Republic of Botswana

Policy Brief

Botswana’s Agriculture and Water Resources

May 2015

Prepared by Department of Water Affairs & the Centre for Applied Research

1 Introduction

This is the fourth policy brief in a series, which is based on the results of Botswana's recent water accounting efforts carried out by Department of Water Affairs (DWA) and Centre for Applied Research (CAR). Earlier policy briefs dealt with '*scarcity of water resources'* (2013), '*water and the mining sector*' (2014) and '*water and irrigation'* (2014). This policy brief on agriculture covers both the livestock and irrigation sectors. Dryland crop production is not covered as it does not abstract water from the environment for the economy[1].

Globally and in most countries, the water sector is a leading water user. For many countries this is due to irrigation. The water accounts[2] show that the Botswana situation is currently different. While the agricultural sector is the leading water using sector (41% of water consumption and 35% of water abstraction over the period 2010-2014, the livestock subsector accounts for around 75% agricultural water use (around 50 Mm^3). This situation is likely to change in future if plans for large scale irrigation materialise, significantly increasing the sub-sector's water use (50 to 350 Mm^3).

Worldwide, the agricultural sector is increasingly competing for scarce water resources with other economic sectors and water salinity and pollution are growing problems (FAO, 2011). Its large share in water consumption is under pressure and likely to decline in future, and yet food production has to increase to meet demands of the growing population (FAO, 2011). As a result, there is growing pressure on the agricultural sector to increase its water use efficiency.

This challenge also applies to Botswana's agricultural sector, and increased water efficiency should guide any future (large scale) irrigation plans. The agricultural sector will have to account for its water use and the achieved productivity along with other strategic development planning concerns.

Main policy messages

Livestock sector

- ✓ *Currently relies on boreholes spread throughout the country, mostly in areas with few if any competing uses;*
- ✓ *The risks of groundwater depletion at livestock borehole is minimal;*
- ✓ *Where possible, livestock should also use seasonal surface water sources. Construction and maintenance of such water sources needs to be encouraged; and*
- ✓ *Access to large reservoirs for livestock should be discouraged, particularly where there are alternative, more valuable options for large options.*

Irrigation

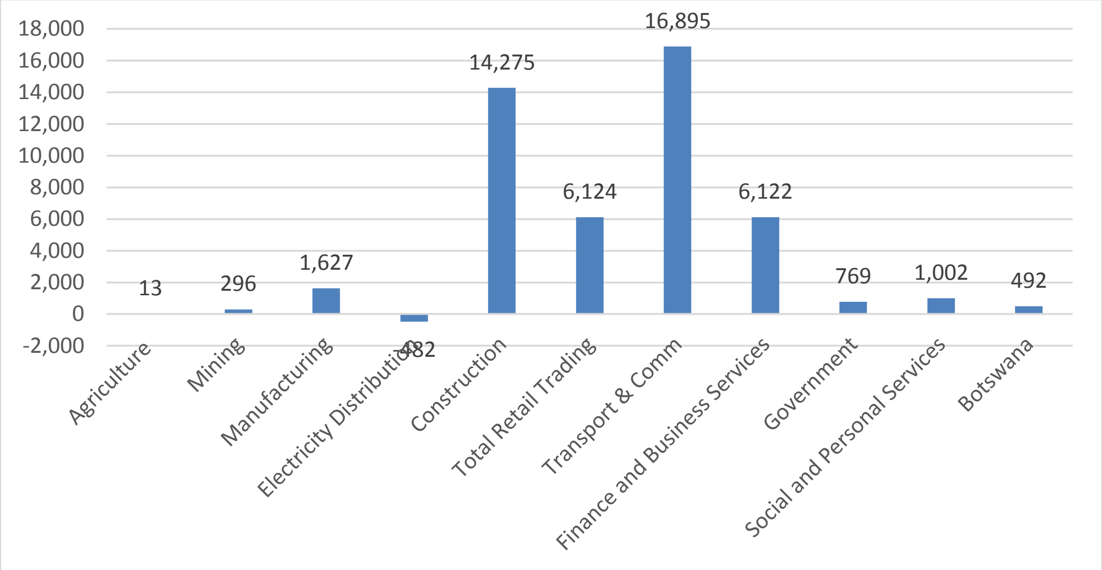
- ✓ *The irrigation sector needs to fully utilise serviced land and available water resources;*
- ✓ *The water conservation potential of drip irrigation needs to be fully utilised;*
- ✓ *The potential of treated wastewater to irrigate over 2 000 ha should be utilised;*
- ✓ *Large scale irrigation projects must be subjected to economic costs benefit analysis and judged from a water efficiency and other key development planning priorities (e.g. poverty, food security). The opportunity cost of water consumption by such projects need to be considered and the ability to pay for water should be considered.*

