

Albert Ludwigs University
Institute for Culture Geography



Final Project Report: Water consumption at household level in Windhoek, Namibia

Survey about water consumption at household level
in different areas of Windhoek depending on income level and
water access in 2010

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SDFN & NHAG



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Abstract

The arid climate and the annual fluctuating rainfall regimes in many regions of Namibia form the basis of the problem of ensuring safe and continuous water supply for the Namibian population. In poor urban regions water supply remains a special problem. As an example Windhoek, the capital of Namibia was studied.

Some areas of Windhoek are growing very fast, especially the low-income informal settlements in north-western Windhoek, where people settle themselves outside of the formal, serviced areas of the City. Here the supply of water is a problem. As no layouts exist for these areas and houses are built randomly, services are normally provided almost as an emergency measure and at minimum levels of coverage. However, water supply for the whole population will also become a problem in the coming years.

Against the background of climate change and the expected changes in supply and demand for potable water, this survey can contribute towards attaining the millennium development goal of *“halv[e]ing the proportion of the population without sustainable access to safe drinking water”* by investigating the demand for water of different sections of the population. The report supplies interested parties with detailed information about the daily water consumption at household level in different parts of Windhoek. It focuses on the purposes water is used for in households as well as on the access to water especially in the informal settlements.

1. Introduction

Windhoek is a city of local disparities. The northern part of Windhoek - housing the old township Katutura, Goreangab, Wanaheda and the northwestern suburbs - is the historical area of mostly black people with low incomes. It is in this section of Windhoek that so called informal settlements, characterized by informal structures are found. In these suburbs, there are large areas of formal plots with formal housing and individual service connections for water, sewer and electricity. There are however an approximate number of 100 000 people living in informal corrugated iron shacks, on land that has not been subdivided and is serviced by low density communal services and in some cases, no services. Some of the people in these areas live under the absolute poverty level. They earn less than 1 US\$ per day.

In contrast, the central and southern parts of Windhoek including the central business district are areas of people earning middle to high incomes. Here, big mansions and malls are situated. These areas are firmly based on industrial and western standards. Those conditions also are valid for water consumption. The state of development of an area can be recognized by its water consumption profile. This is the major thesis of this article. By investigating a population major needs and potential based on its water consumption, it may help to ensure a safe and sustainable water supply and basic sanitation for all people of Windhoek.

This topic is of great importance taking into consideration the challenges Namibia faces like climate change. A growing population, not only by natural growth but also through migration from the north of Namibia with concentration in urban centres adds to increasing demand for water. Cities situated in countries faced with changing climatic conditions face intensified water stress.

2. Targets

It is common knowledge that the City of Windhoek (CoW) has information about water consumption for households, however, the main question, this report aims to answer, is:

“For what purpose exactly is water used for on a daily business in different households depending on income level?”

Out of the data which is collected, the following points will be worked out.

2.1. Water consumption depending on income level

Examining the water consumption levels of several households of different financial backgrounds, distributed between different development levels within Windhoek shall help to compare their daily water consumption patterns. This survey will contribute to improve water supply for all citizens of Windhoek. It is aimed at setting up characteristic water consumption profiles of each income level.

2.2. Specific purposes for which water is used

The City of Windhoek (CoW) already has data about the amount of water used by each household. This data is available from monthly water bills. There is no information about the purposes for which the water is used. For what purposes do people use the most water for, and where would water be saved first, are questions which are unanswered as yet. With this data it will be possible to examine potential uses of water where savings could be made, and create potential indicators for areas of improvement.

2.3. Evaluation of Windhoek’s water supply

Depending on area of residence, different water access systems can be found. There are differences in the size, quality, number and age of pipes. All these factors influence the water supply and therefore the water consumption as well. In the high and mid income areas (see chapter 3.1) every house has its own water access point.

The houses are equipped with taps in the kitchen, bathroom and sometimes more taps in the garden or at the pool area. In low-income areas, less taps are installed and in the informal settlements there are sometimes no private taps at all. A major question is how the type of water access influences water consumption, and whether the water supply system provides every citizen with enough water. Is there room for improvement and where are improvements urgently needed to ensure access to clean water for citizens?

2.4. Approaches

The fourth goal of the survey is to develop approaches where they are needed and as far as this survey can offer them. This will be e.g. perspectives on how to ensure water supply for a growing and developing population. To improve water supply especially in informal settlements and low-income areas is another challenge which needs to be solved. A warming climate with rising variability in precipitation and a growing population make it necessary to develop approaches for saving water and improving efficiency of water use in their daily business at household level.

3. State of knowledge

3.1. Windhoek

Windhoek is placed between 1625 and 1725 m above sea level in the center of Namibia. It is surrounded by Eros-mountains in the east, Auas-mountains in the south and Khomas-highland in the west and north (Diercke, 2008). With a population of 337,995 people in 2009 and a growth rate of about 4.73% (Maanda a. Vernouman, 2009), Windhoek has a growing water demand but only limited water sources. The city is facing the problem of ensuring continuous water supply for its population in the next years.

3.1.1. Climate

Namibia is the driest country south of the Sahara. It contains a semi-desert, the Kgalagadi and the Namib Desert, which is the oldest desert in the world. Namibia's capital has an arid desert climate and an average temperature of 20.1°C over the year. During the months August to November there is a high incidence of wind. In addition to that, Windhoek, like the whole country has a very fluctuating annual rainfall regime (Figure 1) with an average rainfall of 369 mm per year (CoW). This type of rainfall regime is typical for an arid climate. The rainy season is from January to March/April and the potential evaporation rate is about 3500 mm/m² per year. In summary a relative small amount of rain falls in the rainy season. Also a lot of the water evaporates almost immediately due to high temperatures during that time of the year. The high evaporation, which is caused by high temperatures, constantly blowing wind and low average humidity of about 30%, makes it hard to save water in reservoirs, although reservoirs are the main freshwater source for Windhoek.

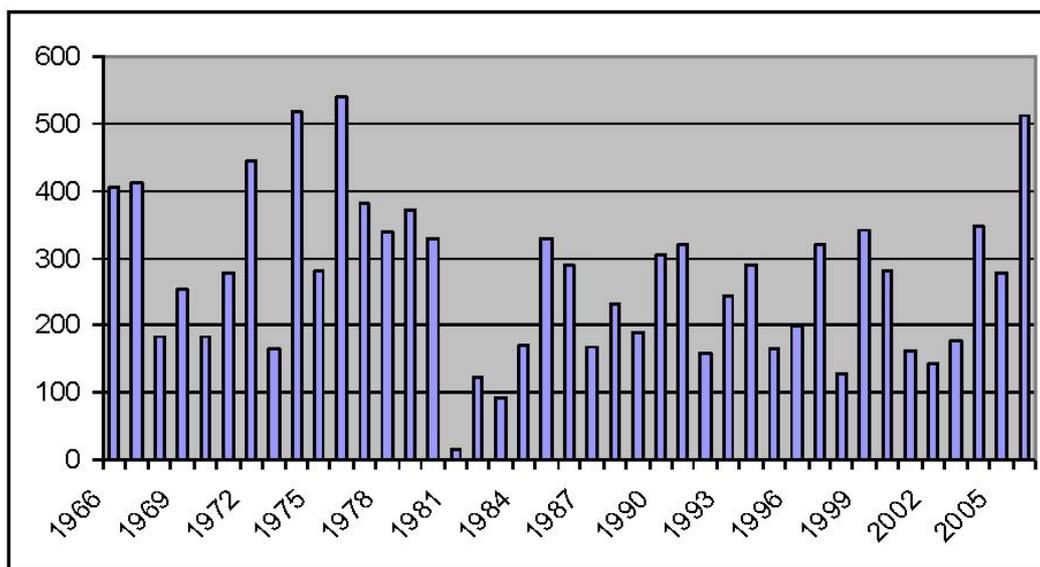


Figure 1: Annual rainfall of Windhoek from 1966 until 2007

(Source: Ministry of Works and Transports, Meteorological service division 2010)

3.1.2. Population

Windhoek consists of several areas with different ethnic groups, different income levels, and living conditions. In the northern areas - Okuryangava, Havana and Hakahana - live the poorest people of the town. In this report we call the northern suburbs, indicated in red in Figure 2, “informal settlements”. Although a lot of these people had originally settled themselves informally, many have been “formalized” by the City rearranging the layouts to allow the creation of formal residential blocks and in some cases formal plots. These people are no longer informal, but still live in informal corrugated iron shacks and their living conditions are mostly like the conditions in informal settlements. Katutura which is next to the informal settlements was 10 km away from Windhoek at the time of its establishment. Today it is part of Windhoek which shows how fast the city has grown. There are five main ethnic groups in Katutura as well as in the whole town: Damara, Nama, Herero, Ovambo and Afrikaans. Afrikaans here means people who are originally from South Africa including black, colored and white people. Katutura is the low-income area coloured yellow in Figure2.

The areas around Khomasdal are classified as the middle-income areas and are indicated in green on Fig 2. To the south and east of the Central Business District (CBD) are the high-income areas coloured in blue in Figure 2. Quite a substantial

part of the white population of Windhoek is of German origin and is found mostly in the high-income areas.

