Water for Urban Development or Rural Livelihoods: Is that the Question for Botswana's Notwane River Catchment?

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Abstract

The point of departure for this paper is the publication by Jeremy Meigh in 1995 entitled 'The Impact of Small Farm Reservoirs on Urban Water Supplies in Botswana'. Urban water supply dams and small rural farm reservoirs occur within the same river catchments of Botswana's eastern belt. The title of Meigh's paper suggests conflict between the two sets of reservoirs. It could also be interpreted to imply the superiority or paramountcy of urban water needs over rural livelihood (agricultural) needs or of urban industrial development over rural development. There has been heightened debate in recent years as to what extent the failure of the Gaborone Dam late in 2014 was due to the small agricultural dams found upstream in the Notwane River catchment which is the source of its water. This paper uses documentary evidence to contribute to the debate. It highlights the legitimacy and livelihood significance of both the large and small dams and presents a more holistic explanation of the desiccation of the Gaborone Dam in the 2000s. It ends by noting the positive steps taken by the Botswana government towards sustainable water resource governance.

Introduction

Botswana is one of the driest countries in Sub-Saharan Africa. Water availability and its sustainable management and equitable supply are, therefore, arguably the most significant factors in the country's long-term socio-economic development (Swatuk and Rahm 2004; SMEC and EHES 2006; World Bank 2010; Ministry of Minerals, Energy and Water Resources [MMEWR] 2012; and Statistics Botswana 2015). As Makgala (2008) aptly observed, the country's currency was named after rain ('Pula') because of the economic, historical and politico-cultural significance of this scarce and variable resource to the well-being of the nation and all its people. Thus, while presently the country has the proud record of providing safe drinking water to nearly 100% of its urban population and approximately 90% of its rural population (Central Statistics Office [CSO] 2009; Government of Botswana and United Nations Development Programme [UNDP] 2012), serious issues of supply sustainability have in recent years occupied the minds of development planners and academics alike (Swatuk and Rahm 2004). Nowhere has this concern been more pronounced than in the southeastern urban-industrial region of the country dominated by Gaborone, the administrative and commercial capital.

Here, as in the rest of the eastern fringe of Botswana, water for domestic/institutional, industrial and agricultural uses has been harnessed from river catchments through a number of large and small dams. Because of water's indispensability to all sectors of society and economy, its increasing scarcity correspondingly raises the potential for conflict between and among competing resource uses and users. Such has been the case since the turn of the present millennium in the city of Gaborone and Notwane River catchment areas (Map 1) where the Gaborone Dam, which caters for domestic/institutional and industrial

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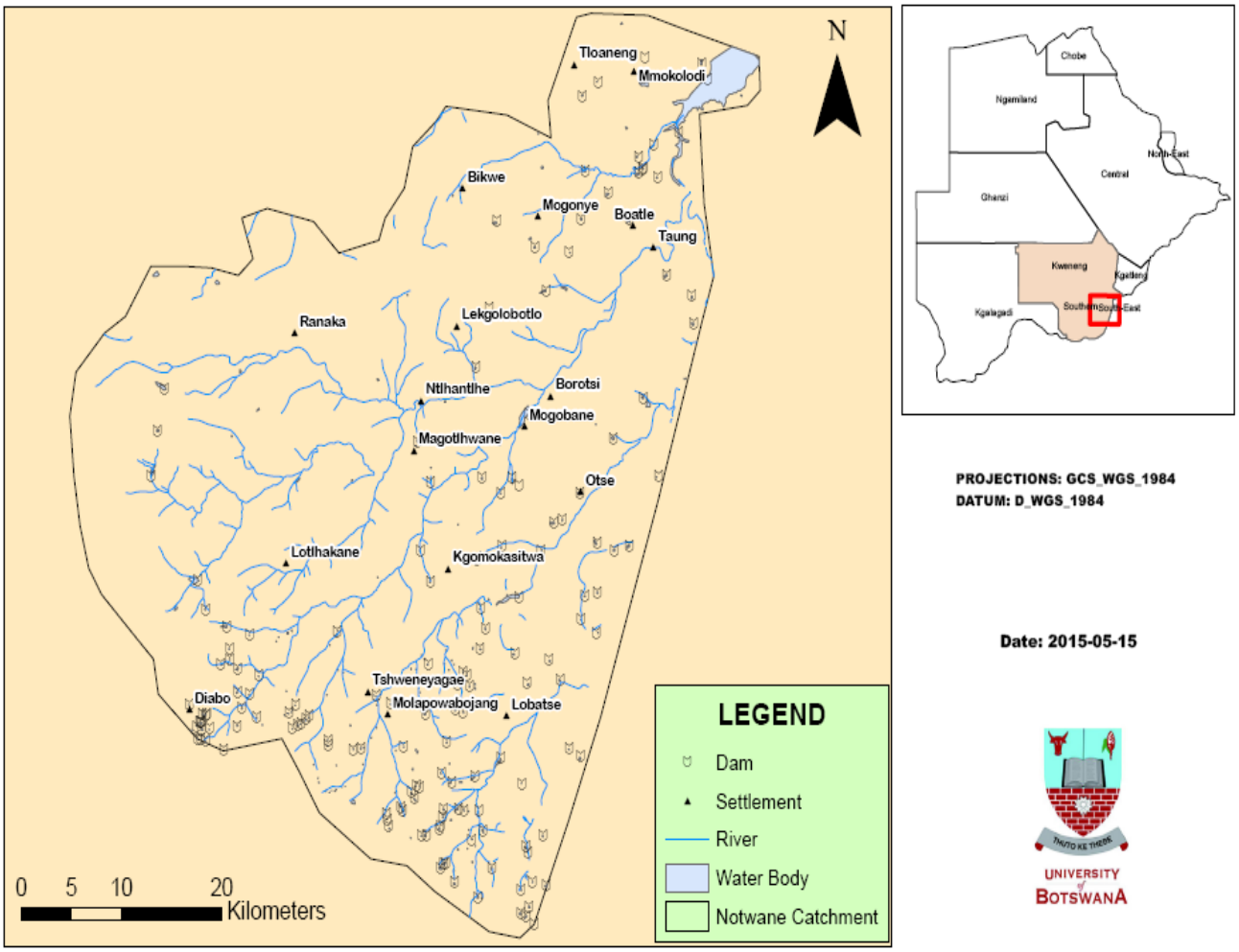
water needs, is pitted against a multitude of small dams serving agricultural (livelihood) and environmental conservation purposes upstream of the reservoir.

