children.

Next, respondents' perceptions on the affordability of municipal water were measured. Most of the respondents (59%) agreed that it was affordable (Table 2.13).

Table 2-13: Opinion on the affordability of municipal water.

Municipal water is affordable	**n**	**%**
Agree	40	59
Disagree	25	35
Don't know	3	6
Total	**68**	**100.0**

However, many qualified their response by stating that it is only affordable since they are receiving indigent support. This question also elicited complaints from several respondents that the municipality was overcharging them. One respondent even reported that her monthly water bill amounts to R 2500, and that she had to spend half a day at the municipal offices to correct the error on her water statement. Several respondents reported similar experiences and questioned the accuracy of the water meters with which the municipality is measuring water usage per household. Table 2.14 provides an indication of meter repairs that are needed in Kleinmond.

Table 2-14: Meters to be replaced (adapted from Overstrand Municipality, 2012a).

Meters older than 20 years	**990**
Meters not working	22
Meters leaking	38
Stop-cocks leaking	38
Total	**1088**

Another relevant piece of information volunteered by some of the respondents is that many of their taps are leaking inside their houses. Figure 2.13 depicts a leaking pipe underneath a kitchen basin.

Figure 2-13: Photograph of a leaking pipe inside a kitchen with a bucket to collect the water drops.

Leaks such as these cause water loss for which the respondents have to pay. Many of them reported the leaking taps to the municipality, but nothing has been done in order to repair them. This links to the issue of perceived responsibility which was raised in section 2.5.2 on perceptions regarding the water tank's operation and value. One may argue that the owner of a house can and should fix a leaking tap – although a lack of perceived ownership may prevent this from happening – while some infrastructure, such as broken pipes leading to houses, can only be repaired by the municipality. While this issue requires further investigation, one can already foresee problems caused by leaking taps, leaking pipes and damp walls. Not only is water lost due to poor (and poorly maintained) infrastructure, but damp walls are conducive to the development of respiratory diseases such as respiratory infections, allergic rhinitis and asthma (World Health Organization, 2009).

Nearly all the respondents (64 respondents, or 94%) reported that they have access to clean municipal water. Two respondents disagreed, referring to the colour of the tap water as sometimes white and not clear, while two respondents answered "don't know". These two respondents also answered "don't know" to the questions that produced the data presented in Tables 2.12 and 2.13. It is quite possible that, contrary to what they were told, the two respondents believed that the researcher is affiliated with the municipality and not Stellenbosch University, and were concerned that their opinion about the municipality may have repercussions for them.

The last question on municipal water was aimed at determining whether respondents considered the municipal water that they receive per month as sufficient for the purposes of drinking, cooking, laundry and bathing. According to the results presented in Table 2.15, the overwhelming majority (94% or more) of respondents deem the municipal water as sufficient for drinking, cooking and bathing. However, only 68% of respondents considered municipal water as sufficient for laundry purposes.

Table 2-15: Opinion on whether municipal water is sufficient for household use.

Municipal water is enough to:	Yes		No		Total	
	n	%	n	%	n	%
Drink	64	94.1	4	5.9	**68**	**100.0**
Cook	64	94.1	4	5.9	**68**	**100.0**
Do laundry	46	67.6	22	32.4	**68**	**100.0**
Bath	67	98.5	1	1.5	**68**	**100.0**

Referring back to Table 2.6, OM's current 4-block-step tariff system discourages inefficient use of water (Overstrand Municipality, 2012a). As "the sustainable supply of potable water is becoming an ever increasing challenge" (Overstrand Municipality, 2012a), water therefore has to be optimally managed, and the municipality has put disciplinary tariffs in place to penalise excessive water consumption.

With regard to the respondents' perception on municipal water, the survey revealed that the municipal water they receive is considered by the majority to be clean, accessible and affordable. However, there were complaints about leaking taps which the municipality neglects repairing, and which resulted in unnecessarily high water bills. This raises the issue of whether responsibility for water-related repairs lies with the municipality or the owner of the house. Furthermore, the OM (2012a) is aware of the increasing challenge involved in providing potable water. Domestic rainwater harvesting could therefore be used as a substitute for municipal water – which this study highly recommends.

2.6 CONCLUSIONS

This survey revealed people's attitudes towards DRWH, their use of rainwater at household level, issues related to safe drinking water, and accessibility and affordability of municipal water. Generally, DRWH enjoys a high level of acceptance among the community members in Kleinmond, who tend to use the harvested rainwater for washing clothes and for general cleaning inside and outside their houses. Domestic rainwater harvesting offers numerous benefits, but unless the users' knowledge about these benefits and other aspects of DRWH increases, its potential will not be fully realised. The success of DRWH depends on the interest, ownership and active support of the users.

