Assessing the availability of community water at Madlangamphisi, a community in the Hhohho region of Eswatini

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Abstract— *The research was conducted to assess the availability of domestic water and the extent of the problems associated with water scarcity at Madlangamphisi area in the Hhohho district of Eswatini. The research was a descriptive survey. A questionnaire was used to collect both qualitative and quantitative data for the survey. A total of 169 households out of 300 households in the community were randomly selected to participate in the survey. The majority (56.2%) of the households confirmed that there was water scarcity problems in the area as the streams they used for domestic water frequently dried up during the winter months. The study showed that a majority, 51.5% used water from rivers as the main source of domestic water, while 40.2% of the people travelled for more than 1,000 m to fetch water. To cope with water scarcity problems, 43.2% of the households reduced their water consumption level during droughts while 45% practiced rooftop rainwater harvesting. The study concluded that Madlangamphisi community experienced serious water scarcity problems since they relied on unprotected water sources for domestic use. Moreover, they had to travel for more than 200 m to collect water from nearest sources which is considered an indication of water scarcity by the WHO. The study observed that there was a need to introduce a rural water supply scheme in the area to solve the water scarcity problems and that households should treat water for drinking by either boiling or use a disinfectant to eliminate pathogenic organisms in the water.*

Keywords— Community, water, rural schemes.

I. INTRODUCTION

Water is a valuable life commodity that supports numerous ecosystems. It is however becoming a scarce resource in most parts of the world, partly due to global warming which results to drought conditions and mismanagement by humans (Srinivasan, *et.al.,* 2012). Eswatini is one of the countries that have an average number of water sources which includes dams, rivers, groundwater, wetlands, springs and streams (Manyatsi and Brown, 2009) to name a few, yet the supply of water is insufficient. The reoccurrence of droughts contributes to the problem of water scarcity. Drought is the temporary decrease of the average water availability. It refers to important deviations from the average levels of natural water availability and is considered a natural phenomenon. It is a result of deficiency in precipitation due to different natural causes that includes global climatic variability and high pressure resulting in lower relative humidity and less precipitation (European Commission, 2007).

Drought is divided into four different categories which are; meteorological, agricultural, hydrological and socio-economic drought (Bond and Lake, 2008). A meteorological drought is an extended period, a season, a year or several years of deficient rainfall relative to the statistical multi-year mean for a region. Hydrological drought is the effects of precipitation shortfalls on stream flows, reservoirs, lakes and groundwater levels. Socio-economic drought describes the effects of demands for water exceeding the supply as a result of a water-related supply shortfall. Agricultural drought is the deficiency of soil moisture relative to plant life usually crops. Once a meteorological drought sets in both agricultural and hydrological droughts may follow (FAO, 2012). Eswatini just like other countries is vulnerable to climatic variability, which manifests itself in a number of hydrological disasters including change in the rainfall regimes as well as extreme weather conditions such as drought (Manyatsi *et.al*, 2010).

Over the years Eswatini has been affected mostly by the meteorological drought (Government of Swaziland, 2008). Examples of droughts that have affected Eswatini in the past include the 1983 drought, 1991/1992, 2001/2002, 2005/2007 and the most recent being the 2014/2015 drought whose effects are still being felt in many rural communities (NDMA, 2015). As droughts reduce the amount of rainfall, this has a negative impact on domestic water availability in particular in

many rural areas. The rural areas are the most affected since a large section of its population has no access to adequate portable water supply.

The clean water supply coverage in the form of taps in houses, taps outside houses, community taps and boreholes stood at 33% for the rural population and 84% for the urban population (Manyatsi and Brown, 2009).Rivers and unprotected wells were cited as the main sources of household water for the rural population, with 45% relying on them. Even though these water sources are available their accessibility may differ for each household in the area. According to Ure (2011) nearly a billion people worldwide have limited access to clean water. In developing countries people walk an average of 6 kilometres a day just to collect water.

Madlangamphisi is one of the areas that receive the lowest amount of rainfall in the country. It fluctuates from an average of 600mm-700mm under normal conditions to a low of 500mm-400mm during drought periods (Manyatsi and Brown, 2009). This study reports on the availability, the sources and quality of water in the area and the adaptation strategies implemented by the community during drought periods.

