Water supply uncertainties and interruptions: impacts on BMC Lobatse operations

Centre for Applied Research and Department of Water Affairs

Botswana WAVES programme

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Contents

Abbreviations

BMC	Botswana Meat Commission
BoB	Bank of Botswana
BWP	Botswana Pula
CAR	Centre for Applied Research
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
EU	European Union
NSWC	North South Water Carrier
SEEA	System of Environmental-Economic Accounting
UN	United Nations
WA	Water Accounting
WaMA	Water Management Area
WAVES	Wealth Accounting and Valuation of Ecosystem Services
WEF	World Economic Forum

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1 Introduction

This pilot enterprise study is undertaken as part of the Botswana water accounting programme. Botswana has a history of water accounting dating back to the early 1990s, carried out in association with the Department of Environmental Affairs. Recently Water Accounts have been constructed in accordance with the global UN standards of System of Environmental-Economic Accounting water Accounts SEEA WA (UN SEEA WA). The reports (DWA and CAR, 2014 and 2015) are (soon for 2015) available on www.water.gov.bw and www.car.org.bw as well as www.wavespartnership.org).

The Botswana water accounts are national but explorations are on-going to identify suitable Water Management Areas (WaMA) in line with the IWRM principle of decentralised basin management (DWA, 2013). The regions will be based on physical characteristics (e.g. river basins or catchment areas) as well as administrative regions (e.g. WUC Management Centres, DWA regions and administrative districts and practical consideration (e.g. ease of data availability).

Another priority for DWA was carrying out of an enterprise pilot study of the impacts of and adaptations to water supply interruptions and uncertainties. The recent water supply problems in south-eastern Botswana adversely impact on the private sector, but details are currently unavailable. Therefore, DWA requested the project to include an enterprise pilot study of water supply interruptions, their impact on the output and profitability and adaptations mitigation measures taken by companies to survive water supply interruptions. In brief, the objectives of this pilot study are:

a. Produce enterprise water balance to demonstrate the importance of water resources for the products;
b. Assess the impacts of irregular water supply and water restrictions in terms of:
    - ✓ Production process;
    - ✓ Production costs; and
    - ✓ Lost revenues.
c. Assess the mitigation and adaptation options and measures taken and the costs and benefits thereof.

The pilot enterprise had to meet the following criteria:

i. Enterprise needs to have an interest in the project and be cooperative;
ii. Enterprise needs to be affected by water restrictions and supply interruptions;
iii. Enterprise needs to be important for Botswana's economy or one of its sectors;
iv. Enterprise needs to be a large water user and client of WUC;

To cut costs, proximity to Gaborone was as advantage. BMC and KBL emerged as suitable enterprises and in the end the WA unit staff and DWA subsequently prioritised BMC.

The following activities were undertaken:

1. Specify data requirements to BMC and WUC;
2. Collection of required data for last 5 to 10 years;
3. Conduct interviews and seminar on impacts and adaptations;
4. Data analysis;
5. Presentation of findings to enterprise and broader business community through BOCCIM and DWA (will be done based on the draft report);
6. Reporting and recommendations.

Since this pilot study is part of Botswana's WA efforts, it is important that the SEEA-WA terminology is adopted. The main terms are summarised in Table 1.

Table 1: Important SEEA terminology

Terms	SEEA description	BMC application
Water abstraction	The amount of water that is removed from any source, either permanently or temporarily, in a given period of time for consumption and production activities. Water can be abstracted for distribution or for own use (once it is used it can be delivered to another user for treatment or re-use).	Water abstracted from BMC boreholes
Water use	Water intake of an economic unit. It is the sum of water: a. provided to that economic unit by a water service provider or another economic sector; and b. Water abstraction from the environment by that economic unit.	Sum of abstracted borehole water plus water supplied by WUC
Water consumption	That part of water use which is not distributed to other economic units and does not return to the environment because during use it has been incorporated into products, or consumed by households or livestock.	The water used minus return flows (see below)
Return flows	Water that is returned into the environment or another economic unit by an economic unit. Returns can be classified according to the receiving body and to the type of water, such as treated water.	Inflow into the pre-treatment facility and LTC sewerage system and water directly discharged into the ground or through run-off.
Water losses	The volume of water lost during transport through leakages and evaporation between a point of abstraction and a point of use, and between points of use and re-use.	Losses in the BMC water reticulation system

Source: United Nations, 2012

The SEEA-WA use the ISIC economic sector classification. The following sectors apply:

- ✓ BMC: meat & meat products: ISIC 1510
- ✓ WUC: collection, purification and distribution of water: ISIC 4100
  This includes fresh water supply and wastewater treatment.