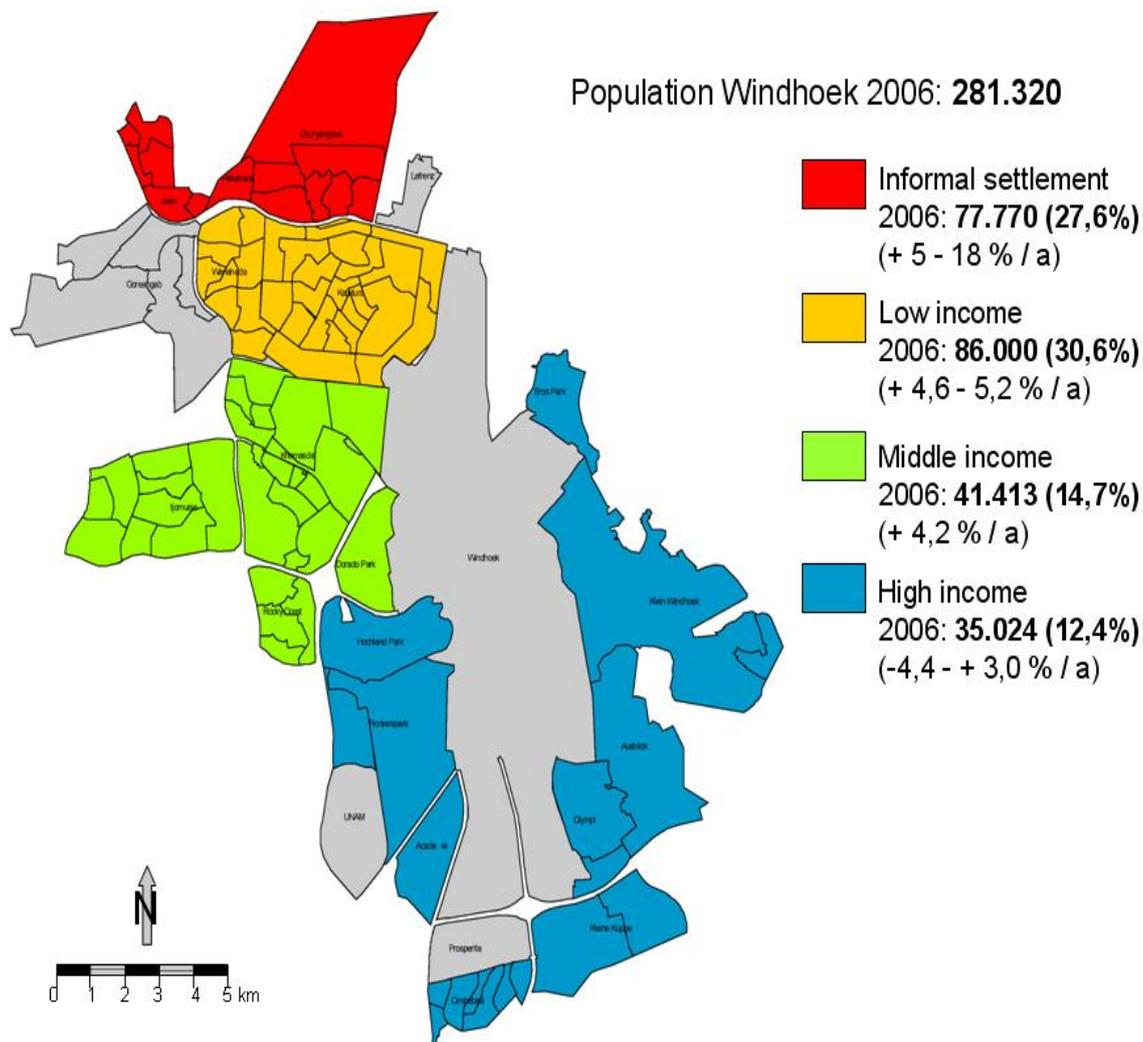


Figure 2: Population of several areas, Windhoek 2006
(Map Source: CoW 2010, edited by T. Uhlendahl)

As shown in Table 1, it is remarkable that almost two-thirds of Windhoek's population is living in the informal settlements and the low-income areas. These are also the areas with the highest growth rates in town. The city of Windhoek had a population of 337,995 people and a growth rate of about 4.73% in 2009 (Maanda a. Vernouman, 2009). The figures for 2009 are estimated based on a measured growth rate between 1991 and 2001. The last census in Windhoek was done in 2001. Today, the informal settlements and the low-income areas have already surpassed the 100,000 population threshold.

Table 1: Population growth of Windhoek 1995-2006, separated in different areas (Source: CoW)

Windhoek Population, 2006				1995 Population	Growth rate (1995-2006)
Urban Locality	Households	Population	Avrg HH Size		
Academia	653	2 391	3.7	2 603	-0.77%
Auasblick **	67	293	4.4	-	
Cimbebasia **	710	2 635	3.7	-	
Dorado Park	1 181	5 062	4.3	1 620	10.91%
Erospark	535	1 604	3.0	2 616	-4.35%
Goreangab	3 943	18 004	4.6	6 850	9.18%
Hakahana	1 973	8 870	4.5	4 210	7.01%
Havana	4 879	15 701	3.2	2 527	18.06%
Hochland Park	1 700	6 834	4.0	4 920	3.03%
Katutura	12 912	66 690	5.2	53 205	2.07%
Khomasdal	5 852	24 759	4.2	18 825	2.52%
Klein Windhoek	2 874	7 561	2.6	6 263	1.73%
Kleine Kuppe **	685	1 773	2.6	-	
Okuryangava	13 749	53 199	3.9	29 073	5.65%
Olympia	999	3 048	3.1	3 326	-0.79%
Otjomuise	1 684	6 956	4.1	1 885	12.60%
Pionierspark	2 559	8 885	3.5	7 076	2.09%
Prosperita* **					
Rocky Crest	1 080	4 636	4.3	110	40.51%
Wanaheda	4 213	19 309	4.6	12 930	3.71%
Windhoek	6 524	21 089	3.2	20 587	0.22%
Brakewater	621	2 021	3.3	3 070	-3.73%
	69 393	281 320	4.1	181 696	4.05%

3.1.3. Water supply in Windhoek

Windhoek is provided with water from three different main sources. 17 Mio m³ of the water demand is covered by dams around Windhoek from NamWater. First to mention here is von Bach dam, which also receive water from Swakoppoort dam and Omatako dam. Another source is Goreangab Reclamation Plant producing 5.4 Mio m³ and Windhoek boreholes water which provides between 1 and 2 Mio m³ of Windhoek's water demand (HRDC, 2007). The amount of water, which is available for Windhoek, is very limited. The rainwater is inefficiently stored in open surface reservoirs with high losses because of high evaporation rates. The reclaimed water

from the world's oldest direct reclamation plant is of very high quality and is used as a blend with water from the dams. As shown in figure 1 the annual rainfall is highly fluctuating and the recharge of the dams is depending on the average rainfall of 369 mm per year. A lot of water in the dams gets lost due to evaporation (about 3400 mm p.a.). Windhoek currently needs 22.6 Mio m³ water per annum. In fact there is not much more water available to satisfy the city's increasing demand. But this is exactly what is taking place in the low income parts of Windhoek like Katutura and Okuryangava including the northwestern suburbs which are growing very fast. Havana for example has a growth rate of 18.06% (tab. 1). The city's growth is only one problem which makes the water supply more difficult. The other issue and probably the bigger one is the uncontrolled development of the informal settlements and the low-income areas which will cause, an up to now unquantified increase of Windhoek's required amount of water (Figure 2).

3.1.4. Water access

Depending on the areas of Windhoek, different kinds of water access are installed. In the high- and mid income areas, individual household water access points are the norm. In the formal low-income areas, every plot has a private water connection, or such connection is available. Some access is discontinued due to non-payment.

In the informal settlements there are mainly three different kinds of water access points. The first one, which is also the most common one is an official tap linked to a pre-paid card system. Everyone with such a pre-paid card is able to buy water at these public water access points (WAP). The municipality sells the cards which can be recharged over and over again. The second one is a similar tap but it is placed among a group of houses, called a housing group. This tap is only for a defined community. Everyone of the community can get water at this tap. The tap is metered and one person in charge gathers the money from the community members and is responsible to pay the water bills. In areas like Greenwell Matongo, there communal taps where people who pays rent to the City can have access to water and payment is recovered from the rental paid. This is the third type of water access existing in informal settlements.



Picture 1: Community tap in upgraded informal settlement
(Source: CoW, picture taken by Maanda, 2004)

The distance between houses and community taps as well as to public taps can differ a lot but it is aimed to be less than 75 meters walking distance. Though on average the distance between public taps and houses linked to such taps is longer and the number of people using public taps is much higher than at community taps.

3.2. Water consumption per capita

The City of Windhoek, based on its own data, estimates the annual water demand at 22.6 Mio. m³ per year. This figure includes water demand of the whole city, including industries and the CBD. The calculated water demand per capita per day based on data of CoW is about 200 liters including industrial water use and tourism. In Chapter 5 another calculation for Windhoek's water demand, based on data of the research, is presented. It shows the water demand of each research area in detail.

4. Research design

4.1. The standardized questionnaire

For this survey a standardized questionnaire was developed. A copy can be found in the appendix. A standardized questionnaire as research tool was chosen to guarantee similar data collection by several interviewers. It was important that the collected information be comparable. The research cooperation partners aimed to collect 1000 questionnaires in four different parts of Windhoek (each about 250). Examined areas were chosen due to different income levels and living conditions. The areas are shown in Figure 2.

The first part of the questionnaire (see Appendix 1) containing questions one to seven deals with the kind of water access and the amount of money which is paid for water per month. Question four (decrease the used amount of water if shortage of water and/or money) was placed in this part because during pretests it turns out that this question is very difficult to answer for a lot of people. Actually question four would fit in part two, which broaches the issue of water usages and items existing in the households. But part two already contains - question eleven (For what purpose do you spend much/the most water?) - another complex question. Hence, the two most difficult to answer and most complex questions were separated and placed in different parts in the concept of the questionnaire. The third paragraph is about the awareness of Windhoek's population about water, its sources and their opinion about the current water supply situation. The last part aims to get basic information about the households of interviewed people. This part contains the most sensitive question. Questions about income like number 16 are always uncomfortable to answer and therefore asked at the end of an interview situation.

4.2. Research application flow

On the 18th of February 2010 the survey was started. After several meetings with the cooperation partners, the research setup was developed. The main subjects were:

- Collect 1000 questionnaires in four different areas, 250 in each area.
- Questionnaires shall be worked out personally in a short interview and not be given away.
- One questionnaire will be used for the whole of Windhoek.
- Data will be collected by going from house to house.
- Six weeks are scheduled for fieldwork from 15th of March till 26th of April.
- Fieldworkers are two volunteers from HRDC, two students from Polytechnic of Namibia and one HRDC trainee from Albert-Ludwigs University Freiburg, Germany.

The fieldwork started on the 15th of March 2010. Informal settlements and low-income areas were visited first. Up to the 5th of April the targeted number of questionnaires was collected in the informal settlements and in low income areas. The questionnaires were completed during personal interviews by going from house to house in these areas.