II. MATERIALS AND METHODS

Madlangamphisi is an area in the Hhohho district of Eswatini located at 26°05′22.70″S and 31°32′59.52″E at an elevation of 397 m above sea level. It is a community of about 300 households. A questionnaire was administered to members of the community to help in the collection of both qualitative and quantitative data. A total of 169 households were selected with 95% confidence level and 5% margin of error.

The daily water consumption for the household was estimated using the following equation.

$$Daily\ Water\ Consumption = \frac{Total\ \ amount\ \ used\ \ in\ household\ per\ \ day}{Number\ \ of\ \ people\ \ in\ the\ household} \quad (1)$$

III. RESULTS AND DISCUSSIONS

3.1 Demographic information

The number of people per household (table 1) were categorised into four groups: 1 to 3 people, 4 to 7 people, 8 to 10 people and 11 to 14 people. A majority of the households 46.2% had 4 to 7 family members. This showed a high population density, and this indicated that the area had a high domestic water demand. According to Jaeger et al.,(2012) when the population is high water scarcity arises as the demand grows beyond the available supply and is mainly limited by physical availability of water. The number of people per household was used to calculate the daily water requirements of each of the households.

TABLE 1
THE NUMBER, FREQUENCY AND PERCENTAGE OF PEOPLE PER HOUSEHOLD IN THE SAMPLE SURVEYED (n=169)

Number of people per household	Frequency	Percent
1-3	52	30.8
4-7	78	46.2
8-10	29	17.2
11-14	10	5.9
Total	169	100.0

Figure 1 below is a presentation of the length of stay the households has in Madlangamphisi area. A majority (74%) of the households had been staying in the area for more than ten years, and only less than three percent had been in the area for more than 50 years. This shows that the information provided about the status of water availability or scarcity was reliable, as the people are well versed and have experienced on all water related issues in the area.