Several sources of literature (Mwenge Kahinda et al., 2007; He et al., 2007; Ward et al., 2008; Domenech and Sauri, 2011) emphasise the importance of training to encourage the user's acceptance of DRWH. Domenech and Sauri (2011), who conducted a study in Spain, emphasise the central role of users in the implementation of rainwater harvesting, as they "become the owners and managers of the systems" (Domenech and Sauri, 2011). Without acceptance and necessary training to maintain and use the tank optimally, it is quite possible that projects such as the one in Kleinmond will not be sustainable.

Therefore a training programme is recommended to fill the knowledge gap to empower users by informing them on the utilisation and optimisation of the system. The users surveyed expressed their willingness to become involved in training sessions to learn about the operation and maintenance of the tanks. Not only does this indicate a sense of ownership; it also indicates a high level of acceptance of DRWH. Such training should include the reasons why DRWH is important, awareness as to why they received the tanks, and how the tanks are meant to benefit them if they use them correctly (i.e. the potential uses of the water, as well as instructions on the maintenance and operation of the tank). Users should also be taught about the potential contamination of rainwater, the health risks involved and how to minimise these, especially if they opt to utilise rainwater for drinking and cooking.

However, with regard to training the entire community, a number of potential obstacles need to be taken into account. First, according to the supplier of the tanks in Kleinmond, Nel Tanks, no manual or user's guide exists to assist the user in how to use and maintain the tank. The CSIR together with the Grail Centrum provided the community members with training manuals on how to use and operate the solar panels with which their houses were fitted, but this was not done with regard to the water tanks. An internet search for training material for water tanks confirmed that several manuals were available in First World countries, such as Ireland, UK and Australia, but none were available in South Africa. The costs involved in designing new training manuals for the South African context will probably be quite high, because such manuals would have to be written not only in simple language, but in several languages and, most importantly, the content of the training manual has to "come from the user". Thus, further research is needed to understand in more depth the challenges and problems the users experience with the tanks, in order to render the training relevant to them. Secondly, it needs to be recognised that people, especially the unemployed, have more pressing priorities – surviving day-to-day with little or no money precludes motivation and interest to attend a course in tank maintenance.

An alternative solution that avoids these obstacles may be to train and appoint one or two individuals in the community to supervise the functioning, operation, maintenance and repair of the tanks, instead of rolling out a training programme geared at all the households. Community members could pay for such individuals' salaries indirectly, for example by increasing the municipal services tariff. At present every household should pay a minimum flat rate of R46 for municipal services (Overstrand Municipality, 2012b) which could be increased slightly in order to expand the lifespan of the tanks.

The survey revealed that the users had little knowledge on reusing water at household level. Should training be undertaken in the near future, it is recommended that methods on how to reuse and save water be included in the training programme. Alternatively, flyers that demonstrate how to reuse water could be distributed.

It should also be borne in mind that certain DRWH tank suppliers issue each tank with a 5-year guarantee certificate. In other words, should a tank break due to a manufacturing default (as seemed

to be the case with at least two of the tanks in the study), the company will repair or replace the tank. Thus, the tanks should be monitored carefully and the supplier should be contacted if tanks are identified as faulty, based on a careful investigation and examination.

None of the respondents filled their tanks with municipal water, and a recommendation would be to do so during the summer season. The community obtains 6 kL water for free and many of community members receive indigent support, which provides them with up to 18 kL of municipal water per month (at R46, including electricity). Small families could monitor their water use carefully and ensure they have municipal water left to store in the tanks as a reserve, which could provide an alternative water source during water shortages or when a need to conduct maintenance and repairs leads to a lack of municipal water.

South Africa is experiencing economic growth which leads to the increasing development of houses, buildings and other structures. It is therefore recommended that in this country more decisive steps are taken to save water in every possible way. In this regard, the example from India should be taken into account, where town planners and civic authorities in many cities are introducing by-laws that are rendering rainwater harvesting compulsory in all new structures. No water or sewage connection is to be delivered if a new building does not have provisions for DRWH (Tamilnadu State Government, 2011).

South Africa should consider rainwater an important manageable resource. As the 30th driest country in the world, full advantage should be taken of rainwater as an alternative water source (Magalies water, 2012). Harvesting of rainwater offers one solution to the problem of preserving water and of ensuring water security for future generations, as one millimetre of rain on one square meter of a roof, equals one litre of water (Nel Tanks, 2012). DRWH can therefore be promoted as a core adaptation strategy for achieving South Africa's goal to provide all of its citizens with water. However, at the same time public participation is fundamental to the sustainability of DRWH projects such as the one in Kleinmond.