Reaching the mid and high income areas, it became very difficult to get contact with people inside the houses. Reasons for that being the higher the income and the better the living conditions are, the better houses are protected by walls and gates. The most houses in these areas are locked up for safety reasons, which made it impossible to get in contact with people inside the houses. The second reason, which made it difficult to collect data in the way it was done in the other areas, was that many people are at work during the day-time. Usually they get back home at 5pm. In Namibia sunset is around 6pm. After sunset it is too dangerous to walk around and try knocking on doors in some areas. Furthermore one hour per day is not enough time to collect the targeted number of questionnaires.

Facing these problems it was decided to distribute questionnaires to pupils in schools in the earmarked areas. The plan was that the pupils would take the questionnaire home and work on them with their parents. Afterwards they would be collected from their schools. This way worked more or less well depending on the different schools.

There were return flow rates from 0 up to 80 %. During distributing and collection of questionnaires, the data from the informal settlements and low-income areas were coded and entered via Excel. On the third of May the field work was completed and the data was entered in Excel. After seven weeks of fieldwork 949 questionnaires were collected (260 in informal settlements, 265 in low-income areas, 247 in mid income areas and 177 in high income areas).

4.3. Analysis

The data was analyzed by using SPSS. In Windhoek the information was entered in Excel because SPSS was not available. In Freiburg, the data was exported from excel into SPSS. It was split into the four areas and analyzed separately. The data about informal settlements was split up again into three different parts due to different types of water access. The results can be compared easily and are presented and discussed in Chapter 4. The analysis was completed at the Institute for Culture Geography of Albert-Ludwigs University Freiburg.

5. Results – water consumption Windhoek

In this chapter the results of the survey are presented and discussed. The first part shows basic information of all four research areas. Major differences between several parts of Windhoek will be highlighted. In the second part special results and information about different areas are discussed and analyzed. The main aspects are saving water, purpose for which most water is used, and vulnerability of households in study areas. In the last chapter, especially disparities inside the informal settlements as well as disparities between informal settlements and low-income areas are investigated. All information, graphs and figures presented in this chapter are based on the collected data during the fieldwork and on data provided by City of Windhoek.

5.1. Basic data Windhoek

Using data mainly from the last part of the questionnaire, background information about the four research areas will be presented below. Background information contains monthly income, water consumption, ethnic constitution and type of water access. Based on this information the areas will be compared in Section 5.2.

5.1.1. Monthly income

Inside Windhoek there is a wide range of income levels. In high income areas like Klein Windhoek, Eros, Olympia or Academia about 60 % of the households earn 15.000N\$ or more per month. This means about 1,600 € or around 2,000 US\$. Comparing to the high income areas, over 36 % of the households in informal settlements have less than 600 N\$ available per month. This figure seems to be very low and might result from the fact, that household income is often under reported for fear that service cost would increase if people are deemed to earn more. But calculating with an average household size of 5 persons, adding the current population with over 100,000 people in the informal settlements (Maanda a. Vernouman, 2009) and the 36.76 percent with less than 600 N\$ per month, it turns out that more than 30,000 people in the informal settlements, are living under the

absolute poverty level with less than 1 US \$ per capita per day. Below, the income distribution of each area is shown. It is clear to see, that the pre defined income areas were chosen very well. Over more Figure 4 highlights the strong disparities, existing within Windhoek.

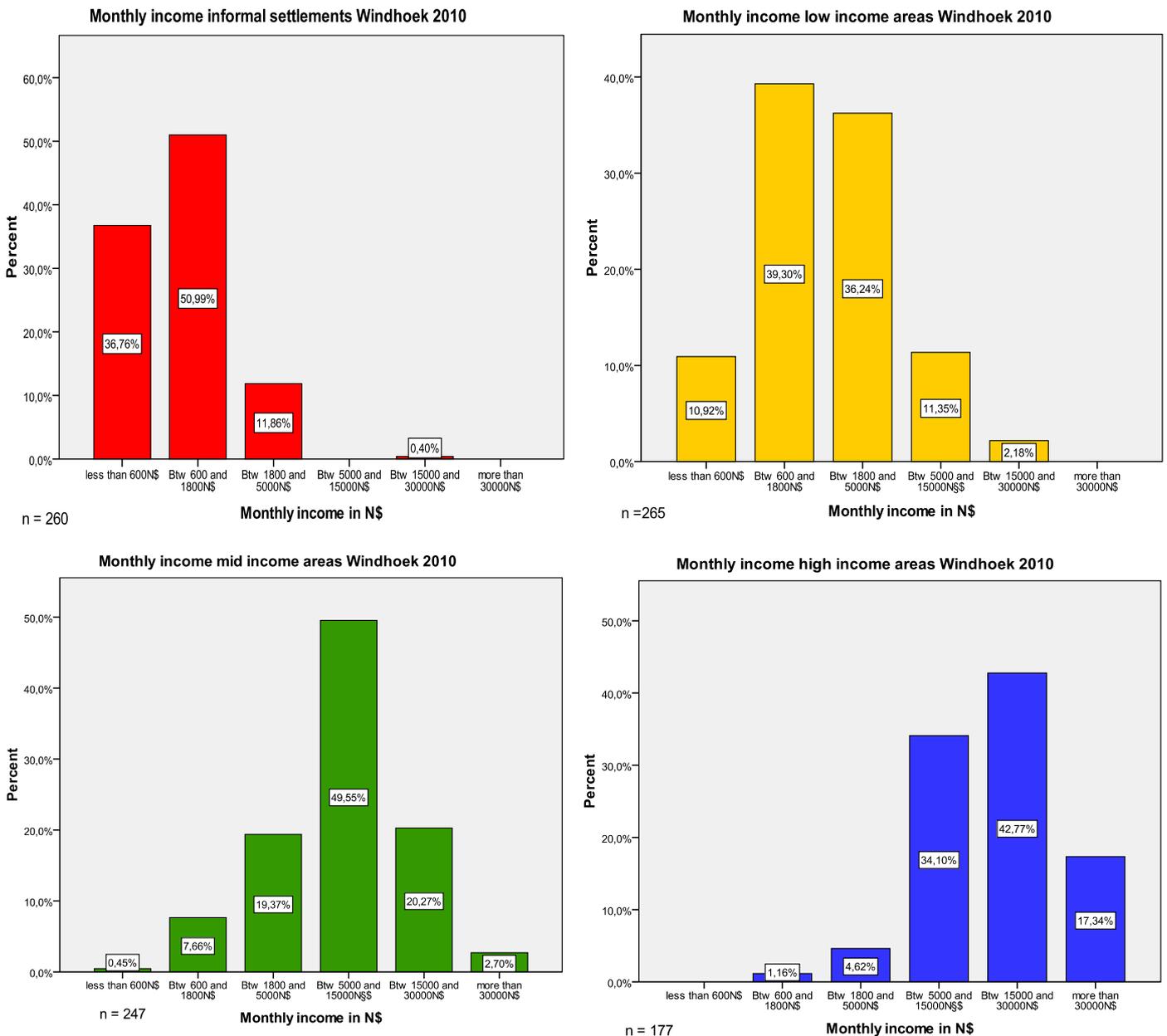


Figure 3: Monthly income in all four research areas Windhoek 2010

5.1.2. Water consumers

One major factor which has influence on water consumption is the household appliances owned. These include, in this context, all water-consuming items and activities like washing machines, dishwashers, car washing, pools, and garden watering. This chapter compares the level of ownership of water consuming appliances and activities in households in different income areas, as reflected in Figure 3. An articulately graduated distinction is recognizable. The higher the income level of a household, the more water consumers exist. Pools and gardens occur with relative high frequency in middle income and mostly in high-income areas.

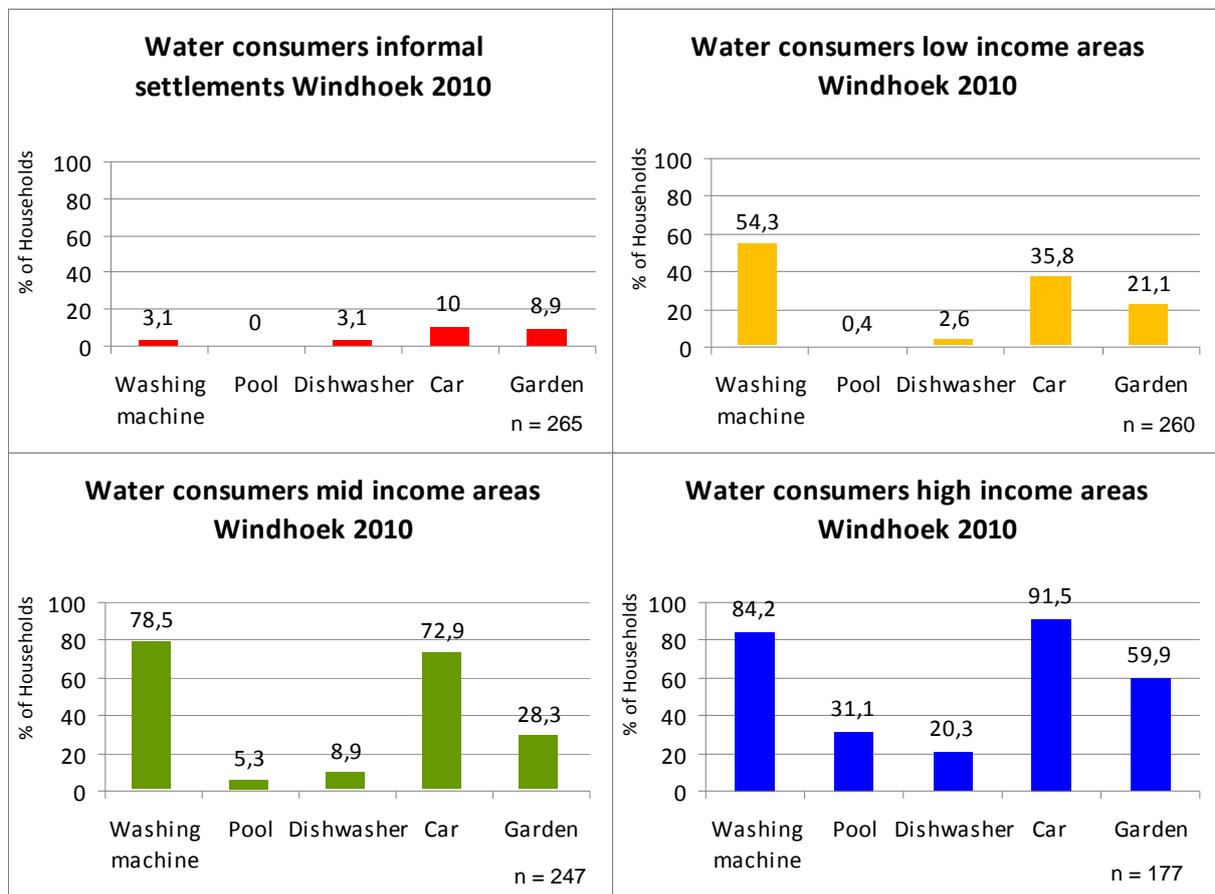


Figure 4: Water consumers in households in study areas Windhoek 2010

period is calculated and the client is credited with the amount(s) estimated during non-reading months. Hence, it is difficult to say how accurate the figures the calculations are based on. The Municipality calculates a 22.6 Mio m³ water demand per year for the whole City. Dividing this amount by the current population figure, one arrives at a figure of 200.9 liters water consumption per capita per day. However, the 22.6 Mio m³ represents the water demand for the whole of Windhoek including industry, the CBD and tourists.