2 Water accounting, scarcity and private sector enterprises

2.1 Water and business

The *March 2015 Business Expectation Survey (BES*) of the Bank of Botswana (BoB, 2015) shows that the business confidence in the country has declined from 52% in September 2014 to 44% in March 2015. The drop in confidence was highest in the export-oriented industries such as BMC (from 88% to 43 %). This reflects concerns about the global competitiveness due to input costs and uncertainties. Unreliable energy and water supplies and the high costs associated with their provision feature high in 2015 as compared to the 2014 survey. The uncertainties and risks should encourage enterprises to mitigate and adapt, and increase their water and electricity efficiency.

Botswana's situation is not unique. The *WEF Global Risk Reports* (WEF, 2012 and 2015) discuss the global risks as perceived by business and government leaders. The recent reports show that water crises have been listed among the top 10 global risks since 2012. In 2015, their likelihood was ranked 8th but their impact ranked highest showing how important water security is. Impact ranking of water crises has been consistent in the top three risks since 2012. The Middle-East/ North Africa and South Asia are least prepared to deal with water crises, and most likely to experience them. Water resource risks in southern Africa are considered lower but as they are relatively new, enterprises may be less prepared to adapt. The reports note that the emphasis of risk management has shifted from *risk identification to risk analysis*, including causes, solutions and interconnections (e.g. with food, energy, climate change and migration). The current water crisis in Botswana shows how important such a shift is for Botswana too.

The Botswana Meat Commission (BMC) is one of the oldest manufacturing operations in Botswana. It is a parastatal, which is important for both the rural and national economy. BMC forms the backbone of the 'meat and meat processing industry', and has significant forward and backward linkages in the rural and national economy. The livestock sector provides the animals for slaughter and payments[1] benefits a large number of rural livestock farmers directly or indirectly (when farmers sell through agents; see e.g. Colclough and McCarthy, 1980 and Hubbard, 1986). Support industries have emerged including livestock trade, tanneries and other meat processing industries. With the rapid growth of the diamond industry, the livestock sector and BMC became less important for the national economy. However, BMC remains important, particularly in the pursuit of economic diversification away from diamonds as well as poverty reduction (offering a beef market for small livestock farmers). Currently, BMC's importance for the national economy lies in exports[2]. In 2014, beef and beef products accounted for 9.6% of the country's export value (excl. diamonds; source: Statistics Botswana). In contrast, it only generated 0.9% of the country's valued added (2013/14 data; Statistics Botswana).

2.2 Identified risks and uncertainties

The Botswana Meat Commission (BMC) has been in operation since 1965 and has exported meat to Europe and other export markets for decades. It operates three abattoirs in Lobatse, Francistown and Maun. In recent years, BMC has struggled financially as a result of FMD outbreaks, (temporary) loss of access to the EU market and inadequate supply of animals for slaughtering. The company is currently struggling to increase throughout, return to profitability and service the accumulated debt. The BMC's

[1] According to the BMC Annual Financial Statement 2013, the company Pula 608.7 million was spent on livestock and meat costs.

[2] BMC currently holds a monopoly on beef exports.

fate does not merely depend on its Lobatse operations but as the largest abattoir, Lobatse is pivotal in increasing economic performance.

In this difficult situation, BMC is now also experiencing serious water supply problems. Water resources are a strategic input, particularly important to meet the strict hygienic and veterinary requirements and requirements of its customers. On average, BMC uses around $4m^3$ to slaughter one head of cattle, making it a large water user. Therefore, water risks relate to the availability of sufficient water as well as water of suitable quality for meat processing.

The following uncertainties and risks were identified:

1. Uncertainty about the timing and duration of water supply interruptions. While water supply interruption are scheduled for Tuesday, Wednesday and Friday from 8 am to 3 pm, this schedule is not followed and BMC staff states that water supply interruptions may occur at any time. BMC staff further stated that WUC does not always inform them in advance so that production planning can be adjusted. During one of the BMC visits on a Monday water had not been supplied since the Thursday before. Initially BMC had rescheduled slaughtering for Friday and Saturday but it had been unable to do this;
2. Quality concerns about WUC water quality after water supply is resumed. WUC supplies BMC with water from its treatment plant at Nywane dam, which blends dam water with water from Ramotswa well field. The water is hard and BMC has to descale the equipment daily;
3. Risk of inability to slaughter animals from the holding pen, leading to higher costs and down-graded animals (this happens when animals are more than 3 days in a holding pen); and
4. Increased risk of measles due to pollution of the rangeland by human faeces in the face of water scarcity (Weekend Post 12-18 Sept 2015).

While BMC staff is adamant that water supply interruptions have become frequent and unscheduled this year, no record is kept of the number and duration of supply interruptions. This is surprising for such a vital production factor in the slaughtering process, and makes it impossible to precisely estimate the impacts on production and financial performance. It is therefore recommended that BMC records water supply interruptions and their duration. This is a simple monitoring measure.