CHAPTER 3: CONCLUSIONS & RECOMMENDATIONS

3.1 CONCLUSIONS

The social research project conducted in the Kleinmond Housing Scheme was conducted to describe amongst others, the condition of the tank and the users' knowledge of the DRWH system. In addition, demographic data, *viz.* gender, household size and employment status, etc., were gathered in order to provide a socio-economic background description of the study population. Data were gathered by means of face-to-face interviews with 68 respondents. Generally, DRWH enjoys a high level of acceptance among the community members in Kleinmond, who tend to use the harvested rainwater for washing clothes and for general cleaning inside and outside their houses. This study noted that without acceptance and necessary training to maintain and use the tank optimally, it is possible that projects such as the one in Kleinmond will not be sustainable. Although rainwater is an alternative source of supply that has the potential to reduce demand for municipal and treated water, it does not in itself address concerns around overall water consumption. Domestic Rainwater Harvesting is a technology that is flexible and adaptable and the study has reflected on the advantages and concerns around the use of rainwater harvesting within the context of a local small town setting.

3.2 RECOMMENDATIONS

- A training programme is recommended to fill the knowledge gap to empower users by informing them, but also to optimise the system. Such training should include:
    - The reasons why DRWH is important,
    - Awareness as to why they received the tanks, and
    - How the tanks are meant to benefit them if they use them correctly,
    - The potential contamination of rainwater and the potential health risks involved and
    - How to minimise risks of contamination, especially if they opt to utilise rainwater for drinking and cooking.
- The costs involved in designing new training manuals for the South African context will probably be quite high, because such manuals would have to be written not only in simple language, but in several languages and, most importantly, the content of the training manual has to come from the user. In other words, this would require participatory workshops prior to the compilation of the manual to make sure that the contents matched the understanding and requirements of the user. Thus, further research is needed to understand in more depth the challenges and problems the users experience with the tanks, in order to make the training relevant to them.

- An alternative solution may be to train and appoint one or two individuals in the community to supervise the functioning, operation, maintenance and repair of the tanks, instead of rolling out a training programme geared at the entire household. Community members could pay for such individuals' salaries indirectly, for example by increasing the municipal services tariff. We have seen that at present every household is expected to pay a minimum flat rate of R46 for municipal services (Overstrand Municipality, 2012b). A small additional sum could be added to contribute to the maintenance of the tanks.

- Nel Tanks issue each tank with a 5-year guarantee certificate. In other words, should a tank break due to a manufacturing default (as seemed to be the case with at least two of the tanks in the study), the company will repair or replace the tank. The tanks should be monitored carefully and Nel Tanks contacted if tanks are identified as faulty after careful and informed investigation.

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APPENDIX A:

SURVEY OF COMMUNITY PERCEPTIONS ON DOMESTIC RAINWATER HARVESTING IN KLEINMOND

CONSENT TO PARTICIPATE IN RESEARCH

Hallo!

I work at Stellenbosch University's Water Institute, and would like to ask you to help me with a study I am doing for the Water Research Commission.

I want to learn what the community members of Mountain View in Kleinmond think about collecting rainwater in the water tanks given to them, what they think about the tanks, and how they use the tanks. I want to find out whether the water tanks help the community members of Mountain View, or not.

I would like to talk to you, as a community member, about this for about 15 to 20 minutes. I will ask you questions on this form, and write your answers on the form.

This study will not be used to tell the Water Research Commission, Stellenbosch University or the government about what *you* do with your tank, or how *you* feel about the tank, or what *you* think about collecting rainwater. For this reason, I will not write your name or your address anywhere on this form.

You can choose if you want to be in this study or not. If you choose to talk to me, but feel unhappy in any way, or do not like the questions I ask you, please tell me. You do not have to answer any questions that you don't want to answer, and we can stop at any time.

If you have any questions or are unhappy about what we talked about, please contact me on 021 808 2708 or Michelle De Kwaadsteniet on 021 808 5803.

Before we begin, please answer the following questions by ticking “Yes” or “No”`:

Do you understand what I explained to you?	Yes	No
Do you understand that nobody except me will know what you tell me today?	Yes	No
Do you understand that we can stop at any time?	Yes	No
Do you have any questions that you want to ask me before we start?	Yes	No
Can I start asking you the questions on the form?	Yes	No

I have explained the project and the implications of being interviewed to the respondent, and I believe that the consent is informed and that he/she understands the implications of participation.

Name of interviewer: Dominique Mannel

Signature of interviewer: _____

Date: _____

Q. no. | | | |

INTERVIEW SCHEDULE

A. INFORMATION ON THE TANK

1. In what condition is your tank?
   1 Good working condition
   2 Broken (leaking, damaged, etc.)
   3 Neither good nor bad

   If broken, please tell me more……

   ……

2. Are you using the tank for anything?
   1 No
   2 Yes

   If yes:

   2.1 For what do you use the tank?
   1 To collect rainwater

   Other [*specify*]:

   ……

   ……

   If you use the tank to collect rainwater:

   2.1.1 How often do you use the rainwater that you collect in the tank?
   1 Daily
   2 A few times a week
   3 Less often than weekly
   4 Never

   2.1.2 For what do you use the water in the tank? [*select all that apply*]
   1 Gardening 2 Cooking 3 Drinking

4 Washing clothes 5 Cleaning the house 6 Bathing

Other [*specify*]:

……

……

……

……

3. Would you like to keep the tank?

   1 Yes

   2 Maybe / Unsure

   3 No

   Why?