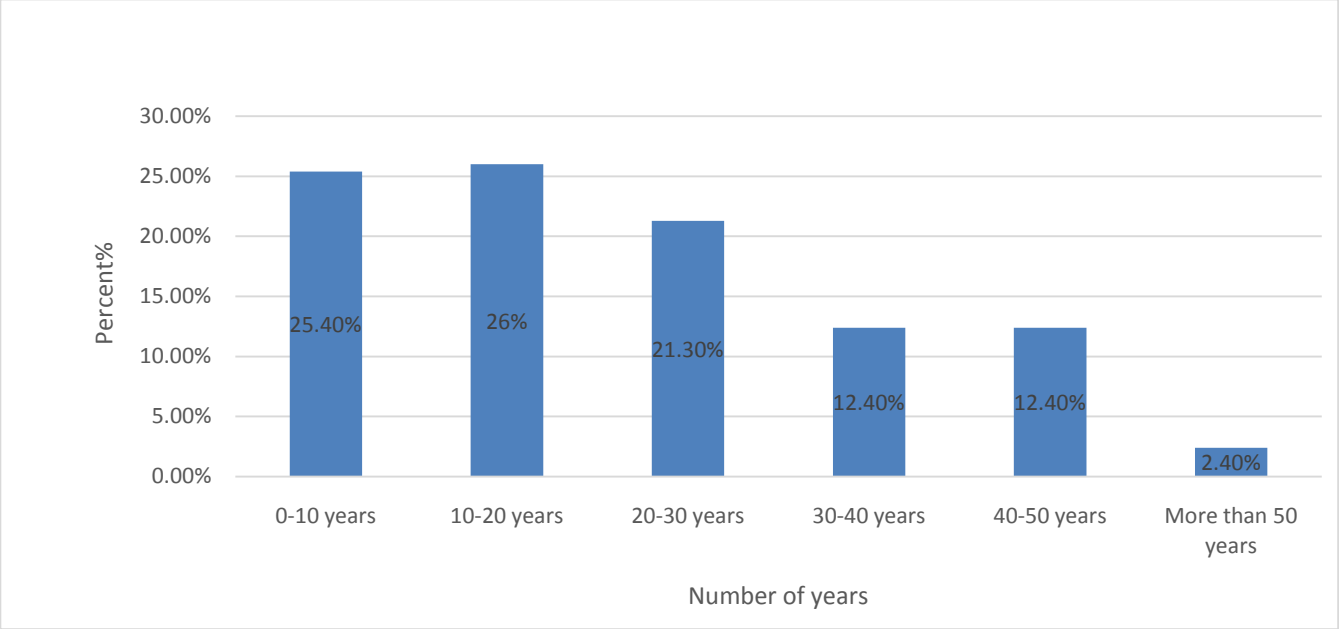

FIGURE 1: Residence time of the households in Madlangamphisi community

3.2 Dominant sources of domestic water for households

Table 2 below shows the various sources of domestic water at Madlangamphisi. The majority 51.5% of the households in the community used the Nkomazi River as their main source of water for domestic use; while 24.9% of the households use a community borehole and 18.3% use harvested rainwater and only 5.3% use seasonal streams. The Nkomazi river and community boreholes were found to be the main water sources. The Nkomazi River was preferred by most of the households since it does not dry up even during dry seasons; hence it is a reliable source of water. Other minor alternative sources of water included buying water from shops specifically used for drinking since it was bought in small quantities.

TABLE 2
DOMINANT SOURCES OF DOMESTIC WATER USED BY MADLANGAMPHISI HOUSEHOLDS (n=169).

Water sources	Frequency	Percent
Borehole	42	24.9
River	87	51.5
Seasonal streams	9	5.3
Rainwater	31	18.3
Total	**169**	**100.0**

Although some of the households used harvested rainwater and streams, they still depended on the community borehole and the Nkomazi River since they could not depend on the unreliable rainfall. The results showed that a majority (56.8%) of the households relied on unprotected water sources, as their main water sources are river and streams. Water from these sources particularly the river and seasonal streams was exposed to contamination owing to the fact that surface water sources were prone to being polluted. This means that the households were more vulnerable to infection by waterborne diseases.

3.3 Accessibility of water sources

Table 3 shows the distance walked by the households to the water source. The distances from the households to the main water sources were divided into seven categories: within homestead yard, outside homestead yard less than 50 m, 50 m - 100 m, 100 m - 200 m, 300 m - 400 m, 500 m - 1000 m and more than 1000 m. The results showed that 40.2% of the households were located more than 1000 m away from the main water source and these were mainly the households that sourced their

water from the Nkomazi River. Furthermore, 17.2% of the households were located 500 m -1000 m away from the main water source. Some of these households collected water from the river, boreholes and seasonal streams. Only 11.2% of the households were located 300 m - 400 m away from their main water source while 8.9% were 100 m - 200 m away from water source, and 1.2% of the households walked for 50 m - 100 m to the main water source.

TABLE 3
THE DISTANCE WALKED BY HOUSEHOLDS TO WATER SOURCE (n=169).

Distance	Frequency	Percent
Within homestead yard	31	18.3
Outside homestead yard, less than 50m	5	3
50m - 100m	2	1.2
100m - 200m	15	8.9
300 m - 400m	19	11.2
500m - 1000m	29	17.2
More than 1000m	68	40.2
Total	169	100.0

This means, only 3% of the households had their main water source outside the homestead yard which was less than 50 m. However, 18.3 % of the households had their water sources within the homestead yard. These were the households that depended on rainfall water as a main water source, which requires collection and storage within the homestead yard. This mean only 31.4% of the community had accessible water sources, based on the 200 m walking distance stipulated by WHO as the measure of water accessibility.

3.4 Time spent collecting water

Table 4 shows the time spent by the Madlangamphisi community when collecting water. The results show that 50.9% of the households walked for more than one hour to fetch water. According to the WHO guidelines, people that walk for more than 20 minutes to fetch water were faced with water scarcity. In the community 76.9% of the households had water scarcity problems as they walked for more than 20 minutes to collect water.

TABLE 4
THE TIME SPENT BY THE MADLANGAMPHISI COMMUNITY WHEN COLLECTING WATER (n=169).

Time spent collecting water	Frequency	Percent
Less than 20 minutes	39	23.1
Between 20 and 30 minutes	21	12.4
Between 30 and 60 minutes	23	13.6
More than 60 minutes	86	50.9
Total	169	100.0

3.5 The means of collecting water commonly used at Madlangamphisi

Table 5 shows the means of collecting water from the various sources used by the Madlangamphisi community. The study found that 6.5% of the household used vans to collect water from the river since it was too far to walk while 43.8% used tractors. These were mostly the households that would walk for more than 30 minutes to collect water. However, 49.7% of the households walked to the water source since they had no better means of collecting water. The distance travelled to collect water seems to have an effect on the amount of water collected (Table 7), the method of collection and the type of

container used for collecting the water (table 6). The longer the distance travelled to collect water, tractors and vans are used as means of collecting the water.