3 BMC abattoir operations in Lobatse

BMC currently operates three abattoirs in Lobatse (since 1965; capacity of 800 animals/day), Francistown (opened in 1989; 400 animals/day) and Maun (opened in 1983[3]; closed in 1996 and re-opened in 2010). The Lobatse abattoir is the oldest[4] and largest and employs some 950 workers (Weekend Post 12-18 Sept 2016). The abattoirs in Lobatse and Francistown usually serve the EU market while Maun slaughters for non-EU markets. BMC holds a beef export monopoly. The company has had a mixed economic performance over the years with profits in some years and losses in others. Factors that adversely influence profitability include:

a. Outbreaks of FMD in Botswana and in neighbouring countries (e.g. 2010 and 2011) and failure to meet EU standards leading to EU beef import bans (e.g. in 2011) and abattoir closures;
b. Climatic conditions (e.g. good rains often induce farmers to sales);
c. Strong reliance an EU export market;
d. Reliance on subsistence farmers that often do not meet EU traceability requirements and with low and stagnant CDM between 190 to 210 kg/animal;

[3] Closed in 1996 because of lack of cattle supply and re-opened in 2010.
[4] The machinery is old and needs modernisation (BMC annual report 2013).

e. Competition from local butchers, leading to; and
f. Inability to source sufficient animals for slaughtering, underutilisation of the slaughtering capacity and inability to meet EU import quota (19 000 tonnes p.a.) and leading to closure of the Maun abattoir in the period 1996-2010.

The most contested issues at present are diversification of the export markets to reduce dependency on the EU market and abolishment of the BMC export monopoly. The export orientation of BMC implies that all production measures and activities need to comply with stringent veterinary requirements and requirements of main export markets.

In brief, BMC experienced operational and financial difficulties, particularly in 2011 and 2012 and is struggling to regain profitability, repay its debts and increase the utilisation of its existing slaughter capacity, including in Lobatse. This background needs to be born in mind when assessing the impacts of water supply interruptions and ability to adapt.

The 2014 DWA water audit report distinguishes four production stages (DWA, 2014): a. receiving process; b. slaughtering process; c. deboning and d. packaging and storage of products. Stage d uses no or very little water. Water is an important input in the other three stages. The audit report is general in its findings and has very little quantitative information. It notes that BMC uses around 5 m^3/ slaughtered animal and lists several BMC plans to reduce losses and save water, including re-use of condensate in the power station. It is recommended that future DWA audit reports include more figures (e.g. water balance), detailed analysis and more recommendations. For example, it should have examined to what extent recommendations of the 2007 EIA report have been implemented.

BMC and WUC together can minimise the (impacts of the) risks and uncertainties by:

a. Timely advance warning about impending water supply interruptions; subsequently, BMC should adjust its slaughtering plans;
b. Increasing water storage capacity so that short-duration water supply interruptions do not affect production (planned);
c. Strict separation of uses of groundwater and WUC supplied water (already done). The latter is reserved for slaughtering processes that require high quality potable water; the former can be used for other purposes if the quality does not meet the veterinary requirements;
d. Regular water quality monitoring of WUC water and of borehole water; and
e. Treatment of borehole water to meet veterinary standards and permit the use inside the abattoir (planned).

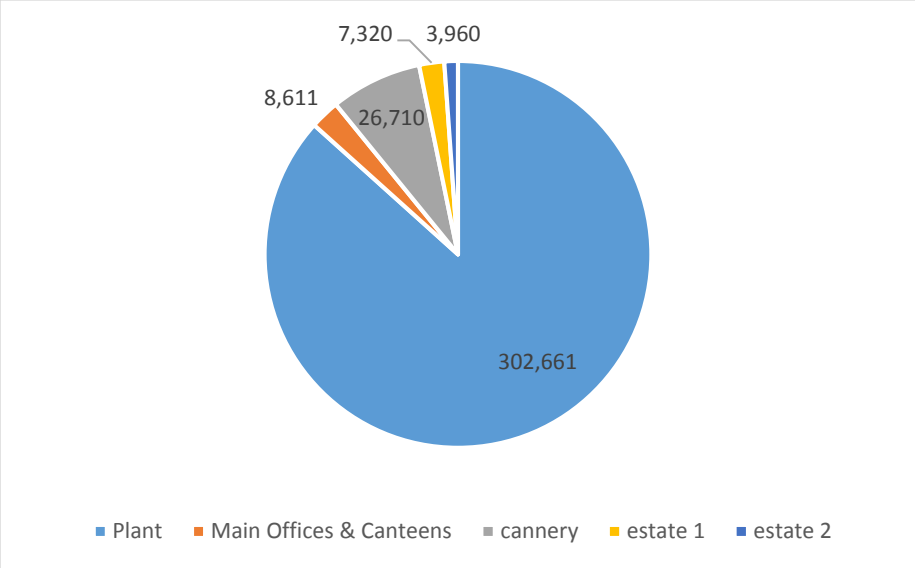
4 Water balance BMC abattoir Lobatse

4.1 Water balance 2006

The retrospective EIA carried out for BMC (Ecosurv and CAR, 2007) gives a reasonably detailed water balance for the year 2006. Water supply for BMC Lobatse covers the abattoir (meters Hill Tank Feed 1 & 2 and veterinary gate) and the cannery, canteen and offices and estate 1 and 2 (each with separate WUC meters). BMC Lobatse used a total of 377,289 m^3 in 2006: 7.6% was supplied by own BMC boreholes (i.e. groundwater) while 92.4% of the water was provided by WUC (surface water). In terms of operations, the abattoir used 86.7% of the WUC supplied water followed by the tannery with 7.6%. Offices, canteen and estate used the remainder 5.7%. (Figure 1).