   ……

   ……

4. If someone would offer to buy the tank from you, would you consider selling it?

   1 Yes, definitely

   2 It depends

   3 No, definitely not

   Why?

   ……

   ……

5. Has the tank ever broken?

1 Yes

2 No

If the tank would break:

5.1. What would you do?

1 Fix it

2 Not fix it

3 I don't know

Other

[*specify*]:……

……

…….

5.2 Would you know how to fix it?

1 Yes, I know exactly

2 Yes, I know more or less

3 Unsure

4 No, I don't know

5.3 What did you do?

1 I fixed it

2 I did not fix it

Other [*specify*]: ……

……

……

……

5.4 Did you know how to fix it?

1 Yes, I knew exactly

2 Yes, I knew more or less

3 Unsure

4 No, I did not know

6. Would you like to learn how to look after the tank?

   1 Yes

   2 No

   3 Maybe/Unsure

7. Would you be willing to pay to repair the tank?

   1 Yes

   2 No

   3 Maybe/Unsure

8. Why do you think the government provided houses with tanks?

……

……

……

……

……

B. ACCESS TO AND MANAGEMENT OF WATER

1. Do you use the water in the tank for drinking?

   1 Yes, always

   2 Yes, sometimes

   3 No, never

   1.1. *If yes*, do you pre-treat the water first?

   1 Yes, always

   2 Yes, sometimes

   2 No, never

2 Have any of the residents of the house experienced any problems using the water of the tank?

   1 Yes

   2 No

   3 Don't know

   If yes, what kind of problems?……

……

3 Please tell me whether you agree or disagree with the following statements:

		SA	A	U	D	SD	Don't know	Don't want to answer
a.	For my household, the price of municipal water is affordable	1	2	3	4	5	9	0
b.	Water should be free for everyone	1	2	3	4	5	9	0
c.	Everyone should pay for the municipal water they use	1	2	3	4	5	9	0
d.	We have access to clean municipal water	1	2	3	4	5	9	0
e.	Collecting rainwater is a good thing	1	2	3	4	5	9	0

4. How often do you:

		Never	Rarely	Some-times	Often	Don't know	Don't want to answer
a.	have disagreements with family/community members over water?	1	2	3	4	9	0
b.	worry about a lack of water?	1	2	3	4	9	0
c.	reuse water?	1	2	3	4	9	0
d.	see animals (such as rats, cats or birds) on the roof of your house or on the roofs other houses in the community?	1	2	3	4	9	0

If sometimes or often: which animals?

……

5. Do you get enough water from the municipality for:

		More than enough	Enough	Unsure	Not enough	Not at all enough	Don't know	Don't want to answer
a.	drinking?	1	2	3	4	5	9	0
b.	cooking?	1	2	3	4	5	9	0
c.	washing?	1	2	3	4	5	9	0
d.	bathing?	1	2	3	4	5	9	0

6. Do you fill up the tank with municipal water?
   1 Yes, often
   2 Yes, sometimes
   3. No, never

C. GENERAL

Is there anything else you would like to tell me about the things we spoke about?

……

……

……

……

……

……..

D. RESPONDENT DETAILS

1. How many people live on your property?……

2. Sex
   1 Man
   2 Woman

3. What is your highest level of education?
   1 No schooling
   2 Lower than Grade 5 (Standard 3)

3 Grade 5–7 (Standard 3–5)

3 Grade 8–11 (Standard 6–9)

4 Grade 12 (Standard 10 / Matric)

6 Further education and training (FET)

7 Higher education and training (HET)

4. Are you currently employed?

1 Yes

2 No

If yes, how are you employed?

1 Full-time 2 Part-time 3 On contract

5. How old are you?

1 Younger than 21 2 In your 20s 3 In your 30s 4 In your 40s

5 In your 50s 6 In your 60s 7 Older than 69 0 No answer

Thank you for your time. Enjoy the rest of your day!

OPNAME OOR GEMEENSKAPSPERSEPSIES MET BETREKKING TOT DIE OPVANGS VAN REËNWATER VIR HUISHOUDELIKE GEBRUIK IN KLEINMOND

TOESTEMMING TOT DEELNAME IN NAVORSING

Hallo!

Ek werk by die Universiteit van Stellenbosch se Water Instituut, en wil jou vra om my te help met ‘n ondersoek wat ek vir die Kommissie van Waternavorsing doen.

Ek wil leer wat die gemeenskapslede van Mountain View in Kleinmond dink oor die opgaar van reënwater in die watertenke wat vir hulle gegee is, wat hulle dink van die tenke, en hoe hulle die tenke gebruik. Ek wil uitvind of die watertenke die gemeenskap van Mountain View help, of nie.

