The challenges of supplying water to small, scattered communities in the Lower Okavango Basin (LOB), Ngamiland, Botswana: An evaluation of government policy and performance

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Abstract

Supplying adequate water and sanitation facilities to small, scattered rural communities and/or large, fast growing settlements in remote areas is a challenge not easily met anywhere in the world. This article focuses on just such a challenge in the remote, rural area of Ngamiland District in north-western Botswana. Drawing on a combination of critical analysis of government and secondary data, participant observation, and key stakeholder interviews conducted over the period 2004–2006, the article shows that despite a good aggregate record of supplying water and sanitation throughout the country, there are abiding, often serious, problems with supply in remote areas. The research reveals that due to a combination of limited human and financial resource capacity, government policy that deliberately under-serves remote areas in order to encourage resettlement, and complacence among key decision-takers, supply problems go unresolved. The article suggests four key interventions as possible ways forward: using the Okavango Delta Management Plan (ODMP) process as a guiding framework for institutional reform; linking research directly to human resource capacity development; treating water as both a social and an economic good; and soliciting an IWRM 'champion' to drive the political process.

Keywords: Access; Potable water; Rural water supply; Institutions; Botswana; Ngamiland

1. Introduction

This article critically examines the Government of Botswana's delivery of water services to the people of Ngamiland. Following on from Government's two main goals for the water sector – clean, reliable and affordable water for household use; sufficient water for economic growth and development[1] – we attempt to answer two questions: How have supply and service performed in the study area? What may be done to improve delivery?

Universal access to basic water services is a fundamental condition of human development (Gleick, 2000). Yet worldwide, at the beginning of the 21st century, a billion people lack access to adequate drinking water and two billion still do not have access to adequate sanitation. "It is alarming as well as unacceptable that in the 21st century there are still large numbers of women and children in the developing world who are forced to collect untreated or impure drinking water from various sources, often having to travel great distances to reach them" (Falkenmark and Rockström, 2004:26). This obvious failure of 'development' – i.e. the inability to provide basic water and sanitation – is not necessarily a direct consequence of the physical scarcity of water but of poor management (Falkenmark and Rockström, 2004; Abrams, 2001; Gleick et al., 2002).

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[1] Stated specifically: 'To meet the water requirements of the population through provision of a clean, reliable and affordable water supply, which is available to all; and to meet water requirements for industrial, mining, agricultural, wildlife, commercial and institutional users in order to achieve the major aims of rapid economic growth and sustained development' (NDP 9, 2003:218).

In Botswana, the proportion of the population without access to safe drinking water – a key Millennium Development Goal (MDG) indicator – is 12.1% (2001); at first glance, this appears to be a laudable achievement for a developing country. A high, consistent national income based on diamond exports has provided the country with the financial resources to facilitate supply-side provision. A conservatively-minded, democratically-elected government early on recognised the social, political and economic value in developing an extensive network of supply. Eighty per cent of the population is clustered within 50 km of the Lobatse–Francistown road along which the multi-billion dollar North South Water Carrier was built; proximity thus facilitating access for the vast majority of Batswana (Swatuk and Rahm, 2004) (see Map) (see Fig. 1).

There are, however, abiding disparities regarding access to this resource as illustrated in Table 1.

Table 1
Access to potable water in Botswana, urban/rural

Location	Inside house/plot	Outside plot	Other
Urban	52.1	47.9	0.0
Urban village	50.1	49.7	0.2
Rural	9.1	84.2	6.7
National	37.1	60.6	2.3

Source: UNDP (2005).

There are also important questions raised regarding the strategy for basic water provision in a remote, rural area such as Ngamiland. As with the rest of the country, exploitation of groundwater resources constitutes the main form of supply. However, "groundwater resources…certainly cannot be characterised as abundant because of the very low rates of recharge over the greater part of the country – virtually zero over much of the Kalahari. Moreover, its