This paper contributes to the recently ignited debate on the role of the small dams in the failure of the Gaborone Dam late in 2014. It highlights the legitimacy and livelihood significance of the small dams and presents a more holistic explanation of the desiccation of the Gaborone Dam in the 2000s. It ends by noting the positive steps taken by the country towards sustainable water resource governance.

Map 1: The Notwane River catchment showing Gaborone Dam and some of the small agricultural dams



Source: Drawn by Botlhe Matlhodi, Department of Environmental Science, University of Botswana

Methods and Dams in Human History and Eastern Botswana

This article is based on review of the literature on water supply and demand in Botswana, with special reference to surface water resources harnessed in the river catchments of the eastern belt of the country. Both official government documents and academic literature throwing light on water resource governance and development to meet domestic, institutional, agricultural and urban-industrial needs were consulted. We also provide a brief historical note on dams in human history and eastern Botswana. In human history, many societies have manipulated the flows of proximate rivers for specific purposes, such as through damming and flow diversions for flood control, irrigation and transportation (Beck *et al*. 2012). According to Beck *et al*. (2012), dam construction dates back to 6500 BC when the Sumerians built dams on the Tigris and Euphrates for flood control and crop irrigation. Dams (large and small) have remained common

instruments for local, national and rural development. Their benefits can far outweigh the unintended negative impacts on the health of user populations or on the downstream aquatic and socio-economic environments (USGS 1996). In Botswana there are two categories of dams namely those constructed to supply water for human and industrial consumption and those built principally for livestock watering during the dry season. The former are much larger than the latter, which are referred to as small agricultural dams.

According to Statistics Botswana (2015), in 2014 there were nine large dams with a combined capacity of 903.2 million cubic metres (MCUMs) (Table 1). All these dams were constructed by the Department of Water Affairs (DWA) and are managed by the Water Utilities Corporation (WUC), a parastatal. All the nine dams in Table 1 are on tributaries of the Limpopo River which forms the eastern boundary with the Republic of South Africa. As can be noticed in Table 1, the primary function of these dams is to supply water for domestic, institutional and industrial purposes to major rural and urban demand centres in the eastern belt of the country in general, but especially in the greater Gaborone area (see below). More recent dams like Thune (2013) and Lotsane (2012) have also provided for horticultural irrigation, but it is too early to gauge the extent to which rural communities in the vicinity of these dams have taken advantage of this opportunity.

Table 1: Large Water Supply Dams in Botswana

Dam	Year commissioned	Capacity (MCUMs)	Yield (MCUMs)	Location	Primary purpose(s)
Gaborone	1964	141.4	9.5	Southeast District	Domestic, institutional and industrial water supply to Gaborone
Nnywane	1970	2.3	0.6	Southeast District	Domestic, institutional and industrial water supply to Lobatse but also to Gaborone if necessary
Shashe	1973	85	23.0	Northeast District	Domestic, institutional and industrial water supply to Selebi-Phikwe, Francistown and Tonota. Original primary purpose was to supply water to the copper-nickel mine in Selebi Phikwe.
Bokaa	1993	18.5	4.9	Kgatleng District	Domestic, institutional and industrial water supply to Gaborone
Letsibogo	2000	100	24	Central District	Domestic, institutional and industrial water supply to Gaborone and nearby settlements through a 360 km pipeline. The urban villages of Palapye, Serowe and Mahalapye are also supplied through the pipeline.
Ntimbale	2008	26	3.6	Northeast District	Supplies water to all villages in the Northeast District and nearby villages in Central District
Dikgatlhong	2011	400	62	Central District	Built to supply water to Gaborone and neighboring settlements through another pipeline. Francistown and the urban villages of Palapye, Serowe and Mahalapye will also benefit from the dam and pipeline
Lotsane	2012	40	6.6	Central District	Supplying potable water to Tswapong villages and to irrigated horticulture in the area

Thune	2013	90	6.5	Central District	Supplies water to the villages of Bobonong, Motlhabaneng, Mathathane, Tsetsebjwe, Mabolwe, Semolale, Gobojango, Lepokole and Molalatau. The dam would also support irrigation farming at Mathathane

Source: Adapted from Statistics Botswana (2015:7).