[1] This does not mean that dryland (or rain-fed) crop farming does not utilise water; it does not abstract water. The amount of water used in dryland farming is significant as it is the dominant form of crop production in Botswana.

[2] Water accounts record water abstraction from the environment into the economy. Natural rainfall is not included.

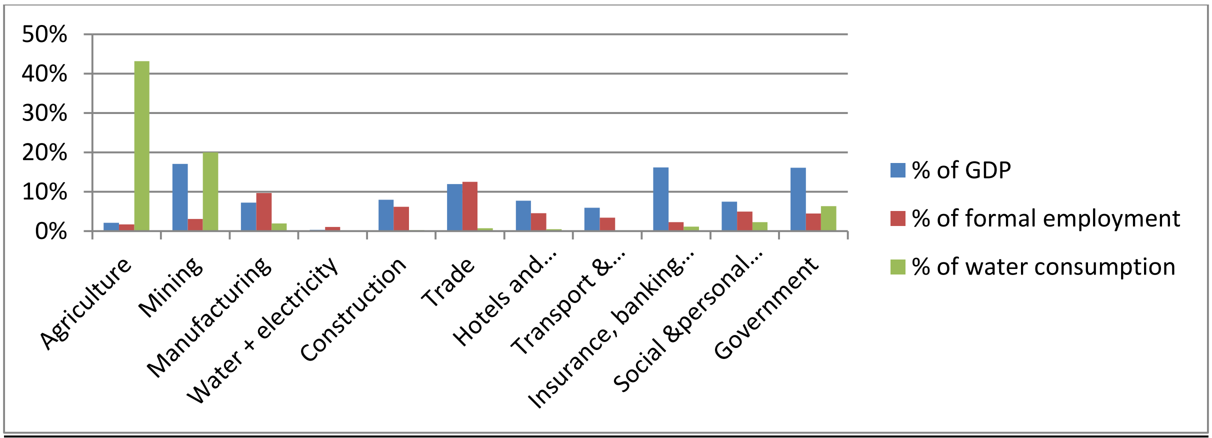
Water accounts 20/11 – 2013/14 are useful to inform development planning, water management and agricultural planning. *Figure 1* shows that *–measured by value added-* the agricultural sector currently generates the least benefit per m^3 of water used. Construction, transport and service sector score much better and also the mining sector performs better. This result is found in many countries and raises the pertinent policy questions as to how much water the sector should get in future and how water productivity can be increased in the sector.

Figure 1: Average annual value added per m^3 by sector (2010/11 to 2013/14; constant prices; BWP 2006)



If job creation is included, the situation does not change fundamentally (Figure 2). The tertiary sector leads water efficiency (valued added and employment creation), followed by industry (better on direct employment creation and poorer on valued added) and mining (better on value added, poorer on direct employment creation).

Figure 2: Agriculture's share in water consumption, output and employment in comparison to other sector (2010/11)



Source: Department of Water Affairs and Centre for Applied Research, 2013.

Currently, Botswana's livestock sector uses much more water than irrigation (estimated between 5-18 Mm^3), but water demand from livestock (55.6 Mm^3) is spread evenly over most of the country, and in many parts there are no alternative uses (low or zero opportunity costs). As grazing resources are the primary production, the risk of groundwater depletion is minimal in most parts of the country. Each sub sector will be highlighted in more detail below.