Within Windhoek the water consumption differs a lot. Hence it is important to disaggregate water consumption according to the study areas as there is a wide range in water consumption between informal settlements and high-income areas. Keeping in mind that low-income areas and informal settlements represent two-thirds of Windhoek's population, it is recognized, that the high consumption rates of high and middle-income areas have a strong impact on the mean of Windhoek's water consumption.

In informal settlements two different calculation methods were used. For areas with taps on the property like in Greenwell the calculation was done as written above. For the areas with pre-paid or communal taps it was calculated different. Due to missing water meters, the questionnaire asked for the number and size of buckets which are carried daily from tap to house. According to this data, water consumption per capita per day was calculated.

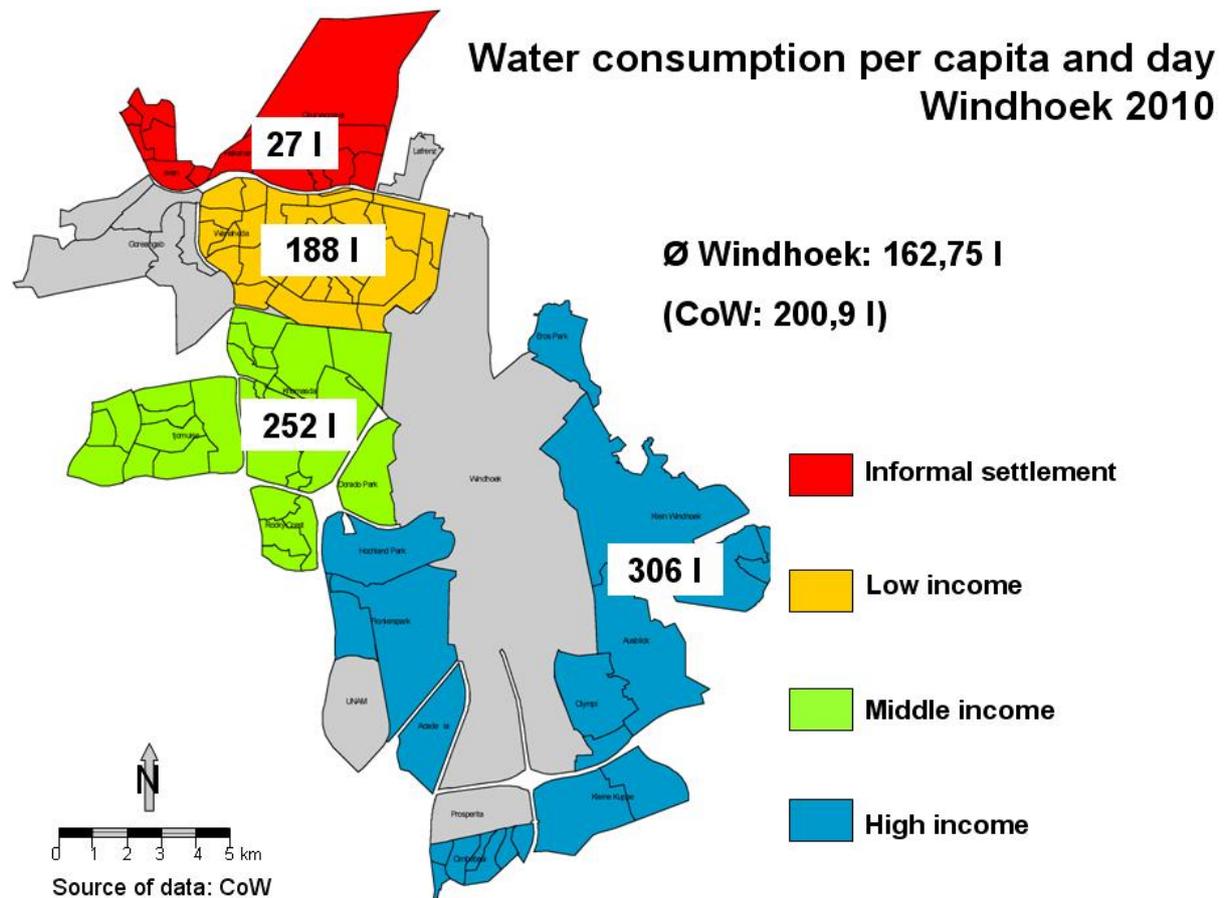


Figure 5: Water consumption per capita per day in study areas

5.1.4. Ethnic groups of Windhoek

Due to the history of Windhoek, the population of Namibia's capital consists of 5 major ethnic groups. The biggest fraction of the population is Oshiwambo (43.48 %) followed by Damara>Nama, Herero, Coloured/Baster people and White people consisting mainly of Afrikaans, English and German speakers. About 60 % of the population has a migration background. The major stream of migration is coming from the north. About 29 % of the migrants are coming from the former Ovamboland. That explains the high contingent of Oshiwambo speakers. The Damara>Nama speaking group are actually two different ethnic groups sharing the same language but originating from different areas. During the fieldwork it turned out, that the most people being Damara or Nama answered on the question to which ethnic group they belong, respectively what is their mother tongue, that they are Damara>Nama. Both groups are living very close together in one part of Katutura which made them mix together.

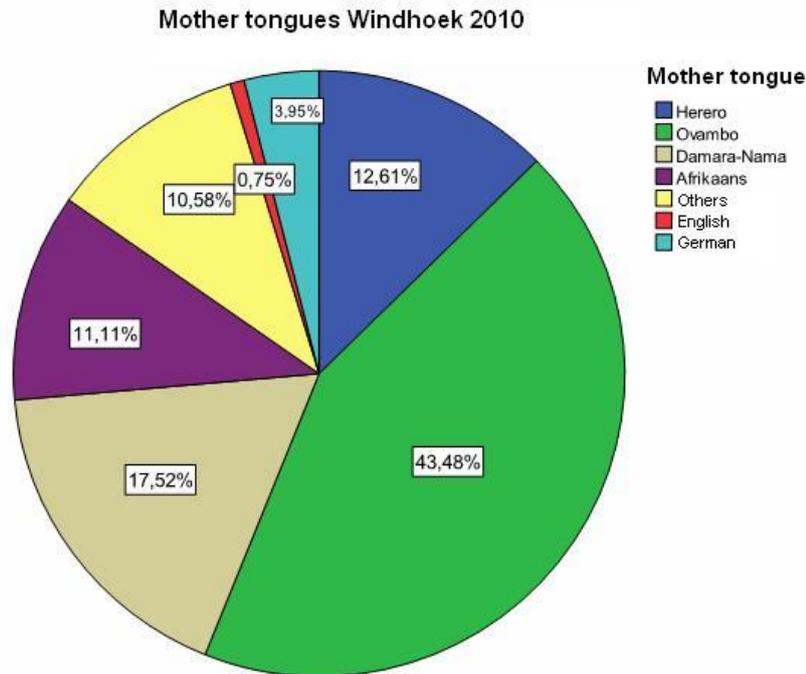


Figure 6: Mother tongues of Windhoek 2010

5.1.5. Types of water access

Depending on the area, the kind of existing water access differs. In high and mid income areas, usually taps are installed inside and outside the houses. In low-income areas the same type of water access is installed but the number of inside taps is lower per household. Households in high-income areas have on average 6.75 taps inside the house. In mid income areas it is 4.72 and in low-income areas it is 1.70 taps inside the house on average. Households in informal settlements basically do not have taps inside or outside the house. Only in a few upgraded informal areas, houses have taps on their own property. The houses in the other parts of informal settlements are provided with public taps linked to a pre-paid system or with a community tap.



Picture 2: Public toilet in the front, on the right a man with typical water canister

In most cases, people settle themselves illegally on unserviced land belonging to the City. These people are then registered by the City and each such group normally give themselves a name. There are also some people who penetrate these areas and live in unregistered illegal shacks. They represent a small group of people who are getting water basically from community taps without paying for. They are not recognized community group members and get water illegally until they get registered and legal access. This is usually a temporary measure applicable where people have squatted illegally. Community taps are sometimes locked and are only accessible for community group members. But it is not that difficult to break the locks and repairing is expensive and takes a while. Access to water then becomes free for a while before repairs are done. The bar “free tap” in Figure 7 represents this group. It is obvious (Figure 7) that most households get their water from pre-paid taps (68.03 %). According to the results of question 15 of the questionnaire, there are too few taps around the areas and they need to be closer to the houses.

