Impacts of Drought Induced Water Shortages in South Africa: Sector Policy Briefs

Report to the
Water Research Commission

by

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This report forms part of a series of three reports. The other reports are:

- Impacts of Drought Induced Water Shortages in South Africa: Economic Analysis (WRC Report No. 2604/1/18);
- Impacts of Drought Induced Water Shortages in South Africa: Areas for Future Research (WRC Report No. 2604/3/18).

TABLE OF CONTENTS

List of Figures

List of Tables

1. Agriculture – with a focus on maize, sugar and cattle

Title:

When considering both direct and indirect costs, the impact of drought to agriculture has been massive

Summary:

- Agriculture is a core component of the South African economy. It is also a sector that has experienced many droughts in the past.
- Although there is literature regarding the production decreases in agriculture as a result of a drought, there is less information regarding the indirect impacts of drought on the country.
- In addition, there is limited information regarding the differential impacts of drought on subsistence farmers relative to commercial farmers.
- Finally, and most importantly, we need to better understand how repetitive and prolonged droughts might shift the character of local, rural economies in South Africa.

Recommendations:

- We recommend a greater understanding of the impact of drought on the broader agricultural sector, and not only the changes in production. We also need to consider the nature of farming in South Africa going forward. Both in terms of climate, and also politics.
- As a country that knows that drought is going to be our reality, particularly with the risk of climate change, it is critical that we put in place the necessary structures to support the diverse makeup of our agricultural sector.

Main text:

Agriculture is a critical sector to our economy for food, employment and foreign exchange. The agricultural sector contributes 3% to national GDP and 7% to formal employment. 8.5 Million people are either directly or indirectly dependent on agriculture for employment and income. These statistics however hide the local, rural importance of the sector to communities.

The agricultural sector is made up of commercial farmers and subsistence farmers. These sectors experience drought risks differently. According to Statistics South Africa's Labour Force Survey (2000-2007), over six million households engage in smallholder agricultural activities. Over two million of these are females and state that the main reason for their participation in this form of agriculture is for obtaining extra food. This group has a fundamentally different risk profile and response to the commercial farming sector that underpins that national food security of South Africa[1]. Many of our farmers are also rain-fed. Therefore, with the projected increased in climate intensity as a result of climate change, these farmers are especially at risk. We need to better understand what the impact of a shifting, mostly drying climate is on our rural economies that are so reliant on agriculture. Furthermore, we need to understand, as farmers shift to irrigation, what the competition for water will look like between and among different users and sectors.

[1] http://www.krepublishers.com/02-Journals/JHE/JHE-45-0-000-14-Web/JHE-45-2-000-14-Abst-PDF/JHE-45-2-147-14-2461-Morojele-P/JHE-45-2-147-14-2461-Morojele-P-Tx[6].pmd.pdf

The agricultural sector is the biggest user of water in South Africa. Agriculture accounts for 60% of water demand, followed by the municipal sector (27%), power generation (4.3%), mining (3.3%), and industrial demand (±3%). The main driver of agricultural water demand comes from the 1,6 million hectares of land equipped for irrigation (DWA, 2013). According to the National Water Resource Strategy, "**Water is the major limiting factor in the growth of this sector and poor water quality has a negative impact on agricultural exports and associated foreign income."**[2]

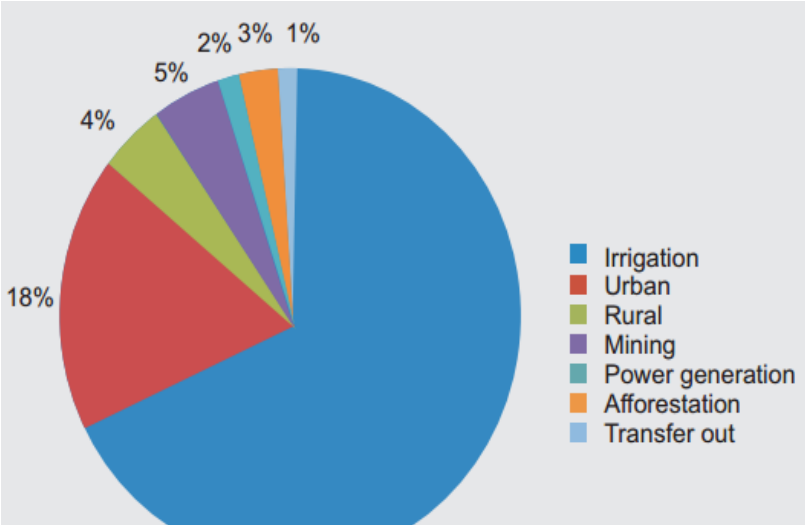


Figure 1: Contribution and current water needs to the major economic sectors

A few highlights on the effect of the drought on the formal agricultural sector (Maize and Sugarcane):

In a normal (non-drought) year, South Africa is self-sufficient in its maize production, and exports excess maize (Agri SA, 2016). During the current drought however, South Africa has moved from being a net exporter of maize to a net importer of maize. For instance, Grain SA – using the market price method – estimated that South Africa will need to import an unprecedented 3.8 million tons of maize in the 2016/17 season at a cost of approximately R3 800 per ton between May 2016 and April 2017 (Agri SA, 2016).

- The Crops Estimates Committee (CEC) estimated that the area of maize planted for the 2016/17 season was likely to be around 2 million hectares, 25% lower than the area planted in the 2015/16 season (Agri SA, 2016).
- Cane production decreased in all cane growing areas and estimates of sugar cane production were estimated to decline from an annual norm of 19 million tons to 14 million tons, and the South African Cane Growers Association estimated that more than 6500 seasonal jobs would be lost because of decreased cane production.

[2] Department of Water Affairs and Sanitation. National Water Resource Strategy. 2013. http://www.wrc.org.za/SiteCollectionDocuments/Acts%20for%20govenance%20page/DWS%20National%20Water%20Resources%20Strategy%202LinkClick.pdf