TABLE 5
MEANS OF COLLECTING WATER FROM THE VARIOUS SOURCES USED BY THE MADLANGAMPHISI HOUSEHOLDS (n=169).

Means of collecting water	Frequency	Percent
Van	11	6.5
Tractor	74	43.8
Walking	84	49.7
Total	169	100.0

Only 34.9% of the households collected their water once a month this was because they hired tractors to collect the water and fill a 5,000 litres tank. The households were then able to use this water for cooking, drinking, cleaning, bathing and even for the laundry. The frequency of water collection depended on the distance travelled to collect water and the number of people using the water on a daily basis.

Households within the same homestead mostly shared the water from the 5,000 litres tanks which made water collection more frequent. The 31.9% of the households that fetched water on a daily basis were the households using seasonal streams and boreholes as their main water sources because they travelled less than 1,000m to fetch the water. Moreover 6.6% of the households fetched their water on a weekly basis. These were the households that used vans as their means of collecting water. Lastly 18.3% of the households collected rainwater and stored it in tanks when it rained. The frequency of water collection indicated that 34.9% of the households used water that was stored within their homesteads. This meant that they did not get fresh supply of water on a daily basis. This showed that the water sources used were not accessible to the residents, thus requiring the households to store the water within their homestead yards for easy access.

3.6 Water collection and storage facilities commonly used by Madlangamphisi households

The majority 59.2% of the households used tanks to collect and store water. The rest of the households 40.8% used from 5 to 200litres containers to collect and store water. This reduced the risk of using contaminated water since the water in these containers was in small quantities and was mostly used up in a day. According to Chakraborty (2017) households that store water within the household are faced with the problem of water scarcity and there is high risk of the water becoming contaminated. The contamination is caused by the biological reaction of the water due to temperature changes and growth of microbes since the water is stagnant, therefore these families are at high risk of falling sick due to storing of untreated water for long periods.

TABLE 6
THE TYPES OF CONTAINERS USED BY THE COMMUNITY PEOPLE TO COLLECT WATER (n=169).

Type of containers used	Frequency	Percent
5 liter containers	1	.6
20 liter container	43	25.4
25 liter container	23	13.6
200 liter container	2	1.2
Tanks	100	59.2
Total	169	100.0

3.7 Level of domestic water sufficiency

The table indicates the amount of water collected and used by each person in the household per day. This water use included cooking, bathing, drinking and cleaning. The average water consumption/capita/day was categorised into 3 groups: less than 20 litres, 20 litres to 30 litres and 30 litres to 40 litres. The table shows that a majority 59.8% of households, used less than 20 litres of water per capita per day. This was proof that these households were faced with water scarcity problem.

TABLE 7
AMOUNT OF WATER USED PER DAY (n=169).

Water collection and use		Frequency	Percent
Amount of water collected	20 litres	4	2.4
	40 litres	41	24.3
	60 litres	55	32.5
	More than 100 litres	22	13.0
	50 litres	19	11.2
	80 litres	28	16.6
	Total	169	100.0
Water consumption/capita/day	Less than 20 litres	101	59.8
	20 litres - 30 litres	59	34.9
	30 litres - 40 litres	9	5.3
	Total	169	100.0

According to WHO, each person should at least use 30 litres of water per day for good health and cleanliness, only 5.3% of the households used from 30 litres to 40 litres of water per capita per day. These showed that 94.7% of the people are at risk of falling sick as a result of poor hygiene and sanitation, caused by inaccessible water sources.

3.8 Challenges of water scarcity

The study revealed that due to hydrological drought conditions the levels of the main water sources were reduced (table 8). A majority, 56.2% of the households agreed that hydrological droughts were experienced annually in both the dry and wet seasons. This was because the area normally receives a low amount of rainfall making it hard to provide the households with sufficient domestic water. However, 43.8% indicated that the hydrological drought only occurred in the winter season when there was no rainfall; these were probably the households who depended on seasonal streams as their main water source.

TABLE 8
PERCEPTION OF HOUSEHOLDS ON THE OCCURRENCE OF HYDROLOGICAL DROUGHT (n=169).