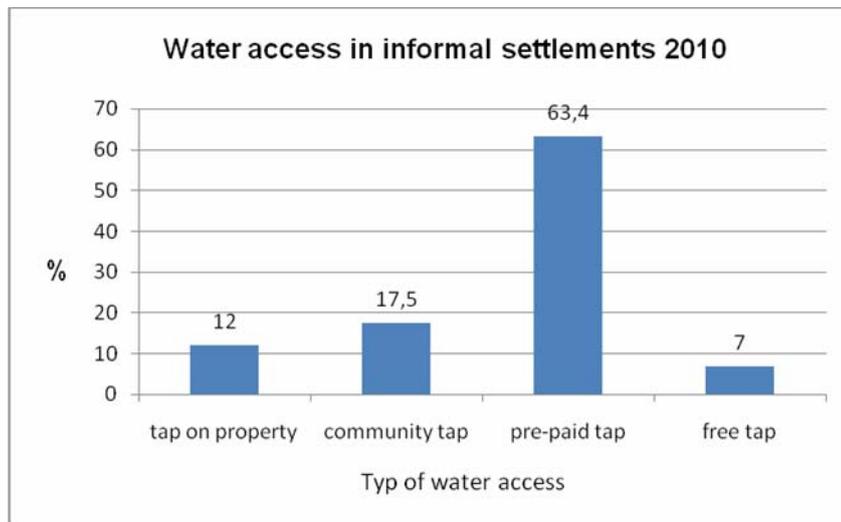


Figure 7: Distribution of different types of water access in informal settlements Windhoek 2010



Picture 3 a + b: Pre-paid system with card in informal settlements

Pre-paid taps used by 252 people on average – maximum is 2000 - and distances up to 800 m from house to tap, demonstrate how difficult the water supply situation in those areas partially is. More detailed information is shown in Figure 8.

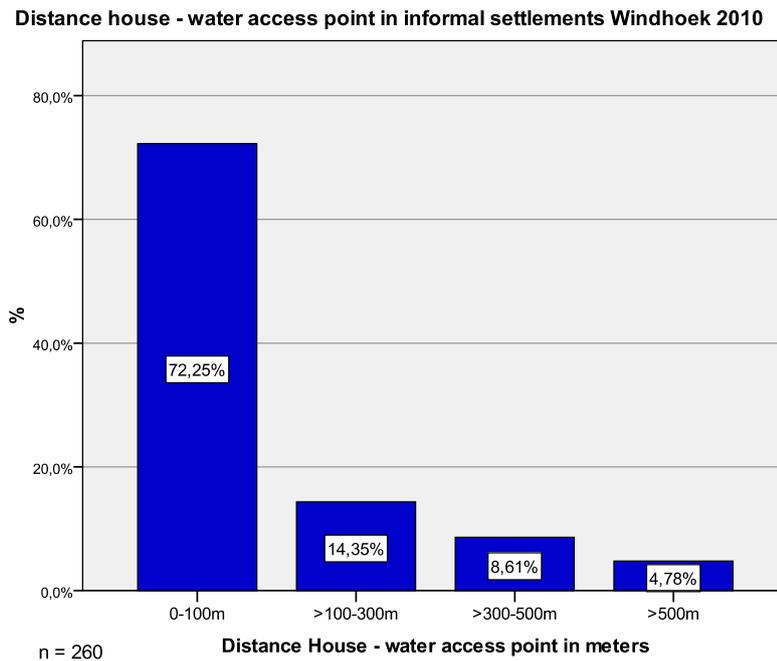


Figure 8: Distance between house and WAP in informal settlements Windhoek 2010

In 2007 the HRDC published a working document on rainwater harvesting (Figure 9). It includes a figure about the deviation of WAP in Windhoek. According to that, 78 % of Windhoek's population has a WAP on the property. Extrapolated from the survey's data of 2010, 74.1 % of Windhoek's population has WAP on the property. This implies a rise of Windhoek's population without WAP on property of 3.9 % in the last three years. In 2007 about 61.000 people had no WAP on property. Today it is about 88.000 people. It is important to keep in mind that the informal settlements are the areas with most HH without a WAP on the property. At the same time they are the areas which have grown the most within Windhoek in the last years.

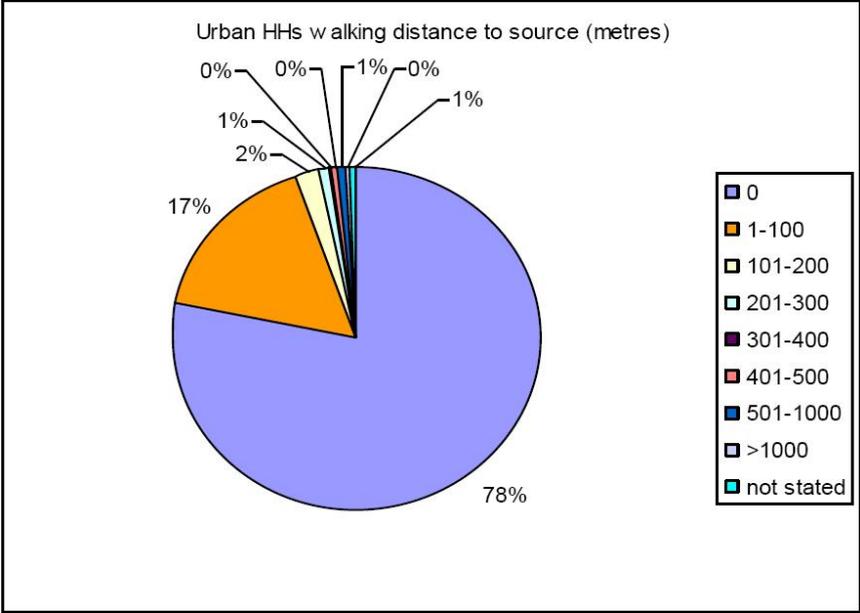


Figure 9: Distance between house and WAP (HRDC, 2007)

5.2. Thematic results

After introducing basic information about water consumption in Windhoek, this sub chapter highlights several subtopics about daily water consumption in each area. Aiming to discover possibilities to save water in daily life and to increase efficiency it is of major importance to get to know the daily water use in detail. Furthermore it is of interest to get data about vulnerability of water supply systems especially of low income areas and informal settlements.

This survey does not serve reliable data on the true water usage. Therefore a detailed investigation on the usage of each household would have had to be done to find out for example how often the toilette is used, how much water is used for each time taking a shower or how much liter run through the irrigation system for the garden and how long it is turned on each day. Such a detailed survey was not possible to conduct within the given time and with the personal capacity.

This survey is serving data about the subjective opinion for what most of the water is used for within the household. Combined with the the inventory of households 'appliances' like pools, cars, garden or washing machines (Figure 4) findings about the discrepancy between the assumable demand of water consumers and the estimated consumption can be done. Without any doubt the assumptions differ a lot between the different research areas depending on the water access. In areas where the water has to be carried from the tap to the shack, the people do know more precisely about for what they use how much of the water they had to carry. In areas where people only have to turn on the tap on the relation the used amount of water is quite a difference, as the following results show.

5.2.1. Assumed most water use in daily business

Depending on the area, people use different amounts of water for different purposes.

This is influenced by living conditions and equipment owned by the households.

People, who have a lot of clothes, may not need to wash as often as people with fewer clothes. Often here means how many times people are doing laundry per week. If you have one pair of trousers for each day, you can wait until weekend and wash all trousers together using the washing machine only one time. But if you only have one or two trousers, they need to be clean every day. Hence, you need to do

laundry more often. In addition, using a washing machine needs less water and washing powder as doing laundry by hand in a bowl. Having a bigger amount of laundry but using a washing machine may use less water than having few clothes which need to be cleaned more often respectively every day. The amount of laundry does not depend on the amount of clothes. Furthermore it depends on the living conditions and how often one piece of clothing is used or needs to be washed.

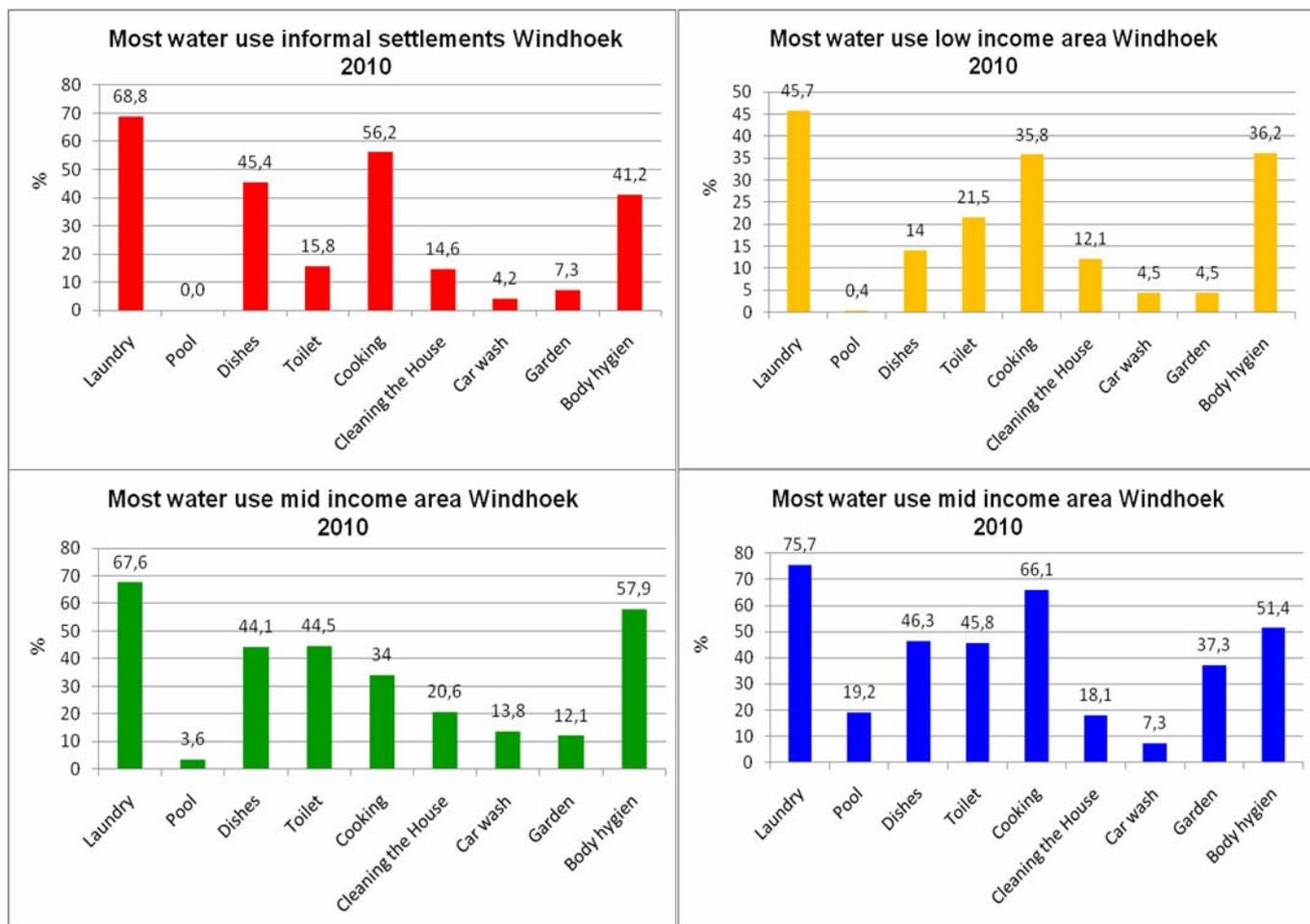


Figure 10: Assumed most water use depending on areas Windhoek 2010
(Multiple marks were possible)

