

# Access to water in gazetted and ungazetted rural settlements in Ngamiland, Botswana

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## Abstract

Lack of access to safe or improved water supply in developing countries is a major global concern, since water is a basic need for sustenance. Programmes aimed at improving access to safe water have been implemented in several sub-Saharan countries. In Botswana, only gazetted settlements have access to water and other basic services provided by the government. This paper examined the level of access to safe water, effort required, and problems encountered in collecting water by households in ungazetted settlements. The paper also investigated whether households in these settlements were willing to pay for improving access to water. The study has been undertaken on settlements located along the Boteti River in the North West District of Botswana. The majority of households in ungazetted settlements satisfy their domestic water requirements through abstracting untreated water from river flows and hand-dug wells when the river is not flowing. Men dominate in collecting water in ungazetted settlements, with the most dominant mode of transporting water being the use of donkey carts. The dominance of men in water collection and use of donkey carts is due to water sources being too distant from homesteads. This has resulted in low water consumption levels, with the per capita water consumption being less than 20 l/capita/day for most households. Such low levels of water consumption adversely affect attainment of desirable personal hygiene and food preparation. The opportunity cost of time for water collection has been estimated at 1.80 Botswana Pula (P) and the price of water is estimated to be P18/m<sup>3</sup> (1.00 P = 0.1755 USD on 18 November 2005). This is higher than the price paid by households residing in rural settlements obtaining water from government or district council water supply schemes. The majority of the households were willing to make a once-off contribution towards improving access to potable water with the mean willingness to pay (WTP) being P161 per household, or just over a third of the statutory agricultural minimum wage in Botswana, P589/month. The potential contribution by household to an improved water supply is significant for a largely unemployed rural population.

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## 1. Introduction

Lack of access to safe or improved water supply in developing countries is a major global concern, since water is a basic need for sustenance. Within the sub-Saharan region, the population with access to improved water supply varies at the national level from 22% for Ethiopia to 95% for Botswana ([www.wssinfo.org/en/233\\_wat\\_africaS.htm](http://www.wssinfo.org/en/233_wat_africaS.htm)). Lack of access to water is directly and indirectly related to

poverty (Roy and Crow, 2004). Direct links are those that have to do with control over and/or ownership of water resources while indirect links have to do with access to safe water. Most frequently occurring diseases such as diarrhoea, cholera, trachoma, and schistosomiasis are water-related. Thus low levels of access to improved water supply which are mainly a result of poverty have major adverse health effects on the population (Madulu, 2000). It has been estimated that 80% of all communicable diseases in Ethiopia are water-related (UNESCO-WWAP, 2003). Households whose members are affected by these diseases have to spend their resources taking care of the ill, and this also reduces labour available for other productive purposes

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thereby accentuating poverty. Thus lack of access to improved water supply is both a result and a cause of poverty (UNESCO-WWAP, 2003).

Several international initiatives such as the 1981–1990 International Decade for Water Supply and Sanitation whose goal was to attain universal coverage of improved water supply have been initiated due to the global concern about improving water supply. The Second World Water Forum held in The Hague in 2000 re-emphasized the importance of providing safe water. The UN General Assembly did recognize the importance of improving water supply, and set the reduction by half by 2015 the proportion of the population without access to safe water as a target for one of the Millennium Development Goals (MDGs) (UNESCO-WWAP, 2003). It has been recognized that improving access to safe water will also contribute towards achievement of several other MDGs. Improving access to safe water is increasingly understood as satisfaction beyond basic needs. There is an acceptance that within rural areas, water is not only important for satisfying a basic need but for supporting critical household productive activities upon which their livelihoods depend. Some of the productive activities include watering a vegetable garden, livestock watering, brick moulding, and beer brewing for commercial purposes (Madulu, 2002; Makoni et al., 2004).

Programmes aimed at improving access to safe water have been implemented in several sub-Saharan countries, e.g. 1971–1990 National Water Supply Programme of Tanzania (Kusiluka et al., 2004), Integrated Rural Water Supply and Sanitation Programme of Zimbabwe (Makoni et al., 2004). Botswana formulated in 1991 a Rural Water Supply Plan as part of the National Water Master Plan (SMEC, 1991). The objectives of this plan have been to improve access to safe water, reduce the vulnerability of the population to water-related diseases, and create conditions for employment generation. Implementation of this plan has generally been guided by the National Settlement Policy which formulated a hierarchy within which settlements in Botswana are classified (DTRP, 1998). The level of services that will broadly be provided to a settlement will depend on its position within this hierarchy. An objective of this policy is to ensure that scarce resources are invested in settlements with a potential for development. The policy also seeks to curb uncontrolled sprouting of settlements that in turn make requests for government services. According to the guidelines in this policy, government will generally only provide services to a gazetted settlement. In order for a settlement to be gazetted, it should have a minimum of 500 people, and be not less than 15 km from a parent/other gazetted settlement. In particular cases, villages may be gazetted with populations below 500 people. Gazetted settlements fall into the following groups which will also determine the institution responsible for water supply:

- Tertiary Centre (500–9999 people) supplied water by the respective district council.
- Secondary Centre (10,000–19,999 people) provided with water by either Department of Water Affairs or district council.
- Primary Centre (>19,999 people) provided by the Water Utilities Corporation, and Department of Water Affairs in some villages (DTRP, 1998).

