Analysis of Water Rights Applications in Botswana (2002-2020)

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List of acronyms

CAR	Centre for Applied Research
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation (formerly DWA)
EWSEP	Emergency Water Security and Efficiency Project
GoB	Government of Botswana
IWRM-WE	Integrated Water Resources Management -Water Efficiency.
NSC	North-South Carrier
NWMP	National Water Master Plan
RAWA	Requested Amount of Water Abstraction
WAB	Water Apportionment Board
WDM	Water Demand Management
WRA	Water Rights Application
WRB	Water Resources Board
WUC	Water Utilities Corporation

1 Introduction

This report is an up-date of the analysis of new water rights applications (WRA) in Botswana conducted by the Centre for Applied Research (CAR). The first report was published in 2019 (CAR, 2019; see www.car.org.bw), and it covered new water rights from 2002 to August 2018. This update analyses the WRA from 2002 to September 2020 in Botswana and evaluates the water right developments and changes since August 2018.

The report has been prepared by Bernard Kelebang. Kutlo Batshabeng assisted with data collation and entry). Jaap Arntzen provided technical advice and supervision.

1.1 Botswana water resources development overview

Water scarcity has become a problem particularly for semi-arid countries like Botswana with distinct wet and dry seasons. Droughts are recurring events and affect rainfall amounts and water resources availability. Botswana has limited groundwater and surface water potential. Botswana's mean annual rainfall is 416 mm, ranging from 650 mm in the north to 250 mm in the southwest with a high interannual and spatial variance. Western Botswana has no surface water and relies on limited -often saline- groundwater from boreholes. The Chobe and Okavango rivers are the only perennial rivers located in the north (see Rahm *et al*., 2006). The sustainable yield of the large dams is estimated at 146.4 Mm^3; this is only 16% of the total dam capacity (906 Mm^3; WUC, 2020). Water supply challenges occur as water demand is forecasted to reach 339.7 Mm^3 a year by 2030 (DWA, 2018).

Historically Botswana has adopted supply management approaches in the delivery of the water resources to various sectors. Recently, the government has developed new dams and water transfer schemes. Botswana has developed the North South Carrier (NSC) water transfer scheme, which includes a 360 km NSC 1 pipeline from Letsibogo dam to Mmashashia; 150 km NSC 2.1 pipeline from Dikgatlong dam to Palapye, and a 110 km pipeline from Mmamashia to Kanye. This allows for water transfers from northern to the more densely population greater Gaborone and southern Botswana and to areas such as Palapye, Serowe, Mahalapye, Shoshong. The proposed extension to deliver water from the Zambezi River would add approximately 520 kilometres to the existing pipeline length (Water Utilities Corporation [WUC], 2020). The country is also currently implementing the Emergency Water Security and Efficiency Project (EWSEP) for water development. The objective of the project is to improve water supply to drought vulnerable areas, increase efficiency of WUC, and strengthen wastewater management.

Despite these water development efforts, meeting water demand is expected to be a challenge as -if uncontrolled- it will grow due to increasing populations and expected economic growth[1]. This therefore requires a change in the water management approach. The Botswana government through the National Water Policy and the Integrated Water Resources Management (IWRM) and Water Efficiency (WE) Plan has adopted the Water Demand Management (WDM) approach. The effective utilisation of the scarce water resources requires WDM approach as opposed to supply management (Segosebe and Parida, 2006). WDM involves a range of strategies including the implementation of '*efficient'* and '*prioritised'* water allocation process.

[1] The Covid-19 pandemic has led to a serious economic contraction in 2020 (budget speech 2021).

1.2 The Botswana water allocation process

Botswana's water allocation process is currently guided by the Water Act of 1968[2]. The act is supported by the Integrated Water Resources Management and Water Efficiency (IWRM-WE) Plan (Department of Water Affairs DWA, 2013). The 2016 National Water Policy (Government of Botswana [GoB], 2016) and the 1991 National Water Master Plan (NWMP) and its 2006 review and the 2018 update (DWA 2006 & 2018). According to the Water Act, all water users outside water work areas[3] need to have water abstraction rights. As per the Act, a *"water right"* means a water right granted or deemed to have been granted under the Act and, subject to the provisions of section 10, and includes an existing right. Applications for water rights are currently made to the Water Apportionment Board (WAB) which may grant to any person the right to divert water from a river or dam, to store, abstract, use or discharge of effluent into public water. A water right does not guarantee that the amount of water requested for abstraction is available and it may be revoked if it is not used for three years. Large water abstractors such as mines are required to submit annual monitoring reports to the WAB. The WAB secretariat, hosted by the Department of Water and Sanitation (DWS formerly DWA), carry out site visits to these major users to corroborate the reports.

In performing its functions under the Water Act, the Board regards any relevant international agreement regulating the use of water to which Botswana is party to, but it does not have specific provision for transboundary water use and allocation. The WAB, through the Water Registrar, keeps an inventory of all water abstraction rights. To this effect, a national database of existing water rights is kept at the DWS, but its coverage and level of detail are unclear, and it is not publicly accessible. The data base could not be accessed for this study.

This paper analyses the trends in the WRA and allowable water abstractions in Botswana from 2002 to 2020 (October) based on notifications of WRA in the Government Gazette. The paper analyses the WRA and allowable water abstractions by district and type of water use.

The following reasons motivated this study:

a. Most of the applied water rights are granted by the WAB, therefore the WRA give a near picture or good proxy of the trends in water use or water demands in Botswana. The findings of this study could be corroborated with the WAB water rights registry.
b. Botswana has limited water resources and very few opportunities for new dams (Centre for Applied Research-CAR and Department of Water Affairs- DWA, 2013 and CAR, 2006). Water supplies are limited due to limited surface water and low groundwater recharge while demand continues to rise. The water rights analysis provides information to the country and WAB on the trends in applications for water allocations. It also gives trends in such applications. The national IWRM-WE plan strongly promotes efficient water allocation and calls for establishment of prioritisation of demand sectors in the water policy. It recommends the following priorities: 1. Basic human needs; 2. Strategic use (e.g., energy generation and food security); 3. Environmental requirements; 4. Other demands based on various efficiency indicators such as livelihoods security, poverty eradication and value added (CAR and DWA, 2013). It also calls for setting targets for sectoral water use and conservation as well as development of water allocation and efficiency guidelines for DWA and Water Resources Board (WRB)[4].