Ek wil graag met jou, as lid van die gemeenskap, vir ongeveer 15 tot 20minute daaroor gesels. Ek sal vir jou vrae op hierdie vorm vra, en jou antwoorde op die vorm skryf.

Hierdie ondersoek sal nie gebruik word om die Kommissie van Waternavorsing, die Universiteit van Stellenbosch of die regering te vertel wat *jy* met jou tenk doen, of hoe *jy* oor die tenk voel, of wat *jy* dink van die opgaar van reënwater nie. Daarom sal ek nêrens op hierdie vorm jou naam of adres skryf nie.

Jy kan kies of jy in hierdie ondersoek wil wees, of nie. As jy met my wil gesels, maar op enige manier ongelukkig voel, of nie hou van die vrae wat ek vir jou vra nie, sê dit asseblief vir my. Jy hoef nie enige vrae te antwoord wat jy nie wil antwoord nie, en ons kan enige tyd stop.

Indien jy enige vrae het, of ongelukkig voel oor dit waaroor ons gesels het, kontak my asseblief by 021 808 2708, of vir Michele De Kwaadsteniet by 021 808 5803.

Voor ons begin, antwoord asseblief die volgende vrae deur ‘n regmerkie by “Ja” of “Nee” te maak:

Verstaan jy wat ek vir jou verduidelik het?	Ja	Nee

Verstaan jy dat niemand behalwe ek sal weet wat jy vandag vir my sê nie?	Ja	Nee
Verstaan jy dat ons enige tyd kan stop?	Ja	Nee
Is daar enige vrae wat jy my wil vra voordat ons begin?	Ja	Nee
Kan ek begin om vir jou die vrae op die vorm te vra?	Ja	Nee

Handtekening van respondent: _____

Datum: _____

Ek het die projek en die implikasies van ons onderhoud aan die respondent verduidelik, en vertrou dat die toestemming oorwoë is, en dat hy/sy die implikasies van deelname verstaan.

Naam van onderhoudvoerder: Dominique Mannel

Handtekening van onderhoudvoerder: _____

Datum: _____

V. no. | | | |

Vraelys

A. INLIGTING MET BETREKKING TOT DIE WATERTENK

1. Wat is die toestand van jou tenk?
   1 Goeie, werkende toestand
   2 Stukkend (lek, beskadig, ens.)
   3 Nóg goed, nóg sleg

   Indien stukkend, vertel asseblief vir my meer……
   ……
   …….....

2. Gebruik jy die tenk vir enigiets?
   1 Nee
   2 Ja

   Indien ja:

   2.1 Waarvoor gebruik jy die tenk?
   1 Om reënwater op te gaar
   Ander [*spesifiseer*]:
   ……
   ……
   ……

   As jy die tenk gebruik om reënwater op te gaar:

   2.1.1 Hoe dikwels gebruik jy die reënwater wat jy in die tenk opvang?
   1 Daagliks
   2 ‘n Paar keer per week
   3 Minder dikwels as weekliks
   4 Nooit

2.1.2 Waarvoor gebruik jy die water in die tenk? [*merk alles wat van toepassing is*]

1 Tuinmaak	2 Kook	3 Drinkwater
4 Klere was	5 Huis skoonmaak	6 Bad

Ander [*spesifiseer*]:

……

……

.....

……

……..

3. Sou jy graag die tenk wil hou?

   1 Ja

   2 Miskien/Onseker

   3 Nee

   Hoekom?

   ……

   ……

   …….

4. As iemand sou aanbied om die tenk by jou te koop, sal jy oorweeg om dit te verkoop?

   1 Ja, beslis

   2 Dit hang af

   3 Nee, definitief nie

   Hoekom?

   ……

   ……

   …….

5. Het die tenk al ooit gebreek?

1 Ja

2 Nee

Sou die tenk breek:

5.1. Wat sal jy doen?

1 Dit regmaak

2 Dit nie regmaak nie

3 Ek weet nie

Ander [*spesifiseer*]: ……..

……

……

5.2 Weet jy hoe om dit reg te maak?

1 Ja, ek weet presies

2 Ja, ek weet min of meer

3 Onseker

4 Nee, ek weet nie

5.3 Wat het jy gedoen?

1 Ek het dit reggemaak

2 Ek het dit nie reggemaak nie

Ander [*spesifiseer*]:…..……

……

……

……

5.4 Het jy geweet hoe om dit reg te maak?

1 Ja, ek het presies geweet

2 Ja, ek het min of meer geweet

3 Onseker

4 Nee, ek het nie geweet nie

6. Sou jy graag wil leer hoe om na die tenk te kyk?

   1 Ja

   2 Nee

   3 Miskien/Onseker

7. Sal jy bereid wees om te betaal om die tenk te laat regmaak?

   1 Ja

   2 Nee

   3 Miskien/Onseker

8. Waarom dink jy het die regering huise van tenke voorsien?

……

……

……

……

……

B. TOEGANG TOT EN BESTUUR VAN WATER

1. Gebruik jy die water in die tenk as drinkwater?

   1 Ja, altyd

   2 Ja, soms

   3 Nee, nooit

   1.1. *Indien ja,* behandel jy eers die water?