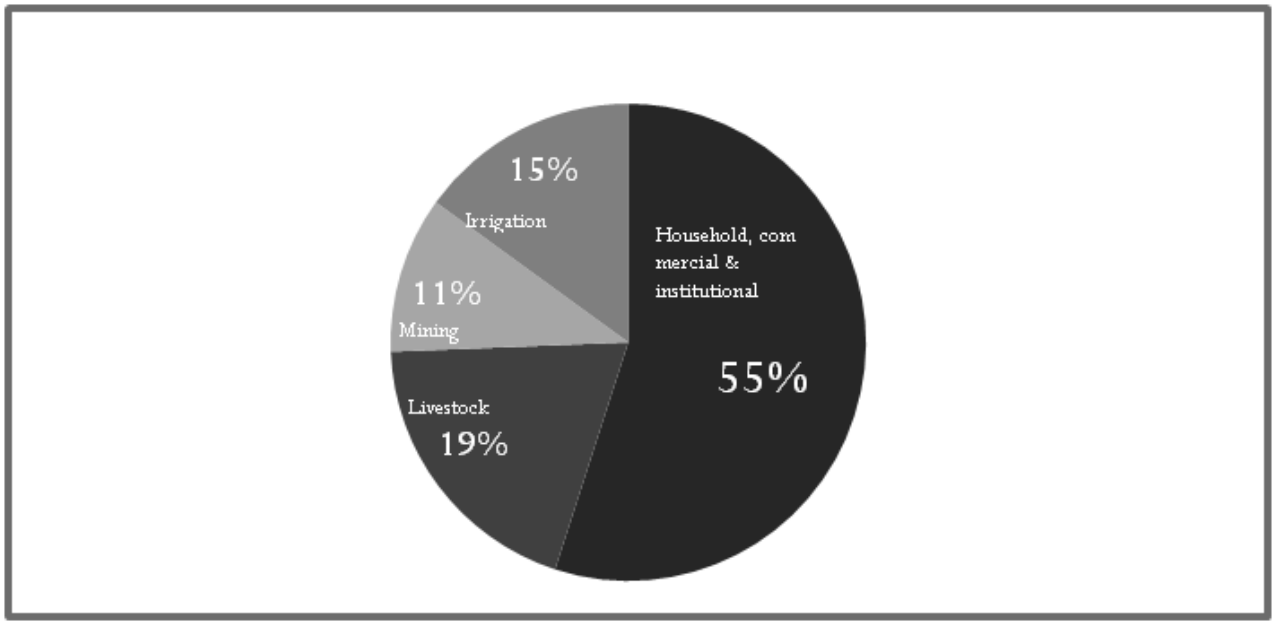
The exact number of operational small agricultural dams in Botswana is not known, because many are reportedly out of service due to siltation and embankment erosion, but they could be well over 300 countrywide (Department of Water Affairs [DWA] SMEC and EHES Consulting Engineers 2006). They occur mostly in eastern Botswana where suitable sites and ephemeral rivers are more numerous. Some small dams were constructed during the colonial era. Good examples of these in the Notwane catchment are Mmakgodumu dam in Kanye and Mogobane dam in Mogobane village. Mmakgodumu dam was built in 1941 at the instigation and leadership of Kgosi Bathoen II to supply water for livestock and people, largely as a response to the severe drought of 1933 which killed many livestock (Manzungu et al. 2009: 216). Mogobane, on the other hand, was the brainchild of Chief Seboko of Bamalete who in 1936 sought the assistance of the colonial government to construct a dam for watering livestock using the labour and oxen of his tribe (Taylor 1977). Mogobane dam was completed and commissioned in 1937. However, most small dams have been constructed since the 1980s by the Ministry of Agriculture under the Dam and Haffir Building Policy of 1974 primarily to provide water for the livestock of small-scale farmers during the dry season (DWA, SMEC & EHES 2006:113) and secondarily to promote fisheries and horticultural irrigation where these are feasible (Meigh 1995). Construction of small dams has continued to-date, facilitated, since 1993, by the adoption and implementation of the 'Agricultural Water Development Policy' of the Ministry of Agriculture. The target beneficiaries of small dams construction were groups of small-scale herd owners (owning fewer than 40 head of cattle) 'who cannot otherwise afford their own water sources' (Ministry of Agriculture n.d:1). Each such dam was a legal entity, backed by a dam group constitution, right to land obtained from the Land Board and water rights secured from the Water Apportionment Board.

In 1992 the Notwane or Gaborone Dam catchment had a total of 203 small dams with an estimated combined capacity of 26 MCUMs (Meigh 1995). A more recent investigation by the Department of Water Affairs revealed that the number of small dams in the catchment had since risen to 237 (DWA 2014).

Sectoral Water Demand and Supply in Botswana and the Gaborone Dam vs Small Dams Question

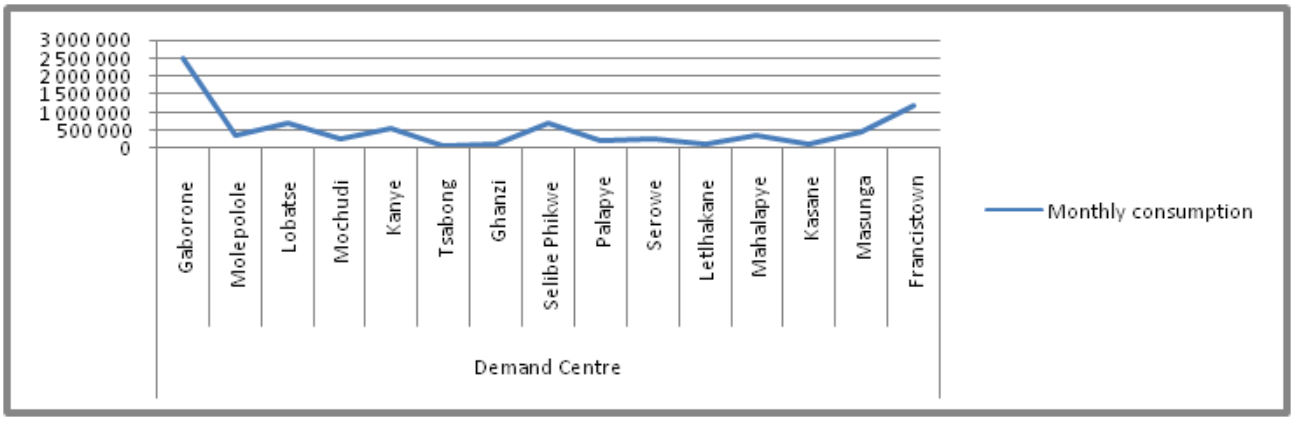
Currently Botswana consumes an estimated 250 MCUMs of water (MMEWR 2012), up from an estimated 193.4 MCUMs in 2000 (Swatuk and Rahm 2004). As Figure 1 illustrates, this consumption is unevenly distributed across sectors, with over half being accounted for by the domestic, institutional and commercial sector. The city of Gaborone and its environs is the leading consumer of water among the settlements (Figure 2), with a cumulative demand of 30 MCUMs per annum or about 75% of all water consumed by settlements in the eastern belt of the country (Paya *et al*. 2012: 2) where 80% of Botswana's population resides. In general, water demand is markedly higher in the southern portion of eastern Botswana which is dominated by Gaborone than in the northern segment where Francistown, the second largest city, is situated (Statistics Botswana 2015).