[2] A review of the Water Legislation is on-going and expected to be completed in 2022.

[3] Where WUC supplies water.

[4] This entity will replace WAB and will be responsible for equity and sustainable allocation of water resources as well as monitoring of water resources.

c. Water is a finite and valuable resource that needs to be allocated and used efficiently for the benefit of current and future generations. This study gives a picture on the level of pressure on the water resources over time, especially the groundwater resources.

This paper is organized as follows, chapter 2 details the approach used in generating the results, chapter 3 presents results on the levels of WRA and allowable water abstractions while chapter 4 provides analysis on the chosen thematic areas related to water abstractions and water use. Chapter 5 provides conclusions and recommendations.

2 Approach

The assessment involved a spatial and temporal trend analysis of water right applications across Botswana (see also CAR, 2019). The approach for this study was to conduct a follow up of the water rights analysis from 2002-2018. Therefore, spatial, and temporal changes are conducted for the period 2002-2020 (September) and changes evaluated.

The water rights applications (WRA) are published in the Government Gazette and CAR has kept a record of the published WRAs since 2002. This data base formed the basis of the analysis. The applications for water rights provide the following information: names of applicants (individual or company), the date of application, location/district, source of water, intended use of water as well as the maximum allowable abstractions. Our analysis focused on two major groups of variables:

1. Number of water rights applications (WRA) per annum by:
   - Source of water;
   - Intended use; and
   - Location (district).
2. Maximum Requested Amount for water abstractions (RAWA) in m^3 per day and annum by:
   - Source of water;
   - Intended use; and
   - Location (district).

The analysis distinguished four main sources of water, i.e. boreholes, rivers, dams, and open wells. For the intended use of water, the records categorize irrigation, livestock, domestic use, construction, industrial, mining, tourism, integrated farming, village water supply and others. For the analysis, we have distinguished irrigation, livestock farming, domestic use (individuals), construction, industrial, village water supply and mining. Other uses of water were combined with the 'others' category. Moreover, a category for 'multiple use' was created to cover applications with more than one intended water use.

Description of key terms used in this report:

- ✓ Water rights applications (WRA) are applications by a potential water user for the right to abstract water for a specific purpose. The right specifies the maximum allowable daily water abstraction;
- ✓ Requested amount of water abstraction (RAWA): this is part of the WRA and indicates how much water the potential user plans to abstract daily. The **daily** abstraction is determined by the proposed type of use.

There were some data inconsistencies and gaps and therefore in some cases assumptions were used. The following is noted:

1. The data base refers to applications for water rights. It does not provide information about the actual acquisition of such rights. It is possible that applications have been turned down by WAB;
2. There is little monitoring of the use of water rights. Therefore, the amount that can be abstracted based on the permits may differ from the actual abstracted amount. Some rights may not be used; others may be over-used;
3. The data set refers to **new** water right applications. It does not capture the water rights and abstractions that existed prior to 2002; therefore, it does not reflect the total abstractions;
4. For the earlier years of the period 2002-2020, fewer applications were recorded; this may be due to missing data (Gazettes not attained) or indeed fewer applications;
5. WRA for livestock use are not available or very minimal from 2002 to 2011 despite the sector's heavy reliance on ground water. It may be that the rights for livestock may be recorded under domestic use for the same years. It may also be that livestock farmers obtain borehole drilling rights from the Land Board and later do not apply to the WAB for actual abstraction rights;
6. Some dam rights for domestic use did not reflect RAWA and therefore the average figure for domestic use (i.e., 18 m^3/day) was assumed to apply to dams too;
7. Some hard copies for the years 2012 and 2015 of water right applications are now missing and therefore the earlier digitized data could not be validated. The data was thus used in its current state;
8. In the case of borehole rights, some applications had more than one borehole. These were not separated and therefore treated as one application with multiple boreholes rights;
9. All water rights for the Chobe district were recorded separately from 2002-2014. Therefore, all the analyzed Chobe WRA and RAWA are only for 2002-2014.The Chobe water rights has since been subsumed into the North West district from 2015 onwards; and
10. The data for 2020 covers January to October only.

A request was made to DWS to avail their records of approved water rights to allow for a comparative analysis of the two data sets. However, the data has not yet been obtained. It would have been interesting to compare both sets and see how many applications are approved or not.