Water supply to those residing in ungazetted settlements is the responsibility of the individual households or persons residing at such settlements. These settlements are commonly in the form of cattle posts, temporary homesteads close to arable lands, and permanent isolated homesteads. SMEC (1991) highlighted the dilemma faced by government in trying to discourage uncontrolled development by not providing services to ungazetted settlements, and encouraging nucleated settlements through the provision of services. This policy is understandably in view of the fact that Botswana has an area of approximately 582,000 sq km, and had a population of 1.681 million people in 2001 giving an impression to its citizens that land is in abundance, and therefore individuals can settle anywhere. Uncontrolled and dispersed settlements increase the per capita cost of providing services by government. The population residing in ungazetted settlements constituted 16% of the national population in 2001 (CSO, 2003). Botswana has made remarkable progress in improving access to safe water. WHO/UNICEF estimated that the proportion of the rural population with access to safe water had increased from 88% to 90% between 1990 and 2002 (WHO/UNICEF, 2004).

It is of interest to determine the level of access to safe water, effort required and problems encountered in collecting water by those residing in ungazetted settlements. A critical issue is to ascertain whether these residents are willing to invest to improve their access to safe water. This paper addresses these questions using a case study approach.

## 2. Study area

The study has been conducted in north-western Botswana, in North West District in Ngamiland region (Fig. 1) within settlements along the Boteti River, a distributary of the Okavango Delta. The delta is a flat, conical alluvial fan with the inundated area varying annually from 5000 to 13,000 km<sup>2</sup>. Flows entering the delta originate from the southern part of Angola which is drained by the Cubango and Cuito Rivers (Fig. 1). Peak flows enter the delta around April, progress slowly through the delta due to the low gradient resulting in peak flows occurring at the outlet of the delta on the Thamalakane River at Maun during the July to August period. The Thamalakane River bifurcates to form the Nhabe River draining into Lake Ngami on the south-west, and Boteti River draining into Mkadikgadi Pan to the south-east. The Boteti River depends entirely for its flows from outflows from the delta and used to flow throughout the year during some years