   1 Ja, altyd

   2 Ja, soms

   2 Nee, nooit

2 Het enige van die inwoners van die huis al enige probleme ervaar met die gebruik van die tenkwater?

   1 Ja

   2 Nee

   3 Weet nie

Indien ja, watter tipe probleme?.....

……

…….

3 Sê asseblief vir my of jy met die volgende stellings saamstem of verskil:

		SSS	SS	O	V	VS	Weet nie	Wil nie antwoord
a.	Vir my huishouding is die prys van munisipale water bekostigbaar	1	2	3	4	5	9	0
b.	Water behoort vir almal verniet te wees	1	2	3	4	5	9	0
c.	Almal behoort vir die munisipale water wat hulle gebruik, te betaal	1	2	3	4	5	9	0
d.	Ons het toegang tot skoon munisipale water	1	2	3	4	5	9	0
e.	Om reënwater op te gaar, is ‘n goeie ding	1	2	3	4	5	9	0

4. Hoe dikwels:

		Nooit	Selde	Soms	Dikwels	Weet nie	Wil nie antw.
a.	stry jy met gesins-/gemeenskapslede oor water?	1	2	3	4	9	0
b.	bekommer jy jou oor ‘n gebrek aan water?	1	2	3	4	9	0
c.	hergebruik jy water?	1	2	3	4	9	0
d.	sien jy diere (soos rotte, katte of voëls) op die dak van jou huis of op die dakke van ander huise in die gemeenskap?	1	2	3	4	9	0

Indien soms of dikwels: watter diere?

……

……

……

5. Kry jy genoeg water van die munisipaliteit om:

		Meer as genoeg	Genoeg	Onseker	Nie genoeg	Glad nie genoeg nie	Weet nie	Wil nie antwoord
a.	te drink?	1	2	3	4	5	9	0
b.	te kook?	1	2	3	4	5	9	0
c.	wasgoed te was?	1	2	3	4	5	9	0
d.	te bad?	1	2	3	4	5	9	0

6. Vul jy die tenk met munisipale water?

1 Ja, dikwels

2 Ja, soms

3. Nee, nooit

C. ALGEMEEN

Is daar enigiets anders wat jy graag vir my wil vertel oor die dinge waaroor ons gepraat het?

……

……

……

……

……

……

D. BESONDERHEDE VAN RESPONDENT

1. Hoeveel mense woon op jou perseel?……..

2. Geslag
   1 Man
   2 Vrou

3. Wat is jou hoogste onderwysvlak?
   1 Geen skoolopleiding
   2 Laer as Graad 5 (Standerd 3)
   3 Graad 5–7 (Standerd 3–5)
   4 Graad 8–11 (Standerd 6–9)
   5 Graad 12 (Standard 10 / Matriek)
   6 Verdere onderwys en opleiding
   7 Hoër onderwys en opleiding

4. Is jy tans werksaam?
   1 Ja
   2 Nee

   Indien ja, hoe is jy werksaam?
   1 Voltyds 2 Deeltyds 3 Op kontrak

5. Hoe oud is jy?
   1 Jonger as 21 2 In jou 20's 3 In jou 30's 4 In jou 40's
   5 In jou 50's 6 In jou 60's 7 Ouer as 69 0 Geen antwoord

Dankie vir jou tyd. Geniet die res van jou dag!

UPHANDO LWEZIMVO ZOLUNTU MALUNGA NOKHONGOZELO LWAMANZI EMVULA EKLEINMOND

IMVUME YOKUZIBANDAKANYA KUPHANDO

Molo!

Ndisebenzela iWater Institute ekwiYunivesithi yaseStellenboch. Ndingathanda ukucela uncedo lwakho kuphando endulwenzela iKomishoni yophando ngezamanzi (Water Research Commission).

Ndifuna ukwazi banzi ngezimvo zoluntu lwaseMountain View eKleinmond malunga nokukhongozela amanzi emvula ngamatanki abawanikiweyo. Ndifuna ukwazi ukuba baziva njani ngamatanki kwaye bawasebenzisa njani. Ndinomdla wokwazi ngalomba kuba ndinomnqweno wokuqinisekisa ukuba urhulumente uyazi ukuba lamatanki ayalunceda okanye awaluncedi na uluntu.

Ndingathanda ukuthetha nawe njengelungu lokuhlala, imizuzwana nje embalwa (15-20 yemizuzu). Ndizakubuza imibuzo ebhalwe apha kuleform kwaye neempendulo zakho ndizakuzibhala kwalapha kuleform.