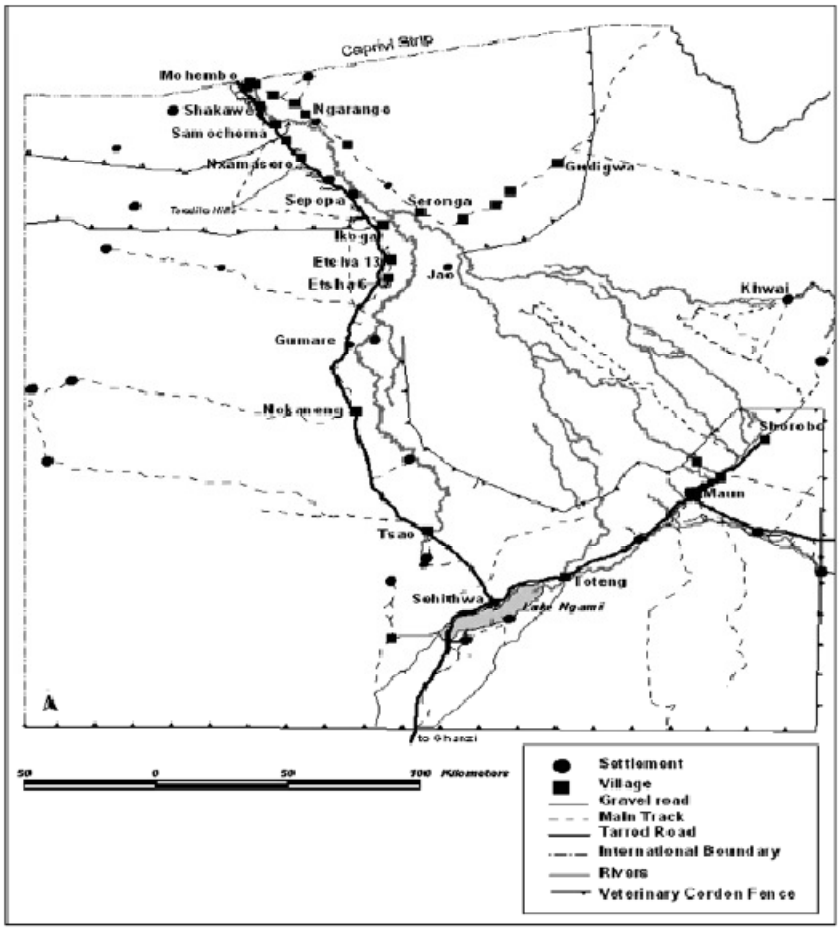

Fig. 1. Map of Ngamiland around the Okavango delta.

quality is often deficient with high salinity and excess concentrations of fluorides, nitrates and other harmful elements in some regions" (SMEC, 1991).

The article proceeds as follows. Section 2 presents our research methodology. Section 3 describes the rural village water supply programme in Botswana. Sections 4 and 5 examine key issues in water supply to gazetted and ungazetted settlements in Ngamiland. Section 6 presents key stakeholder (i.e. government as defined in the Okavango Delta Management Plan process) perspectives on these issues and problems. Section 7 provides conclusions and makes recommendations.

2. Methodology

This study relies on both primary and secondary data. The primary data sources include semi-structured interviews with key informants in each of the institutions involved in water management in the Lower Okavango Basin. These were recorded and later transcribed and written in English. Several telephonic interviews were conducted to get information that was not available through formal channels. Analysis of existing raw data on natural resource use issues in the study area from HOORC, particularly that collected at *kgotla* meetings held at 43 villages during the Okavango Delta Management Plan (ODMP) stakeholder consultation process throughout the LOB during the time period 31/01/05 and 12/05/05; and official government documents in the form of policy documents, legislation, study/inquiry reports, development plans and any other relevant government documents that was accessed. The method used to analyse this data is 'interpretive' and triangular: 'Interpretive research…relies on first hand accounts, tries to describe what it sees in rich detail and presents its "findings" in engaging and sometimes evocative language' (Kelly, 2001). Triangulation maximizes the variety of sources of information until a saturation point is reached – i.e. additional information adds no new knowledge; rather, it reinforces the findings already in hand. The purpose of our interpretive analysis is to provide not definitive 'proof', but 'thick description' so as to better understand problems with sustainable water resources management in the study area (see also Kgomotso and Swatuk, 2006) and to put forward plausible suggestions for improvement.

3. Rural village water supply programme in Botswana

In Botswana, water, like other natural resources, is public property whose use and rights are defined and regulated by the Water Act and its subsidiaries (Water Works Act and the Water Apportionment Act) (Moyo et al., 1993). It is therefore controlled and allocated by the state. Three organisations are responsible for water supply in Botswana: Water Utilities Corporation, Department of Water Affairs and District Councils. WUC is responsible for urban water supply, DWA for major village water supply and District Councils for small/medium rural village water supply. With regards to rural village water supply, water services are only provided to officially recognised villages. In 1994, WUC provided services to 21.5% of the population, DWA to 22.5% and the District Councils to 22%. The remaining 34%, living in sparsely populated settlements (mainly cattle posts), do not have a reliable source of water (Talenyana and Maunge, 1994). People living in these areas are responsible for their own water supply. These are usually sourced from privately owned boreholes, hand dug open wells, rivers or hauling water from major villages or towns.

The Botswana National Settlement Policy (White Paper No. 2 of 1998) influences the availability or lack of a water supply scheme in a village or settlement. This policy is a long-term comprehensive spatial development policy whose main aim is to achieve balanced development. One of its basic features is the creation of settlement hierarchy to facilitate growth of settlements in support of agricultural production and other productive activities. The main aim of this is to concentrate scarce financial resources in selected settlements with the highest potential for development (RoB, 1997). For a settlement to be provided with water by the government, it has to be gazetted a village. According to this policy, a settlement may be defined as a village when it fulfils the following major criteria: consist of a minimum population of 500 people; be situated at least 15 km away from the nearest village; have a headman and a Village Development Committee.