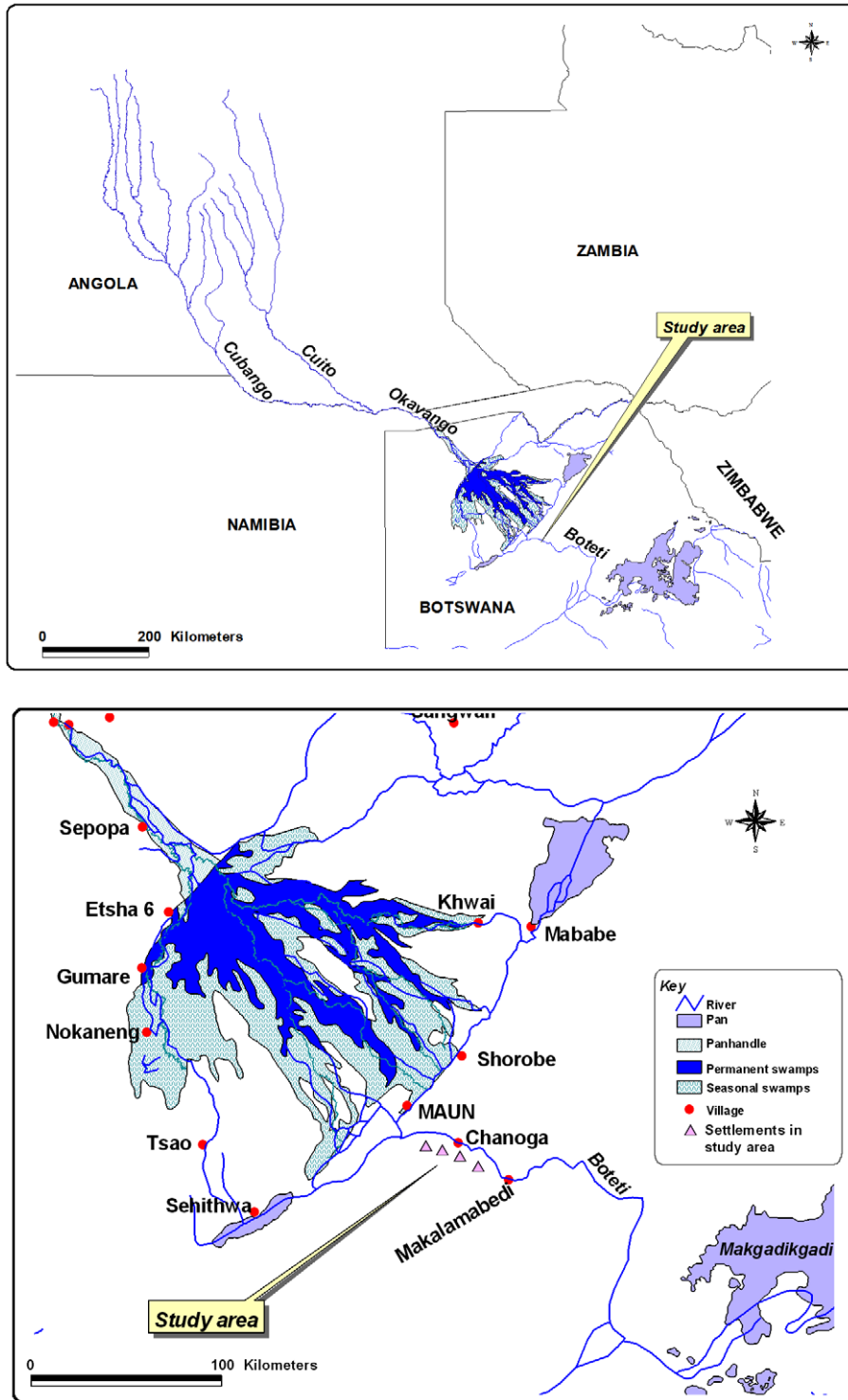


Fig. 1. Location of the study area in north-western Botswana, and downstream of the Okavango Delta.

(Fig. 2). Communities in the study area have adjusted to high variation in seasonal flows with high flows occurring during the dry season (July–December). There is also a relatively high inter-annual variability of these flows (Fig. 2). The average annual rainfall in the study area is less than 400 mm/y and falls during the November to March period. Maximum monthly temperatures range from 22 to 34 °C

while the maximum daily temperatures are in the order of 30 to 32 °C (Scudder et al., 1993).

The study area falls within Ngamiland region which in 2001 had a population of 121,568 people or 7% of the national population. The urbanised village of Maun is the district headquarters. In 2001 its population was estimated to be 43,776. Gazetted settlements constitute 67%

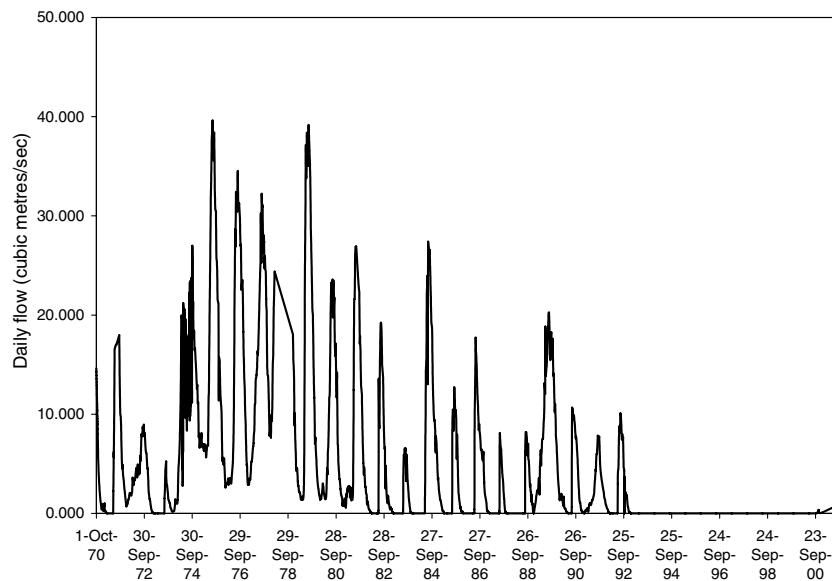


Fig. 2. Variation over time of daily flows of the Boteti River at Samedupi showing flows throughout the year during the 1974 to 1982 period, and no flow from 1993 to 1999.

of the district population, while ungazetted settlements account for 33% (CSO, 2003). The study was specifically conducted in six ungazetted settlements (Mawana, Xhobe, Xhana, Xharega, Samedupi, Tshibogo-la-matebele) all located along a 30 km stretch of the Boteti River between Maun and Makalamabedi. These settlements had a population of 1480 people in 2001. Livelihood activities in these settlements vary seasonally, and are quite diversified at the level of the household to reduce the risk associated with factors such as low rainfall (Scudder et al., 1993). The livelihood activities include livestock and arable farming, and to some extent, horticultural farming, fishing and the sale of crafts and natural products or veld products. Some veld products are also used in the home, e.g. as food.