Figure 1: Botswana Water Consumption by Sector, 2011



Source: DWA (2011)

Figure 2: Average monthly water consumption by major settlements in Botswana (kilolitres), March 2012 – April 2014



Source: Based on data from Statistics Botswana (2015)

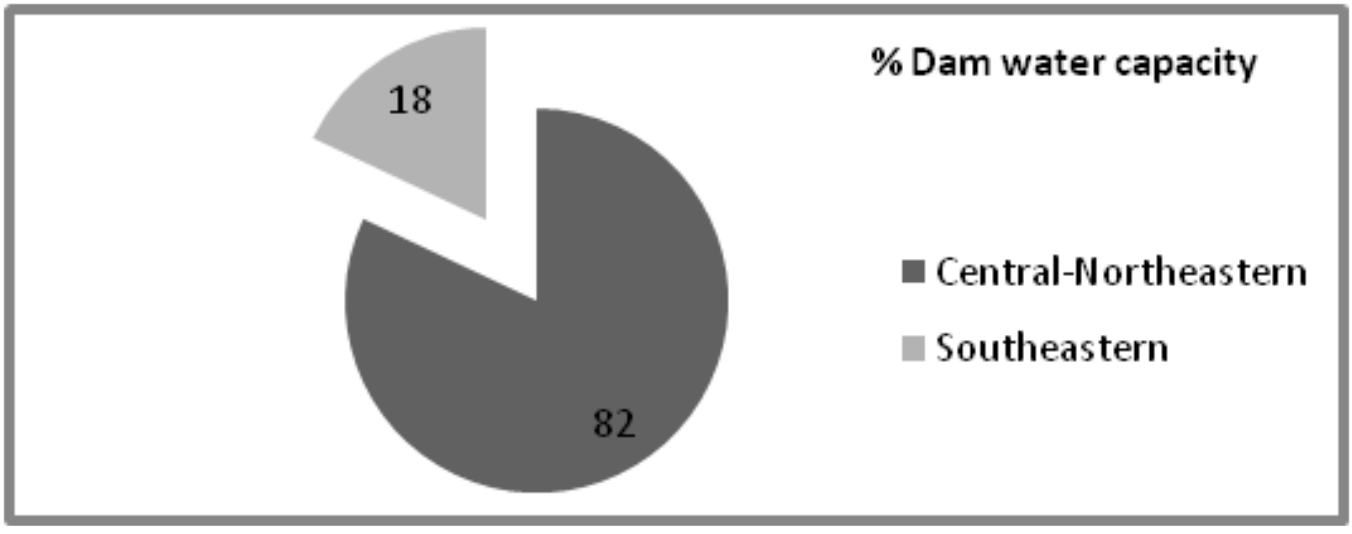
The focus of this paper is on surface water resources. Ninety percent of urban water supply in Botswana comes from surface water sources (CSO 2009); specifically from the dams listed in Table 1 above. Originally, Gaborone's water was wholly supplied from the Gaborone Dam which was constructed in 1964 when the country's headquarters was relocated from Mafeking (now Mahikeng) in South Africa to Gaborone inside Botswana in preparation for independence in 1966 (Mgadla 2016). However, by the mid-1970s the planned-for population of 20,000 had already been exceeded (Sebego and Gwebu 2013). This, in combination with the dam's low safe yield and severe drought episodes that occurred frequently, necessitated the following progressive actions to forestall water shortage to the extent technically possible:

- Raising the dam wall in 1985 to increase storage capacity to the current 141.1 MCUMs;
- Construction of Bokaa Dam on the Mestimotlhabe River near Bokaa village with a safe yield of 4.9 MCUMs to augment the Gaborone Dam's 9.4 MCUMs;

- Development of the Ramotswa wellfields in 1983 for additional safe yield of 0.95 MCUMs at the height of a severe drought;
- Entering into an agreement with the Republic of South Africa in 1990 for supplementary supplies from Molatedi Dam; and
- Construction of Letsibogo and Dikgatlhong Dams in the north-central zone of the eastern belt with two parallel 360-km pipelines conveying the water to Gaborone and settlements in between (Table 1). Construction of the Letsibogo-Gaborone pipeline (North-South-Carrier 1 Water Transfer Scheme [NSC1]) started in 1999 and was completed in 2000. Due to financial constraints, full implementation of the second phase of the project (NSC2) was envisaged only during National Development Plan 11 (NDP11), 2017-22 (Paya *et al.* 2012).

Indeed, without these mitigation measures the city of Gaborone and associated villages would have had an absolute water crisis. Even with these measures, the water supply authorities were forced to progressively intensify the harsh water rationing which had commenced in the early 2000s to conserve the limited quantity from outside the Gaborone area. In fact, after years of progressive decline in water volume (Figure 4), the Gaborone Dam had completely failed by December 2014 when the water level had fallen below the pumping level. With hindsight, therefore, the capital city should have been situated in the wetter north-central region of eastern Botswana which today accounts for 82% of the water stored in WUC dams (Figure 3). Indeed, a minority in Botswana's pre-independence Legislative Council advocated such a location, but were overruled by the majority (Mgadla 2016).

Figure 3: Geographic Distribution of Dam Water Storage Capacity in Eastern Botswana



Source: Based on Table 1

It is also worth noting that, unlike livestock water supply for small-scale farmers which is the responsibility of the Ministry of Agriculture, the development and provision of water for domestic/ institutional and industrial use has (until recently) involved a number of other institutions (for example, Department of Water Affairs and Local Government). This arrangement created problems of co-ordination and potential conflict (MoFDP 2010).

Recent water sector reforms promise, among other achievements, to a) minimize the number of hands in potable and industrial water resource governance, b) improve co-ordination among water institutions, c) increase stakeholder participation and d) generally embrace a new water resource governance

paradigm (see 'Signs of a Sustainable Water Future' below). If effectively implemented, these reforms would hopefully overcome the problem of the policy-practice disjuncture noted by Swatuk and Rahm (2004) in Botswana's water resource management. The reforms could, therefore, minimize the potential for conflicts among competing but legitimate water uses or strategies, such as that between the Gaborone Dam and small agricultural dams in the Notwane catchment addressed in the next section.