The EIA found a significant discrepancy between BMC and WUC provided data. In the absence of detailed water use monitoring by BMC, the reasons for the differences could not be established. The retrospective EIA notes that the amount of effluent generated is not regularly measured. Based on some monitoring data from the Lobatse Town Council, on average 45% of the water used ends up in the pre-treatment plant and subsequently in the municipal sewerage system. This is well below the international standard that 80 to 85% of the water used is treated, and it follows that the difference of 30 to 40% is untreated surface run off and sinks into the ground (Ecosurv and CAR, 2007). The EIA recommends that the percentage of pre-treated water should be urgently increased to reduce uncontrolled discharges.

Figure 1: Water use by sector BMC Lobatse (2006)



4.2 Current water balance

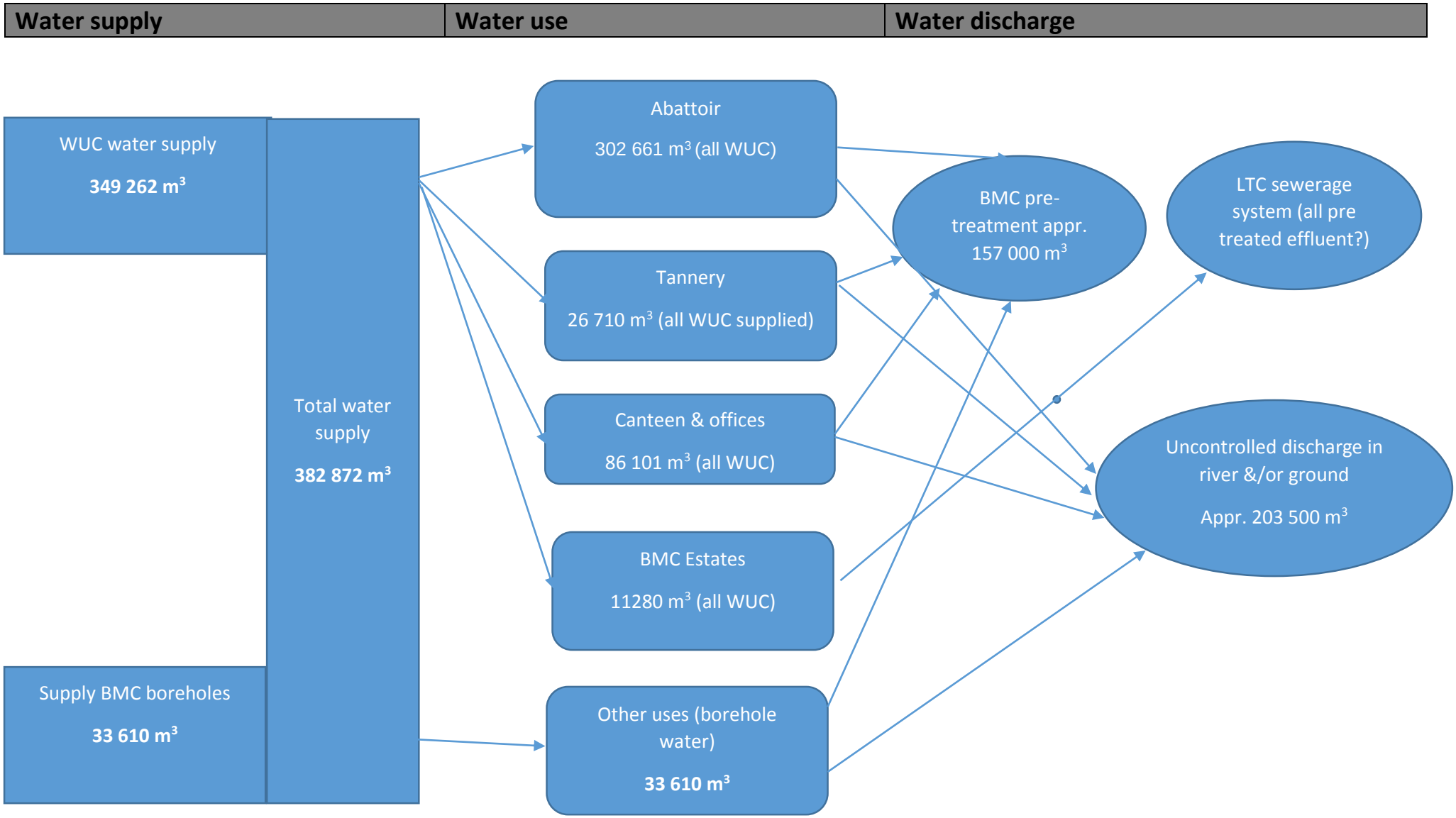
BMC has several main water inlets from WUC: veterinary gate, hill tank feed 1 and 2 and canteen-offices. The cannery receives water from hill tank feed. WUC also supplies BMC houses (called the estate), whose water use is unrelated to production.