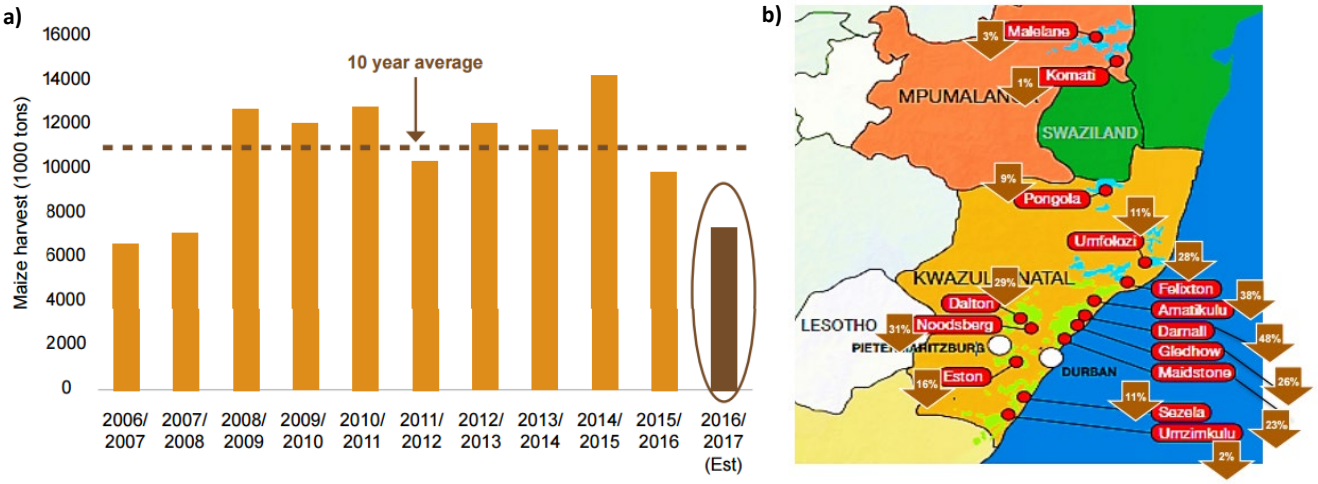


Figure 2: (a) Maize crop harvested; (b) Changes in sugar cane production (2014/15 to 2015/16) in growing regions (Agri SA, 2016)

A few highlights on the effect of the drought on the formal agricultural sector (Livestock)

The livestock sector is the largest contributor to total agricultural gross domestic product accounting for about 48% of South Africa's agricultural output in terms of value (GCIS, 2015). Further, cattle and calves slaughtered contribute about 9.7% to the total gross value of agricultural production (DAFF, 2014). The sector supports about 500,000 jobs, with milk producers employing some 60,000 farmworkers and providing 40,000 indirect jobs within the milk processing value chain (GCIS, 2015).

- In the livestock sector, drought resulted in natural grazing areas becoming seriously depleted leading to the forced slaughtering of livestock, and livestock deaths due to fodder unavailability. Increases in red meat slaughter rates of 23% (cattle), 37% (sheep) and 12% (pigs) were reported for November 2015 to December 2015.
- 40,000 cattle died in KwaZulu-Natal in 2015 (Maré and Willemse, 2016)
- A slow increase on a year-to-year basis in the standing stock show that the national herd is slowly increasing. A sharp increase in the standing stock (as is evident in the figure below) from the year 2014 to 2015 may be an indication of a shock in the market such as drought, that causes primary producers to sell more of their animals to the feedlot. In 2015 there were on average 30% more cattle in feedlots at any given time than during 2014 per month. The large number of cattle that was fed during 2015 in comparison with 2014 shows that very little replacement stock was kept on farms. Farmers thus desperately decreased their herd size to survive the drought (Maré and Willemse, 2016).

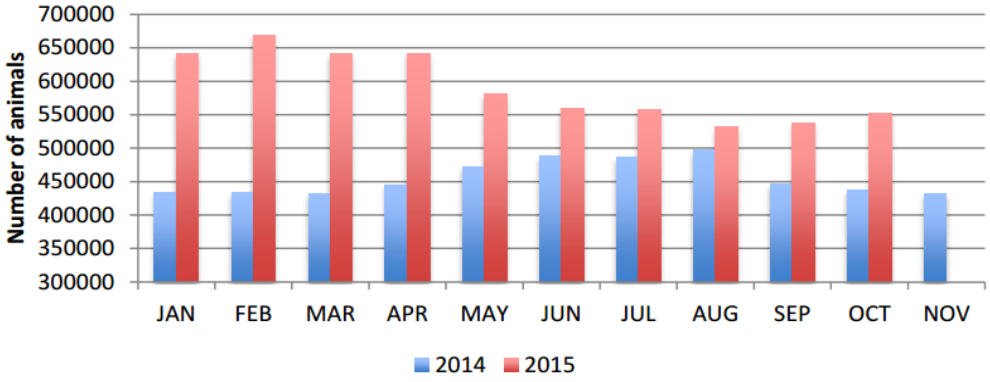


Figure 3: Monthly cattle feedlot standing stock in South Africa (SAFA, 2016 in Maré and Willemse, 2016)

There is a ripple effect through the economy as a result of agriculture suffering a drought. For instance, the South African Agricultural Machinery Association (SAAMA, undated) reported that due to the drought, yearly tractor sales were down 11% and sales of combine harvesters declined by 30% as at January 2016. Producers of seeds reported severe increases in unsold maize seed stocks that will not be fit for resale in the next production season. Maré and Willemse (2016) established that the cost of the basic food basket was likely to increase by 30%. This increases the burden on consumers, as unemployment and inflation are at the highest level, which makes people with limited resources more vulnerable to food insecurity.

The maize industry stimulates the economy directly by providing secondary industries with over R1.5 billion worth of business each year (NDA, 2001). According to BFAP (2012), white maize is important for human consumption while yellow maize is mostly used for animal feeds. South Africa is the largest producer of maize on the African continent and, in a normal production season, 40% of maize produced in South Africa is traded in the Southern African Development Community (SADC) region (Agri SA, 2016). Therefore, a drought in South Africa also affects the region of SADC more broadly.

A window into the life of a small-scale maize farmer…

I am a small scale maize farmer, who had 0.25 ha of land in 2011 and 0.5 ha of land in 2016, 3 employees in 2011 and 2 employees in 2016. I used 1 bag of manure in 2011 and 1.5 bags of manure in 2016, and had an output of 3 (50kg) bags of maize in 2011 and 5 (50kg) bags of maize in 2016.
As a result, my white maize output decreased by 2 bags per hectare, consistent with my expectation of the drought.

As a result of the dams drying up and reduced river water levels, irrigation water was not enough leading to the maize crop being burnt. As a short-term response, I joined with others and volunteered to dig up furrows that bring water to dams. Because of the drought there was livestock encroachment into maize fields and this led to conflicts. Fences around maize fields were reported

stolen. In response, the farmers as a group discussed these problems with livestock owners and almost took the issue to court. However, it was possible to find out of court resolutions.

The drought has been very difficult. In the future, it would be easier if we could: (i) expand the storage capacity of existing dams, (ii) build more dams and boreholes, (iii) conserve water especially when irrigating. To be specific, farmers should be compelled to irrigate for not more than three hours per day.

Conclusions:

Droughts are not new to the agricultural sector of South Africa. Neither are they going to stop or get smaller. According to the National Water Resources Strategy, "South Africa has low levels of rainfall relative to the world average, with high variability and high levels of evaporation due to the hot climate, and increasing challenges from water pollution. South Africa is the 30th driest country in the world and has less water per person than countries widely considered to be much drier, such as Namibia and Botswana."[3] With this variable and stressed climate, the agricultural sector has often had to deal with water shortages. As a result, there is significant literature in South Africa regarding the impact of drought on agriculture. However, there is less literature on the downstream effects of this drought on the broader economy of the country. There is also less understanding on what the possible scenarios are for agriculture under a shifting climate going forward. This is especially important for the rural economies that are wholly dependent upon agriculture.