### 3. Methodology

A reconnaissance survey of the ungazetted settlements was undertaken prior to the actual household survey in order to appreciate the extent to which communities in the ungazetted settlements depend on Boteti River water supply throughout the year. Following this reconnaissance survey, a semi-structured questionnaire was developed and pre-tested on 10 households in the study area, and then modified accordingly. The actual survey was undertaken during September 2005 and covered all (80) households found in the ungazetted settlements. For each household the questionnaire was administered to the head of the household, but in the event that the head of the household was not available, any member of the family familiar with the day-to-day activities in the household was interviewed.

The first section of the questionnaire contained questions on the socio economic characteristics of the household. The second and third sections contained questions on the different sources and quantities of water consumed

when the river is flowing and when it is not flowing. Households were also asked about their perceptions on the quality of water that they use. The fourth section contained questions on the use of water for livestock watering, gardening and fishing. The fifth section was aimed at soliciting households' valuation of water supply service of the river using the concept of the willingness to pay (WTP). The last section attempted to get the household views about problems of water supply and their suggested solutions.

Use was also made of data collected by Tsholofelo (2005) who administered a questionnaire to households in Chanoga, a gazetted settlement located along the same river and within the same area. Chanoga had a population of 381 people in 2001. In Chanoga settlement, water is supplied through standpipes.

Information on water consumed by a household was estimated on per household and per capita bases using households' recall information on the size and the number of water containers, and the frequency of water collection during the week.

The price of water was estimated using the opportunity cost of time which places a monetary value or price on the amount of time taken collecting water. According to Roy and Crow (2004), households in most of the developing countries expend considerable time to gain access to water. The main reason why the opportunity cost of time is used to estimate the price of water is because the majority of households in rural areas use unimproved water sources and no actual price per unit is associated with its consumption (Asare, 2004). The basis of valuation of time is that the time devoted to collecting water by households could be used in the next best alternative activities to earn income. The price of water was estimated using the average statutory minimum hourly wage rate in the trade industry obtained from the Department of Labour of Botswana.

According to Ministry of Finance and Development Planning (1996), in Botswana, the shadow price of unskilled labour is estimated at 50% of the minimum wage.

In estimating the value of the water supply from Boteti River, households were asked about their possible one-time contribution to the costs of improving their water supply by government in the event that water was not available from Boteti River. To make the valuation process easier, households were given the option to state their Willingness To Pay (WTP) in units with which they were familiar. Such units are the number of livestock (cattle, goats and sheep) or number of bags of maize or any other crops grown. Using the current market value of these units, the WTP of households was then converted to cash values to derive the total and average values for the water supply service.

## 4. Results and discussion

### 4.1. Socio economic profile of respondents

Respondents were almost equally divided between sexes in the ungazetted settlement with females comprising 52%. Females made up 61% of the respondents in the gazetted village. The 31–40 year age group was dominant in the gazetted village of Chanoga, while the 41–50 year group was the most frequent in ungazetted settlements. Most of the respondents (83%) in the ungazetted settlements are unemployed. The sources of income for the households in Chanoga and ungazetted settlements are formal employment, self employment, old-age pension, sale of livestock, sale of fish, remittances and sale of agricultural produce. In the gazetted settlement the main source of income was remittances which were reported by 29% of the sampled households. In Chanoga, 64% of the sampled respondents

were unemployed. The clinic and other district council services provide most of the employment in this settlement. In the ungazetted settlements the main source of income was the sale of livestock (23% of households). The main sources of income for the households are generally unreliable and accentuate the dynamic poverty trap in which households find themselves.

Household sizes varied from 1 to 10 persons in both gazetted and ungazetted settlements (Fig. 3). The largest and smallest household sizes were reported in the gazetted settlement in Chanoga. Table 1 shows the household characteristics in the gazetted and ungazetted settlements. There was no significant difference between the size of families in gazetted and ungazetted settlement ( $P > 0.05$ ).

Some of the residents of ungazetted settlements have lived in these locations for periods up to 40–70 years (Fig. 4).

### 4.2. Primary water sources and means of transporting water

All the households in the gazetted village obtain water for domestic purposes from standpipes supplied from boreholes by the district council (Fig. 5). The water supplied from standpipes is not paid for by households. Standpipes have been located so that a household walks a maximum of 400 m to collect water in gazetted villages. This reflects the commitment of the government to improving access to water for people living in gazetted settlements. With water sources in the proximity, households can use their time in productive activities other than collecting water. In contrast 89% of households in ungazetted settlements satisfy their domestic water requirements through abstracting and using untreated water from the Boteti River during