The Surface Water for Urban Development or Rural Livelihoods Debate

This section highlights not only the debate implied in this paper's topic but also attempts to justify the co-existence of the two types of dam in the Notwane catchment.

The genesis and basis of the debate

Gaborone's water supply problems noted above inspired a public debate in 2014 as to why the Gaborone Dam was failing to meet the demand. Media reports pointed an accusing finger at the collective impact of the numerous small, mostly livestock water dams found in the Notwane River catchment upstream of the Gaborone Dam (for example: *Sunday Standard* 1 January 2014; *WeekendPost* 27 February 2014; *Mmegi* 12 December 2014). Consequently, the authorities had to address key national institutions among which were Parliament, local councils and the *Ntlo ya Dikgosi* (House of Chiefs) to respond to media reports, some of which were misleadingly inaccurate. For example, there was a claim that the small dams were illegal and owned by rich private individuals (Bosaletswe, 2014). The seeds of the debate were sown in 1992 when the study by Gibb *et al*. (1992) established that the 203 small dams reduced inflow into the Gaborone Dam by intercepting some of the runoff. The findings of the study formed the basis of Meigh's (1995) publication entitled 'The Impact of Small Farm Reservoirs on Urban Water Supplies in Botswana'. Meigh reported that the small dams intercepted 25% of Notwane River catchment runoff, resulting in a 30% decline in the sustainable yield of the Gaborone Dam. Since the current sustainable yield of the Gaborone Dam is 9.4 MCUMs (Table 1), this means that, without the upstream small dams, the yield would have been 13.4 MCUMs, which is still only about 45% of the current estimated annual water requirement for Gaborone.

As our contribution to this debate, we argue and provide evidence below that Gaborone's water supply problems has a multivariate causal nexus of which the small dams are just one variable. Before this, we first make a case for the need for both the large dams and the small agricultural dams in Botswana's river catchments.

The need for both large and small dams

We have demonstrated above that both the large and small dams are legitimate Botswana government infrastructural instruments for national socio-economic development. Without the large dams, for instance, it would have been difficult for Botswana to achieve the milestone of supplying safe water to the 100% or vast majority of its population. We have seen that 80% of the population is found in the eastern belt of the country where all the large dams are located. Thus, the beneficiaries of water from large dams include both the urban and rural or semi-urban populations of this belt. The Gaborone Dam and water works provide for the Greater Gaborone population, which includes all the major villages listed in Table 3. The large dams also supply water to the industrial, service and commercial activities, since most of these are also concentrated in the same belt.

These urban-industrial consumers of water account for most formal employment in the country and are associated with greater water productivity (value addition per cubic metre of water consumed) than agriculture (World Bank 2010). The urban-industrial sector contributes significantly to the national economy and to the revenue used by government to promote infrastructural and rural development

(Mmopelwa and Seleka 2011; MoFDP 2010). Indeed, as noted earlier, the newer large dams like Thune and Lotsane were designed to cater for both domestic and agricultural development needs (Table 1). Thus, there is no questioning the need to have sufficient water in the large dams to meet domestic, institutional and industrial needs in both urban and rural contexts.

Similarly, the majority of the small dams are sources of critical dry season water supply for livestock belonging to small-scale farmers too poor to afford the cost of sinking and equipping boreholes (MoA 1998). None of the small dams in the Notwane catchment is illegal and the overwhelming majority of them are communal dams (Gibb *et al*. 1992). As Whiteside and CORDE (1997) have observed, the small dams complement the agricultural cycle of the small herd pastoralist, enabling him to have a share of communal rangeland resources.

Livestock is the second major consumer of water in Botswana, after the domestic/institutional and commercial sector (Figure 1). This is a reflection of the significant socio-economic and cultural functions that the livestock sector performs in the lives of Batswana. Thus, despite the precipitous decline in agriculture's share of the GDP, from about 40% in 1966 (MoFDP 1997) to about 2% in recent decades (Statistics Botswana 2016), government's support to the sector in general and the dominant livestock sub-sector in particular has remained significant because of these functions. The specific functions of livestock include the following:

a) *Serves as a good entry point for poverty alleviation and securing rural livelihoods*. Livestock rearing is a traditional occupation requiring no special skills for the participation of the average Motswana. Thus, if well targeted, efficient and environment friendly, government support to the sector could benefit many rural poor sustainably (DWA, SMEC and HES 2006).
b) *A significant source of income for small herd owners*. Keith Jefferis' (2007:4) analysis of the impact of livestock sales on income and poverty established that 'income from cattle provides a greater proportion of total income for poorer households' than for richer families.
c) *Traditional livestock has multiple values.* Unlike modern commercial livestock farming whose major objective for cattle rearing was cash income from sales, traditional farmers view cattle as a bundle of values. According to Richard White (1993), cash sales accounted for only 33 percent of the total household benefits derived from traditional cattle; the other outputs being milk (35%), meat (19%), draught power (6%) and gifts out (7%). The latter include the cultural functions of *mafisa* (loaning out of some cattle to poorer families for herding purposes) and *bogadi* (bride price) through which poorer households secured breeding nuclei for entry into the livestock sector and possible exit out of poverty (DWA, SMEC and EHES 2006). While there is no recent study comparable to that of White (1993), a baseline case study by the Botswana Vulnerability Assessment Committee (2010) for Ngamiland and Ghanzi indicates that households in those regions derived about 30% of their cash incomes from sale of livestock and livestock products.
d) *Agricultural sector's most significant contributor to GDP.* The livestock sub-sector accounts for 80% of agriculture's contribution to Botswana's GDP (DWA, SMEC and EHES 2006).