2 The livestock sector and water resources

Grazing and water are serious resource constraints for Botswana's livestock farmers. The prevailing semi-arid conditions limit the rangeland productivity and surface water. There are few perennial rivers (Chobe, Okavango and to a lesser extent the Limpopo Rivers) and small-scale surface water (e.g. pans, small dam and haffirs) is only available during the rainy season (October- March), mostly in eastern northern Botswana. Livestock relies on groundwater for the rest of the year through boreholes and wells. A large number of livestock boreholes are spread out over the entire country with the exception of National Parks, Game Reserves and Wildlife Management Areas (together around 40% of the land area).

Boreholes are expensive to drill and operate and they can only be afforded by large herd owners (with herds of over 100 cattle). Some livestock farmers with smaller herds (usually 20 to 100) may form syndicates to jointly operate and manage a borehole. Livestock farmers, who cannot afford a stake in a borehole have to purchase water from borehole owners or keep their livestock close to villages, where there is access to reticulated water but grazing is poor. Village water reticulation systems are not meant for livestock watering but the practice is fairly widespread. Government supports water development for livestock through its LIMID subsidy programme. Livestock boreholes are normally spaced 6 to 8 km apart. This spacing rule is based on the required amount of forage necessary for livestock. Where this rule is applied, the risk of water depletion is minimal. Grazing resources restrict the number of livestock per borehole to livestock density levels, where groundwater depletion is unlikely to occur (except in areas with no or extremely minimal recharge).

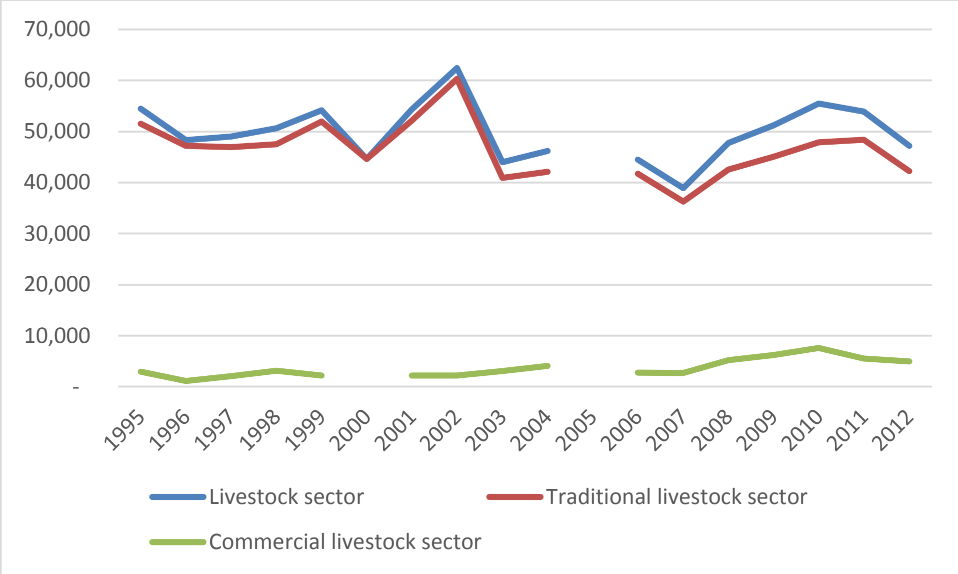
The above is the view on water resources from a farmer's perspective. In the Water Accounts, water use of the livestock sector is put in a national perspective, linked to the National Accounts. It also offers comparison with other economic sectors. It has to be noted that livestock water use is not metered and monitored. Therefore, the water use was estimated by multiplying the number of livestock by the internationally accepted figures for daily water consumption by type of livestock[3]. Livestock figures have been taken from the annual Agricultural Statistics.

The water accounts show that the water consumption of the livestock sub-sector has fluctuated around 50 Mm^3 per annum with a high of 62 Mm^3 (2002) and a low of 38.9 Mm^3 (2007). There is no trend towards water consumption by livestock as the national herd has not grown (the average annual herd size is 2.1 million livestock units for the period 1995 – 2012). The traditional sector accounts for over 90% of the water use by livestock, which is kept in communal areas throughout the country. The livestock sector supplies the meat processing industry (mostly BMC), which used 1.5 and 1.1 Mm^3 in 2012/13 and 2013/14 respectively.