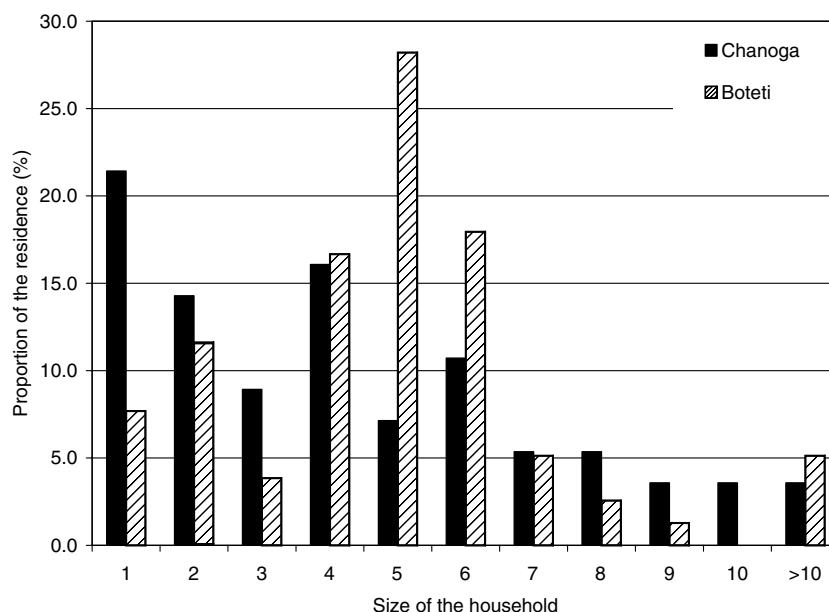


Fig. 3. Size of households in Boteti (ungazetted settlements) and Chanoga (gazetted settlement).

Table 1  
Sizes of households in the gazetted and ungazetted settlements

Variable	Gazetted	Ungazetted
Number of households	65	81
Average size of households	4.57	4.80
Median size of households	4.0	5.0
Standard deviation	3.28	2.49
Coefficient of variation	71%	52%

the period when this river is flowing (Fig. 5). When this river is not flowing between the months of March and July, or August to December, 69% of the households obtain water from unprotected hand-dug wells often located within the bed of the same river. Distances to water sources for residents of ungazetted settlements generally range from 0.5 to 4.0 km. According to WHO and UNICEF (2000) any water sources located at a distance greater than 1.0 km is generally considered to be inaccessible and adversely affecting the per capita volume of water used to satisfy basic personal hygiene.

The most dominant mode of transporting water by residents of ungazetted settlements is the use of a donkey cart with 68% of the households using either their own or hired donkey carts (Fig. 6). Use of animals to ferry water instead of it being carried on the head as is done by 28% of the households, is an indication of water sources being too distant from homesteads.

Women are customarily expected to be responsible for ferrying water for household use. In this study, however, men are predominantly undertaking this duty (Fig. 7) principally because the water sources are distant from the homesteads. In addition, donkey carts traditionally are driven by men.

#### 4.3. Quantity of water consumed

The volume of water collected per household in ungazetted settlements varied from 20 to 400 l/day with an average of 100 l/day per household. Respondents indicated that of the water ferried to homesteads most was used for drinking and cooking; bathing and laundry are done in the river. On per capita basis, water consumption was less than 20 l/capita/day for 73% of the households (Fig. 8). WHO and UNICEF (2000) indicated that when water consumption is less than 20 l/capita/day, basic personal and food hygienic requirements for water cannot be satisfied. Long distances to water points and the fact that poorer households must carry water on their heads, result in lower per capita water consumption of these households. For 27% of the households water consumption was at least 20 l/capita per day (cf. Admassu et al., 2003; Gulyani et al., 2005). Thus, access to adequate and good quality water by households is one of the serious problems in the ungazetted settlements.

#### 4.4. Collection time

Households in ungazetted settlements spend on average 85 minutes per day collecting water during the period when Boteti River is flowing, and 83 minutes when it is not flowing. When the river is not flowing water is collected mostly from hand-dug wells located along its bed. Thus, there was no significant difference in time taken to collect water by households between two periods ( $P > 0.05$ ). The water collection time for households in ungazetted settlements for this study is mainly a function of distance to the water point, which impacts directly upon the remaining time for other household activities.

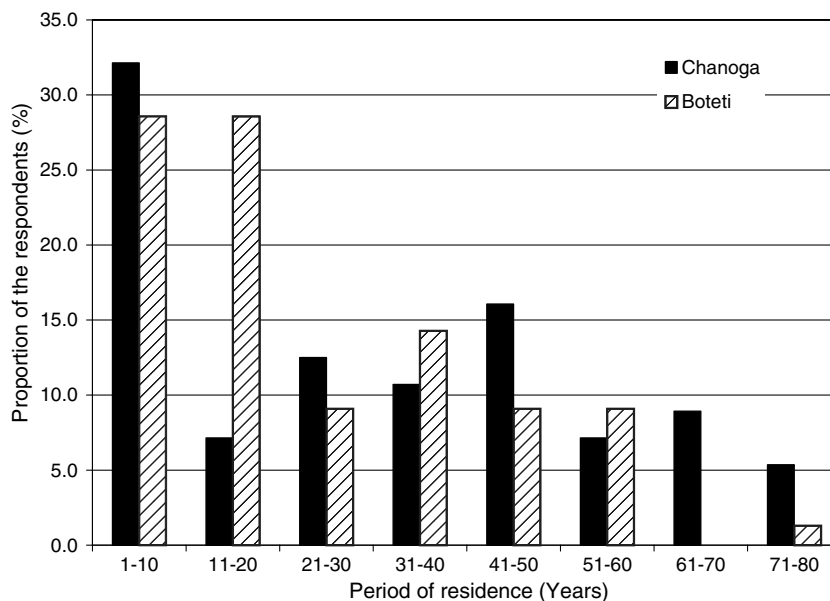


Fig. 4. Period of residence in the study area.