The foregoing discussion indicates that small dams cater to the water needs of an important traditional livelihood source, pastoralism. Large dams provide the urban and rural populations in eastern Botswana with clean and safe water for domestic and various socio-economic purposes. Therefore, the two classes of dam are needed, as, in our view, they complement each other in advancing the socio-economic welfare of Batswana.

Towards an explanation of the Gaborone Dam's desiccation

It is evident from Meigh (1995) that the small dams in the Notwane River catchment cannot be completely absolved from contributing to Gaborone's water woes of the 2000s. However, in this section, we demonstrate that small dams are in a multi-factor causal nexus that includes: inadequate surface hydrology, adverse climate variability, accelerated population growth-cum-demand, and water wastage. These are discussed below:

i) *Inadequate surface hydrology*. It would appear that the founding fathers of Gaborone as the seat of post-independence Botswana ignored the realities of the surface hydrology of the location they chose and under-estimated the settlement's potential to grow rapidly into a primate city and to attract migration into its hinterland (Mgadla 2016). Compared to the central and northern parts of eastern Botswana which were wetter and had several major tributaries of the Limpopo, the southeastern region was drier and had only one major river, the Notwane, also a tributary of the Limpopo. It is for this reason that only a small fraction of Botswana's large dam capacity is accounted for by the Gaborone (southeastern) region (Figure 3).

ii) *Accelerated population growth-cum-water demand.* When the Gaborone Dam was commissioned in 1964, Gaborone as a settlement had only about 4,000 people. Gaborone town itself was planned to cater for a maximum population of 20,000 (Fawcus and Tilbury 2000), a figure that was breached within the first decade of Botswana's independence in 1966 (CSO 2011). Further, Gaborone has not only grown into Botswana's primate city, but its pull has also contributed to the accelerated growth of settlements within its hinterland (Table 3) whose potable water needs are also met by the Gaborone Dam and allied dams, namely Bokaa and Nnywane. Thus, despite measures to increase local water supply capacity noted earlier, by 1991 it had already become evident that these efforts alone would fail to meet demand for the greater Gaborone region by the end of the seventh National Development Plan (NDP7) period in 1997 (Ministry of Finance and Development Planning 1991), hence the north-south water transfer schemes alluded to earlier.

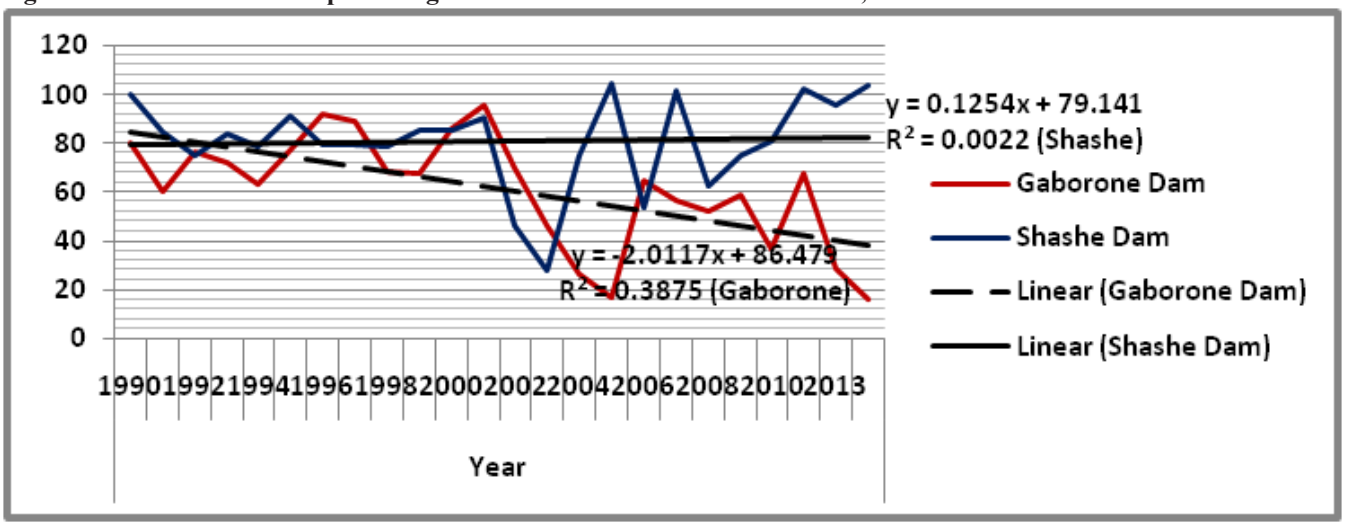
Table 3: Population statistics and inter-censal population change in Greater Gaborone, 1991 vs 2011

TOWN/MAJOR VILLAGE	POPULATION		POPULATION CHANGE	
	1991	2011	Absolute	Percentage
Gaborone	133,500	231,592	+98,092	+ 73.5
Lobatse	26,000	29,007	+3,007	+ 11.6
Gabane	6,000	15,237	+9,237	+154.0
Kanye	31,400	47,007	+15,607	+ 49.7
Moshupa	11,400	20,016	+8,616	+ 75.6
Thamaga	13,000	21,471	+8,471	+ 65.2
Mogoditshane	14,200	58,079	+43,879	+309.0
Molepolole	36,900	66,466	+29,566	+ 80.1
Mochudi	25,500	44,815	+19,315	+ 75.8
Tlokweng	12,500	36,323	+23,823	+190.6
Ramotswa	18,700	28,952	+10,252	+ 54.8
TOTAL	329,100	598,965	+269,865	+ 82.0

Sources: 1). Table 1.6 Distribution of population in urban settlements: 1971-2001 **http://www.cso.gov.bw/templates/cso/file/File/Table_1.6_Distribution_of_Population_in_Urban_Settlements.pdf .** Accessed 28 August 2015). 2011 Botswana Population and Housing Census – Alphabetical Index of Districts **http://www.cso.gov.bw/templates/cso/file/File/2011%20Census%20_Alphabetical%20Index%20of%20Districts.pdf.** Accessed 28 August 2015.

iii) *Adverse climate variability.* As a semi-arid country, Botswana is among the most water stressed nations in the world and, according to Gassert *et al*. (2013), the situation is likely to worsen towards the mid twenty-first century, as the impacts of climate change become more intense (World Bank 2010). According to the Water Utilities Corporation (WUC), the Gaborone Dam has been adversely affected by the frequent and severe droughts experienced over the Notwane River catchment since the 2002/2003 rainfall season (MMEWR 2014). This claim is supported by the progressive decline in the Gaborone Dam's water level (see broken trend line on Figure 4) compared to, for instance, that of Shashe Dam in the wetter region (see solid black regression line on Figure 4). This, in combination with the low sustainable yield and excessive demand implied in Table 3, culminated in the Dam's failure during the 2014/2015 rainfall season.