3 Main findings

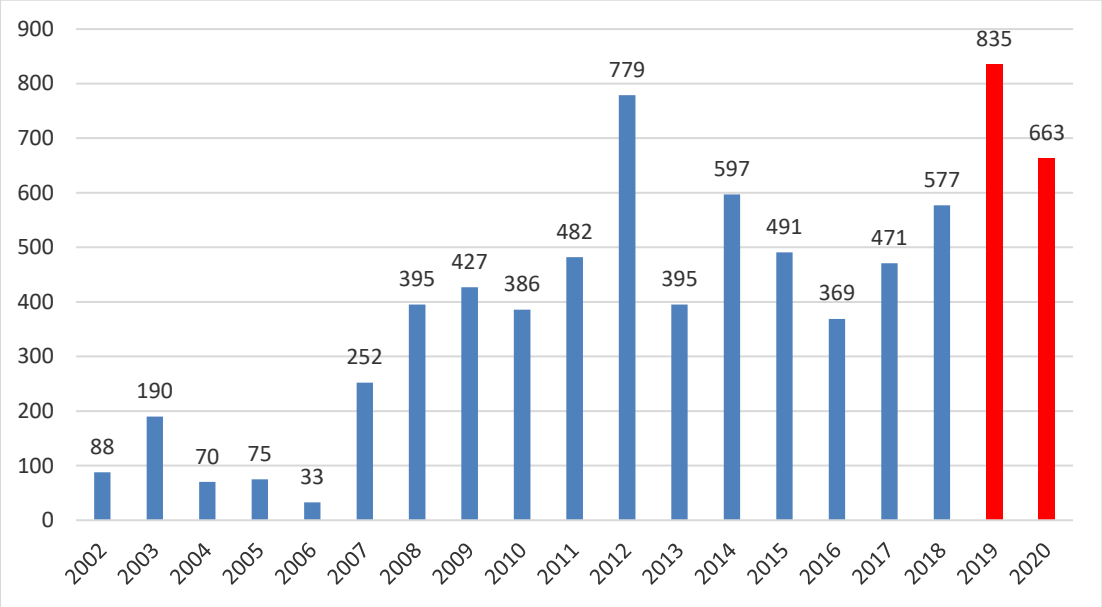
This section presents an analysis of the WRA for the period 2002-2020 in Botswana. The section provides temporal and spatial analyses both the WRA (3.1) and RAWA (3.2).

3.1 Water right applications (WRA)

Total water right applications

Figure 1 presents the number of WRA from 2002-2020 for all water uses and sources in Botswana. There is no clear trend in WRA, especially in the last decade. The figure shows that WRA were low before 2007 and started increasing from 2008. The lower figures from 2002 to 2007 could be due to lack of data or that there were indeed fewer WRA. The water rights show a fluctuating pattern but there is an increase in 2007 to 2012 and 2016 to 2020.

Figure 1: Annual water rights applications (numbers; 2002-2020)



Note: red are new data.

Water right applications by district

Table 1 shows the WRA by district for the period 2002-2020. Central district has the highest number of WRA at 2,764 or 36.4% of all WRA. The results are not surprising because Central district accounts for 32% of the country's population (Statistics Botswana, 2013) and is the largest in terms of total size (also see, CAR, 2019). Northwest district has the second highest number of WRA followed by Kweneng district. The Chobe district water rights have been subsumed into the Northwest district from 2015 onwards. The water rights in the Chobe districts are insignificant and averaged 2 WRA per year from 2002 to 2020.

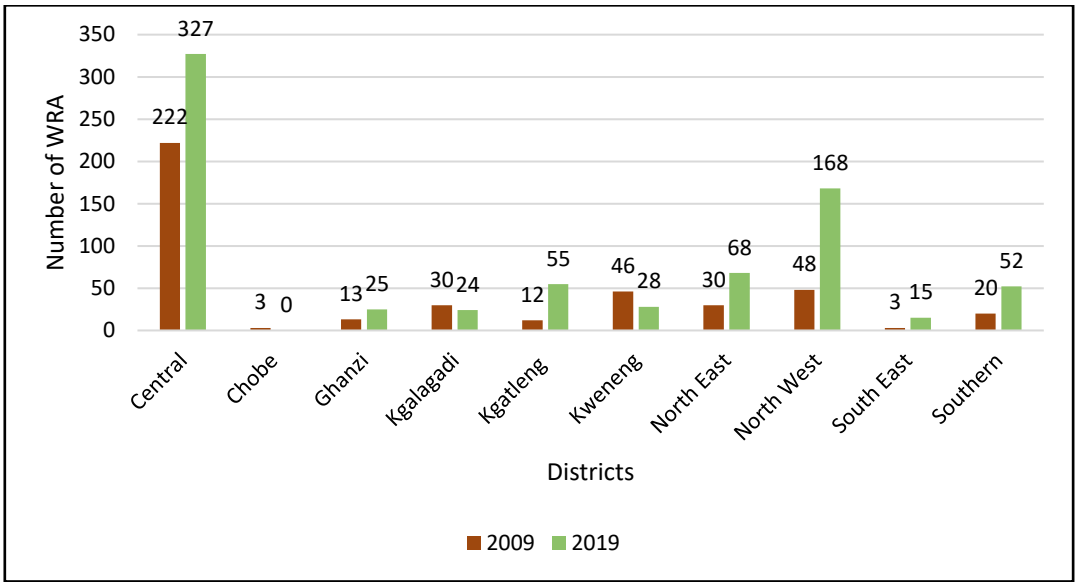
Table 1: Water rights applications by district (total for period 2002- 2020)

District	Number of WRA	% share of WRA
Central	2,764	**36.4%**
Chobe	32[5]	**0.4%**
Ghanzi	444	**5.8%**
Kgalagadi	393	**5.2%**
Kgatleng	503	**6.6%**
Kweneng	866	**11.4%**
North East	647	**8.5%**
North West	1,059	**13.9%**
South East	295	**3.9%**
Southern	593	**7.8%**
National	**7,596**	**100.0%**

[5] These are the total water rights from 2002 to 2014.

As an illustration, the number of annual WRA are shown for 2009 and 2020 (Figure 2). All districts apart from Kgalagadi, Chobe and Kweneng have experienced a growth in the number of WRA. Central district has the highest number of WRA followed by North West district. Pressure on the water resources continues to increase for the Central districts while for the North West district may be due to the addition of the Chobe districts water rights. The overall increase in the WRA for most districts shows growing pressure on the water resources, particularly the groundwater resources.