Our diverse climate in addition to substantial water infrastructure provide some form of hedging against climate impacts in South Africa. South Africa is home to a series of diverse hydro-climatic zones that result in droughts impacting our country at different times or intensities. This provides a form of hedging. For example, while the northern parts of the country experience drought, the southern parts of the country, driven by different rainfall and climate regimes, do not experience the same drought. In addition, water infrastructure in South Africa, provides an additional level of security for irrigation farmers. Those that practise rain fed agriculture are especially at risk of variable and erratic rainfall patterns.

We critically need to better understand the following aspects of agriculture and drought to ensure that our future risks can be mitigated:

- How does drought impact agriculture indirectly (we have a good understanding of indirect impacts)?
- How does drought impact upon the agricultural economy? It is critical that we understand this from a hydro-climatic zone aspect, so that we can make climate-appropriate decisions regarding action.
- How does drought impact upon the rural economy? Many national-level studies hide the fact that urban centres are protected in many ways from the impact of drought. Rural areas, deeply connected to the agricultural sector will experience drought impacts differently. The

[3] Department of Water Affairs and Sanitation. National Water Resource Strategy. 2013. http://www.wrc.org.za/SiteCollectionDocuments/Acts%20for%20govenance%20page/DWS%20National%20Water%20Resources%20Strategy%202LinkClick.pdf

same is also true for the relative impact of drought on commercial farmers vs. subsistence farmers.

2. Tourism – with a focus on Kruger and iSimangaliso

Title:

Tourism experienced both opportunities and risks because of the recent drought in South Africa

Summary:

- The tourism sector in South Africa is broad and diverse, with far-reaching activities. These range from eco-tourism to agro-tourism and also the water use of hotels themselves. Each of these activities have different needs and impacts associated with water. Therefore, the impact of the drought is difficult to evaluate across the single sector. As a result, there is limited information on this topic.

Recommendations:

- As a major sector within the economy of South Africa, it is critical that we get better understanding of the interplay of water shortages and the tourism sector.
- Also, in many cases our tourism sector is supported by a functioning natural ecosystem. Therefore, it is critical that we evaluate the value of tourism through protection of our natural ecosystems too.

Main text:

Tourism is an important sector in South Africa, whose water needs are diverse and often indirect. The tourism sector represents almost 3% of the GDP of South Africa, which translates into 4.4% of employment in South Africa (Stats SA, 2015). There are also many indirect contributions associated with tourism. According to the World Travel & Tourism Council, the tourism industry directly contributed ZAR 102 billion to South African GDP in 2012, and supports 10.3% of jobs in the country[4].

The tourism sector is diverse and complicated in terms of its water use and impacts. For instance, the direct impact of drought is important for activities such as rafting, boating, canoeing, or fishing that may not be possible in low-flow situations. Water shortages may also influence animal and bird migratory patterns affecting wildlife viewing or hunting.

There are indirect impacts of drought that may affect the profitability of the tourism sector too. In the recent drought, game reserves and parks were left with few options: (1) reducing the number animals by relocating them to places where there is still grazing, (2) reducing the numbers of animals by disposing them off through live sale, and (3) hunting where it is necessary (SABC, 2015). For herbivores, an additional option is to bring in feed such as hay to supplement the limited grazing available in the veld. Increased operation costs together with potential changes in visitor numbers will negatively impact the sector. The ultimate outcome results in decreased tourist Rands earned for the

[4] https://en.wikipedia.org/wiki/Tourism_in_South_Africa

local economy and a reduction in sales taxes, potentially leading to unemployment (Thomas et al., 2013).

Some experiences from the Kruger National Park (KNP) in the recent drought are of interest. Kruger National Park is one of the largest game reserves in Africa. It covers an area of 19 485 square kilometres in the provinces of Limpopo and Mpumalanga in north-eastern South Africa. The recent drought in the Kruger National Park had significant environmental consequences. However, there were limited changes to the actual number of visitors to the Park. In the 2014/2015 financial year, visitor numbers increased by 6,6% from 1 556 916 to 1 659 793[5].

Unlike hotels and restaurants which rely on municipal water supplies, Kruger National Park obtains and treats its own water. Water supplies were not particularly interrupted by the 2016 drought. The main impact of the drought in so far as water supply is concerned was to increase pumping costs because the Crocodile and Letaba rivers were very low (expensive to extract water from very low river levels). The also drought necessitated KNP to open boreholes that were not currently in use, which had impacts on expenditure. Since Kruger National Park extracting water from extremely low flows during the drought, there were worries about water quality issues. However, with effective water quality monitoring, no water quality related issues arose following the drought. But the drought resulted in an increase in water quality monitoring costs.

There are however some positive impacts of a drought. For instance, a positive outcome of the drought in so far as water supply is concerned was to increase water conservation awareness. The drought also appears to have had positive impact on game viewing opportunities and visitor numbers in KNP It is hypothesized that drought enhances game viewing: drought implies decreased vegetation density and better game viewing. One would hypothesize that since the number of carcasses during a drought increase, in particular because of hippo and buffalo die-offs, visitation would go down. However, KNP hypothesizes that increased social media exposure and marketing may have mitigated this potential. In general day visitors and occupancy went slightly up during the drought year. But since this is just a hypothesis, it should be tested using a visitor survey to establish broad trends: is there a relationship between drought and enhanced (i) visitor numbers, and (ii) game viewing experience?

Addition hypothesized impacts of the drought, according to the Kruger National Park are as follows:

- KNP hypothesizes that there might be relationship between drought intensity, cattle deaths and increased incidences of snaring at the KNP periphery. This follows increased snaring incidences on the periphery of KNP during drought events, but this is a matter for scientific investigation.
- **KNP hypothesizes that the drought may be associated with the significant reduction in the number of rhinos poached**: the vegetation is sparse, it is easier to track poachers and it is more difficult for them to hide: what is the impact of the drought on rhino poaching?

[5] https://www.sanparks.org/assets/docs/general/annual-report-2015.pdf

- Finally following drought, KNP decided to do some hippo and buffalo off-take to supplement food to schools and orphanages in surrounding communities. KNP processed the meat before offering it to communities. Data available from KNP show that **72** hippos were culled and processed at a cost of **R833,244** and **104** buffalo were culled and processed at a cost of **R499,946.52.**

Another South African National Park, iSimangaliso Wetland Park also shared their perspectives on the drought. iSimangaliso Wetland Park (a UNESCO World Heritage Site) is situated on the east coast of KwaZulu-Natal, South Africa, about 275 kilometres north of Durban. It is South Africa's third-largest protected area, spanning 280 km of coastline, from the Mozambican border in the north to Mapelane south of the Lake St. Lucia estuary, and made up of around 3,280 km^2 of natural ecosystems, managed by the iSimangaliso Authority.