Settlement populations are reviewed, on average, once every 10 years. At that time, the District Council may decide to reclassify a settlement as a village. This is done in consultation with the District Physical Planning Unit and the District Land Use Planning Unit. Recommendations are then forwarded to the Minister of Local Government with whom the final decision rests. Certain settlements may not be declared villages although they satisfy the basic criteria. Thus, beyond the basic guidelines, it is clear that decisions are often taken on an *ad hoc* basis.

The National Settlement Policy (NSP) has developed a three-tier hierarchy of primary, secondary and tertiary centres. According to NWDC (n.d.), the criteria for determining settlement hierarchy is:

- economic potential and employment generation,
- availability of natural resources especially waters to sustain it,
- population size,
- availability of infrastructure and services or the ease with which these can be provided,
- the role of the settlement as a service centre or its potential as a service provider to its hinterlands.

Table 2 shows the settlement hierarchies as they exist in the Ngamiland District.

Primary centres are large urban and rural settlements with a population of more than 20 000 offering employment

Table 2
Ngamiland settlement hierarchies

Hierarchical level	Population range	Number of settlements in the district
Primary centres	20000–100000	1 (Maun)
Secondary centres	10000–19999	1 (Gumare*)
Tertiary centres I	5000–9999	0
Tertiary centre II	1000–4999	12
Tertiary centre III	500–999	17
Tertiary centre IV	250–499	45

Source: Ngamiland District Settlement Strategy, Plantec Africa (2003).

opportunities as well as social and infrastructure services. Secondary centres are immediate settlements where the population ranges between 10000 and 20000, or which are District or sub-District headquarters (even if the population is less than 10 000 as with the case of Gumare, population 6067). The tertiary centre category is subdivided into four categories viz I–IV as shown in the table above. According to the Ngamiland District Settlement Strategy (Plantec Africa, 2003), the recent review of the NSP now restricts Tertiary IV centres to Remote Area Dweller settlements.

In total, according to the 2001 census report, there are over 562 settlements in Ngamiland District. Of these, only two, Gumare and Maun, have a population of more than 5000 people. Table 3 below shows that the vast majority of settlements in Ngamiland District consist of fewer than 249 people – far below the required level for gazettement.

Since water is a basic need, it is first established in all newly confirmed villages before the establishment of other infrastructural services such as primary education or health. At present, there are more than 460 rural village water supply schemes operated and maintained by various District Councils in Botswana. According to currently adopted standards, a typical village supply scheme consists of four major water supply components. These include: Energy and Pumping Components, Transmission Main, Distribution Network and a Storage Tank. The service levels provided by these schemes are measured using the currently adopted Botswana rural village water supply design manual. According to this manual, minimum requirements that should be achieved (Hagos, 1994) include:

- Thirty litres per person per day through public standpipes.
- People should not walk more than 400 m one way to fetch water.
- One public standpipe with two taps to serve roughly about 200 people.
- Storage facilities with a capacity that can meet a short time balancing and 48 h emergency requirements.
- A back up water source in order to secure availability of water in case main operational sources fail.

Table 3
Ngamiland District Settlement sizes and numbers, 2001.[a]

Population size	Number of settlements	% of settlements
<249	478	87
250–999	61	11
1000–4999	10	2
5000–9999	1	0.2
>10 000	1	0.2

Source: Ngamiland District Settlement Strategy, Plantec Africa (2003).

[a] Total number of settlements vary between 551 and more than 600 depending on the study consulted.

The main water source for most recognised villages in Botswana is groundwater based. Usually more than two boreholes are drilled per village. The groundwater table for all these boreholes varies from place to place, with depths ranging between 50 and 150 m (Hagos, 1994). During the initial development of most village water supply schemes, emphasis was placed on minimising the initial capital costs by drilling the boreholes close to the villages (within 5–7 km radius from the centre of the village) rather than transporting water having a reliable source from longer distances. According to Hagos (1994), this development approach has resulted in problems such as the drying of many boreholes annually especially during droughts, because they were drilled on relatively poor aquifers (reaffirmed by Masamba, interview, 24/10/05). In such situations, it is difficult to secure reliable and sustainable services.

The lack of users' participation in money or labour, and the large organisational structure of the District Council's Water Units, lead to very high overhead costs, and thinly spread services (in order to cover all villages with at least 500 people). This makes district water supply service expensive, inefficient and unsustainable (Hagos, 1994; Makgasane, interview, 22/09/05). Supply costs in rural water supply include, among others, development, initial construction, running, upgrading and rehabilitation. Virtually none of these costs is recovered through payment. Water provided through village standpipes is currently free to the users (government is piloting metered standpipes in gazetted villages). Where water is reticulated to households (either on-plot or in-house), the billing system is ineffective (Makgasane, interview, 22/09/05; also RoB (2001)). People have become used to poor service and not having to pay for services (although some have expressed willingness to pay for a *reliable* – both quality and quantity – service; see, Mmopelwa et al., 2005). These and other problems such as unaccounted for water losses raise questions about the sustainability and reliability of district water supply services.