A major factor here is school uniforms of children. They need to be clean every day. Pupils from high income areas owning more than one uniform only need to wash once a week, while pupils from informal settlements owning only one uniform need to wash daily or every second day. Furthermore, uniforms of pupils from informal settlements and low income areas are exposed to more dust and dirt than uniforms of other pupils. Surprisingly in all areas people have answered that the most water is used for laundry, cooking and body hygiene (Figure 10). In high income areas pools

and gardening are mentioned to use a lot of water too, but not in the same numbers as these consumers exist in the households. These are areas where definitely water could be saved. Beside this it shows, that the high water demand of pools and irrigating gardens is widely underestimated by the owners. In the rainy season the City of Windhoek calculates with a daily demand of 45,000 m³ on a rainy day and with 75,000 m³ on a dry day. This difference results mainly from garden irrigation.

It is important to keep in mind that water in all areas used for laundry cooking and body hygiene in similar proportions though the amounts for each activity differ thus the differences in water consumption per capita of each area.

5.2.2. Where to save water first

Question 4 asked about the purposes for which the water was used where possible savings could be applied first. The savings might be necessary because of dry seasons or due to a lack of money. The second reason (body hygiene) occurs much often especially in the poor areas of Windhoek.

Information about that gives hints about how vulnerable the water supply system and even more how vulnerable a society linked to such a system really is. This question also offers information about how important several things are to people with different living conditions. In high income areas especially this point may bring up possibilities to save water on a daily basis. Knowing, that some purposes people use water for, are not as important as others, may help to figure out where people are more likely to save water first. This question should furthermore be combined with the results of 5.2.1 to get better basic information.

What all four areas have in common is the highest bar at laundry. Remembering that laundry was also the main bar at Figure 10, it is clear that water is saved where it is supposed to be used the most. But the major perception here is the high bar at body hygiene at the graph of informal settlements. This bar implies a high vulnerability of the informal settlements population. In case of less available water, the people would reduce washing themselves which results in a decrease in the hygienic situation. Though the dry and hot climate is not conducive to typical diseases as found in other African countries, it still raises the possibility of infections or outbreaks of diseases due to insufficient water supply and basic sanitation.

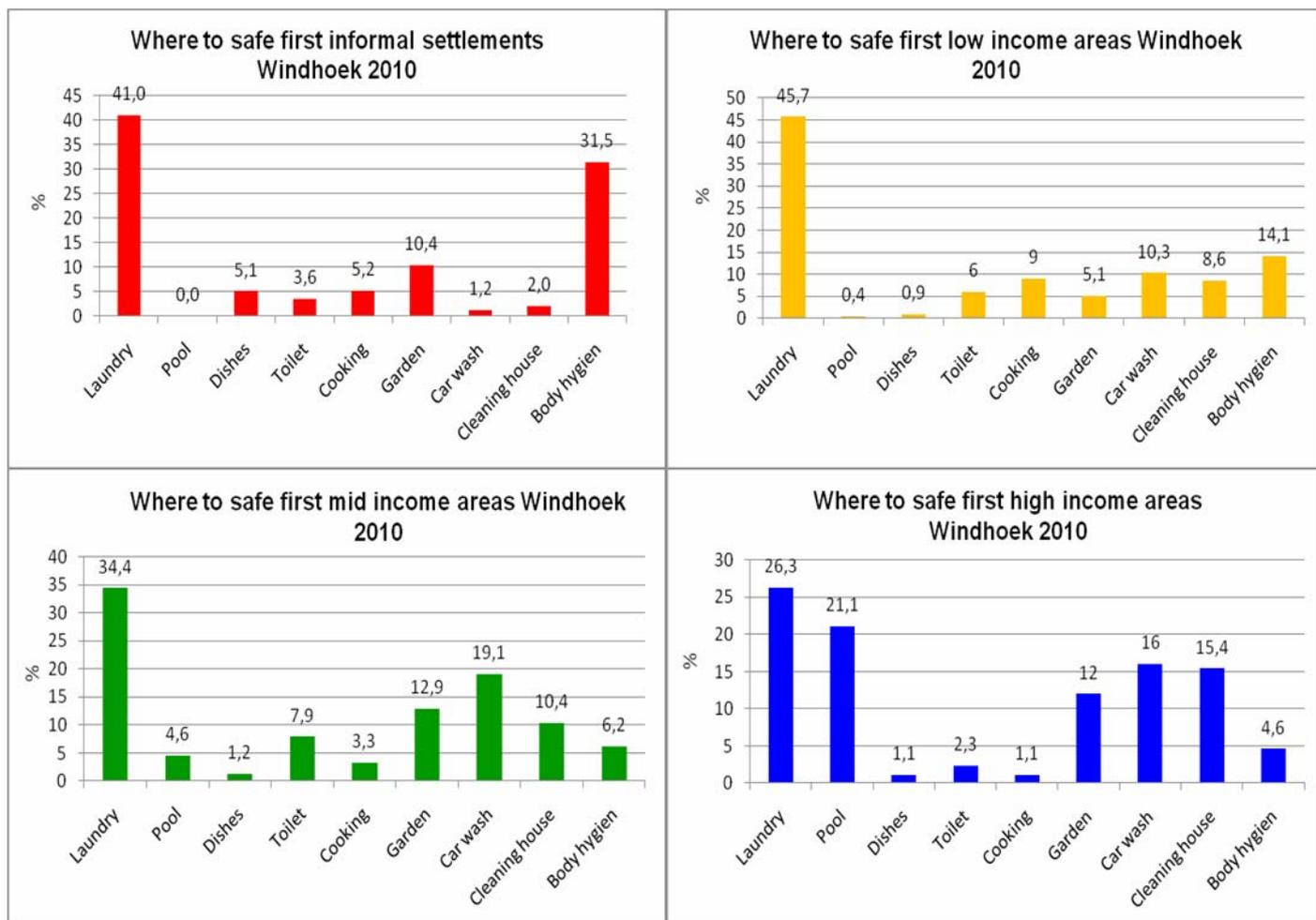


Figure 11: Where to safe water first depending on areas in Windhoek 2010

5.2.3. Sanitation

Beside access to clean water, basic sanitation is the second major subject of MDG 7 target 3. Sanitary conditions have a strong influence on the state of health of a society.

While halving the proportion of people without access to clean water seems to be achievable, guaranteed access to basic sanitation for the same amount of people is something else. Basic sanitation includes toilets, waste water systems and showers or other places where people can take care of body hygiene. Without access to waste water systems, all the wastewater coming from cooking, body hygiene, toilets and laundry water containing washing powder, gets into the ground water system. Another way is to pour waste water into rivers and surface waters where it stays for long time. An example for that is the Goreangab dam. Its water should actually

provide the population with clean water. But the water in the reservoir is too polluted, that it needs to be run through an intense water treatment system with modern techniques before it is fed into the water supply system.

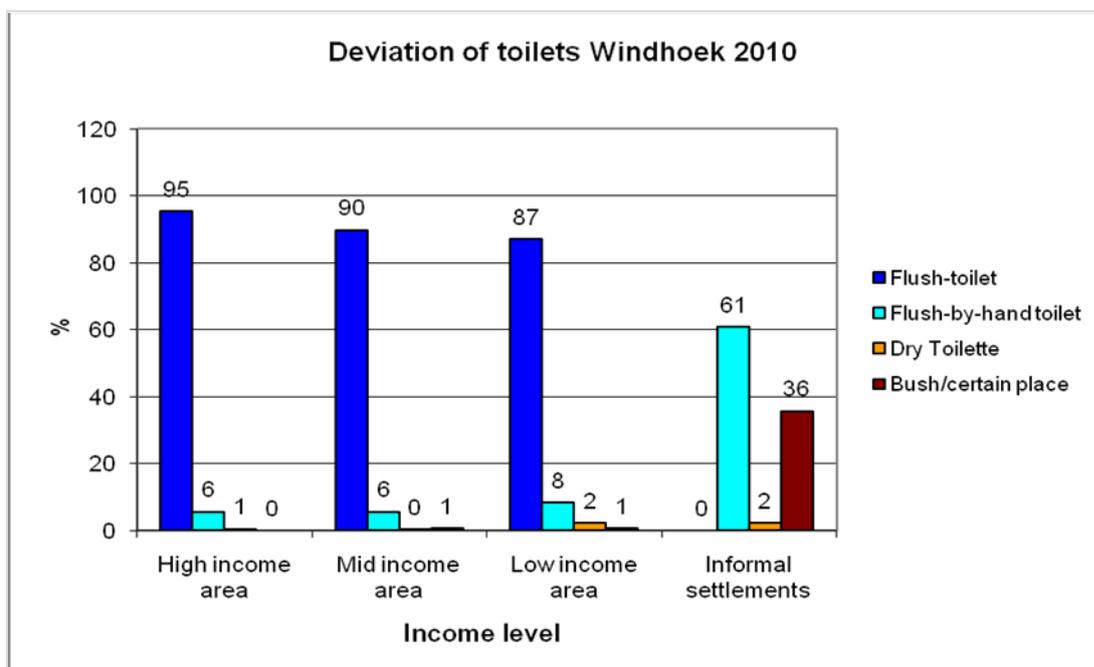


Figure 12: Distribution of toilets in Windhoek 2010 (multiple marks possible)

As shown in Figure 12, the majority of Windhoek’s population has access to flush toilets. Only in informal settlements flush toilets are mostly not available. Here the most people answered (61 %) to use toilets which need to be flushed by hand e.g. with buckets even though Windhoek does not have bucket systems. Whereas in all other areas the toilets are inside the house or at least on the property of the household, the toilets in the poorest part of Windhoek are public flush toilets (Picture 3). Besides the few flush- toilets, a new kind of water saving toilet was recently installed as a pilot project. It is called a dry toilet because it does not need water at all but is a ventilated pit latrine. Following the results of the survey, this kind of toilet does not seem to be accepted by the population. It is not clear, if the answers for flush-by-hand-toilets meant the few public flush-toilets or if the people where to shy to tell the interviewees to use bushes or do open defecation, which was mentioned with 36%.