The iSimangaliso Wetland Park were very proactive in communicating the impact and also their response to the drought in 2015/2016. The following excerpts are taken from their website https://isimangaliso.com. "The drought, in combination with the effects of the historical long-term separation of the Umfolozi River from the Lake St Lucia system by previous management strategies, has produced extremely low lake levels and higher salinities, particularly in the northern parts of the estuarine lake system. Land use activities, such as commercial plantations, are placing further strain on the water resources in the Park."[6] During the drought, the higher salinity levels began to reach the limits of tolerance of the normal estuarine invertebrate fauna. A number of actions were undertaken to mitigate the effects of the drought. These included pumping water to artificial boreholes as well as putting out a tender to remove portions of dredged soil in Lake St Lucia estuary in an effort to restore natural ecosystem function to the estuary.[7]

Other impacts of the drought, according to interviews with iSimangaliso staff include:

- Game viewing was improved as animals would cluster around available water points. On the contrary, fishing in the northern part of the park was negatively affected as the lake dried out.
- Natural resources harvesting, for example, 'incema' (a rush used for making mats) was negatively affected by drought to the point that it could not take place in 2016 as the 'incema' was not enough for sustainable harvesting. There was also pressure on the park by local communities to allow cattle to graze in the park during the drought.
- Businesses around the iSimangaliso Wetland Park were negatively affected as they had to find alternative sources of water. Some of the business dug boreholes while other opted to purchase water. One lodge was shut down as getting water was costly. It seems that businesses had to absorb the cost associated with water shortages and in turn not offer

[6] https://isimangaliso.com/newsflash/isimangaliso-drought-update/
[7] https://isimangaliso.com/newsflash/isimangaliso-drought-update/

accommodation discounts where they could have done so in a normal year. The accommodation prices did increase following the drought.

Conclusions:

We do not understand the makeup of our tourism sector sufficiently. Furthermore, we do not understand the exact impacts of water shortages or drought on the sector. Therefore, a full analysis of the tourism sector, including its impact to the economy through direct and indirect means is necessary. This analysis also needs to include reference to how water is a core operating need, not only for the tourists themselves, but also for the animals and natural ecosystems that many of our tourism sites are situated around.

Key questions regarding the impact of drought on the tourism sector include:

- What are the water-related needs of the entire tourism sector? This includes quantity, quality, timing and also water needs for ecosystem function.
- What are the costs if these needs are not met? For example, do we experience less tourism numbers? Are our profit margins reduced as a result of higher operating costs?
- What are the opportunities that we have seen as a result of the drought? This includes investments into water saving technologies and improving efficiencies. How can these be quantified?
- What does a depressed tourism sector do to the broader economy of South Africa? What are the indirect impacts?

3. Agro-processing – with a focus on sugar cane

Title:

A double whammy: agro-processing is impacted both through agriculture and water supply for operations during a drought

Summary:

- Due to the importance of the agricultural sector in South Africa, it is a natural progression for the agro-processing sector to be critical too. This is not only because of foreign exchange earnings from exports, but also from an employment perspective.
- The impact of drought and water shortages to the agro-processing sector is identified by the Government of South Africa as a risk. However, there is not complete picture of what this means in a quantitative sense for the economy.
- The recent drought impacts to the agro-processing sector were mostly focussed around lower production from agriculture, due to the heavy water footprint associated with agricultural production. However, there are also major risks associated with the processing and operations within factories. These impacts are less understood.

Recommendations:

- Increased understanding of the water needs of the agro-processing sector is necessary. As indicated, although these needs may be less than the direct water requirements of agriculture. However, due to the strategic importance of the sector, it is important that the inputs for the sector are met.
- We also need to consider the strategic importance of agro-processing for food security or for export. In some cases, the heavy water footprint associated with some foods, which is then exported, may need to be balanced against growing other crops with a different comparative advantage, perhaps targeted towards less water consumption but increased food security. This is especially true when considered alongside a changing climate in the future, and what makes sense now, may not make sense going forward.

Main text:

Agro-processing in South Africa is the largest sub-sector of manufacturing, representing 29% of output and 29% of value added during 2006-2010. The relative contribution of the agro-processing sector in the manufacturing sector is shown below (DAFF, undated)[8]. Its contribution

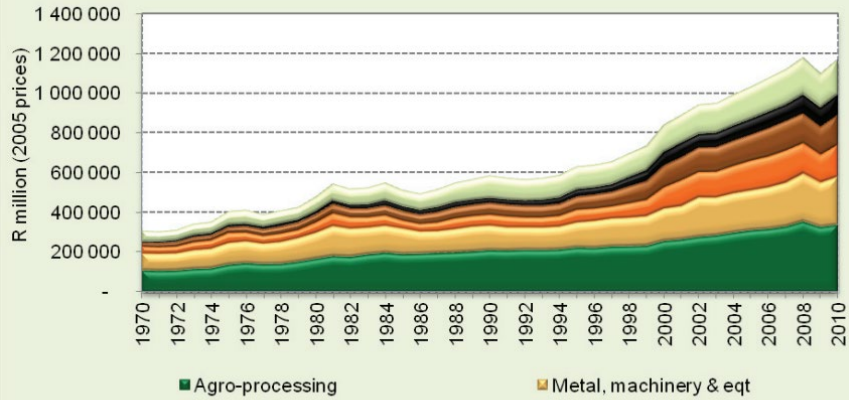


Figure 4: Real output by industries in the manufacturing sector (DAFF, undated)

[8] Department of Agriculture, Forestry and Fisheries, n.d. Introducing agro-processing: The status of the agro-processing industry in South Africa.
http://www.nda.agric.za/doaDev/sideMenu/AgroProcessingSupport/docs/Brief_introducting%20agro%20processing.pdf

to domestic fixed investment and export was 28,5% and 13,6%, respectively, during the same period. The agro-processing sector comprises of a highly diverse group of sub-sectors and industries. The major sub-sectors include: food processing, beverages, aquaculture, horticulture & medicinal plants, aromatics and flavourants. The impact of drought on each of these sub-sectors of agro-processing is experienced differently.

Agro-processing in South Africa is dominated by the food industry which, between 2006 and 2010, represented the largest proportion of output (42%). The sector is also critical in terms of foreign exchange earnings from export. Moreover, the food processing sector is now the largest manufacturing sector in employment terms with some 300,000 employees at a national level. Gauteng makes up the biggest contribution to this figure at 91 000 (in 2015), followed by the Western Cape (SAG, 2016). Therefore, there are distinct linkages to drought, not only through processing of food, but also due to the upstream linkages with agriculture. These impacts are felt within the broader fiscal balance of the country in addition to internal food security and employment impacts.

As a result of the drought, agri-businesses in South Africa have been particularly affected. For instance, a study was done on the economic impact of the drought on agriculture dependent formal and informal businesses in the Free State. These impacts were felt locally. However, for many businesses that export, the drought also impacted upon our foreign exchange earnings. The most affected businesses were agri-businesses and agriculture related businesses such as butcheries which use a lot of water for, inter alia, boerewors production, and fruit and vegetable businesses which use water for keeping vegetables fresh. Hlalele et al. (2016) conclude that the current drought has had significant adverse effects on agriculture dependent businesses. Hlalele et al. (2016) found that about 80% of the businesses lost above 50% of their employees due to the drought in the Free State. Moreover, about 87% of these businesses lost over 50% of their revenue.