Water shortages		Frequency	Percent
Frequency of hydrological drought	During the winter season	74	43.8
	Every year in both dry and wet seasons	95	56.2
	Total	169	100.0
Does water source dry up	Yes	54	32.0
	No	115	68.0
	Total	169	100.0

Furthermore, 32% of the households alleged that their water sources were unreliable since they often totally dried up. These are the households using seasonal streams and rainwater as their main water sources. The results indicate that the community experienced water shortages, mostly in the dry seasons when there is no rainfall due to drying up of the main water sources; hence residents were faced with water scarcity.

3.9 Other challenges

There is many other problems people face when there is water shortage in a community. These were separated into four categories (table 9), 1) decrease in water consumption level, 2) travelling long distances to collect water, 3) using untreated water and 4) the outbreak of waterborne diseases. A majority of the households 43.2% are forced to reduce their water consumption level, making them to use less than 30litres/capita/day. 20.7% have to travel long distances to fetch water, this are the households that hire tractors or use vans to collect water from water sources. The use of untreated water stands at 28.4% and it is the main cause of waterborne disease outbreak which is at 7.7% as the water may contain contaminants.

TABLE 9
CHALLENGES FACED BY THE COMMUNITY DUE TO WATER SCARCITY (n=169).

Problems of water scarcity	Frequency	Percent
Decrease in water consumption level	73	43.2
Travelling long distances to get water	35	20.7
Using untreated water	48	28.4
Outbreak of water borne diseases	13	7.7
Total	169	100.0

3.10 Sharing of water sources

A large number of the households 55.6% used water sources that were shared with other communities (table 10). According to Eckstein (2009) the explosion of population in developing nations within Africa combined with climate change is causing strain within and between nations. As a result of the strains there are conflicts that may spark within a community and between communities. Even though some of the water sources were shared, the sharing of the water sources had not led to conflicts in the past to the present date at Madlamngamphisi. This however, may not be guaranteed to the future.

TABLE 10
PROBLEMS CAUSED BY SHARING WATER SOURCES (n=169).

Sharing of water sources		Frequency	Percent
Is water source shared	Yes	94	55.6
	No	75	44.4
	Total	169	100.0
Does the sharing cause conflicts	No	169	100.0

3.11 Strategies used to cope with water scarcity problem

The strategies that were used to cope with water scarcity problems are summarized in table 11 and included: 1) water recycling, 2) rooftop water harvesting 3) buying water from shops, 4) water rationing and 5) the construction and rehabilitation of boreholes. Only 45% of the households practiced rooftop water harvesting. They argued that dust contaminated the water thus treatment measures were needed to make the water safe for domestic use. Water rationing was only done by 36.1% of the households and the limitation of water rationing and recycling was failure to maintain pumps. Another strategy included the construction and rehabilitation of boreholes and 11.8% of the households considered this. However, its limitations included the absence of expertise to implement. The bore holes were sometimes vandalised making it expensive to maintain. Furthermore, 4.1% of the households alleged that they bought water from shops this water was used for drinking since the water from their main water source contained sediments making it unsafe for drinking. Water recycling was used by 3% of households by reusing water used for washing dishes to clean.

TABLE 11
STRATEGIES USED TO COPE WITH WATER SCARCITY (n=169).

Strategies to cope with water scarcity		Frequency	Percent
Strategies used	Water recycling	5	3
	Rooftop water harvesting	76	45.0
	Buying water from shops	7	4.1
	Water rationing	61	36.1
	Construction and rehabilitation of boreholes	20	11.8
	Total	169	100.0

3.12 Materials used for rooftop water harvesting

The households were asked on the materials used to harvest rainwater (figure 1), 66.9% of the population use iron sheets, tanks and gutters to harvest water. These were mostly the households that used river and rainwater as their main water source, because they already own tanks which they used for storing the water.About17.8% use iron sheets and 210litre oil drums and 15.4% use iron sheets and buckets. The households that use 210litre oil drums and buckets are mostly the households that use boreholes since they have no plastic tanks. A majority uses plastic tanks and irons sheets, because the people wanted to harvest and store more water.