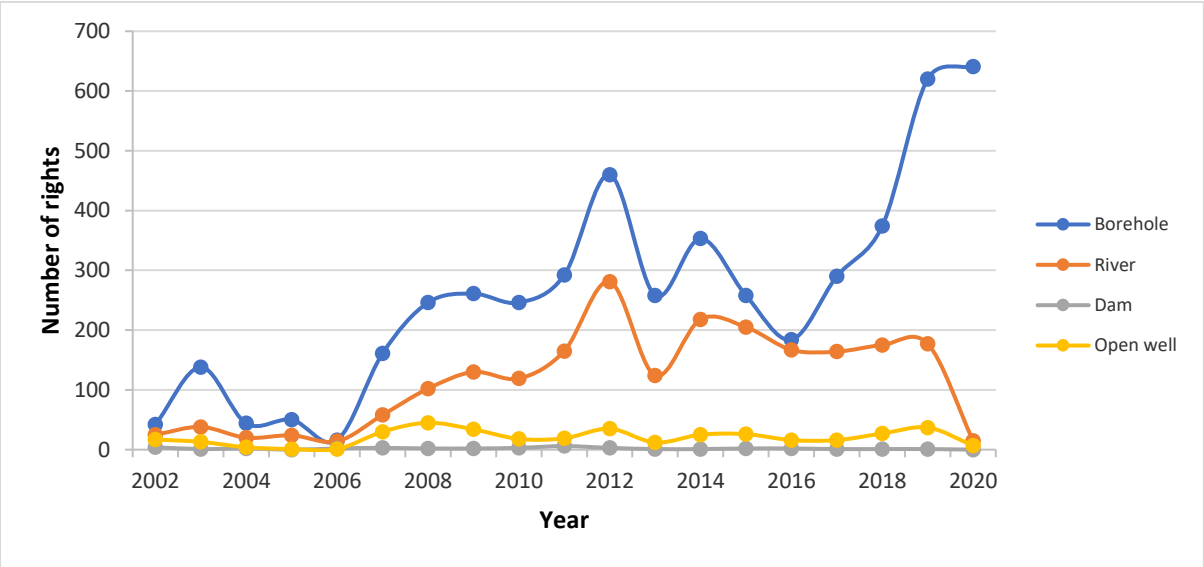
Figure 2: Annual WRA by district (numbers; 2009 & 2020)



Water right applications by source of water

The WRA for boreholes show a sharp increase from 2016 to 2020 (Figure 3). Borehole WRAs are the highest in number and there has been a growing gap between borehole and other water sources WRA since 2016. This reflects growing pressure on the country's groundwater resources. As the recharge of groundwater resources is low, the risk of groundwater depletion is rising; most wellfields abstractions exceed their sustainable levels (CAR, 2019). Dam water rights are low as the country has few opportunities for new dams. Dams are mostly developed and managed by WUC for public water supply and agricultural activities. River WRA have decreased significantly from 2019 to 2020.

Figure 3: Annual WRA by source (numbers; 2002-2020)



Note: 2020 data for January-October only

Table 2 shows that Central District has the highest share of WRA for all the water sources for the period 2002-2020. The district has more than a quarter share of WRA for boreholes, rivers, and dams and more that 50% share of WRA for open wells. Central district has several seasonal rivers, has good fertile soils for irrigated farming and has the highest number of livestock in Botswana.

Kgalagadi, Kweneng, South East, Ghanzi and Southern district have their share of river WRA under 3%. This is not surprising as the eastern part of the country has no to limited surface water resources. Most of the water resources for this area from groundwater resources. In contrast, river WRA are relatively high in North West because of the Okavango River and Delta. As the Delta is a RAMSAR and World Heritage site and the Okavango is a shared water resource, this needs close monitoring.

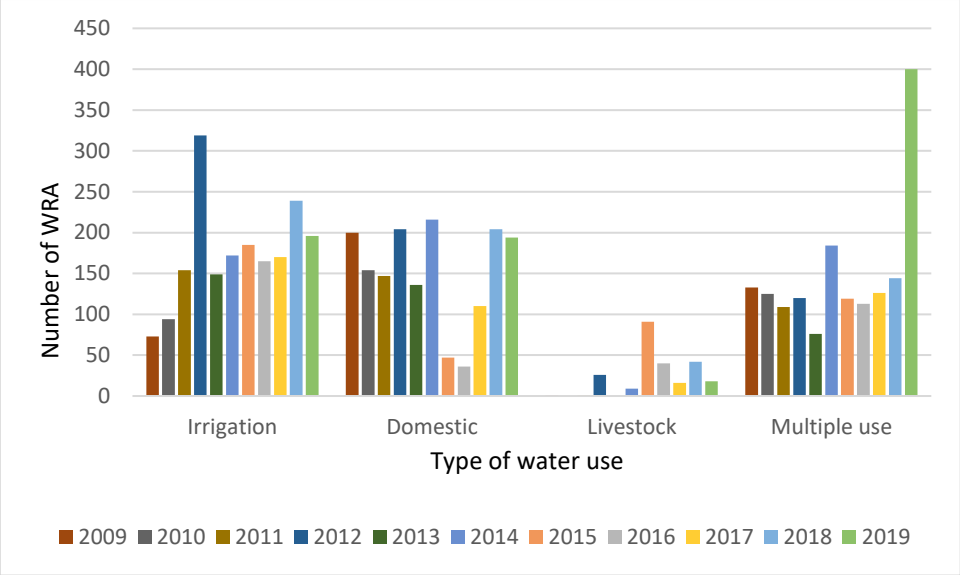
Table 2: Total water rights applications by source of water for the period 2002-2020 (as %)

District	Borehole	River	Open Well	Dam	Total
Central	35%	34%	67%	37%	36%
Chobe	0%	1%	0%	0%	0%
Ghanzi	8%	1%	3%	0%	6%
Kgalagadi	8%	0%	1%	0%	5%
Kgatleng	6%	8%	0%	3%	7%
Kweneng	19%	2%	5%	26%	13%
North East	2%	22%	4%	11%	8%
North West	5%	30%	18%	0%	13%
South East	5%	1%	1%	3%	4%
Southern	11%	1%	1%	20%	8%
Total	100%	100%	100%	100%	100%

Water right applications by type of use

The project analysed the number of WRA by type of use[6]. Only major water uses are presented in figure 4 which include, irrigation, domestic, livestock and multiple use. Figure 4 shows that irrigation, domestic use, and multiple use have the highest WRA over the years. The applications for irrigation seem to increase while annual applications for domestic use are stable and those for livestock are low. There is a sharp growth in multiple use rights in 2019, most likely due to government's drive towards integrated farming. Government is also currently implementing policy reforms that will allow farmers to use a portion of their agricultural land for non-agricultural businesses. Most of the the multiple use applications are for domestic and irrigation, implying that the applications are in crop production areas or *'masimo'*.