4. Access to water supply by gazetted villages in Ngamiland

Most of Ngamiland is rural, with the exception of Maun that is considered a major village. Village water supply service provision is one of the Ministry of Local Government's statutory functions. The Ministry empowers District Councils to provide reliable and sustainable water supply services to all people living in recognised villages.

With the exception of Maun, the rest of Ngamiland relies on the rural village water supply programme for its water services. Maun, as both primary centre and major village, gets its water supply from the Department of Water Affairs. Some unrecognised settlements get services through the Remote Area Development Programme; an unreliable programme, which was only developed for drought emergencies. Reliable water supply is therefore limited outside recognised villages.

The majority of settlements in Ngamiland District are along the Maun–Shakawe road, Mohembo–Gudigwa road and along the Okavango River, the Delta and the Thamalakane River (NWDC, n.d.) (see Map). Villages in the Sehithwa area (located in the Ngami Sub-District) are clustered around Lake Ngami. The settlement pattern in the Okavango sub-District is also such that there are several villages with small populations located within a few kilometres of each other; a good example here is Etsha 1 through 13.

There are no major water storage facilities in Ngamiland; pumping of groundwater is the preferred option because it has been the least controversial of the supply practices. The Okavango Delta is a protected resource with no major developments that can be built on it or having its waters diverted for storage (Baeti, interview, 19/05/2005, Maun). A 1986 plan to exploit surface waters of the Delta was shelved after public protest and a negative Environmental Impact Assessment. Currently the Government is undertaking the ODMP process as part of its commitment to the Ramsar Convention on Wetlands of International Importance (ODMP, 2005; Swatuk, 2003; Kgomotso and Swatuk, 2006).

According to the Ngamiland District Development Plan 6 (NWDC, n.d.), most of the settlements in Ngamiland have adequate water from boreholes. The quality of this water is generally unreliable because not all water supply schemes have treatment facilities. Rehabilitation schemes to clean the water in most of the villages are still under construction. For those villages without adequate water, water bowsers/tankers are used to supply the villages. Delivering water by tanker truck is very expensive. Sandy roads also make access difficult and hence the need to identify more sustainable sources of water (NWDC, n.d.; Makgasane, interview, 22/09/05). Most of these villages still experience seasonal shortages of water. Table 4 shows principal sources of supply of drinking water for households in most villages and settlements in Ngamiland.

As indicated in Table 4, 26313 households were located in Ngamiland during the 2001 National Population Census with 20210 (76.8%) having access to tap water. 2339 (11.5%) of these households have water piped indoors, 3786 (18.7%) have water piped outdoors and the remaining 14085 (69.9%) depend on communal stand pipes. Besides these three sources of reticulated water supply, the remaining 23.2% of the population rely on other sources. Of these sources, boreholes are the next reliable source and only 1910 (i.e. 31.3% of the 23.2%) of the households get their water via this source. 2305 (37.7% of 23.2%) of the households depend on rivers or streams for their water supply with most of these households located on the eastern side of the Okavango River and Delta, where there are permanent water sources. 12.7% of the 23.2% use wells, 9.2% depend on tankers that are extremely unreliable, 2.2% rely on dams and pans, 1.2% rely on rainwater tanks, 0.5% on springs, and the remaining 5.2% rely on other sources that could include hauling from nearby villages, or buying from borehole owners. Non-reticulated sources of water (wells, pans, rivers, rainwater tanks and springs) are affected by seasons and accessibility of the area (bowser/tanker). During the dry season, droughts and periods of no-flow in the Delta or its outflows (March–July or August–December), all sources of water supply are affected. Unreliable sources such as wells, pans, ephemeral rivers and streams are affected more as the people have to seek other distant sources. Water availability is unreliable in the entire Ngamiland area and not all households in recognised villages such as Maun rely on reticulated water supply. Some households still depend on the other sources such as tankers, wells, rivers, streams, and dams/pans.

Table 4
Sources of supply of drinking water supply for households in Ngamiland

Principal source of water supply	Ngamiland East	Ngamiland West	Delta
Piped indoors	1846	438	55
Piped outdoors	2929	752	105
Communal tap	7790	6198	97
Bowser/tanker	287	271	2
Well	419	357	1
Borehole	1426	482	2
River/stream	484	1569	252
Dam/pan	124	9	0
Rainwater tank	19	53	0
Spring	9	21	0
Other	265	27	0
Unknown	17	7	0
Total	15615	10184	514

Source: Ngamiland District Development Plan 6: 2003–2009 (n.d.).