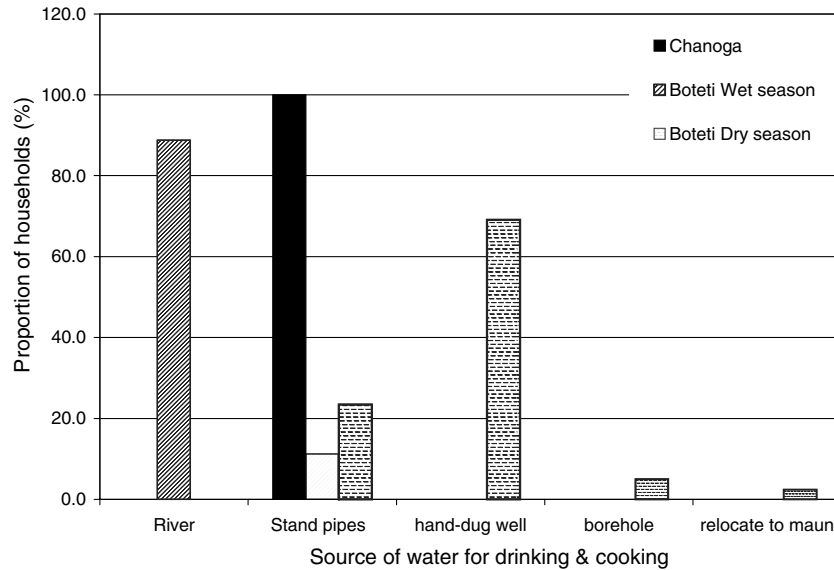


Fig. 5. Source of water for drinking and cooking.

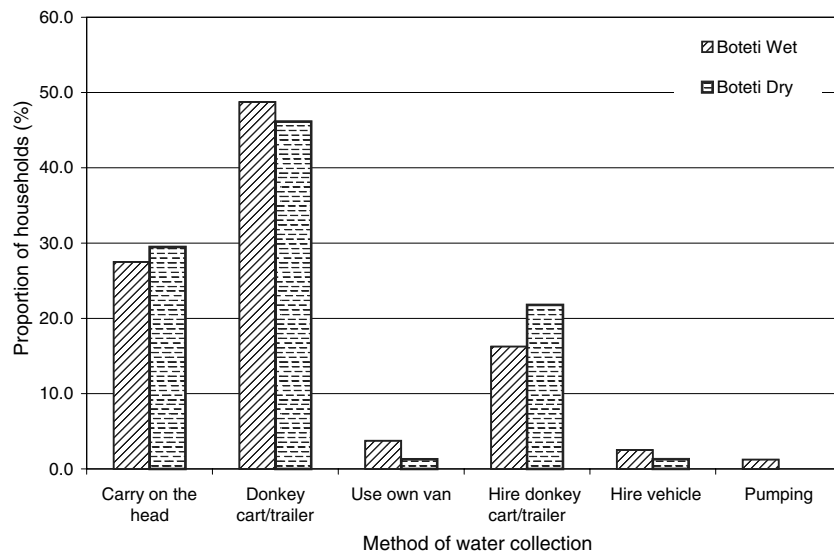


Fig. 6. Method of water collection when the river is flowing (Boteti Wet) and when the river is not flowing (Boteti Dry) in the ungazetted settlement.

The average statutory minimum hourly wage rate for 2005/2006 in the trade industry in Botswana is P2.88 ( $P$  = Botswana Pula, the national currency). Using the recommendation that the shadow price of unskilled labour is 50% of the minimum wage, the hourly minimum wage to be used in this study is therefore P1.44. The opportunity cost of collecting water for an average household would therefore be P1.80. This is the minimum value foregone by a household in collecting water. Given that the average water consumption by a household is estimated at 100 l, the price of water (P/litre) in the ungazetted settlement would be P0.018/litre (P18/m<sup>3</sup>). This price is significantly higher than the P1.25 to P8.15/m<sup>3</sup> charged as from January 2005 by the Department of Water Affairs for metred water in gazetted rural villages. This is primarily due to the signif-

icant amount of time taken by households in collecting water. Thus, households in rural areas, especially in ungazetted areas, incur significant costs in getting water.