Rough daily water balance

The Lobatse abattoir slaughters around 500 animals per day with an associated water use of 3 000 m^3/day. Of this 75% is used in production operations, while 25% is used in canteens and offices. WUC supplies most water. In the past, WUC supplied at least 95% of the water used but this percentage has decreased to 80% as BMC is now using more own borehole water too (see mitigation and adaptations). BMC currently operates three boreholes, of which only one is metered. Water abstraction has been on average around 19 000 m^3 per annum in the period 2010-15[5]. This is around 3% of the water use. Assuming that similar amounts are abstracted from the other two boreholes, own water abstraction is estimated to be between 5-10% of water use. No recent water abstraction data from own boreholes are available, hence abstraction losses cannot be estimated. Similarly, losses from WUC water are not recorded. It is estimated that half of the water used ends up in the pre-treatment facility and sewerage. This suggests that the recommendation of the 2007 EIA report has not yet been implemented.

[5] Water abstraction from the borehole shows high inter annual variation (see Figure 6).

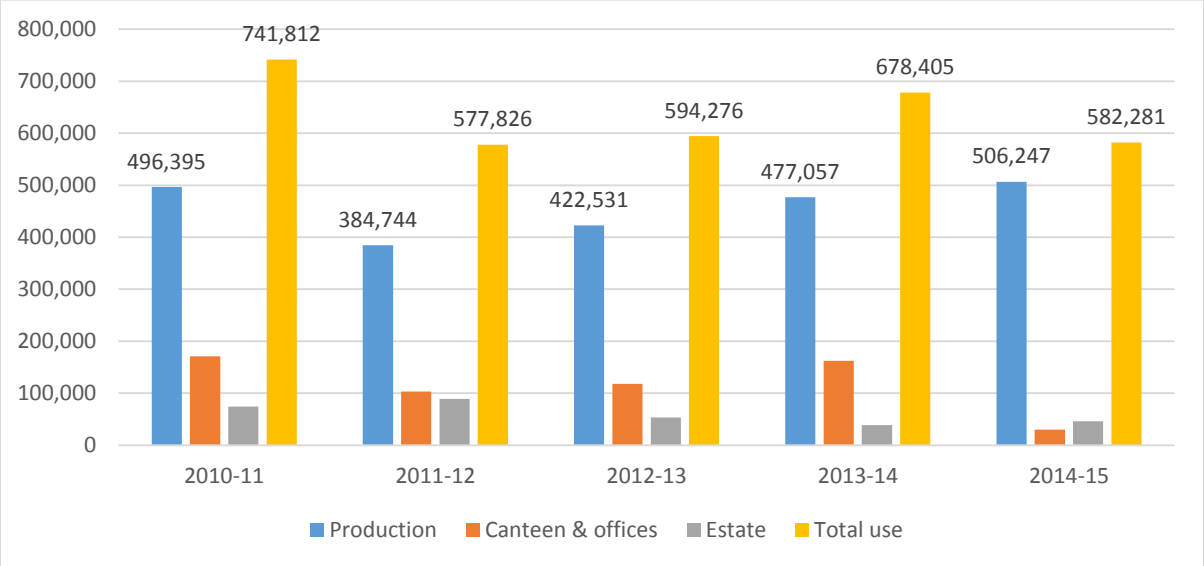
Figure 2: Water balance 2006 BMC operations Lobatse (source: BMC data in Ecosurv and CAR, 2007)



4.3 Water use from WUC

WUC provided water sales data (volume and revenues) for the period 2010/11 to 2014/15 (Figure 3). BMC annual payments to WUC vary between BWP5.6 to 10.4 million, excluding the estate (source: BMC figures).

Figure 3: WUC water sales to BMC Lobatse operations (m3; 2010/11 – 2014/15).