Figure 4: Relative trends in 'percentage full' of Gaborone and Shashe Dams, 1990-2011



Source: Based on data from Statistics Botswana (2015) and WUC (2015)

iv) *Water losses.* Much water treated to potable standards is currently lost through leakages and wasteful practices, especially in the villages (Mudanga 2011), including those in greater Gaborone (Table 4). Nationally, the average loss for 2014 was reported as 25%, well above the internationally accepted level of 15%. While it is impossible to have a loss-free water supply system, the current high waste rates could only exacerbate greater Gaborone's water crisis, especially when considered in conjunction with water loss through evaporation from the dams estimated to be as high as 65% (MoFDP 2010).

Table 4: Percent losses of treated water for selected major villages in Greater Gaborone, 1997/1998 – 2007/2008

URBAN VILLAGE	% WATER LOSS RANGE OVER 1997/1998 -2007/2008
Ramotswa	26.1 – 57.4
Molepolole	26.3 – 45.6
Kanye	12.0 – 42.9
Tlokweng	16.6 – 34.4
Mogoditshane	3.2 – 20.1

Source: CSO (2009:69)

Thus, only a holistic approach to the explanation of the Gaborone Dam's desiccation in the 2000s would put the role of small dams in proper perspective for the lay stakeholder. While little could be done to prevent climate variability or to modify the surface hydrology, the factors of escalating demand and water losses are amenable to management intervention. The next section discusses some of the promising recent water resource governance interventions with the potential to foster a sustainable water future.

Signs of a Sustainable Water Future

The motto of Botswana's Water Utilities Corporation (WUC) is *'We Keep it Flowing For You'* (https://www.wuc.bw). This reflects the dominant supply oriented water management paradigm of the 1970s when the water supply parastatal was formed. Besides, the water demand then was low as WUC's mandate was to cater only to the water needs of the relatively small urban-industrial sector dominated by Gaborone and Francistown. As noted above, by the late 1990s, the reality of Botswana as a water-stressed nation and the imperative to adopt a water resource governance paradigm aligned to this reality had more than become evident to all. Fortunately, the review of Botswana's National Water Master Plan in 2006 (NWMPR 2006) culminated in recommendations for the nation to shift to the *water demand management* (WDM) paradigm, to adopt the Integrated Water Resource Management (IWRM) framework and to effect other 'water sector reforms' (WSRs) that would facilitate effective implementation of these governance models. Our optimism for a more sustainable water future for Botswana is based on these recommendations and especially on the fact that the Botswana government has since taken practical steps towards implementing them and developing an *enabling policy* which we discuss below.

Water Demand Management

WDM is designed to restrain demand for water through changing consumer behaviour by using various economic instruments (for example, tariffs) and non-economic measures (for example, water rationing and/or water conservation awareness campaigns). Measures promoting water use efficiency, treatment and re-use of waste water, storm water capture, and reduction of water wastage and losses would also be part of WDM. This is in contrast to the water supply management approach in which growth in water demand was met through technological and engineering interventions to increase supply (for example, by constructing more dams or exploiting more well fields).

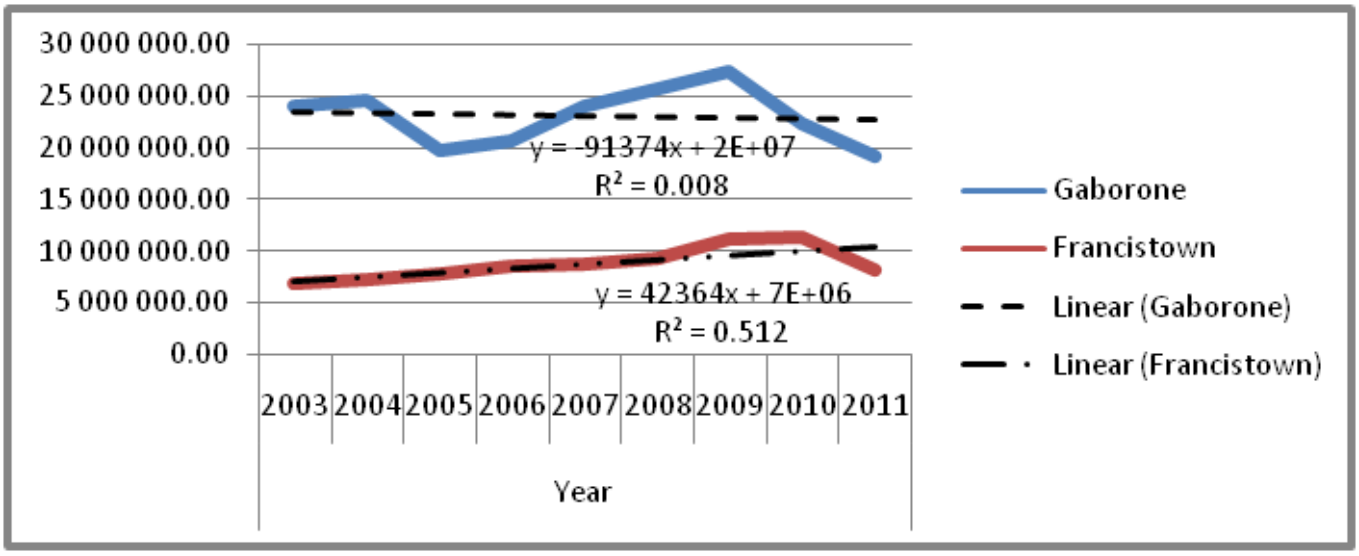
That WDM is effective in restraining water consumption is illustrated by Figure 5 below which shows discernible dips in treated water production for Gaborone in 2005 and from 2010 due to drought-induced water rationing, in contrast to Francistown where such rationing did not obtain (Statistics Botswana 2015).