Figure 4: Water rights applications by use (numbers; 2009-2019)



The shares of different water uses are further shown in figure 5. The highest share of WRA is for domestic use (30%) followed by multiple use and irrigation (both 28%). Livestock use has the least WRA among the major water users in Botswana from 2002-2020. The share of multiple use WRA has increased since the last analysis (2002-2020).

[6] The following water uses are capture in the government gazette, Construction, domestic, industry, irrigation, livestock, Mining, multiple use, Village water supply and others.

Figure 5: Aggregate percentage share water resource applications by use for five major water users (2002-2020)

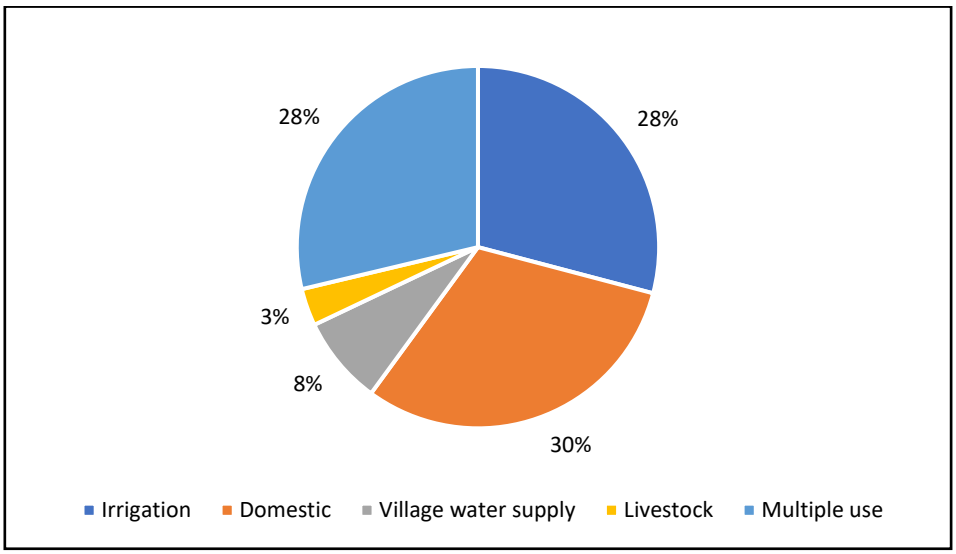


Table 3 shows sector dependency on available water sources for the periods 2002 to 2020. Boreholes have the highest share of applied water rights for multiple use, livestock, domestic, village water supply and mining. River WRA are the highest for irrigation, construction, and industrial use.

Table 3: New water right applications by source and use of water (2002-2020; as %)

Water source	M U	Irrigation	Livestock	Domestic	VWS	Construction	Mining	Industrial	Other
Borehole	**74%**	35%	**65%**	**74%**	**99%**	19%	**100%**	25%	40%
River	23%	**64%**	17%	13%	1%	**80%**	0%	**75%**	52%
Dam	0%	0%	0%	1%	0%	0%	0%	0%	2%
Open well	2%	1%	18%	12%	0%	1%	0%	0%	7%
total	100%	100%	100%	100%	100%	100%	100%	100%	100%

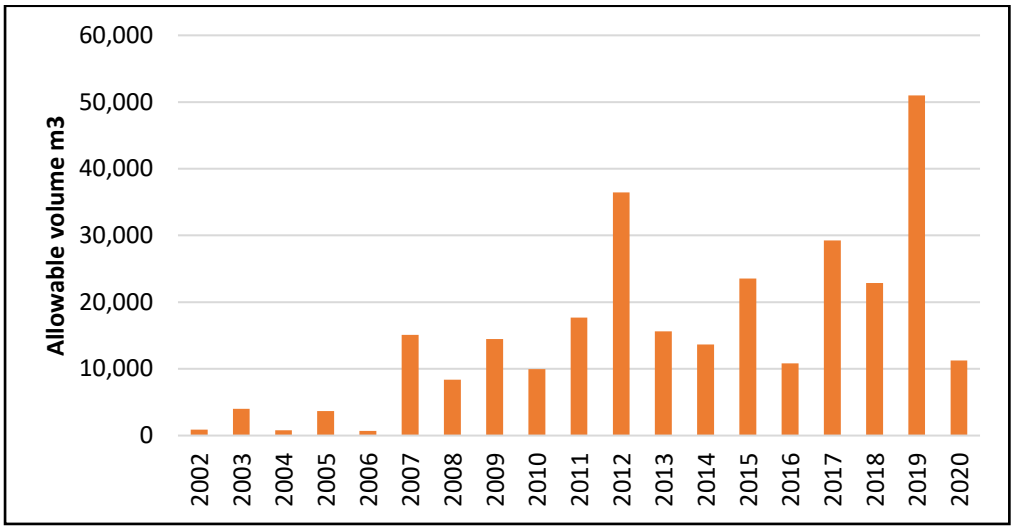
Note: MU -Multiple use, VWS- Village Water Supply

3.2 Requested amounts of water abstractions (RAWA)

Annual requested amounts of water abstractions

Figure 6 shows that the annual RAWA vary widely with peaks in 2012 (close to 40 Mm^3) and 2019 (over 50 Mm^3). There is no clear trend.