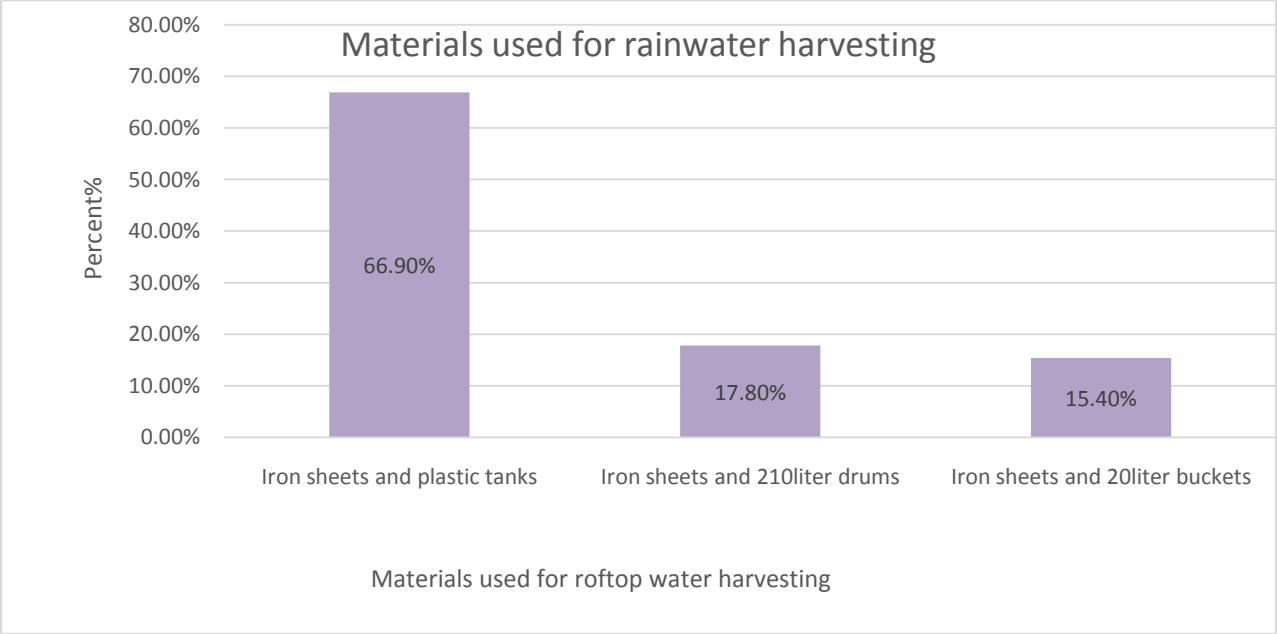

FIGURE 2: Materials used to harvest rainwater

3.13 Water rationing and the levels at which it is implemented

The households were asked as to whether they practice any form of water rationing (table 12). Water rationing defined as limiting the amount of water use in the household due to concerns of scarce water supply. It is practiced at household and community level. Only 36.1% of households practiced water rationing at household level. It was done by allowing each household to fetch a specified water amount per day. However, 63.9% of the households did not comply with water rationing practice. The households alleged that water rationing would cause a reduction in their water supply which would result to poor hygiene. The failure to comply with water rationing by the majority of the households could further exacerbate the water scarcity problem.

TABLE 12
LEVEL OF WATER RATIONING AND HOW IT IS IMPLEMENTED (n=169).

Water rationing		Frequency	Percent
Level at which rationing is done	Homestead level	61	36.1
	Not done	108	63.9
	Total	169	100.0
How rationing is done	Allowing each household to collect specified water amount per day	61	36.1
	None	108	63.9
	Total	169	100.0

IV. CONCLUSION

The results of the study show that there is a water scarcity problem at Mandlangamphisi. The only available reliable source of safe drinking water was the borehole which supports 24.9% of the households. The prevalence of hydrological droughts results in the drying up of several water sources, forcing the majority 56.8% of the households to rely on unprotected water sources which included the Nkomazi River and other small seasonal streams. These water sources are unsafe for domestic use without treatment. Most of the water sources were inaccessible as the majority 68.6% of the households travelled for more than 200 m to collect water, with 76.9% of these spending more than 20 minutes. The WHO, affirms that persons who travel for more than 200 m and spend more than 20 minutes to collect water are facing water scarcity. The majority, 65.1% of the households used less than 30 litres/person/day of water a further indication of water scarcity.

The strategies used to cope with the water scarcity problem in the area were found to include rooftop water harvesting, water rationing and purchasing bottled water for drinking. A majority of which are unsafe without treatment.

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