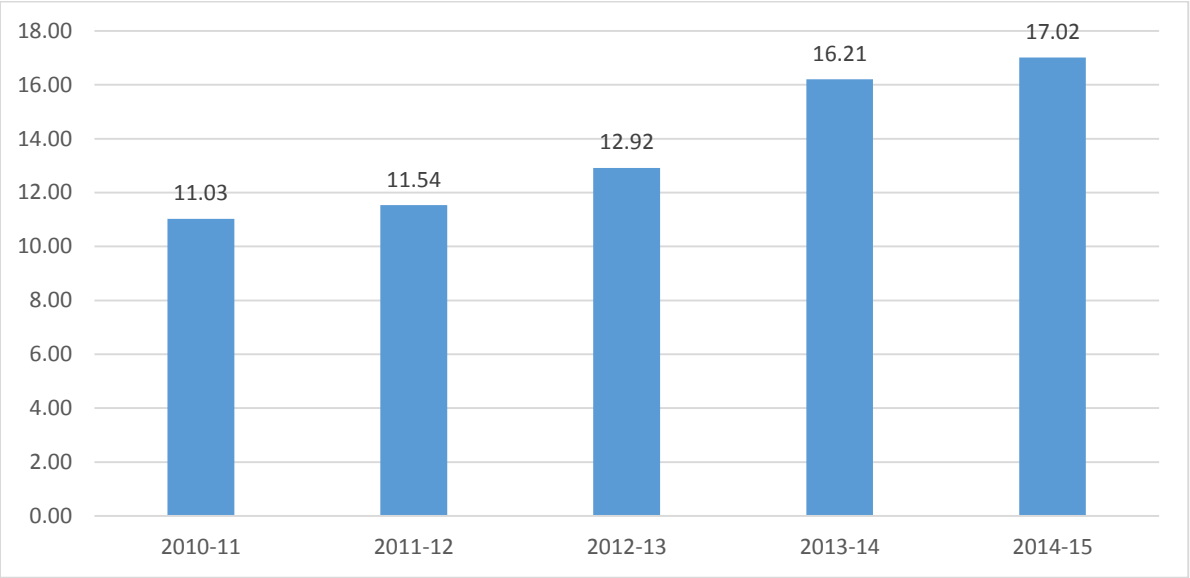
Notes: BMC Lobatse has three plots for production (veterinary gate and hilt tank feed 1 & 2), 1 for canteen and office and several for the BMC estate (houses).

Source: compiled from WUC data.

Water use for production fluctuates between just 385 000 to 506 000 m^3 while total water use fluctuates between 578 000 to 742 000 m^3. There is a trends towards decreased use of WUC water for canteen, offices and the estate. WUC water use for production has not decreased significantly, as BMC considers it safest and best to utilise WUC water for production to meet veterinary and market requirements.

BMC provided data for the water payments to WUC (see figure 4). The unit costs have risen sharply from BWP11/m^3 in 2010/11 to BWP17/m^3 in 2014/15.

Figure 4: Unit water costs in production (BWP/m³)

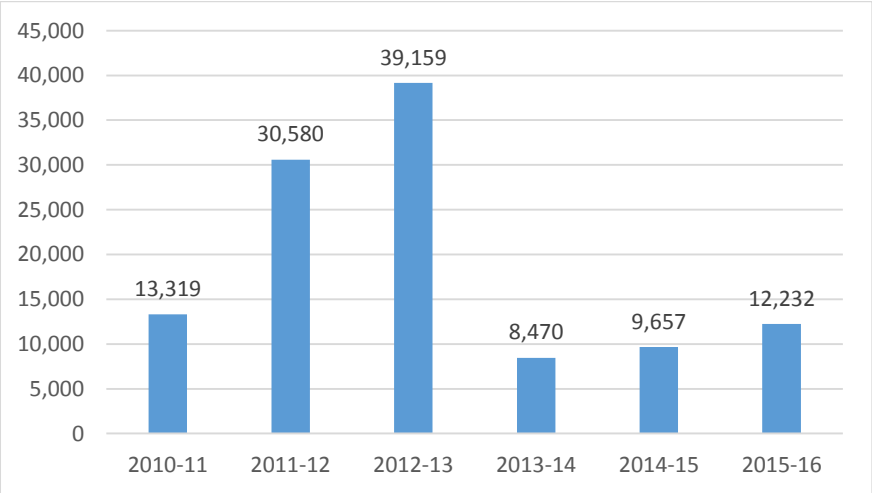


Source: BMC data. (excl. estate water use).

4.4 Water abstraction from own borehole (borehole 1)

BMC supplied data for water abstraction from borehole 1[6] for the period 2010- mid 2015 (see figure 5). During the period 2010 -2012 water abstraction was high and increasing to 39 159 m³ per annum. Water abstraction subsequently virtually stopped in the years 2013 and 2014 (with the exception of September – October 2013) but abstraction resumed in January 2015 with an average of 3 846 m³/ month in 2015, i.e. the same order of magnitude as in 2012 and 2013.

Figure 5: Water abstraction from BMC borehole 1 (in m³)



Source: BMC data.

[6] BMC has two other boreholes, but these are not metered and abstraction is not known. .The weekend post reports that BMC has 2 boreholes with a capacity of 50 m³/hour.

5 Interruptions in water supply

According to BMC staff, interruptions in WUC water supply have become common in 2015 and are particularly bad since April 2015. In April – May, four days of slaughter were lost due to water supply failures. Water supply failure has affected slaughtering and reaching production targets. BMC is often not notified in advance of interruptions, which usually last for part of the day. In a few instances water supply is out for the entire day.