Figure 6: Annual RAWA (2002-2020; 000m^3)



RAWA by district

The results of the spatial analysis of RAWA are summarised in Figure 7. Like the WRA, Central District has the highest amount of RAWA as compared to the other districts and accounts for just over 50% of total RAWA; it is more than its share of RAWA (36.4) showing that the Central district applications refer to 'higher abstraction uses".

Figure 7: Total RAWA applications by district for the period 2002-2020 (000m^3)

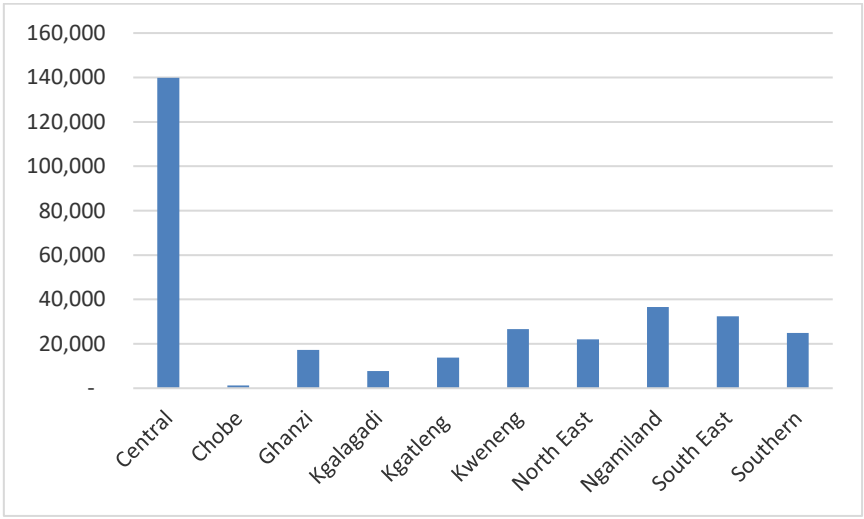
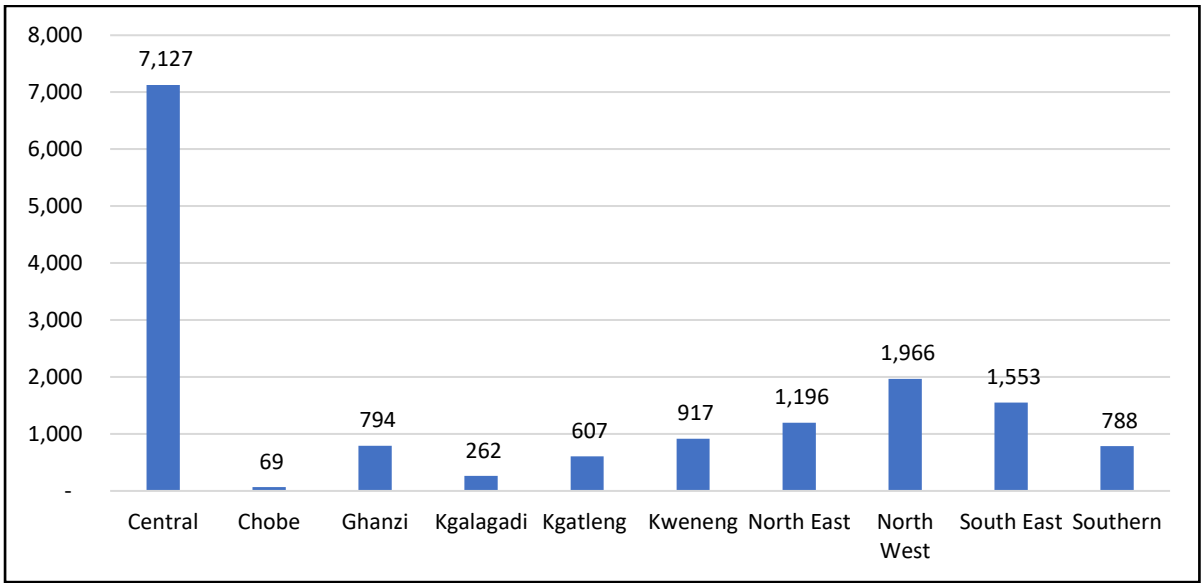


Figure 8 shows the average amount of RAWA by district for the period 2002-2020. Central district has the highest RAWA, followed by North West and South East, respectively.

Figure 8: Average annual RAWA by district (2002-2019; 000 m^3)



Note: 2020 is excluded as data did not cover the entire year.

Water abstraction by source

For the period 2002-2020, RAWA remain highest for boreholes at 59%, river RWA the second highest at 40% followed by open well and dam abstractions (Table 4). Borehole, river, and dam abstractions are still the highest in Central and Kweneng still has the highest amount of dam rights. Nothing has changed in terms of the RAWA since the last analysis of the WRA.

Table 4: Total RAWA by source for the period 2002-2020 (000 m^3)