Table 1: Employee and estimated revenue loss (Hlalele et al., 2016)

Employee loss since dry conditions started and estimated revenue loss (%)	Frequency of Employee loss	Frequency of estimated loss of revenue
20	2	1
30	2	1
40	0	0
50	3	4
60	2	3
70	0	4
80	0	2
90	0	0
100	6	0
Total	**15**	**15**

This brief especially considers the impact of the drought on the sugar industry, with a focus on the Amatikulu Sugar Mill on the KwaZulu-Natal North Coast between Durban and Empangeni. The supply chain for the sugar business starts with the supply of sugar cane as raw material. A large percentage of the cane growing land that feeds Amatikulu is not irrigated. Like any other crop, sugarcane is dependent on rain for growth. If rainfall is below average as was the case in 2016 (the lowest average in 112 years), sugarcane productivity is heavily impacted.

Sugar processing relies heavily on water for extraction of juice, steam production and other internal processes. Much as the process itself (within the factory fence) is a net water producer. Therefore, as a result of the sugar cane processing, water is generated as a by-product. At Amatikulu, 120 tonnes per hour of excess water is produced as effluent and is eventually used for irrigation on selected cane fields. During the drought however, operations had to stop completely as there was insufficient water to operate the mill. The river supplying the mill went completely dry meaning there was no input water. Areas that were affected and their respective processes included the extraction plant, boilers, cooling towers, and cooling water systems. There was also no water available for human consumption. The mill experienced a number of mechanical challenges which caused milling stoppages.

*According to Manqele et al. (2016), the direct effect of the current drought of on sugarcane production resulted to an estimated loss in gross revenue of **R2 billion** at industry level. On the other hand, the indirect and induced effect of drought on sugarcane production resulted to an estimated loss of revenue into rural economies of **R6 billion.***

The drought forced the mill to implement upon a number of short and longer term solutions to mitigate against the water shortage. These ultimately will have a positive effect on the water use efficiency of the mill. As a short-term response to the drought, about 8 boreholes were erected in strategic areas which were estimated to supply the mill with a minimum of 61m^3/hour of water. The mill also implemented water rationing (potable water) to consumers like the mill villages, primary school and four farms around the mill. Well points in river beds were installed to abstract water into the sugar mill. Water was also abstracted from two neighbouring farms with healthy size dams. Purified water was bought from commercial suppliers like Mandini Municipality, which is 24 kilometres from the mill costing about R4.2 million in months. The mill converted the 5,000 tonnes molasses tank into a strategic storage for water. The mill also installed an effluent pipe to recycle all the effluent back into the diffuser and as make up to the injection water cooling towers. Lastly, water was piped and pumped from nearby dams. These immediate and long term actions presented challenges like compromised quality of recycled effluent, condensate quality, and carry over into turbine control valves.

Conclusions:

A few observations of the impact of drought on the agro-processing sector include that drought impacts to the industry are often overshadowed by the impact of drought on the agricultural sector.

This is especially true when the agro-processing facility is situated in a rural area and therefore the water supply for processing is very small in comparison to irrigation needs. However, the water needs for agro-processing are more exact, with specific amounts needed at a particular quality and time. These needs are less flexible than irrigation, resulting in greater impacts being experienced by agro-processing facilities (such as shutting down processing for extended amounts of time). This challenge is mitigated when agro-processing industries are supplied by water through municipal supply. However, municipal supply also has its challenges such as leakages.

The agro-processing sector has been identified as a strategic sector for growth in South Africa, thus it is important that we recognise its particular sensitivity to drought. To better respond to the impact of drought on the sector, we need to better understand the full value chain of the agro-processing sector. In addition, although agro-processing has been lauded as a growth sector in South Africa, we need to be cognisant of the significant upstream water footprint it represents. Agro-processing requires a strong and healthy agricultural sector to support it with produce. If investing in the sector, we need to be aware of the climatic or political changes that may fundamentally shift the character of agriculture in South Africa.

4. Large and small businesses in urban areas

Title:

Drought and business: more action, less rhetoric

Summary:

- The story of the business sector and their water security is essentially the story of our urban water supply. Therefore, businesses are sensitive to drought, especially when key components of their operations are dependent upon water at a specific quality and time. However, some of the major water-related risks that businesses face are made worse by the poor functioning water supply systems we have. This is especially true in smaller municipalities. Although businesses (especially large business) has vocalised their concerns regarding water, there have been limited examples of active measures put in place to mitigate these risks.
- Businesses sit at the interface of the water value chain and a particular products' supply chain. Depending on where they sit, their risks are distinct. Therefore, it is not only about the water supply to a single company, but also the water supply to their labour, their customers and the community in which they are situated. Water and business is more than purely water for inputs. This is why businesses need to be good water stewards, and consider their role in water outside of just the factory fence.

Recommendations:

- We need to better understand our businesses and the risks that they are facing. There are currently initiatives underway, such as the CDP Water questionnaire. These are focussed at large businesses however. The Ministry of Small Business Development needs to consider an analysis of the water-related risks of small business as a core component of their activities going forward. This will ensure that small business does not suffer as a result of drought when mitigating activities could be put in place beforehand.
- We need to interrogate the response of government to businesses that have tried to increase their efficiency. This is because, during times of drought, when a blanket reduction of water usage is effected, those that are the most efficient are impacted the worst. This is a perverse outcome which does not support the right behaviour. We need to consider how to take into account good actions that companies undertake before a drought comes into effect.

Main text:

"Businesses", both large and small, are difficult to segregate into a specific sector. In this brief, we have considered the business sector as businesses that are using water within a city or small town. Therefore, their water usage is considered urban in nature. These can be for a broad range of activities. As a result of the drought, businesses in South Africa have been affected. Agro-processing businesses in particular, but also businesses in towns or cities that do not have secure access to water to carry out their operations. Insights into the impact of the drought for business are separated into large and small businesses, as they have different risks and impacts because of the drought in South Africa.

The national development plan articulates the important role of small businesses and cooperatives in achieving inclusive economic growth, and that these small enterprises are key to achieving the plan's job creation target for 2030. According to the Finscope Survey 2010, South Africa had 5 979 510 small businesses; over 60% of the owners had less than a matric certificate, whilst 58% of small

business owners were women. Most small businesses, according to the Finscope Survey, are informal SMMEs (Amra et al., 2013).

The impact of drought on the sector is dependent on the importance of water for various types of small businesses. For small businesses that are particularly dependent on water for operations, water restrictions (or disruptions in the supply of water) could impact on revenue and income. Over time, the viability of businesses may also be threatened. The types of businesses that may be most affected by droughts include food businesses, hairdressers and car washing businesses.

There are a few studies on the impact of drought on small businesses. One study was conducted on agriculture-dependent small businesses in the town of Thaba Nchu, where most small businesses surveyed were in the informal sector, and had a turnover of less than R50,000 per annum (Hlalele et al., 2016). The study found that butcheries use a lot of water for production purposes (including boerewors production), while fruit and vegetable businesses use water for keeping vegetables fresh. Respondents indicated that the drought negatively impacted on their businesses; for instance, vegetables withered due to lack of water. 87% of businesses reported losing over 50% of their revenue due to the drought (Hlalele et al., 2016). There is also anecdotal evidence of the impact of drought on small businesses. For instance, newspaper articles cite businesses on the East Rand reporting losing clients due do water shortages[9], while guesthouse owners in Bela-Bela[10] also reported that they have been impacted. More comprehensive studies on the impact of water shortages on small businesses are required.