Daily water use data were available for the period 2010-2015. The data only show a few days without any recording. This may be due to lack of reading or supply failure. If the next day's reading is very high, we assume that it was lack of reading (made up the next day). There are only two instances of supply failure (1 of 1 day and 1 of 2 days). This would amount to a loss of slaughter of around 1 500 animals. As stated earlier, BMC does not keep a record of water supply interruptions, which makes it impossible to document in detail the water supply interruptions (and hence their production and financial impacts).

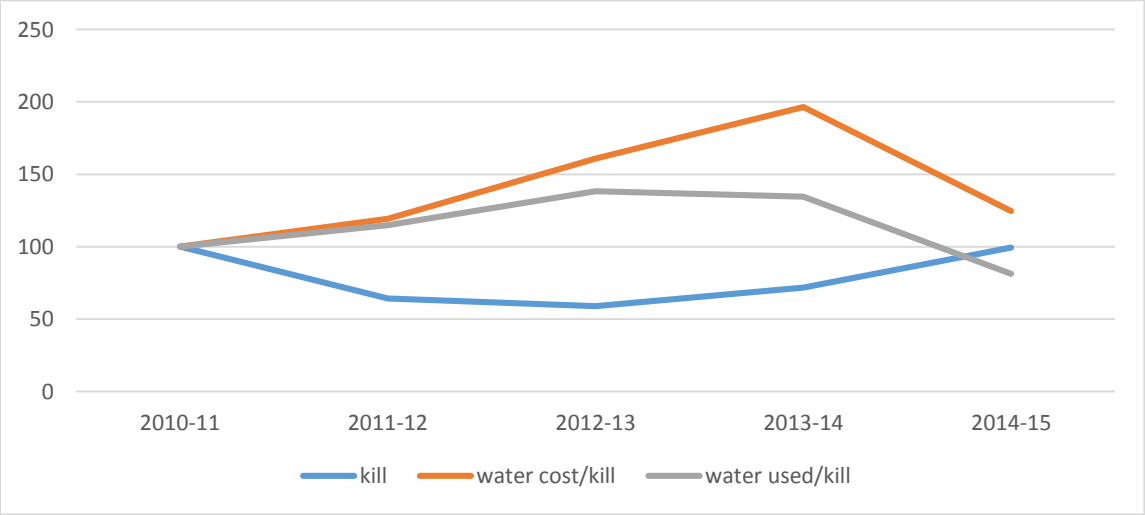
6 Impact of water supply interruptions

Discussion with BMC staff made it clear that water interruptions have a negative impact on production and revenues and lead to cost increases. However, due to lack of data no detailed impact assessment could be made. Undoubtedly, water supply have a negative impact on BMC performance as they lead to slaughtering losses, reduced production and plant capacity utilisation and reduced revenues. They also lead to increased production costs, particularly in the receiving and production stages:

a. Congestion in the holding pans and need to clean and move animals more frequently;
b. Extra watering (drinking and cleaning) and feeding costs due to longer stay of animals in the holding pans;
c. Over time labour costs for work during weekends

Figure 6 shows the relationships between number of kills and water use and costs per slaughtered animal over the period 2010-2015. When slaughtering is low, the water use and cost per animal killed are relatively high. BMC Lobatse used an average of 6.3 m^3 of water per slaughtered animal and the average water costs were BWP86/animal slaughtered.

Figure 6: The relationship between kills and water use and costs/ animal killed (2010-11 = 100)



BMC estimated that losses could as high as BWP1 million per day without water (Weekend Post, 12-18 Sept. 2015), but this figure could not be verified. Using data from the BMC 2012/13 financial report (this was a good year for BMC), the average revenue/ animal slaughtered was BWP7 225 for all abattoirs. If water interruptions prevent slaughtering of 500 animals in one day, daily revenues losses could be BWP3.6 million[7]. The same Weekend Post article also indicated that general water supply problems could lead to increased defecation in the bush with increased risks of measles.

7 Adaptation and mitigation measures

BMC has not yet managed to fully adapt to water supply interruptions. The main strategy is to develop more boreholes and treat the borehole water to standards acceptable for use in the plant. BMC has increased its use of its old borehole (yield of 10 m^3/hour) and drilled and equipped another 2 boreholes (combined yield of 40 m^3/hour). Only the old borehole is metered. Assuming that the new boreholes operate 6 days/week and for 18 hours/day, the water abstraction is estimated to be 224 640 m^3. Combined yields of the three boreholes would permit slaughtering of 225 animals/day. BMC has now permission to use borehole water for cleaning of the holding pans, saving WUC water for the production plant.