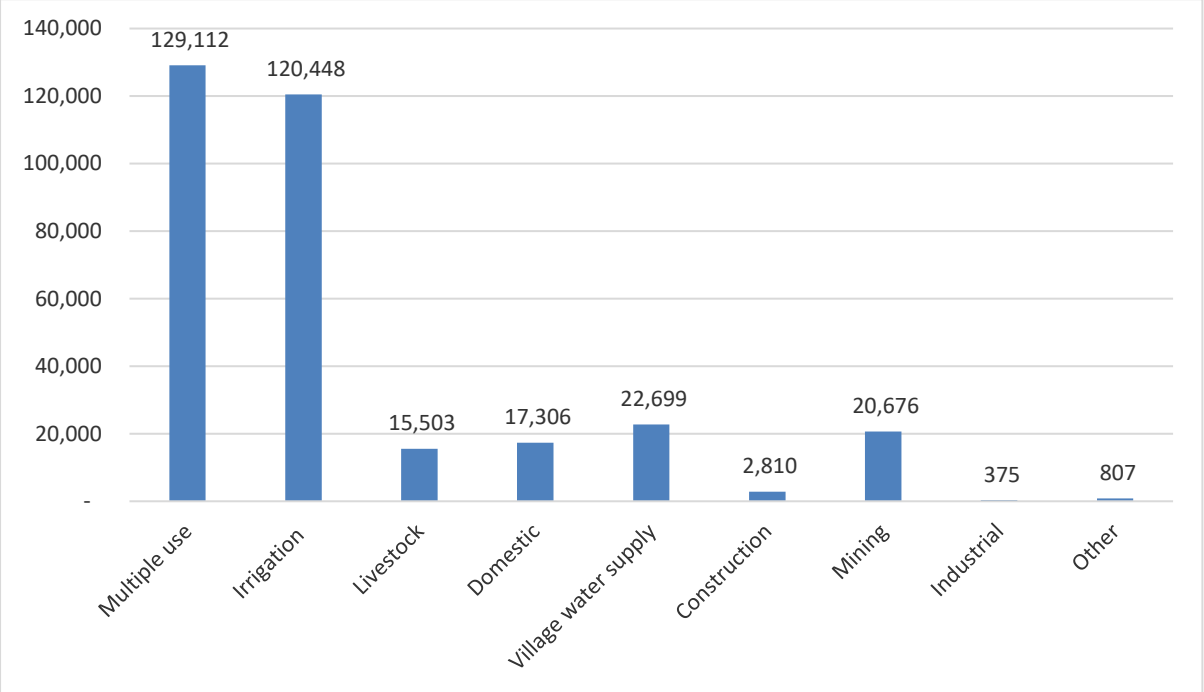
District	Borehole	River	Dam	Open Well	Total
Central	194,410	117,726	272	2,854	315,262
Chobe	7,320	18,346	-	182	25,848
Ghanzi	43,717	15,025	-	237	58,978
Kgalagadi	17,900	15,025	-	209	33,134
Kgatleng	15,433	31,485	-	191	47,109
Kweneng	33,437	17,018	368	483	51,305
North East	3,985	39,959	114	250	44,309
North West	24,912	47,747	-	842	73,501
South East	13,989	2,540	50	27	16,606
Southern	32,942	1,825	274	46	35,088
Total	388,044	306,697	1,078	5,321	701,140
% of total	55%	44%	0%	1%	100%

RAWA by use

Multiple use has the highest amount of RWA followed by irrigation for the period 2002-2020 (Figure 9). This is the same for the period 2002-2018 (CAR, 2018). However, the RAWA for irrigation use are likely to be more since the sector is subsumed within multiple use category. RAWA for multiple use

has grown from around 76.8 Mm^3 to 129 Mm^3 and RWA for irrigation has grown from 62.4 Mm^3 to 120 Mm^3.

Figure 9: Total RAWAs by use for the period 2002-2020 (000 m^3)



The RAWA for five major water uses for the period 2008-2020 are shown in Figure 10. There is no clear trend in RAWA for all the five water uses. Multiple use and irrigation have the highest annual RAWA. The multiple use RAWA are relatively high compared to the period 2010-2016.

Figure 10: Annual RAWA for major uses (000 m^3; 2008-2020)

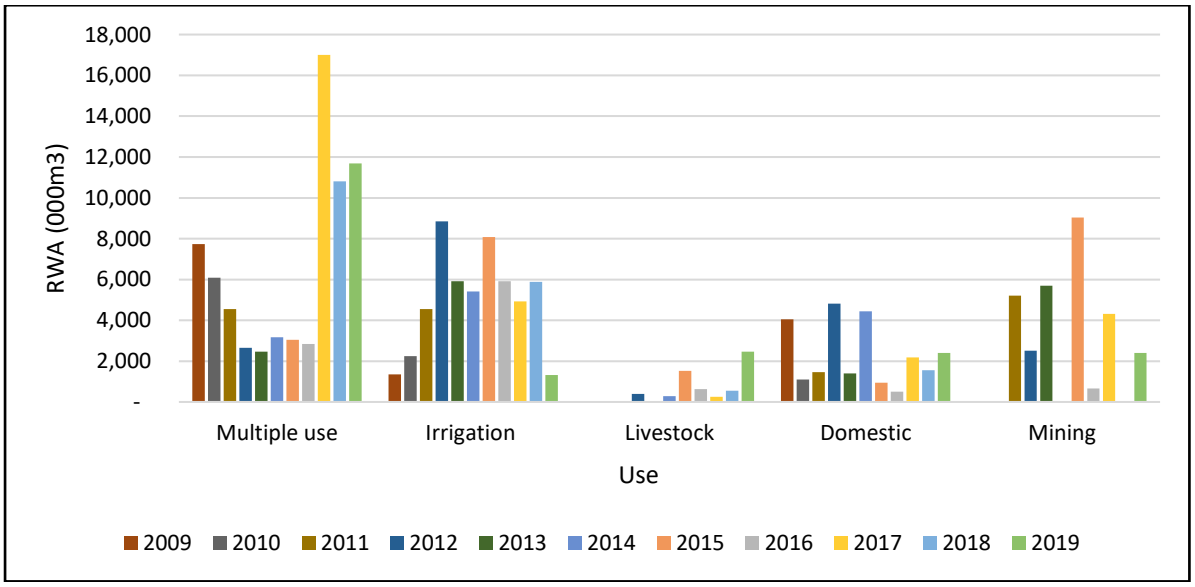


Table 5 shows the average amount of RAWA by water use and the total RAWA per total WRA applied for water from 2002-2019. The RWA per WRA indicates the intensity of water use by sector. While multiple use has the highest average amount of RWA, it shows that mining uses the highest amount of water per water right in Botswana.