#### 4.5. Water quality

Some of the respondents considered the river water to have some objectionable attributes such as presence of particles, offensive odour and colour (Fig. 9). River water was considered to cause infections by 19% of the respondents. Measures being taken by some households to improve the quality of water include boiling, settling and sieving. It is of interest to note that while 19% of the households perceived the water as causing infections, a far greater number of households (60%) indicated that they boiled

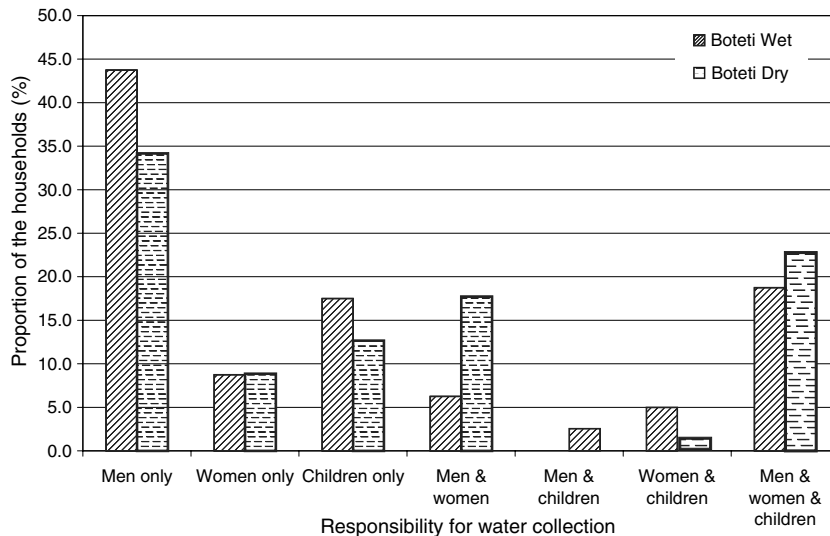


Fig. 7. Responsibility for water collection in the ungazetted settlement.

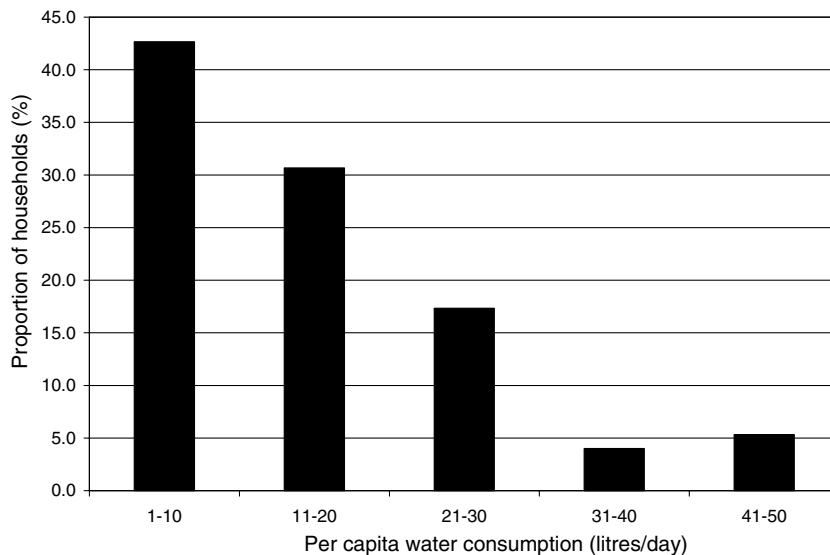


Fig. 8. Per capita water consumption in the ungazetted settlement.

the water before use. It is not clear whether households are boiling the water without an understanding of the reason, or boiling is considered a solution to all water quality problems.

#### 4.6. Other benefits of water

Other than the use of the river as a source of water for domestic uses, households also use the river for livestock watering, gardening and fishing. Table 2 shows the proportion of respondents using the river for other benefits.

Livestock watering is the most important use of the river irrespective of whether the settlement is gazetted or ungazetted. The level of ownership of livestock is similar with 64% and 68% of households in gazetted and ungazetted settlements respectively owning livestock. Livestock owned

comprise cattle, donkeys, goats, and horses. Interestingly fishing and gardening which have a potential to supplement household food and income are practised by very few households. The neighbouring village of Maun with a population of about 50,000 people provides a ready market for fish and vegetables, but the community in the study area is not taking advantage of this opportunity. These three different uses of the river have the potential to conflict with domestic water supply to households in ungazetted settlements. Multiple uses of water sources observed in this study area reinforce the view that the provision of water in rural areas should be considered beyond satisfying basic domestic water needs only (Madulu, 2000). Livestock watering is an important aspect which has not always been considered in the development of rural water supply systems. However, owners of livestock will demand that water be provided