The second major issue besides toilets is body hygiene. There are differences in hygiene level, water demand and waste water disposal based on how people wash themselves. Using showers or baths requires adequate waste water disposal through

pipes, because the most showers and baths are connected to a pipe system. However in the informal settlements using a bath does not mean the same as in high income areas. The informal settlements are mainly not connected to waste water systems. The only pipes existing are those, providing water at public or community taps. So, taking a bath here means using a bowl and buckets for body hygiene. After wards the used water is just thrown away outside the shacks. Figure 13 shows what is used for body hygiene in different areas.

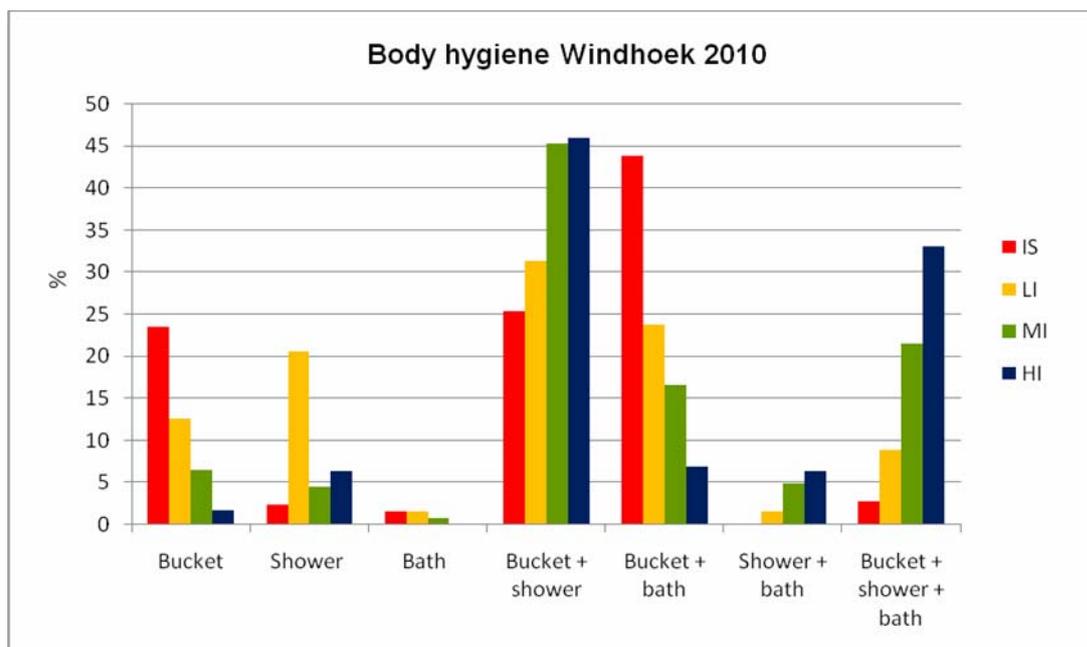


Figure 13: Body hygiene in study areas of Windhoek 2010

5.3. Disparities within informal settlements

5.3.1. Differences in water consumption depending on water access

Within informal settlements, three types of water access exist as already discussed in Section 5.1.4. In Greenwell Matongo, a part of the settlement that is in the beginning stages of developing, private taps are installed outside the houses. The biggest part of the population uses public pre-paid card systems, which represents the second type of water access system. A third type is the community tap which is only used by a fixed number of community members. These taps are installed to serve a number of houses belonging to a community/savings group. There is one more group of people using WAP. This group consists of those people who neither belong to any kind of community group nor owning a pre-paid card. These people get water for free

from access points which are not yet linked to a system or they go to community taps to get water illegally but for free as long as the pre paid cards are introduced. Some people also obtain water illegally from the cisterns of the communal toilets.

Taps on the property

In Greenwell Matongo a lot of people already upgraded their shacks into brick houses. They are part of a savings groups supported by SDFN and NHAG. Some of them already have water access points on their property. The average water consumption per capita in informal settlements is 27 liters per day. In the areas with taps at the houses like in Greenwell, the average water consumption per capita per day is 109 liters and one household consists of 6.4 people on average. This amount will get close to the average water consumption of low-income areas (Figure 5) in the next years. They have toilets on the property and some of them are even equipped with showers and washing machines. Their development level is almost the same as the level of low-income areas. Households like these are only a small group in the informal settlements (figure 7).

Community taps

A bigger group than the one with taps on the property is the one living in houses linked through membership of a community/savings group. The group usually has one tap for itself for exclusive use. The average number of people using this tap is 219. One community consists of 45 households on average; the average household size is 4.7 people. Their water consumption per capita per day is 21.5 and the average distance between house and tap is 62 meters. The community tap is, besides the pre-paid tap, one of two major approaches. It can be found mainly in Hakahana but also in other parts like Freedom Land.

Pre-paid / public taps

The pre-paid system is the most common in informal settlements of Windhoek. Everyone who neither belongs to a community group nor living in areas like Greenwell can get a pre-paid card at the municipality. This card or token has a computer chip inside and costs 100 N\$ to buy. The card or token can then be recharged over and over again for smaller amounts. At those taps people pay 8-9 N\$

per cubic meter of water. The interviewed people in this area as well as people linked to community taps have the best knowledge about water prices. About 37 % of the interviewed people with pre-paid cards using community taps could answer question 5 about the price of one cubic meter of water. In all three other areas which were studied, almost no one could answer this question (less than 1 %). The average distance between houses and a pre-paid tap is about 150 m which is more than twice the distance between houses and a community tap. The longest distance which was mentioned, was 800 m from house to pre-paid tap. Not only are the distances higher but also the number of people using one tap is. The average number of people using a pre-paid tap is 252 and the water consumption per capita per day is 28.8 liters on average.

The last groups of people using taps are those who are not linked to any kind of water supply system. Due to a lack of resilient data about that group, only the three already discussed water access systems are summed up in Table 2 below.

Table 2: Summary characteristics of different types of water access in informal settlements Windhoek 2010

	Distance house - tap	Amount of people using tap	Water consumption per capita and day
Tap on property	/	6,4	109
Community tap	62 m	219	21.5
Pre – paid / public tap	152.24 m	252	28.8

(The table shows calculations based on the numbers given in the questionnaires by the interviewees).

5.3.2. Vulnerability of the water supply situation in informal settlements

In the informal settlements of Windhoek 36.76 % of the population are living under the absolute poverty level as shown above. Water scarcity or rising water prices have influence on every citizen of Windhoek. The people living in informal settlements suffer the most under such changes. This becomes considerable when one looks at Figures 13 to 15. In case of water scarcity, people in informal settlements, no matter what kind of access they have, would reduce laundry or those things which have a major influence on their health like body hygiene, cooking and cleaning the house. Even in those areas with taps on the property, people would save water by reducing the use of toilets. This could mean either they would not flush as much as under normal conditions or it could mean they would start using the bush or other places instead of their own toilet.

Only a few houses in these areas have refrigerators. Hence, they can't keep food in proper conditions as long as other people. Usually they cook three times a day. Cooking improves food quality especially in a country like Namibia where meat takes a very important part of daily meals.

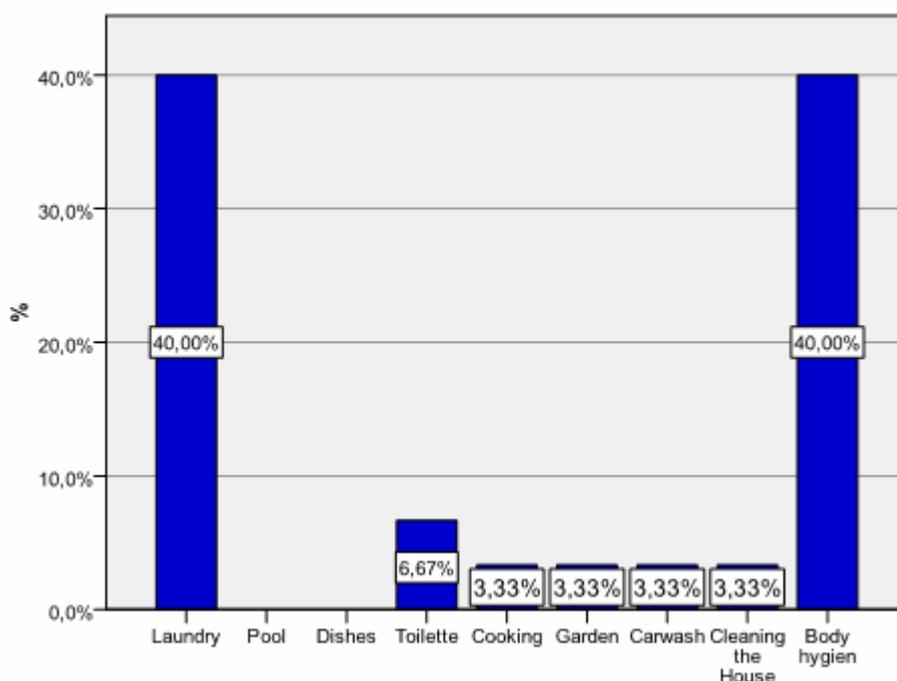


Figure 14: Where to save first in households with tap on property in informal settlements of Windhoek 2010