Maun 'is the centre of economic activities in the district...a focal point for tourism, and a business centre for local craft industries such as basketry, skins and Basarwa crafts' (Mmopelwa et al., 2005). Water supply for Maun comes from two wellfields (the Thamalakane and Shashe) and is augmented with surface water during certain times of the year. The Shashe wellfield has however been depleted and will soon be decommissioned (Gojamang, interview, 19/09/05, Maun). Four electricity-powered and 19 diesel-powered boreholes help deliver this supply. Borehole depths range from 20 to 60 m (Plantec Africa, 2003). Mmopelwa et al. (2005) conducted a survey in the high-employed, middle-income suburb of Chobe in Maun. According to the authors, 89% of respondents reported unreliable and unpredictable water supply; 74% reported year-round water shortages; and 19% experienced irregular water supply during the year. Bombo (in Mmopelwa et al.,

2005) attributed problems of water supply to, inter alia, frequent breakdown of borehole engines, old equipment and machinery used for the reticulation of water, pipe bursts and power cut-offs. Between January and October 2004, DWA recorded 249 breakdowns with a total repair cost of P329, 540, a significant amount of money given that these are recurrent problems. Often times, households go without water for several days due to easily avoided problems such as leaving the borehole engine to run out of diesel fuel (personal observations). Households interviewed revealed a number of contingency plans to ensure supply, and listed them as: travel to other places (35%); stored water in containers (53%); asked for water from people with overhead storage tanks (12%). Households also revealed poor quality of water, including unusual taste (saltiness), discolouration, and high degree of sedimentation and staining of baths (suggesting high mineral content). Mmopelwa et al. (2005) tested the water and found the quality to be poor and inconsistent.

Given that Maun is the District Headquarters and that this is one of the wealthier parts of the village, it would not have been unreasonable to expect better quality and quantity of supply. However, these are common problems throughout Maun (personal observation), often becoming worse during the driest parts of the year.

5. Access to water supply in ungazetted settlements of Ngamiland

Thirty-three percent of the Ngamiland population live in areas/settlements of less than 500 people. For these people, the Okavango River and its outflows are an important source of water. In a study of six ungazetted settlements and one gazetted settlement (Chanoga) along the Boteti River, Tsholofelo (2005) found that whereas all households interviewed in Chanoga obtain water for domestic purposes from standpipes supplied from boreholes by the District Council, 89% of all 80 interviewed households in ungazetted settlements "satisfy their domestic water requirements through abstracting and using untreated water from the Boteti River during the period when the river is flowing" (a total of 1480 people are said to live in these six settlements; the 80 households canvassed equate to about 37% of this population). The remaining 11% travel to collect water at standpipes in Chanoga or other gazetted villages.

During the dry season (March–December), 69% of households "obtain water from unprotected hand-dug wells often located within the bed of the same river" (Tsholofelo, 2005). Some of these wells can be up to 30 m deep (Bendsen, personal communication, 2005). Other households haul water in tanks and drums from nearby villages with stand pipes using donkey carts and vans; otherwise people walk to reach a source of water and carry buckets on the head. This division of labour is gendered, as men collect water via donkey cart and women carry buckets. Tsholofelo (2005) found that distances covered to the water source in ungazetted settlements range from 0.5 to 4.0 km, and in some cases more. For one interviewee, 'relocating to Maun' was found to be a viable dry season strategy.

In most places, communities share water sources with their livestock and wild animals. Sixty nine percent of the ungazetted households interviewed use water for watering livestock; 64% of residents of Chanoga (the gazetted settlement) use the same river for the same purpose (Tsholofelo, 2005). Often, people are unable to collect water due to the presence of predators such as crocodiles or aggressive mammals such as hippos and elephants. Crocodiles are reported to attack livestock while elephants attack people and also stir up the water thereby altering its quality and colour.

The open access nature of the river also creates problems of pollution. According to member of parliament for Maun, R. Ramsden, 'Some places like Maun Lodge and Riley's Hotel drain their sewage straight into the river' (Chanoga kgotla meeting, 04/03/05). According to two residents, 'Waste is dumped everywhere, particularly by people from Maun who hold parties along the river banks'; and 'Government officials who camp in our area also leave litter around their camps' (Chanoga kgotla meeting, 04/03/05; confirmed by personal observation, June 2005).

Given the unreliability of the source itself, consumption levels of water in ungazetted households are low. Tsholofelo (2005) found that 73% of the households consume no more than 20 l per person per day; while only 5% consumed 40l–50l/p/d. Water carried to the household is only used for drinking and cooking; bathing and laundry is done at the river. While this reduces the demand for potable water, it poses other problems such as pollution from activities carried out at the river.

Usable groundwater resources are generally limited in much of the district outside the Delta, with a high risk of striking saline or brackish water (NWDC, n.d.). Away from the Delta, the only source of clean water is fresh aquifers that are extremely sensitive because they are surrounded by saline aquifers (WRC, 2004). The practice of settling around boreholes in the context of highly permeable Kalahari sands subjects the aquifer itself to pollution by humans and animals (Huntsman-Mapila, personal communication, 2005). Treatment of this water and care of the water source is therefore essential if water of acceptable quality is to be regularly supplied. Other sources include rainwater harvested in natural depressions/pans, and rainwater tanks attached to staff houses and public facilities (NWDC, n.d.; Mmopelwa et al., 2005). In most ungazetted settlements people depend on the river when it is flowing, and dig wells (by hand) during the dry season.