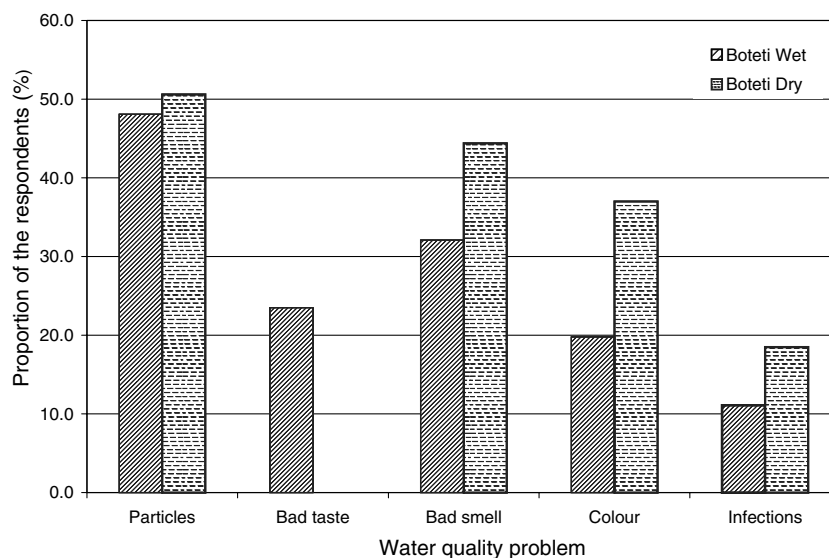


Fig. 9. Issues of concern by households in ungazetted settlements with regard to the water quality of the Boteti River.

Table 2

Beneficial uses of the Boteti River by residents of gazetted and ungazetted settlements

Type of use of the river	Proportion of the respondents (%)	
	Gazetted settlement (Chanoga)	Ungazetted settlement
Livestock watering	64	69
Fishing	10	16
Gardening	11	16

for their livestock even at water sources developed solely for domestic water supply (Arntzen et al., 1999).

The study obtained views of households in ungazetted settlements with regards to existing mechanisms for managing water abstraction for domestic purposes from the Boteti River. The majority of the households (63%) were partly or not satisfied with management of the river as a source of domestic water. Bathing at or close to locations from which water is abstracted, and littering along the river were of major concern. Littering was attributed to picnics and parties done by residents of Maun along the river. There were concerns by 69% of the households in ungazetted settlements regarding fishing. The few fishermen were perceived to contaminate water during cleaning of fish and stirring of water by nets. Excessive use of water for gardening water was an issue of concern for about 53% of the respondents.

#### 4.7. Willingness to pay for water supply

Asked about their willingness to pay to have better or improved access to water supply, 65% of the respondents in the ungazetted settlements indicated that they would be willing to pay towards a project that would improve water supply, while 33% indicated that they were not will-

ing to pay. Some of the respondents who had said that they were not willing to pay anything indicated that they were too poor, while others felt that the supply of water is, and should be the responsibility of the government.

The total potential contribution of households to improving their water supply was estimated to be P7 867 with a mean of P161 per household. Of the respondents who were willing to pay, 59% expressed their WTP in the form of cash, 4% in the form of cattle, 35% in the form of goats and 2% in the form of agricultural produce. The positive WTP expressed by some of the respondents suggests that government can obtain part of the funds from the beneficiaries. These funds could be used in meeting capital costs. The desire by households to contribute towards water supply improvement is a reflection of the difficulties they encounter in accessing water, and also the realisation that water they are currently using is of poor quality.

## 5. Conclusion

Households in the gazetted village obtain water for domestic purposes from standpipes supplied from boreholes by the district council. The standpipes are within a distance of 400 m. The majority (89%) of households in ungazetted settlements satisfy their domestic water requirements through abstracting and using untreated water from the Boteti River during the period when this river is flowing. When this river is not flowing between the months of March and July, or August to December, households obtain water from unprotected hand-dug wells often located within the bed of the same river. Distances to water sources for residents of ungazetted settlements generally range from 0.5 to 4.0 km. These distances are relatively high in relation to WHO recommendations. The most dominant mode of transporting water by residents in ungazetted settlements is the use of a donkey cart which clearly indicates

that water sources are located beyond walking distances from homesteads.

The volume of water collected per household varies from 20 to 400 l with an average of 100 l per household. On per capita basis, consumption was less than 20 l/capita/day for 73% of the households. For 27% of the households water consumption was at least 20 l/capita per day. In addition, to low per capita consumption, the perception of households is that river water has some objectionable attributes such as presence of particles, offensive odour and colour which predispose them to infections.

The opportunity cost of collecting water for an average household was estimated at P1.80 and the price of water was estimated at P18/m<sup>3</sup>. The price of water is high due to the greater amount of time used in collecting water.

Other than the use of the river as a source of water for domestic uses, households also use the river for livestock watering, gardening and fishing.

The total WTP households willing to pay was estimated to be P7 867 and the mean and median WTP were P161 and P100, respectively. Government can therefore tap funds from the contributions of the rural people.

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