BMC has identified 4 suitable additional borehole sites on its premises. Assuming a similar average yield as the existing ones, BMC could slaughter 525 animal/day; this is close to its slaughtering capacity and would mean that BMC becomes almost independent from WUC supply. The big issue is the water quality that has to meet veterinary and EU standards. The construction of a treatment plant for softening and biological treatment is planned to achieve acceptable water quality. The costs are estimated to be around BWP1 million. According to the Weekend Post 12-18 September the treatment plant for borehole water to safe drinking standards will costs BWP 3 million but will lead to savings of 0.5 million per month. The latter appears too optimistic given the fact that BMC's average monthly WUC bill was BWP 760 000 in 2014-15. Expanded use of own borehole water is likely to lead to costs savings as abstraction and treatment costs of borehole water are likely to be considerably less than the WUC unit price (BWP17/m^3 in 2014/15). If the combined boreholes would yield 225 000 m^3 p.a.

BMC further plans to expand its on-site storage capacity to avoid production disruptions of brief water supply interruptions. . The existing storage capacity was around 1 600m^3 and will be doubled. At a rate of 4 m^3/animal, full storage would cover over one day of full capacity slaughtering. The estimated costs are around BWP3 million.

Some adjustments have been made in the production process too. Operations with the carcass handling have been reduced from 2 to 1 operation reducing water consumption. Water saving devices have been installed for offal production to save water. There should be scope to reduce water use significantly as current water use is very high by international standards (2.5 to 5.5 m^3/ animal). Future plant modernisation should lead to increased water use efficiency.

There is further potential to harvest rainwater. The BMC ground could yield 8 to 17 000 m^3 (50 and 100% efficiency) or 2-4 % of water use). This could lead to savings of BWP 95 000 to 190 000 (Ecosurv and CAR, 2007).

BMC will be able to achieve considerable cost savings through improved water resource management. For 2014/15:

[7] While some costs may go down, others do not change and therefore profitability will decline.

- ✓ If water efficiency was increased to 4m^3/animal, this would have saved BMC BWP 1.2 million in 2014/15; and
- ✓ If 75% of the water was provided by own boreholes at a cost of BWP10/m^3, this would have saved the company BWP2.8 million.

8 Conclusions and lessons

A detailed water balance was provided for 2006 in Figure 3 (Ecosurv and CAR, 2007). Some changes have occurred since then including increased use of ground water for non-plant operations (three boreholes are used but only one is metered).

BMC is currently struggling with water supply interruptions and its economic consequences. It appears to be a long-term strategy to meet its own water needs by groundwater abstraction and treatment from a total of seven boreholes. Once sufficiently treated, groundwater may also be used in the abattoir operations. The unit ground water cost of own water supply are expected to be lower than that of WUC water (BWP17/m^3 in 2014/15), and therefore increased ground water supply would make BMC more resilient and competitive[8]. The increased storage capacity will also increase the company's resilience, especially for short duration supply interruptions.

Better late than never. It is a pity that a water crisis is needed to stimulate BMC to amend its water management strategy. As far as we can ascertain BMC has not acted on most recommendations of the retrospective EIA, which include rainwater harvesting, re-use of treated effluent for non-plant production purposes and more water efficient production technologies. The water use/slaughtered animal varied between 4.6 and 7.9 m^3 in the period 2010/11 - 2014/15 with an average of 6.3 m^3.

While BMC invests in adaptation measures (treatment plant, storage and boreholes), it expects long term costs savings. Supply interruptions are likely to occur in future until good rains will fill up the dams and or the capacity of the north-south water carrier is doubled.

A more general lesson for major water using enterprises in Botswana is to increase water security and resilience by investing in increasing water use efficiency and –where appropriate- own water supply (often groundwater). Good communication between the service provider (WUC) and the client (BMC) is needed to ameliorate the adverse impacts of water supply interruptions. During meetings, BMC staff expressed the wish for better communication between WUC and BMC.

Lessons for BMC and other water dependent enterprises:

a. Keep records of water supply interruptions;
b. Efficient water management and increasing water security should be a high(er) priority for corporate management & strategic planning. This includes:
    - ✓ Record reticulated water supply & interruptions;
    - ✓ Increase water storage;
    - ✓ Increased own water abstraction; balance surface and groundwater use;
    - ✓ Incorporate water efficiency as factor in capital investments & production technologies; and
    - ✓ Harvest rainwater and run-off and re-use/ recycle treated effluent where possible
c. Monitor/ meter water flows with leak detection and water balances
d. Water interruptions have serious consequences for enterprise performance in water dependent industries. Anticipate rather than react to water problems (as has happened now)

[8] Obviously, it is important to avoid depletion of groundwater resources in Lobatse. Therefore careful monitoring and reporting to the Water Apportionment Board are needed.

For the Department of Water Affairs ass the water resource management arm of government:

i. Encourage closely controlled use of groundwater by key industries and services to reduce pressure on surface water sources and limit adverse economic impacts of water supply interruptions;
ii. Benchmark industries' water efficiency with international standards;
iii. Carry out detailed water audits that also review findings and recommendation of earlier EIAs and coordinate with environmental enterprise audits carried out under the 2011 EIA Act.

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