Oluphando neempendulo zakho aziyi kusetyenziswa gwenxa. Andiyi kuxelela iWater Reseach Institute, iYunivesithi yaseStellenbosch okanye uRhulumente ukuba wena ucinga okanye wenza ntoni ngetanki lakho. Andiyi kubaxelela ukuba wena uziva njani ngetanki lakho kwaye andiyi kubaxelela izimvo zakho malunga nokukhongozela amanzi emvula. Ukuqinisekisa oko, andiyi kulibhala igama okanye idilesi yakho naphina kuleform.

Ungakhetha ukungazibandakanyi koluphando ukuba uyafuna. Ukuba uyavuma ukuthetha nam, wamkelekile, nceda undixelele ukuba kuthe kwakho into engakonelisiyo. Nceda undazise nokuba kukho mbuzo uthile othe awawuthanda. Akunyanzelekanga ukuba uwuphendule umbuzo ongafuni ukuwuphendula, singayeka nanini na uthanda.

Ukuba unayo nayiphi na imibizu okanye kukho nto othe awayithanda kwintetho yethu, nceda uqhakamshelane nam kule nombolo 021 808 2708 okanye utsalele uMichelle De Kwaadsteniet ku 021 808 5803.

Nceda uphawule ecaleni kwalemibuzo ilandelayo: :

Wanelisekile yingcaciso yam?	Ewe	Hayi
Uyazi ukuba akukho namnye umntu, ngaphandle kwam ozakuyazi into esithethe ngayo namhlanje?	Ewe	Hayi
Uyazi ukuba singayeka nanini na uthanda?	Ewe	Hayi
Ingaba ikhona imibuzo onayo phambi kokuba siqale?	Ewe	Hayi
Ndingaqalisa ukukubuza lemibuzo ikuleform?	Ewe	Hayi

Ndimcacisele ngokupheleleyo lowo bendimvavanya malunga neenjono nemiphumela yoluphando. Ndiyakholwa ukuba uyaziqonda iinjongo zoluphando nemiphumela yalo.

Igama lomvavanyi: Dominique Mannel

Isignature yomvavanyi : _____

Umhla: _____

Q. no. | | | |

UHLELO LOVAVANYO

A. IINKCUKACHA NGETANKI

1. Injani imeko yentaki lakho?
   1 Lisebenza kakuhle
   2 Lonakele (liyavuza, lophukile njalo-njalo)
   3 Ayintlanga kodwa ke ayimbanga
   Ukuba lonakele,
   cacisa……

2. Ingaba uyalibenzisa itanki?
   1 Hayi
   2 Ewe

Ukuba uthe ewe:

2.1 Ulisebenzisa entweni itanki (wenza ntoni ngetanki)
   1 Ukukhongozela amanzi emvula
   Okunye [*cacisa*]:
   ……

Ukuba ukhongozela amanzi emvula:

2.1.1 Uwasebenzisa kangakanani amanzi owakhongozela ngetanki?
   1 Yonke imihla
   2 Iintsuku ezimbalwa evekini
   3 Ngaphantsi kweveki
   4 Andikhe ndiwasebenzise

2.1.2 Uwasebenzisa entweni amanzi etanki? [*khetha zonke iindlela owasebenzisa ngayo*]

1 Ukunkcenkceshela	2 Ukupheka	3 Ukusela
4 Ukuhlamba iimpahla	5 Ukucoca endlwini	6 Ukuhlamba umzimba

Okunye [*cacisa*]:
……

3. Ungathanda ukuligcina itanki?

   1 Ewe

   2 Mhlawumbi/Andiqinisekanga

   3 Hayi

   Kutheni usitsho?……

   ……

4. Ukuba kungakho umntu ofuna ukulithenga itanki lakho, ungalithengisa?

   1 Ewe, ndiqinisekile, ndingalithengisa.

   2 Kungaxhomekeka

   3 Hayi, ndiqinisekile, andinakulithengisa

   Kutheni usitsho?……

   ……

5. Lakhe lophuka itanki lakho?

   1 Ewe

   2 Hayi

5 Ukuba lingophuka itanki:

5.1. Ungenza njani?

1 Ndingalilungisa

2 Andinakulilungisa

3 Andazi

Okunye[*cacisa*]:

……

……

……..