Disaggregation of the agricultural sector, shows that the value added/m^3 of water is higher in the livestock sub-sector (average of BWP14.15/m^3) as compared to the crop sector, which includes irrigation (BWP8.80/m^3).

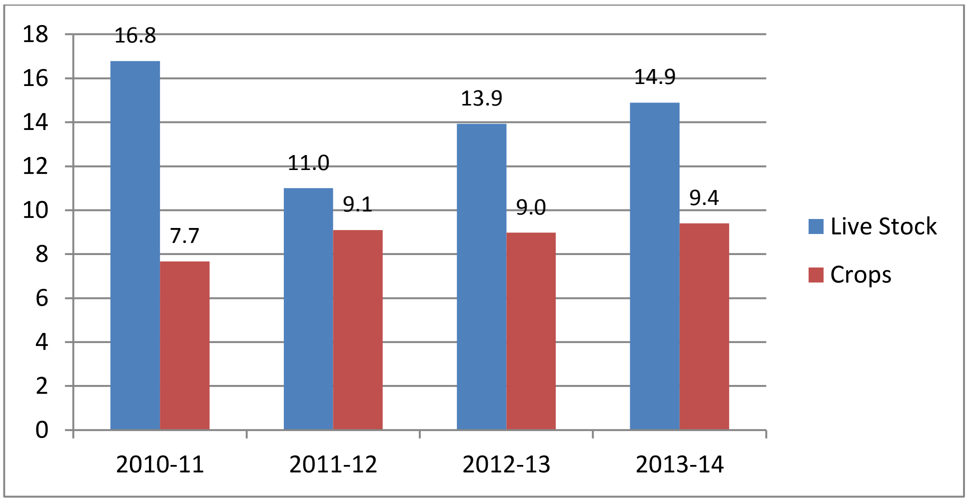
[3] Cattle: 50 L/d; goats and sheep: 5 L/d and donkeys: 20 L/d. The actual daily water in-take may differ depending on drought conditions.

Figure 3: Water consumption in the livestock sector (000 m^3; 1995 – 2012/13)



Note: estimates are based on livestock figures from the Agricultural Statistics.

Figure 4: Value added in crop and livestock subsectors (2010-11 to 2013-14; BWP 2006)



Note; the crop sector is mostly dryland farming. Irrigation is only a small component.

It should be realised that the meat and meat processing industry that depends on the livestock sector generates much higher outputs per m^3, i.e. BWP 923.83/m^3 in 2013/14 (constant 2006 prices). Apart from increasing water use efficiency in the agricultural sector, expansion of the agro-processing industry would justify water allocations to agriculture.

3 Irrigation and water resources

The situation of irrigation differs from the livestock subsector as its water use is localised and often competing uses exist. Before the country embarks on large irrigation plans, it is wise to have a closer look at the water use in the irrigation sub-sector.

In Botswana, crop production has not grown since 1980s in terms of area planted and production. The sector is dominated by rain-fed subsistence farming and the irrigation sub-sector is very small. Country-wide around 200 000 ha are annually planted but the estimated irrigated area (e.g. 2006 Review of NWMP; SMEC & EHES, 2006)) is around 1 200 ha with an estimated water use of 18 Mm^3

(using the 'standard' figure of 15 000 m^3/ha). Water use for irrigation is not metered and no accurate data exist for the actual amount of annually irrigated land and associated water consumption.

The irrigation sub-sector is expected to grow in future as the country adapts to climate change[4] and seeks to increase food security and domestic food production. The 2006 Review of the National Water Master Plan (SMEC & EHES, 2006) forecasts a tripling of water use for irrigation to 50 Mm^3 in 2030. If plans for a large irrigation scheme near Pandamatenga will materialise, water use for irrigation could increase to well over 300 Mm^3 per annum. This raises the policy issues whether it is wise to expand the irrigation to such a high level, what is the current water efficiency of irrigation sector and how can this be improved and how much of future shared water allocation should be reserved for irrigation (e.g. how much of the Zambezi-Chobe water allocation should be used for irrigation and for what strategic purposes)? To explore these questions, a brief profile of the current irrigation sector is presented below. It must be noted that the irrigation sub-sector is very poorly documented.