Water quality is a common problem in most water sources in Ngamiland. Sometimes the quality is so bad that even wild animals and livestock cannot drink it (Masamba, interview, 24/10/05). Water quality problems include: high salinity, offensive odour and colour (Tsholofelo, 2005). Water from some boreholes used for wildlife watering around Kumaga has been reported to have red algae (Mosojane, interview, 21/09/05, Maun). When there is no water purification system, such as in most ungazetted

settlements, communities have to deal with these kinds of issues. According to Tsholofelo (2005), most communities have resorted to boiling the water, letting it settle and sieving it. This was also suggested by a water chemist at HOORC as a method to be recommended for all residents of Ngamiland, including those residing in high-cost housing in Maun (Masamba, interview, 24/10/05). In Xaxaba, an ungazetted settlement, there have been cases where community members, mostly children, allegedly fell sick after drinking water from the river (Ngami Times, 14–21/10/2005). Communities that depend on rivers for domestic water supply and livelihoods in general also worry about upstream-downstream activities that may affect both the quantity and quality of the water (Bendsen, 2005a,b).

6. Water supply problems in Ngamiland and government response

While in absolute terms Botswana has made remarkable progress in providing water services to most of its population residing in other parts of the country, the same cannot be said for Ngamiland. WHO/UNICEF estimated that the proportion of the rural population with access to safe water in Botswana had increased from 88% in 1990 to 90% in 2002 (WHO/UNICEF, 2004). Most of the remaining 10% without access to safe water is resident in Ngamiland. Ngamiland comprises about 8% of Botswana's population, and in 2001, 48% of the population in Ngamiland East had no access to piped water of whatever quality, while in Ngamiland West this percentage was approximately 28.2%. While this paper deals with access to water supply, it should also be noted that access to water resources in Ngamiland means more than just water supply for drinking and cooking. As described elsewhere (Kgomotso and Swatuk, 2006), people in Ngamiland are extremely dependent on the Okavango River's ecosystems and the goods and services that it has to offer. No other district in Botswana is as dependent on natural resources for livelihoods as is Ngamiland District (CSO, 2001).

Table 5 shows a sample of all types of villages and settlements in Ngamiland, their water sources, the type of service they receive, the water authority responsible, and the problems with their water services. This section highlights the responses of key interviewees to perceived supply problems as highlighted in the above sections. These problems or challenges either hamper a reliable supply of water services or impede progress toward sustainable use and management of water resources. As shown below, DWA and the District Council are well aware of these problems but face their own problems in trying to supply and manage water resources in the district.

6.1. The challenge of providing a reliable domestic water supply

As shown in Sections 3 and 4 above, there is a serious water supply problem in Ngamiland. This is especially so in non-gazetted settlements where one third of the district population lives. Officers from both the DWA and the District Council responded as follows: "Nothing can be done about water supply problems of these settlements" (Reakae, interview, 19/09/05, Maun). There is an element of

Table 5
Water supply and water related problems in some villages and settlements in Ngamiland

Vilage	Status (Gazetted or non-gazetted)	Population	Source of water	Type of service available	Water authority	Issues/problems present
Mababe	Gazetted	157	Borehole	Standpipes	DC (CWU)	Seasonal/periodic shortages
Komana	Gazetted	186	Borehole	None	DC (CWU)	No reticulated water supply
Xaxaba	Gazetted	78	River and borehole	None	None	Borehole not working Water quality poor Long distances covered to fetch water
Ditshiping	Gazetted	238	River	None	None	Water stirred up by elephants Water quality no good Long distance covered to fetch water
Sexaxa	Non-gazetted	534	Borehole	Standpipes	DC (CWU)	Only three standpipes
Tsodilo	Non-gazetted	172	None	None	DC (RADP)	No drinking water
Khwai	Non-gazetted	395	River	None	DC (RADP)	No reticulated water supply
Senkondomboro	Non-gazetted	655	River	None	None	Crocodiles in the river threat to people
Chanoga	Gazetted	381	Boreholes	Standpipes	DC (CWU)	Periodic/seasonal shortages
Shakawe	Gazetted	4389	Treated river water	Standpipes and private connections	DC (CWU)	Water quality problems
Gumare	Gazetted	6067	Boreholes	Standpipes and private connections	DC (CWU)	Water shortages (some boreholes dry) Water colour and quality poor
Maun	Gazetted	43,776	Boreholes	Standpipes and private connections	DWA	Seasonal water shortages Poor and inconsistent quality Erratic supply

anger in some officers when one mentions the issue of water supply to the areas. For example, the supply manager from DWA responded: "They must go back to larger villages where they can get water. Why are they refusing to move?" (Gojamang, interview, 19/09/05, Maun). Remote dryland settlements, like Tsodilo, requested to be connected to the district water supply system. In larger villages like Etsha and Nokaneng the supply of water to individual homes was highlighted. DWA's response to most of these issues was that it only develops systems and hands them over to the District Council. District Council on the other hand maintains that it fails to keep up with the demand because of lack of sufficient resources, both financial and human, to build water supply schemes and supply gazetted settlements. Where the DWA supplies water (i.e. Maun), most water shortages are blamed on the supply scheme's inability to pump water to some parts once the water table drops (Gojamang, interview, 19/09/05, Maun). The system is simply not capable of supplying the rapidly growing demand in Maun and its localities. With regards to the availability of water resources to cater for Ngamiland, DWA posits that the current abstraction levels are very insignificant and neither projected increase in population nor per capita demand is expected to have a significant impact on the hydrology of the Delta (DWA, 2005). This suggests that water shortages in Ngamiland are an issue of management failure, not physical water scarcity. Key interviewees attributed water supply problems to one or more of the following:

- Growing demand from increasing population.
- Lack of enough boreholes to pump water.
- Settlement patterns in the district.
- Lack of sufficient funds by DC to supply more villages.
- Shortage of labour at both DWA and DC to carry out activities such as building water supply schemes (due to the government's zero growth policy that has been in place for the past 5 years), maintenance and operation.
- Shortage of staff with relevant skills (management, technicians, supervisors etc).
- Centralisation of staffing decisions.
- The expensive nature of water development in the district (groundwater abstraction).
- Delayed responses to attend to pump breakdowns due to transport problems, resulting in pump breaks not being attended to for long periods of time.
- Destruction of water storage tanks in remote areas by large mammals, particularly elephants, especially in the dry season, and the difficulty of attending to these problems.

6.2. The challenge of managing water quality, minimising pollution and protecting water resources

The threat of water pollution by inadequate management of fluid wastes in the villages, river activities such as laundry and bathing, floodplain gardening, wastewater handling in tourist camps and lodges in the Delta are regarded as a potential danger by both primary and key stakeholders (Bendsen, 2005a). DWA responded that there are indications that the authorities responsible for issuing licences for lodges and monitoring adherence to environmental standards lack the resources to carry out proper control (DWA, 2005). DWA itself does not monitor the activities that pose a threat to the quality of water resources (Ramoshibidu, interview, 19/09/05, Maun).

DWA is also currently doing nothing to prevent the drying up of aquifers, as there are no regulations dealing with this (Reakae, interview, 19/09/05, Maun). An example of a depleted aquifer is the Shashe wellfield aquifer. The freshwater lens, which has developed in the Shashe River Valley, has been continuously exploited for the domestic water supply of Maun and is now reported to have declined by 15 m (Bauer et al., 2005). The extended period of no flow in the Shashe River has resulted in deterioration of water quality in many production boreholes due primarily to increasing salinity. Additionally the proximity of Maun to the Shashe wellfield has facilitated the continuing encroachment of settlements into the wellfield, creating a serious threat of contamination (WRC, 2004). This has raised concerns about the sustainability of the present freshwater pumping and led to the planning and development of new wellfields along different seasonal streams, and the eventual decommissioning of the current abstraction site (Bauer et al., 2005). Key stakeholders, drawing on data collected by their various offices (see, also ODMP, 2005), confirmed that water quality problems resulted from one or a combination of the following:

- Lack or insufficient laws governing groundwater abstraction and use.
- Lack of monitoring of abstraction levels from boreholes.
- Over abstraction resulting in salt water intrusion into freshwater aquifers.
- Land use activities such as agriculture, pit latrine toilets in areas with high water table.
- High solar radiation resulting in high evaporation, leaving salts in the water.
- Climate change resulting in declines in water tables.
- Lack of recharge of aquifers.

6.3. Challenges of supplying productive water

Government continues to view 'productive water' as that which facilitates concentration of people and cattle away from the Delta. This means a continuing emphasis on borehole development. Borehole development in Ngamiland District has increased dramatically, from fewer than 50 in the early 1960s to more than 1100 to date (Vander Post, personal communication). Demand for these sources continue to grow while government's ability to monitor development and use is severely limited (Bendsen, personal

communication). The vast majority of these boreholes are either privately owned by households or commercial livestock farmers. Smallholders who keep livestock for subsistence purposes depend on seasonal or perennial (river, pan) water sources, or pay a fee to borehole owners who have developed these water points on communal land. The density of boreholes has increased tremendously as the distance between them has been reduced from 8 to 6 km (Ramoshibidu, interview, 19/09/05, Maun). The tourism industry is also allocated a lot of water as boreholes for watering wildlife are also increasing especially in dry areas that are mostly used by farmers for grazing their livestock. Competition for both grazing areas and water by wildlife and livestock is increasing (Naidu, interview, 19/09/05, Maun). This puts pressure on both vegetation and water resources.

Despite numerous warnings regarding borehole development and its impact on aquifers (SMEC, 1991), government is reluctant to restrict the ability of people to search and exploit their own water – be they large-scale cattle farmers through borehole development or subsistence dwellers in ungazetted villages through hand dug wells.