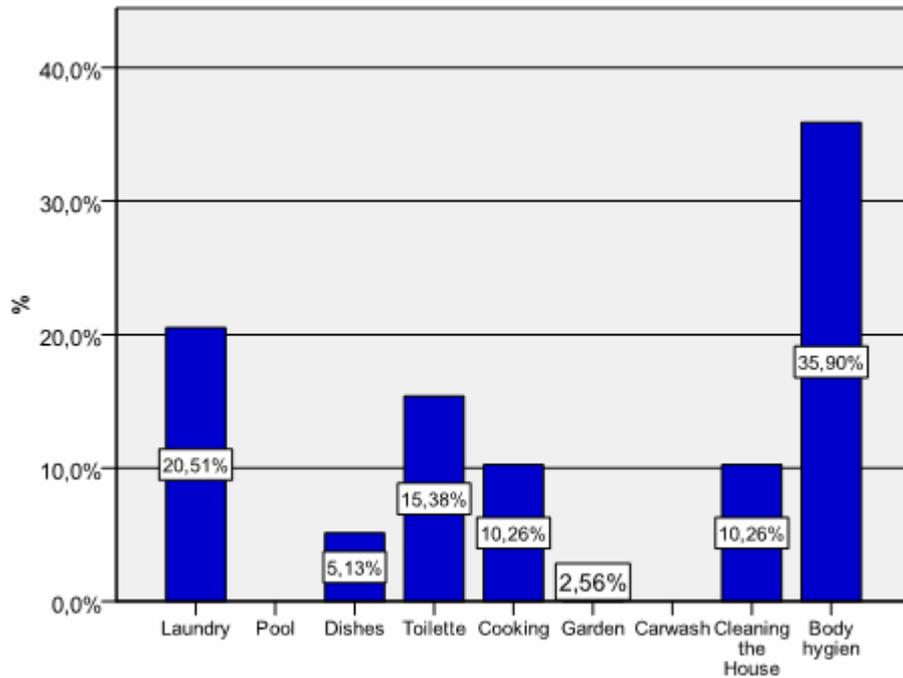


Figure 15: Where to save first in households with community tap in informal settlements of Windhoek 2010

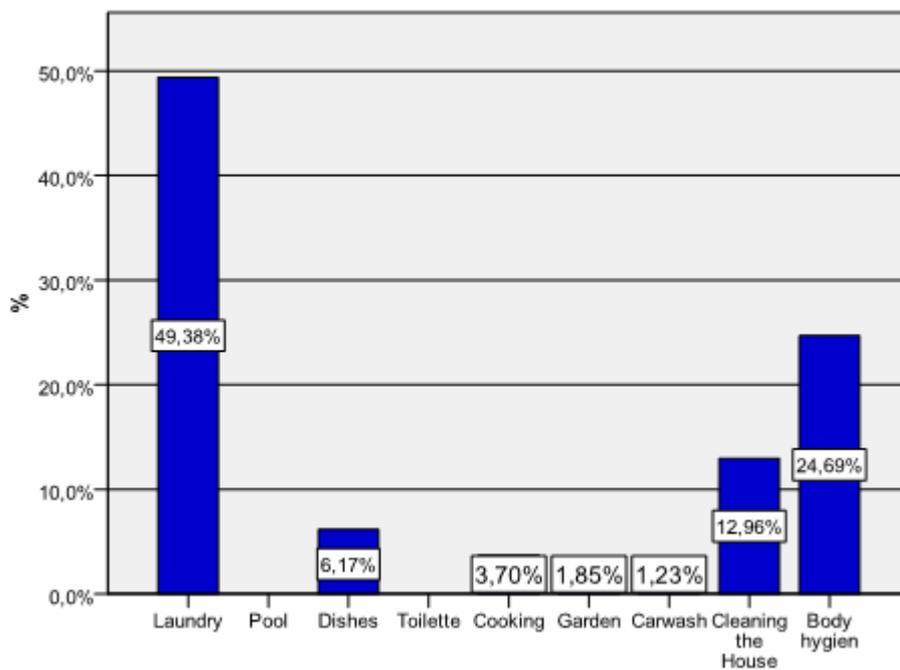


Figure 16: Where to save first in households with pre-paid tap in informal settlements of Windhoek 2010

Summing up the parts of Windhoek where people are provided with water through community taps or pre-paid taps are the most vulnerable ones. Higher prices for water or a scarcity of water will put high stress on the people living there. Additionally, there is just no possibility to save water because they only consume as much water as needed to cover their basic needs like drinking, eating and basic body hygiene. In all areas of the informal settlements, people would decrease the used amount of water for body hygiene which has a bad influence on their state of health.

5.4. Challenges for Windhoek's future water supply

Windhoek's water sources are limited. At the same time the population keeps growing with about 4.7% each year. Areas like Greenwell reflect the major challenges for the future. Providing houses with better water access causes a fast increase of water demand (in Greenwell from about 30 liters per capita per day to over 100 liters per capita and day). Hence, developing the poor areas of Windhoek means a rising water demand for more than 100.000 people. The water demand of the informal settlements would increase by about 400 %. The informal settlements would need 8,715 m³ of water per day and about 3.2 Mio m³ per year more than today. Reaching water consumption levels similar to in low income areas, the water demand would be 17,110 m³ per day higher than today which represents a rise of more or less 800 % in the informal areas.

The development of several areas is only one of two future challenges for Namibia's capital. The other one is the natural growth rate. Even without the rising water demand due to developing areas, the usual water demand of Windhoek plus the demand of 14,000 new citizens every year needs to be covered. Each issue on its own is hard to challenge. Therefore it is urgently necessary to increase efficiency and save water wherever possible. This can only be achieved by following a bottom-up approach starting at household level.

6. Criticism on methods

6.1. Barrier of language

As already discussed in chapter 3, besides English, in Windhoek five main languages are spoken. Hence, it is always possible to make interviews with people speaking little or no English at all. The group of interviewers was fluent in 4 languages spoken. Situations however still occurred where people did not speak any of the languages the group was able to speak or only poorly. This sometimes made it difficult for the interviewer to get the right information or to avoid misunderstandings.

6.2. The interviewer

During the fieldwork, the experience was that people reacted differently depending on who is interviewing them. Adult black men acted very cautiously and carefully. They suspected interviewers to be inspecting their homes and interiors. It took a lot of time to convince them that they are really coming from one of the cooperation partners and to prove that this is a serious survey. Women and white persons on the contrary were very friendly and hospitable and were interested in the survey. Hence, it is hard to say if skin colour, ethnic origin mother tongue and gender influenced the answers given by the interviewed people.

6.3. Standardized evaluation

During the development of the methodology for this survey, it was agreed, that one questionnaire for whole Windhoek should be used. Asking in informal settlements about pools or gardens or in high income areas about the number of buckets used every day to get water from public taps is inappropriate. Hence, the questionnaire includes paragraphs which do not fit in every area. This caused some confusion during the fieldwork. Furthermore, the evaluation in the mid and high income areas was done by using school pupils who took the questionnaires home with the questionnaire completed without the supervision of one of the interviewers. But the big difference was that in informal settlements and in low-income areas interviews were conducted with a member of the household. There might have been some

misunderstandings in answering the questions. Actually a second questionnaire, designed for a different evaluation method should have been made but was not because of time and financial restrictions.

6.4. Extrapolation of the water demand

For the calculation of the average household demands there are some restraints needed to be mentioned. Conducting the study people were asked for their monthly water bill. These figures are in many cases only assumptions made by the interviewed people and not the real figures. In the low income areas not in every case the people were showing their water bill. And even if they did, the problem with the not correct read meters still exist. In the middle and high income areas the questionnaire was distributed by pupils to be filled in by their parents at home. If the parents were taking their water bill into account or filling in any number, nothing can be said about.

While the numbers for the water demand in the informal settlements might be taken as correct basing on the real amount of cans carried from the tap to the shack, the numbers for all other areas seem to be a little bit too high because the average for the whole of the city does not leave big space for industrial water use and the demand by the tourists.

Even though the numbers in Figure 5 might be a little bit too high for the low, middle and high income areas it is obvious, that as far as a family has a tap on the ground or flush toilets the water usage rise steeply. So, if the water demand per person in the low income area is more than 5 times higher compared to the informal settlements or only 4 times does not make a big difference focusing the rising water demand by improving the needed and demanded water supply of the people in the informal settlements including basic sanitation.

7. Conclusion

Windhoek is a city of disparities. It has a wide range of different living conditions, different types of water access and different people of different origin. Due to the climate, water remains a scarce resource. However, Windhoek is growing, especially due to migration mainly from the north and a high birth rate. Hence, it is necessary to collect and analyze information in every part of the City. Each area has different living conditions and needs specific solutions for specific problems. The areas where development is most urgently needed are the informal settlements. They are the most vulnerable parts of Windhoek. Furthermore this is the location of one third of Windhoek's population. The development on the one hand and the population growth on the other hand are the main issues which need to be challenged. The major problem remains ensuring water supply for a steadily growing and developing city. One way must be to save water in daily life. This is only possible in high and mid income areas. In the other areas the people are not using much water as their water consumption only covers their basic needs. Pools and gardens with plants that demand a lot of water as found in mid- and high-income areas are not suitable for the Namibian climate. At the household level rainwater is still an unused water source. Some households collect rainwater but are not able to save it in the right way. Often a lot of the collected water gets lost due to evaporation. Some people just do not know that it is necessary to cover water tanks to avoid or at least reduce evaporation.

Even though the numbers in Figure 5 for the low, middle and high income areas might be a little bit too high, comparing the water consumption in several areas, it becomes clear that there is no capacity to save water in informal settlements and low income areas. Only the basic needs are covered here. But in mid and especially high income areas there is potential to save water in uses related to gardening and pools. Hence, the biggest effort to save water should be made in the high and mid income areas. At the same time, at least the informal settlements need to be developed. Although this will result in higher demand for water it is inevitable that living conditions within the city should be improved.

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