Table 5: Average annual RAWA by sector and RAWA per WRA (000m^3)

Sector	Av RWA (2002-2019)	RAWA per WRA
Construction	1,005	33.0
Domestic	2,452	11.4
Industrial	194	16.0
Irrigation	4,585	28.9
Livestock	1,127	14.8
Mining	1,801	205.3
Multiple use	6,180	36.0
Other	194	19.7
Village water supply	4,357	37.8

RWA from 2020 are shown in table 6. Most of the multiple use RAWA are from boreholes at 66.7% followed by rivers at 32.8%. Most or the irrigation RAWA are from the river. Boreholes are the dominant water source for mines, villages, and domestic use.

Table 6: Annual RAWA by source and major uses (% share; 2002-2020)

Abstraction by source and use	Multiple use	Irrigation	Domestic	Village water supply	Mining
Borehole	66.7%	19.7%	83.2%	97.1%	100.0%
River	32.8%	80.1%	12.3%	2.9%	0.0%
Open Well	0.2%	0.1%	0.6%	0.0%	0.0%
Dam	0.3%	0.2%	4.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

4 Recent changes and developments in WRA and RAWA

This section evaluates the changes in water rights application trends since the last analysis which was conducted for the period 2002-2018. Three areas were observed for further analysis:

- **Growing applications for groundwater resources.** There seems to be an increasing pressure on the available groundwater resources. There is a widening gap between applications for groundwater resources (boreholes) and surface water resources (dam and river). While this may be due to the limited available surface water resources, this is a worrying trend for the available groundwater resources. The trend is also worrying because the groundwater resources are not being measured and monitored. This trend may be unsustainable and there is a need for interventions that will reduce the growing number of WRA and RAWA or generally, the use of already allocated groundwater resources in Botswana.
- **Growth in multiple water use rights.** There has been a growing trend in multiple use water rights. This trend is more pronounced for the 2002-2020 analysis. The change is attributed to a change in agricultural policy allowing for integrated farming. On a positive note, these may be a sign of growing diversification within the agricultural sector (which is currently dominated

by livestock) as most of the multiple rights applications are for irrigation and domestic water use.

- **Irrigation still among the highest users of water in Botswana from 2002 to 2020.** The results show that irrigation has the highest amount of RAWA following multiple use. Most of the irrigation water rights are also subsumed within the multiple use rights. Irrigation also shows that it has one of the highest water use per water right applied for (table 5). This requires interventions, for example through:

    - ✓ Measures to reduce water losses within the irrigation sector;
    - ✓ Use irrigation technologies that reduces evaporation and water loss;
    - ✓ Limit the amount of water allocated to the irrigation sector; and
    - ✓ Introduction of metered water at farm level.

  These measures and others not stated here if implemented may reduce the total water use in the industry and reduce the pressure posed by the new WRA and RAWA.
- **Mining has the highest intensity of water use per WRA.** The analysis of annual RAWA by sector and WRA shows that the mining sector has the highest water use intensity. Most mines face serious water challenges and have strong incentives to use water efficiently. There may be further scope for reduced fresh water use in the mining sector through a raw water charge and increased use of wastewater resources.

5 Conclusions and recommendations

This paper reviewed the application for water rights over the period 2002-2020. This study conducted an analysis of the WRA and RAWA from 2002 to 2020 (September).

The WRA and the RAWA are the highest for 2019. The year 2020 (up to September) has relatively high WRA being the third highest. The WRA shows an increasing pressure on the groundwater resources in Botswana; there has been a sharp increase in borehole rights from 2019. It remains to be seen whether this pattern will continue in time. The water rights are most applied for domestic, multiple use and irrigation, respectively. Multiple use, irrigation and mining are the highest users of water, respectively.

In terms of the significant changes after 2018:

- ✓ WRA and RAWA have increased significantly in 2019.
- ✓ WRA and RAWA for multiple use has increased its share for the years 2019 and 2020.

There is increasing pressure on groundwater resources and without sufficient data on the levels and recharge of groundwater resources, it is difficult to know whether the increase is sustainable. This calls for proper monitoring and a systemic procedure in the handling of RAWA and WRA to avoid unsustainable levels of water abstraction. Linking the water rights allocation process to the water accounts that are produced by DWS would also help water allocations to boost economic growth.

The WAB keeps a record of **actual** water rights applications. It is recommended that this record be made public and is compared with the analysis of the water right **applications,** which form the basis of our analysis. The WAB records should also be used to support and strengthen the country's water accounts that are produced by DWS. In addition, there should be effective monitoring of the use of water rights and compliance with the conditions. Unused water rights should be terminated to avoid that such rights are suddenly all together utilised and can disrupt water resource management.

References

Centre for Applied Research (2006). Wastewater and water accounting in Botswana; from disposal to optimal use.

Centre for Applied Research (2019). Analysis of new water rights applications in Botswana (2002-2018).

Centre for Applied Research and Department of Water Affairs (2013). Findings of the Botswana Water Accounts 2010-2012.

Department of Water Affairs (2013). Botswana Integrated Water Resources Management & Water Efficiency Plan. Gaborone, Botswana: Government of Botswana.

DWA (2006). National Water Master Plan Review. Ministry of Land Management, Water and Sanitation Services and Ministry of land, Infrastructure and Transport.

DWA (2018). National Water Master Plan Update: based on Smart Water Management. Ministry of Land Management, Water and Sanitation Services and Ministry of land, Infrastructure and Transport. Government of Botswana (2016). Botswana National Water Policy.

Rahm D, L. Swatuk and E. Matheny (2006). Water Resource Management in Botswana: Balancing Sustainability and Economic Development. Environment, Development and Sustainability (2006) 8: 157-183. DOI 10.1007/s10668-005-2491-6.

Setlhogile T and R. Harvey (2015). Water Governance in Botswana. Policy Briefing 144. Governance of Africa's Resources Programme.

Water Utilities Corporation (2020). Annual report 2019/2020.

World Bank (2017). Cubango-Okavango River Basin: Multi-Sector Investment Opportunity Analysis. Volume 2: Draft Main Report.