Integrated Water Resource Management

Botswana has adopted the Global Water Partnership definition of IWRM as a process of co-ordinated development and management of water, land and related resources in order to maximise economic and social welfare without compromising the sustainability of ecosystems and the environment (DWA 2013). Together with the NWMPR (2006), IWRM provided the framework for policy intervention in the water sector during the Tenth National Development Plan (NDP10) period, 2009-2016.

This effectively meant that the country committed itself to the adoption and application of the Dublin (or IWRM) Principles which, among other provisions, recognise the river basin or watershed as the key surface water management unit and the social, economic and ecosystem value of water (MMEWR 2012). It is possible that if the watershed (or hydrographic) approach had been applied to the management of the water resources in the Notwane River basin the impact of small dams on runoff into the Gaborone reservoir would have been minimised.

Figure 5: Water production (kilolitres) trends for Gaborone and Francistown, 2003-2011



Source: Based on data from Statistics Botswana (2015).

Other water sector reforms

The other useful reforms adopted recently in the water sector include the following:

a) *Reduction in the number of institutional players* in the water sector from 19 to 2 since 2009, in order to reduce duplication of resources, promote equity and efficiency in water service delivery, increase accountability and strengthen water resource stewardship (MMEWR 2012). In 2009, WUC and DWA became the only water authorities in the country; the former assuming all water and waste water service functions, while the latter became the sole water resource manager. To perform its stewardship functions strategically and within the IWRM and WDM frameworks, DWA, with the assistance of UNDP and GEF, developed a 17-year Integrated Water Resource Management and Water Efficiency (IWRM and WE) Plan (DWA 2013).
b) *Rationalisation of the legal framework for water resource governance* by creating the Water Resources Board (WRB) (with DWA as the secretariat) and the Water and Energy Regulator (WER). The stated functions of WRB are equitable allocation of water resources among users, water resource monitoring and formulation of relevant policies. WER, on the other hand, would ensure financial sustainability and compliance with service standards within the water resources sector (MMEWR 2012).
c) Practical steps towards *institutionalisation of water accounting*. In 2012, with the assistance of the World Bank, DWA started creating water accounts, towards building a database on the quantity of water resources (stock accounts) and the volumes and value of abstracted and distributed water (flow accounts) (DWA and CAR 2013). The plan ultimately was to integrate the data into future national development planning. This database will obviously be invaluable to the implementation of the Integrated Water Resource Management and Water Efficiency Plan alluded to above.

Drafting of the Botswana National Water Policy

To give effect to the WSRs and the paradigm shifts outlined above, the Ministry of Minerals Energy and Water Resources has drafted a national water policy which emphasizes the principles of efficiency, equity, and sustainability (MMEWR 2012: 4-5). The overall objective of the draft policy is 'to provide a

national framework that will facilitate access to water of suitable quality and standards for the citizenry and provide the foundations for sustainable development of water resources in support of economic growth, diversification and poverty eradication' (MMEWR 2012:4). Once approved by Parliament, one hopes that government will also swiftly review the Water Act of 1968 for necessary updating and alignment with the progressive water resource management reforms just outlined. The Water Act has provided the legislative framework for water resource governance in Botswana for the past 50 years, it surely needs review.

Conclusion

The answer to the rhetorical question we mooted as this paper's topic is obviously 'no'! Integrated Water Resource Management principles would dictate that both rural livelihoods and urban industrial development get their fair share of available water resources. The Notwane River catchment caters for both through the large dams (Gaborone, Bokaa and Nnywane) and the 237 small agricultural dams, several of which predate the Gaborone Dam. Both sets of dams were constructed lawfully and with government financial and/or policy support.

Unfortunately, at the time the dams were constructed, the prevailing water resource development approaches were sectoral and supply oriented, and without any prior socio-economic or biophysical impact assessments to suggest impact mitigation or enhancement measures. Perhaps, if impact assessments had been in vogue, dam development was co-ordinated and the Notwane catchment was viewed as the water resource management unit, less runoff into the Gaborone reservoir would have been intercepted by the small dams upstream. However, this paper has also demonstrated that the greater proportion of the Gaborone Dam's problems was due to the joint impact of several factors, some of which were beyond human control.

Nevertheless, the recent adoption of WDM and IWRM frameworks and associated institutional reforms and policy initiatives bodes well for the future. To reflect a genuine shift from the sectoral and supply driven to the integrated and demand management paradigm of water resource management, WUC's motto should be changed from 'We keep it flowing for you' to something like 'Let's conserve it to keep it flowing for all'! As noted in the introduction, it is no accident that Botswana's national currency is *Pula*, which means rain; not diamond or copper, despite the commanding significance of mineral wealth to the country's economy. We hope that we have contributed positively and objectively to the small-dams-Gaborone-dam debate. We are aware that the Gaborone Dam filled up to full capacity following Cyclone Dineo's downpours in the 2016/2017 rain season, but given the high probability of increased climate variability-cum-climate change during the present century, the debate is likely to recur in the not too distant future.

Acknowledgements

We gratefully acknowledge the African Union's Research Grant Programme's financial support for this project (ACT4SSAWS) that is funded by the European Union (EuropeAid/132-331/M/ACT/ACP). However, the views expressed are solely the responsibility of the authors of the paper. We would also like to thank the Department of Environmental Affairs in Gaborone for giving us free access to their library collection. We are grateful to Ms Botlhe Matlhodi of the Department of Environmental Science at the University of Botswana for preparing Map 1. Our final appreciation is to the Editor and anonymous reviewer for their insightful and constructive comments on the manuscript.

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