Based on data from the Ministry of Agriculture, we estimate the number of irrigation farmers in the range of 500 to 750, mostly small, farmers. This is less than half of the farmers that have been issued irrigation rights by the Water Apportionment Board. The amount of annually irrigated land is not exactly known. The serviced irrigation land is in the range of 950 to 2 250 ha but only around half is annually used[5]. Clearly, both irrigation water rights and serviced irrigated land are seriously under-utilised, creating short-term opportunities for expansion.

The sector comprises mostly small individual farmers, irrigating up to 2 ha[6] and a few large farms (e.g. Talana farm with 380 ha under irrigation). The Ministry of Agriculture operates smallholder irrigation schemes at Glenn Valley (200 ha), using treated wastewater, and Dikabeya (60 ha), using reservoir water. Irrigation in Botswana is predominantly for horticulture, mostly vegetables and citrus crops. Irrigation farms are typically found along ephemeral rivers, near dams or wastewater treatment works. More than two-third of the farmers (68.8%) supply their own water; over a quarter (28.2%) use village water supplies (mostly small backyard gardens) and a few (3.2%) depend on government irrigation schemes. River water is the most important source (54.2%), followed by groundwater (38.4%) and dam water (7.3%). Treated wastewater is as yet rarely used and there is considerable potential to increase the use of treated wastewater if the wastewater quality is sufficient. Increasing re-use and recycling of treated wastewater should be a major policy priority, although the irrigation sub-sector will have to compete with other sectors for this resource.

The official estimate is that the irrigation sector uses 18 Mm^3 water per annum (SMEC & EHES, 2006). This figure is used to-date in the Water Accounts, but the findings of the preliminary work done on the sector suggest that this figure is probably an over-estimation as it assumes that all service land is being used. Based on different estimates for the irrigated land and different water uses/ha, it is estimated that current annual water use is lower and in the range of 9 to 12 Mm^3. Around 10% of this is re-used treated wastewater.

There are mixed indications about the water efficiency in the sector. It is positive that most farmers use drip irrigation, which is a water-efficient technique (Figure 3). Sava & Frenken (2002) show that drip irrigation may use less than half the amount of water of surface irrigation technologies (e.g. sprinklers). It appears, however that the water saving potential of drip irrigation is not achieved as available (incomplete) data suggest that water use for drip irrigation on government schemes is

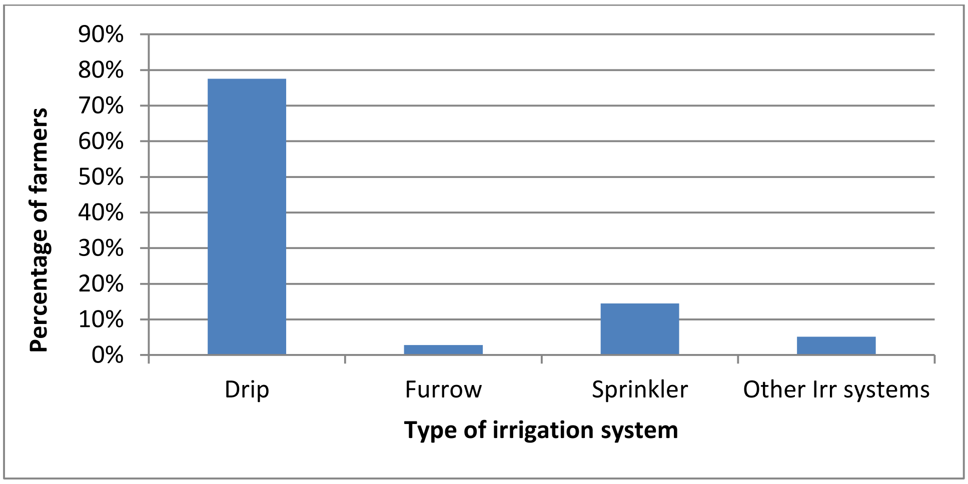
[4] Water storage and irrigation would be adaptations to climate change and may contribute to greater food security.