7. Conclusions and recommendations

This article has highlighted the universally perceived importance of supply of water of sufficient quality and quantity for domestic and productive activities. In this regard, Botswana, as a developing country appears to be performing very well, with 88% of the population having access to water. The government is rightly proud of this achievement. However, we have attempted to show how national aggregates hide realities at local level. Eighty four percent of rural Batswana have off-plot access to water, with 'off-plot' varying dramatically from well-functioning communal standpipes to 30 m deep hand-dug wells. As shown above, all of this water varies in quality and quantity.

Water supply is tied directly to Botswana's national settlement policy that encourages settlement in limited areas so that services may be concentrated. In recognised settlements, supply is erratic, expensive, and often unreliable in terms of both quality and quantity. This is prevalent even in the District Headquarters of Maun, where fully 33% of Ngamiland's entire population resides. While not an outright management 'failure' perhaps (especially considering the important human, financial, technical and decision making constraints operative at District level), this does suggest that water supply management institutions in Ngamiland (DWA in Maun; District Council in association with DWA elsewhere) are dramatically underperforming and in need of serious reform.

In ungazetted villages the picture is far less optimistic. As shown above, the majority of residents of six ungazetted settlements along the Boteti River use less water than globally accepted standards (either 25l/p/d or 50l/p/d depending on the source). The quality of this water is unreliable while access to its supply is often fraught with competition from wild animals. This suggests not only a management failure, but also a failure of policy, in particular a settlement policy that refuses to recognise the mobile livelihood patterns and processes of most Ngamiland residents (Kgomotso and Swatuk, 2006).

Indeed, residents in the Boteti area prefer to migrate to collect water rather than resettle permanently; this reflects their own understanding of livelihood sustainability being dependent on seasonal mobility. This seems an important point, for not only does it contrast with government policy, it also brings under the spotlight the sustainability of fixed settlement policy in a dynamic physical environment. At the same time, government is making decisions in the absence of scientific data – hence the desire of the DWA to undertake hydrological modelling within the context of the ODMP project.

Key stakeholders in government recognise and often acknowledge the limitations of their performance. Working within standard bureaucratic and sectoral frameworks, however, local water suppliers ascribe to performance criteria set down by superiors located in Gaborone. To them, 88% looks quite good as an aggregate performance indicator. Theirs is a completely unreflective style of policy making and implementation. To challenge this and other aspects of delivery is often met with resentment and aggression. The researchers' inquiries sometimes were dismissed outright, such as 'there are no problems with grazing lands in Ngamiland' (Muchina, interview, July); or refusal to discuss (the Agricultural Resources Board); or complacence, such as 'As long as the water [rain in Angola] is coming down, the aquifer will recharge, so there is no problem' (Naidu, interview, 19/09/05). However, as shown in this paper, there are serious problems with water supply in Ngamiland.

Institutions are perceived to be at the centre of the world's water crisis. Centralised decision-making, lacking both transparency and accountability, based on narrow scientific understandings of the definition of water, and often made in the service of political and big business interests has led to unsustainable, inequitable and inefficient practice around the world (UNDP, 2006). This process has been captured by Allan (2003) in terms of the 'hydraulic mission' – a phenomenon that was most prevalent in the early modern period in Western societies, but still dominates in many developing societies. This form of decision-making and conception of the role of water in society is particularly problematic in water scarce states such as those of Southern Africa, especially Botswana.

Another problem with water resource management in the developing world is the fragmented nature of institutional decision-making. The water cycle has not been the determining factor in decision-making, neither within nor across sectors. To the contrary, decisions have been taken, after which the search for water – i.e. overcoming the limitations of the water cycle-begins. How can these problems be overcome? In the short-term there seem to be several viable interventions.

First, if achieving IWRM is a process – and not a template – then the ODMP process provides the context wherein contrasting views can continue to debate ways forward (personal observations). Stakeholder participation and data gathering exercises are extremely important in this regard. If inequitable, inefficient and unsustainable practice is to be overcome, then the voices of those who suffer at the hands of bureaucratic routine and organisational culture must be heard, and their views must be supported by good science.

Second, capacity building linked to research is also a way forward. All organisations within Botswana suffer from human resource constraints. Like other developing countries, Botswana lacks sufficient data to make informed decisions. Training a new generation of managers, schooled in the values of IWRM, who conduct necessary research within the resource base, can only help change organisational culture and bureaucratic routine in the long-term. Developed countries took several hundred years to move toward IWRM; how reasonable is it to ask developing countries to do the same within a generation or two?

Third, water especially at local/water point level must be treated as both a social and an economic good. District Councils are tasked with the difficult project of providing water to scattered small villages. This is only one of the many responsibilities of a financially crippled organization. As politically unpopular as it may be, the indiscriminate and unmonitored pumping of groundwater must be regulated. How better to regulate groundwater abstraction than through charging fees for doing so? Granted, the ability to monitor is already limited, even in Maun. Improving this situation in the short-term requires support from central government in terms of revenue and human resources.

Fourth and last, although it might appear idealistic, overcoming these numerous problems of water resource management in Ngamiland, and in the country as a whole, may require a champion – a popular and influential political personality who could press for change. Could the current Vice President, Ian Khama, be Botswana's 'Mandela factor'?

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