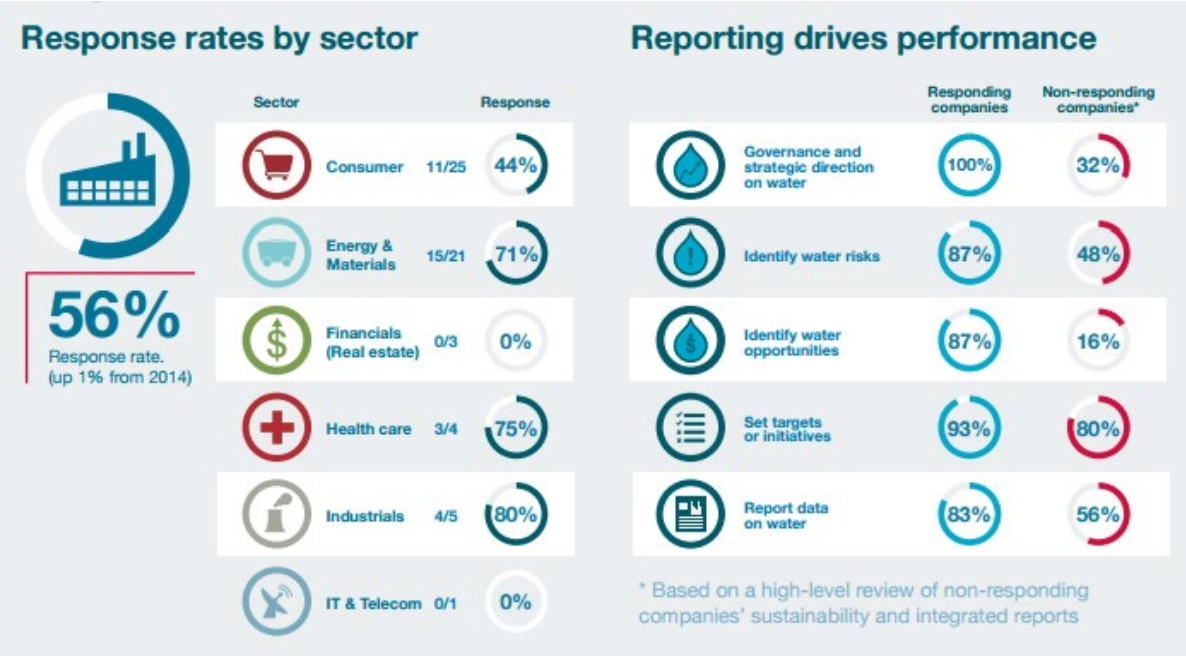
Although the small-businesses sector was negatively impacted by the recent drought induced water shortages, details of the specific impact on depend on the business in question. A grocery operator interviewed stated that the impact of the drought was mainly experienced in the ablution facilities where there was no adequate water. The facility could only deliver poor service and this negatively affected customers and staff. As a short-term response, the grocer bought a 2,000 litres Jojo tank. The taxi operator stated that the impact of the drought was mostly felt on the customers. Since they did not have money to afford taxi fares, there were very few customers asking for a ride (business was very poor). The lack of water also had an impact on sanitation: it was not possible to wash and keep clean the taxi, which negatively impacted on business. The small-scale fashion designer stated that a consistent water supply was fundamental to its core business, which involves ironing and washing. Since water was in short supply, they had to fetch it from a stand pipe tap located a 5-minute walk distance as a short-term response. However, the queue at the stand pipe lasted for about 30 minutes, thus wasting business time. The fetched water was not sufficient for bathing, drinking, cleaning, cooking for the 4 employees, activities they needed to do in the course of routine business. Thus, the business to make trade-offs: employees had to stop bathing at work, with the saved water used for cleaning the business premises.

The impact of the recent drought on large businesses in South Africa has also been severe. The following are excerpts from the recent CDP report on water in South Africa. “The analysis of the 2015 CDP water data shows that 83% of respondents report that their direct operations are exposed to water-related risks, the highest of any sample in the world, with more than half of these risks expected

[9] http://www.news24.com/SouthAfrica/News/east-rand-businesses-hit-hard-by-water-shortages-20151111
[10] https://www.enca.com/south-africa/drought-hits-tourism-bela-bela

to manifest within the next three years and with two thirds of those risks having a financial impact of medium to high. Furthermore, 70% of responding companies experienced detrimental water impacts in the reporting year (2015), with the next most impacted sample being Switzerland at 50%."[11]

There are a diverse number of sectors reporting on their water-related risks. There are also a number of areas that companies are focussing on in response to their recognition of water risks. This however, does not seem high enough considering the recognition of water-related risks. "When companies do respond to CDP, they find and disclose severe, urgent water risk and advocate for action. Yet we see very little uptake of water reporting and water management by non-responding companies and the response rate remains largely unchanged at 56%. It is of serious concern to us that the recognition of the critical need to carefully and proactively manage water risk in South Africa appears to be limited to a small group of companies. In particular it is inexplicable that while CDP responding companies who carefully assess water risk and conclude that it is a significant near term risk, many other companies outside the CDP reporting net appear to remain disengaged."[12]



Conclusions:

We require more research and understanding regarding the inputs needs of our businesses. This obviously includes the key input of water. This understanding needs to be compared with the water system in which the business is located. For instance, some businesses may receive water through municipal infrastructure, while others supply their own water. Depending on where water is received, the risks associated with drought are distinct. It is also critical that the small vs. large business

[11] http://www.nbi.org.za/wp-content/uploads/2016/06/Executive_Summary_CDP_South-Africa_Water_2015.pdf

[12] http://www.nbi.org.za/wp-content/uploads/2016/06/Executive_Summary_CDP_South-Africa_Water_2015.pdf

distinction is made both in terms of the risks being faced, but also in terms of the possible response options that may be relevant.

We need to promote good water stewardship among the businesses of South Africa. This may include helping businesses consider their role in the water system beyond purely their operational needs. Each business represents a number of employees, customers and a community in which they are situated. All of these people require secure access to water for their business to thrive. Therefore, business should consider their role in supporting good water management as a long-term strategic investment into their business. No single business can do this alone. Coming together is of paramount importance.

5. Mining

Title:

Mining, mining everywhere and not a drop to drink.

Summary:

The recent drought saw many articles mentioning the impact of the drought on the mining sector of South Africa. This is especially true for the coal sector. As a country were mining is the most important sector to our economy, this is especially important. However, there was limited quantitative information is available regarding the direct and indirect impacts of water challenges for the mining sector and economy more broadly.

Recommendations:

- The mining sector needs to become less secretive on its water needs and how drought may affect the sector.
- The water sector needs to have a better grasp on the economic impact of mining impacts on water quality. This includes Acid Mine Drainage.
- Research is required on the impact of poor water quality on the sector that are using degraded resources. Research is also required so that the impact of mining in degrading such water resources is possible.