[5] Irrigation division data: 35.6% in 2011-2 and 53.1% in 2012-3; horticultural division data: 4 012 ha of irrigated land is allocated, of which 66% is developed and 55% (2 209 ha) cultivated in 2012/3

[6] Tahal Consulting Engineers (2000) National Master Plan for Agricultural Development. Volume 1.

around 1 500 m^3/ha per annum. In one scheme with mostly drip irrigation, the estimated water use was as high as 1 850 m^3/ha. The policy challenge is therefore to increase water efficiency for drip irrigation and to utilise the excess water for irrigation expansion.

Figure 5: Irrigation systems used by irrigation farmers



Irrigation schemes are not metered and farmers do not pay for water. These factors do not encourage water efficiency and may explain the observed high water use for drip irrigation. Moreover, some schemes are poorly designed from a water efficiency perspective (e.g. open canals). One irrigation scheme has to irrigate all land, whether used or not, to avoid pipe bursts in the irrigation system. If only half of the land is actually irrigated, the water efficiency is down by 50%!

In order to justify further water allocations, the irrigation sub-sector needs to account for the water it uses. There are several concerns here. Firstly, the production and value added of the irrigation sector is not known. This makes it impossible to compare the economic benefits of an m^3 of water used in irrigation with that of competing sectors. It is necessary to collect better data for the irrigation sub-sector to assess its competiveness for water resources. It is a good development that the 2015 Agricultural Survey for the first time included specific questions on irrigation. Secondly, water abstraction, use and consumption for irrigation are not directly measured. Water losses and water returned to the environment are also unknown. Therefore, it is impossible to differentiate between abstraction, use and consumption. In addition, there is lack of monitoring on the use of water rights for irrigation. Thirdly, there appears to be lack of understanding among some farmers about water requirements for irrigated crops in terms of required supply reliability and water quality as well as lack of appreciation to conserve water. The 2013 National IWRM Water Efficiency Plan (DWA, 1014) observes that irrigation farmers do not pay for water, or pay very little, which discourages efficient water use. Fourthly, the sector uses mostly fresh water while there is a growing amount of treated wastewater (estimated at 27.1 Mm^3 by DEA and CAR, 2006). Only around 10% (or 2.5 Mm^3) of wastewater is being re-used: around 1 – 1.5 Mm^3 for irrigation. Available wastewater could irrigate over 1 800 ha. Concerns also exist about the variable and generally low quality of treated wastewater. As wastewater is located close near population centres, it is a valuable resource for irrigation and other potential users such as the construction sector. The 2003 National Master Plan for Wastewater and Sanitation (NMPWWS) estimates an increase in wastewater to over 73 Mm^3 in 2030 (SMEC *et.al*, 2003). This would be sufficient to cover the sector's forecasted needs (excl. the Pandamatenga scheme).

The main policy issues that arise with respect to irrigation are:

a. Should Botswana expand the irrigation sector or to import irrigated products from water abundant countries?
b. How can Botswana establish a productive and water efficient irrigation sector?
c. What products (e.g. in terms of food security) should be produced by the irrigation sector and how much water and land should be made available for this purpose? This require an irrigation policy and strategy (e.g. NAMPAADD implementation).
d. How could water efficiency be promoted, and to what extent and how can the irrigation sector compete with other economic sectors for water?
e. What should be the irrigation tariffs and based?

Readings

DWA (2013). *Botswana Integrated Water Resources Management and Water Efficiency Plan- Main Report.* Government of Botswana.

DWA and CAR (2013). *Environmental- Economic Accounting for Water in Botswana: Detailed accounts for 2010-11 and 2011-12 and General Trends 1993-2010*. Ministry of Minerals, Energy and Water Resources.

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