5.2 Ungakwazi ukulilungisa?

1 Ewe, ndiqinisekile, ndiyakwazi

2 Ewe, ndicinga ukuba ndiyakwazi

3 Andiqinisekanga

4 Hayi, Andazi

5.3 Wenza njani?

1 Ndalilungisa

2 Azange ndililungise

Okunye[*cacisa*]:

……

……

……

……

……

……

5.4 Wakwazi ukulilungisa?

1 Ewe, ndakwazi

2 Ewe, noko ndazama

3 Andiqinisekanga

4 Hayi, andizange ndikwazi

6. Ungathanda ukufunda ngokunonophela itanki?

   1 Ewe

   2 Hayi

   3 Mhlawumbi/Andiqinisekanga

7. Ungakubhatalela ukulungisisa itanki?

   1 Ewe

   2 Hayi

   3 Mhlawumbi/Andiqinisekanga

8. Ngokubona kwakho, kutheni urhulumente enike umzi ngamnye itanki?……
……
……
……
…….

B. UKUFUMANEKA KUNYE NEMPATHO YAMANZI

1. Uyawasela amanzi etanki?

   1 Ewe, rhoqo

   2 Ewe, ngamanye amaxesha

   3 Hayi, Andizange ndawasela

   1.1. *Ukuba uthe ewe*, uyawagonya kuqala?

      1 Ewe, oko

      2 Ewe, ngamanye amaxesha

      2 Hayi, andikhe ndiwagonye

2 Ukhona umntu apha endlwini okhe wanengxaki namanzi etanki?

   1 Ewe

   2 Hayi

   3 Andazi

Ukuba uthe ewe, nceda ucacise malunga neengxaki ezo……
……
……

3. Nceda utsho ukuba uyavumelana okanye awuvumelani nezimbono:

		SA	**A**	**U**	**D**	**SD**	**DK**	**Andifuni kuphendula**
a.	Ngokwendlu yam, amanzi kamaspala ayafikeleleka	1	2	3	4	5	9	0
b.	Amanzi kufanela ukuba abesimahla kumntu wonke	1	2	3	4	5	9	0
c.	Kufanele ukuba wonke umntu awabhatalele amanzi kamaspala awasebenzisayo	1	2	3	4	5	9	0
d.	Akululanga ukufumana amanzi kamaspala acocekileyo	1	2	3	4	5	9	0
e.	Ukukhongozela amanzi emvula ngumbono omhle	1	2	3	4	5	9	0

4. Zikwehlela kangakanani ezizinto zilandaleyo:

		Azange	**Inqabile**	**Ngamanye amaxesha**	**Ixhaphakile**	**Andazi**	**Andifuni kuphendula**
a.	ukungavisisani nosapho okanye abamelwane ngamanzi?	1	2	3	4	9	0
b.	ukuxhalaba ngokunqongophala kwamanzi?	1	2	3	4	9	0
c.	Ukuphinda usebenzisae amanzi asele esebenzile?	1	2	3	4	9	0
d.	Ukubona izilanyana (ezifana neempuku	1	2	3	4	9	0

	okanye iikati) eluphahleni lwendlu?						

Ukuba uthe ngamanye amaxesha, ixhaphakile okanye rhoqo, zeziphi izilwanyane?

……

5. Umasipala ukunika ngokwaneleyo amanzi oku:

		Ngokwaneleyo		**Andiqinisekanga**	**Akwanelanga**	**Akwanelanga tu**	**Andazi**	**Andisuni kuphendula**
a.	sela?	1	2	3	4	5	9	0
b.	pheka?	1	2	3	4	5	9	0
c.	hlamba iimpahla?	1	2	3	4	5	9	0
d.	Hlamba umzimba?	1	2	3	4	5	9	0

6. Uyawagalela amanzi kamaspala etankini?
   1 Ewe, amaxesha amaninzi
   2 Ewe, ngamanye amaxesha
   3. Hayi, andikhe ndiwagalele

C. OKUNYE

Ikhona mhlawumbi enye into ongathanda ukundixelela yona malunga nalomba sithethe ngawo?

……

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D. IINKCUKACHA ZALOWO EBEVAVANYWA

1. Bangaphi abantu abahlala apha?

……

2. Isini
   1 Indoda
   2 Umfazi

3. Leliphi elona banga liphezulu lemfundo yakho?
   1 Andizange ndiye esikolweniGrade 1
   2 Ngaphantsi koGrade 5 (Standard 3)
   3 Phakathi koGrade 5 no grade 7 (Standard 3-5)
   4 Phakathi koGrade 8 no Grade 11 (Standard 6-9)
   5 Ndafikelela ku Grade 12 (Standard 10/imatriki)
   6 Further Education and Training (uqeqesho oluphezulu)
   7 Higher education and training (imfundo ephakamileyo)

4. Ingaba uyaphangela (uqeshiwe)?
   1 Ewe
   2 Hayi

   Ukuba uthe ewe, usebenza msebenzi mni (intlobo yengqesho)
   1 Full-time 2 Part-time 3 Ikontraki

5. Mingaphi iminyaka yakho?
   1 Ngaphantsi kwe 21 2 20 ukuya ku 29 3 30 ukuya kwi 39 4 40 ukuya kwi 49
   5 50 ukuya kwi 59 6 60 ukuya kwi 69 7 Ngaphezu kwe 69 9 Andifuni kuphendula

Enkosi ngexesha lakho! Ulonwabele usuku lwakho!