Main text:

The mining sector of South Africa, our economic powerhouse, did not escape a drought untouched. The South African mining industry contributed about 7.6% to the gross domestic product, supporting about 1.4 million jobs in 2014 (CMSA, 2015). The mining sector is broadly classified into open cast and deep mining. Open cast mines refers to extraction of minerals which are fairly close to the surface. Deep mining is also referred to as underground mining. A major decision to operate by means of underground mining rather than open cast is the strip ration or the number of units of waste material in a surface mine that must be removed to extract one unit of ore. The two kinds of mines produce a variety of rock residuals. Both mines could be affected by drought induced water shortages. Mines dewater, and use water for transporting extracted material, facilitating separation of minerals from waste material, transporting and storing tailings, supressing dust, and in other associated industrial uses such as cooling power systems and washing equipment.

In South Africa, mining uses about 3% of the total country water (Turton, 2008). Although mining utilises little water (relatively), sufficient water supply is critical to sustainable future mining activity. Shepherd (undated) indicates that water has become a key risk for mining companies in South Africa. The Stats SA (2009) water accounts reveal that gold and uranium were the biggest water users, followed sequentially by chrome, manganese, other metal ores, platinum group metals, iron ore, and finally coal. Shepherd (undated) shows that severe water shortages result in the cut back of mines on the processing rates of their concentrators, which could lead to a reduction of tonnages processed or even the closure of some concentrators for short periods. Mines are vulnerable to drought to the extent that mines compete with other sectors of the economy for water, and authorities are likely to ask mines to cut back on usage of water before they ask communities to cut back (Shepherd, undated).

In general, mining is mostly considered with respect to its impact on water quality. During a drought, these impacts are further compounded. Pollution because of mining has been identified as one of the major pressures affecting our water resources in South Africa. Mine water negatively impacts water increasing the levels of suspended solids, leading to mobilization of elements such as iron, aluminum, cadmium, cobalt, manganese and zinc and decreasing pH of the receiving water. During drought conditions, these impacts are exacerbated due to the reduction in dilution factor due to lower water levels[13]. In the mining areas around Johannesburg the polluted groundwater discharging into streams in the area contributes up to 20% of the stream flow. The effect of the contaminated water from the mines can persist for more than 10 km beyond the source.[14]

All South Africa's nine Water Management Areas experienced a drop in river health between 1999 and 2011, as shown in the map. The Limpopo Water Management area experienced the most dramatic fall, with its Ecological Condition Index (ECI) dropping by 21 points, from 83 in 1999 to 62 in 2011. Research suggests that increased pressure from mining activities and agriculture in that region, as well as poor waste water management, contributed to the decline.

The direct costs of drought on the mining sector are multi-fold, including production decline, revenue losses, and increase costs for water treatment. Moreover, the drought induced water deficiency can indirectly affect workers' quality of life, lead to unemployment, starvation, disease, and risk of conflict, all triggering humanitarian and human development concerns. A decrease in water supply resulting from drought can lead to a limited market supply of minerals, thus directly impacting their market prices. The domestic market developments might also have repercussions for international trade and exported or imported quantities. The above direct costs associated with drought represent costs for the mining sector. However, there is even less clarity regarding the indirect costs of poor water quality, because of mining, compounded by the drought. For many sectors, such as urban or rural water supply, or irrigation, clarity regarding the increased costs they are likely to face because of the drought and mining pollution is critical. For many of these businesses, increased operating costs to treat water will take them out of the production.

An example of the impact of drought on the mining sector: At the Richard's Bay Mine (RBM) in KwaZulu-Natal, water is obtained from three sources namely Umfolozi River (sporadic), Lake Nhlabane (main source) and Lake Nsezi, which is fed by the Tugela-Goedertrouw Transfer system and managed by Mhlathuse Water Board. From the beginning of the drought in 2014 till recently, RBM solely relied on water from Lake Nsezi as the other two sources were too low to use. RBM uses water throughout its operations from the mining process for separation of heavy minerals and the beneficiation process.

[13] *Impacts of mining on water resources in South Africa: A review (PDF Download Available)*. Available from: https://www.researchgate.net/publication/228513226_Impacts_of_mining_on_water_resources_in_South_Africa_A_review [accessed Mar 29, 2017].
[14] http://aidc.org.za/coal-key-resolving-drought-not-wet-wipes/

However, because of drought, new investments are also made, which are ultimately a positive impact. In the same region as RBM, a newly-opened R74m desalination plant allows South32 to maintain operations at its Hillside Aluminium Shelter Complex during drought, which resulted in the implementation of stringent water restrictions in the Richard Bay domestic and industrial sector. Desalinating seawater was identified as the preferred alternative as it will supply adequate water to ensure operations are maintained and it will also be able to supplement the municipality water supply in times of critical shortage (South32 president for South Africa region, Mike Fraser).

There may however be positive impacts of water stress and drought on the mining sector. The following is an excerpt highlighting the responses that some mines have undertaken as a result of water shortages: "Sibanye Gold is one of South Africa's most profitable mining companies, an achievement they manage to combine with a reputation for taking their social responsibilities seriously. Using an innovative water treatment process – Crystalactor® technology – it is producing potable water which not only supplies the mine's water requirements, but can eventually supplement the local water supply thus alleviating water stress in surrounding communities. The Crystalactor® cost-effective water solution with low operational and maintenance costs resulting in a significant cost saving to the mine. This technology allows the Sibanye Gold mine to treat and re-use mine water at approximately half the cost of drinking water from the local water supplier, Rand Water."[15] Therefore, mining companies can have a positive impact on communities while securing their long-term sustainability in terms of water.

Conclusions:

If the impact of drought on the mining sector is real, then we need to properly quantify this impact. Perhaps, by knowing the true economic impact of reduced mining profitability compounded by reduced water quality levels, we may be able to make the economic argument for increased regulation and investment in improving water quality.

[15] https://www.royalhaskoningdhv.com/en-gb/blog/water/de-stressing-water-shortages-in-south-africa/6508

6. Water Quality

Title:

Water quality: a major challenge exacerbated by drought and very poorly understood

Summary:

- The shortage on information regarding water quality in South Africa is astounding. Firstly, in terms of the relationship between drought and water quality, and secondly in terms of this in relation to economic impacts.

Recommendations:

- We need to better understand the relationship of water quality, drought and our economy so that we can create an economic argument to improve regulation and implementation of the legislation that already exists in South Africa.

Main text:

The economic impacts of drought in relation to water quality are under-researched and difficult to quantify, not least because of insufficient research on the economic impacts of deteriorating water quality even in the absence of drought. Secondly, understanding the impacts of drought on water quality is extremely complex, and again, under-researched in the South African context. The complexity is partly due to the number of variables to be considered in water quality, including dissolved oxygen, nutrients, sediments, dissolved organic carbon, pH, metals, organics and ecology.

In general droughts, and the wetter period immediately after a drought, tend to have profound water quality effects, with the actual effects dependent on the characteristics of the water body and its catchment (Mosley, 2015). Work done by Mosley (2015) in Australia showed that reduced water flow and volume during drought generally resulted in increased salinity because of reduced dilution and increased concentration. Increased temperatures and enhanced stratification resulted in increased algal production, more toxic cyanobacterial blooms, and lower dissolved oxygen concentrations. On the other hand, nutrients and turbidity often decreased in water courses during droughts because of reduced loads from agricultural sources. Point sources of pollution generally showed deterioration in water quality due to a lowered dilution factor (Mosely, 2015). In addition, however, post drought floods can result in pollution spikes, due to storage and build-up of material and changed geochemistry (such as sulphide oxidation) during drought. In some cases, Mosley notes, this resulted in severe downstream impacts such as deoxygenation. A study on Flag Boshielo Dam (Dabrowski et al., 2014), showed that during a severe drought between November 2002 and December 2005, water quality deteriorated, with high levels of dissolved salts, especially K, Na, Cl, F, and total alkalinity. Following the drought, dissolved salt concentrations dropped, and there was a short flush of inorganic N and P.

There is little research in South Africa on the water quality impacts of drought. Initial investigations by Andrew Slaughter (Institute for Water Research, Rhodes University) of three sites in the Crocodile Catchment indicate a complex water quality response to drought, depending on the land-use upstream of the monitoring point. His investigations, which are in an early stage and are not for publication yet indicate that the issue of drought impacts on water quality is complex and site specific.

His findings thus far show that deterioration in water quality has significant, if insufficiently quantified impacts:

- it reduces the amount of water available for use as more water must be retained in our river systems to dilute pollution to acceptable standards;
- it increases the costs of doing business as many enterprises are forced to treat water before being able to use it in their industrial processes and the cost of municipal water treatment increases;
- it reduces economic productivity as an increased number of work days are lost due to water-related illnesses and as poor water quality reduces productivity in certain sectors (e.g. poor water quality impacts on crop yields and makes crops vulnerable to import restrictions from countries with strict quality standards; and on recreation and tourism);
- it threatens human health and livelihoods where people are exposed to poor water quality for consumptive or domestic usage; and
- it has environmental implications where biological and chemical contamination of water can impact on important aquatic species.

Some of these impacts are clearly visible, such as major fish kills, whilst others are more insidious and long term. Combined, however, they are already having a significant negative impact on socio-economic development in South Africa.

The following examples indicate how poor water quality has economic impacts across a range of sectors:

- A study conducted by Dearmont et al. (1998) on the impacts of water quality on municipal water treatment costs revealed that that when chemical contamination was present in groundwater, the chemical cost of water treatment rose by $95 per million gallons from a base of $75. In other words, the cost more than doubled. A 1% increase in turbidity was shown to increase chemical costs by 0.25%.
- In Harare, the cost of pollution led to a doubling of expenditure on water treatment chemicals due to severe contamination of most of the city's water sources.[16]
- Researchers from Kansas State University in the USA estimated that pollution of fresh water with agricultural nutrients costs government agencies, drinking water facilities and individual Americans at least $4.3 billion a year in total. They calculated this cost by looking at factors such as decreasing lakefront property values, the cost of treating drinking water and lost revenue from reduced recreational activities.[17]
- In the agricultural sector, deteriorating water quality impacts on crop yields: for example, heavy-metal pollution can not only result in lower plant growth rates (ranging from 13% to 70%), but also in a decrease in the yield of wheat (40% to 83%) (Athar and Ahmad (2002)). It also impacts on long-term soil productivity through, for example, salinization of land, and, critically, on export of crops where irrigation water quality does not meet the stringent standards of the EU or the USA.

[16] https://www.newsday.co.zw/2015/06/29/pollution-doubles-water-treatment-costs/
[17] http://www.alternet.org/story/108856/how_much_does_it_really_cost_us_to_clean_up_our_waterways_from_farm_runoff

- Farmers risk losing contracts with international clients because of poor water quality. In 2012, it was reported that water pollution was “a growing threat to the livelihood of emerging tobacco farmers in Groblersdal, as this affects the contracts the farmers have with British American Tobacco”. The farmers claimed that their previous year’s crop had been rejected because of “chemical residues on the tobacco leaves”. In 2014, it was reported that the European Union had given a final warning that it would “stop imports from crops irrigated with water from the Olifants because of the level of health-threatening pollutants from mines seeping into the river”. Later that year, the non-profit Bench Marks Foundation released a statement about the impact of poor water quality on the economy, saying that farming exports were “affected by the influx of collieries with many vegetable farmers downstream from the mines in the Kendal Ogies area losing European clients due to the bad quality of water used for irrigation” (CER, 2016).
- In the tourism sector, water pollution may cause loss of wildlife sanctuaries and degradation of protected areas, fish kills, health impacts for tourists, and visual impairment of water resources, discouraging tourist activity in affected areas. It is estimated that the U.S. tourism industry loses close to $1 billion each year, mostly from losses in fishing and recreational activities because of nutrient-polluted water bodies. In the Philippines, tourism losses due to water pollution represent around 70 percent of the total US$ 1.3 billion annual economic losses from water pollution (WB, 2003).
- More broadly, in the South African context, the direct and indirect costs of contamination in the form of salinisation in the Middle Vaal River, which is an area with particularly high urban, mining and industrial pollution, were estimated by Urban Econ in 2000: it was estimated that direct costs of R80.5 million per annum would be saved if levels dropped to 200 mg/l TDS while increasing salinity to 1 200 mg/l TDS would increase salinity-related costs to R183 million. (Nieuwoudt et al., 2004).

The above examples are indicators of real financial impacts to the economy as a result of poor water quality. There may also be impacts that are not direct financial amounts, but also have an impact on the economy. For example, diarrhoeal disease causes an estimated 3.6 % of the total disability-adjusted life year (DALY) global burden of disease and results in the deaths of around 1.5 million people each year (WHO 2012). Estimate are that 58% of that figure, or 842 000 deaths per year, results from unsafe water supply, sanitation and hygiene. This includes the death of 361 000 children under the age of five, mostly in developing countries (WHO 2014). Poor water quality increases the incidences of water borne diseases, resulting in costs to households in medical treatment, and lost working days, costs to the public and private health care systems, and costs associated with deaths from water borne diseases. For example, in 2005, an outbreak of typhoid in Delmas resulted in five deaths, 596 cases of typhoid and by 3,346 cases of diarrhoea. In 2003, nearly 4000 cases of cholera were reported in South Africa. A recent WRC study shows cholera, shigella, salmonella and other harmful viruses and bacteria at every sampling point on the Umgeni River between the Inanda Dam and Blue Lagoon in Durban. In June 2014, three babies died in Bloemhof from drinking contaminated water.

Conclusions:

In summary, very limited work has been done on the economic impacts of deteriorating water quality and drought in South Africa, either in specific catchments or at a national level. The relationship between water quality and drought is still not well understood. A research question then

arises as to what are the economic costs of deteriorating water quality attributed to drought or at least during dry years? In addition, emerging research indicates that pollutants have different impacts on women and men, and this is an area where significantly more research is needed to ensure the protection of both women and men from water pollution.

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