

Article

Water Sustainability of Selected Mining Companies in South Africa

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Abstract: Many parts of the world, and South Africa specifically, are facing a water crisis, not only because of the scarcity of water, but also the quality of the available water. Apart from agriculture, industry is viewed as the second largest user of water and can, therefore, have a significant impact on the saving of water. The purpose of this research is to investigate how selected South African listed mining companies are measuring, managing, and disclosing their water risks, as well as engaging with stakeholders. The selection of the mining companies was made using the companies with the highest market capitalisation figures of those that have a primary listing on the Johannesburg Stock Exchange (JSE). The sustainability/integrated/annual reports for 2013 were reviewed using the Ceres Aqua Gauge™ (Boston, MA, USA) as the framework. The findings of this research were that the selected mining companies had grasped the seriousness of the water crisis in South Africa, and the effects it will have on their businesses in future. Most concerning was the activities relating to water management in the supply chain; all of the selected mining companies were found to have no evidence of this in their reports, subsequently this is an area that needs to be addressed in future research.

Keywords: water sustainability; South Africa; mining; Ceres Aqua Gauge™; measurement; management; engagement; disclosure; water risk

1. Introduction

Water is an irreplaceable resource that is vital to human life and is rapidly becoming one of the scarcest and most sought-after resources worldwide. In 2009, the global use of water by sector was 70% by agriculture, 20% by industry, and 10% for domestic use [1]. What makes the water scarcity problem more complex is that it is often not clear as to who is accountable and to what extent. The responsibilities of both consumers and companies go well beyond their own direct water consumption and pollution. This is why it is important for companies to look further than the water use in company operations, by considering, for instance, water use in their supply chains [2].

Companies can arguably transfer resources more quickly than governments; they have more influence than individual citizens and can impact supply chains beyond their corporate borders. However, companies use vast amounts of water and will continue to do so since they have the necessary resources [2].

1.1. The South African Perspective

South Africa is currently in the grip of the worst drought in decades. In 2015, the lowest rainfall levels were recorded since 1904 when the recording of rainfall levels first started [3]. South Africa's rainfall

levels are approximately 50% of the world average; 80% of the rainfall occurs within a period of five months, and the country's rivers have a high rate of evaporation as they are small and shallow compared to rivers in other countries [4]. The latter motivates the reason to conduct research on South African companies' water usage, as the country may already be disadvantaged by its short rainfall season.

It is envisaged that South Africa will be facing a shortfall between water supply and demand of 17% by 2030. Even though this shortfall is significant, it is likely to be an underestimate as it excludes uncertain impacts of climate change and the declining water quality in the country. Because of this estimated shortfall, businesses will need to anticipate disruptions in water supply, and face higher water bills and more stringent water regulations [5].

South African companies could be facing a number of serious challenges, and, in the future, these challenges could include water shortages, poor water quality, and an ageing water infrastructure. Therefore, the objective of this research is to establish to what extent the selected mining companies are recognising the importance of water in their businesses and whether they are showing a commitment to combat the issue of water scarcity in South Africa.

1.2. The Mining Perspective

The mining sector was selected for this article since South Africa is synonymous with mining. Mining has played an essential role in South Africa's economy over the past 100 years. In 2015, the mining industry contributed R286 billion towards the South African Gross Domestic Product (GDP), representing 7.1% of the overall GDP. R89.4 billion from mining directly contributed to fixed investments in 2015, R3.7 billion in royalties, and R12.5 billion in taxes were paid to the South African government in 2015/2016. These funds are used to improve the infrastructure and lives of the country's citizens. Mining in South Africa is also a substantial contributor to employment with 457,698 people directly employed in the mining sector in 2015. Additionally, it is estimated that every mining employee supports between 5 and 10 dependants; therefore, indirectly the mining industry supports approximately 4.5 million people [6].

South Africa has the fifth largest coal deposits in the world, and, in 2006, coal accounted for 93% of electricity generated in South Africa. Furthermore, South Africa is also the number one supplier of platinum and one of the top five producers of gold in the world [7].

From the above it is evident that the mining sector is vital for South Africa and its people, therefore, this article investigated the contribution of the mining sector towards the safe guarding of water, as a critical resource in the country.

When compared to other industries in South Africa, the mining industry does not consume large quantities of water, as is evident from Figure 1. However, the effects of mining activities on water quality can be substantial. Contamination of water resources has the effect that there is less water available for human consumption and large amounts of money have to be spent to recycle and purify contaminated water [8].

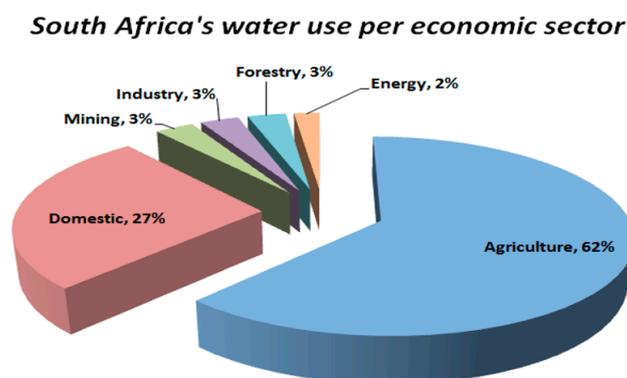


Figure 1. South Africa's water use per economic sector [9].

South Africa has almost 6000 abandoned mines, of which many contribute to uncontrolled acid mine drainage (AMD). The South African government and South African taxpayers are bearing the cost to treat the AMD in the Witwatersrand area where gold mines have closed down and little or no provision has been made to treat the ground water flowing into the old mine shafts. AMD water has already discharged and contaminated springs and rivers [7]. Closed mines should be pumped and treated indefinitely to prevent contamination of surface and ground water, which can cause major long-term environmental liabilities for mining companies [10].

Mining operations usually cannot be relocated, making the sector susceptible to changing local water availability and community concerns about water use. Unlike the manufacturing sector, mining operations depend on the location of ore and cannot change their locations to mitigate or adapt to regional water scarcity or water quality impacts. The mining sector also produces significant amounts of wastewater related to ore mining and refining. Mining operations may be disrupted by severe rain or flooding, and climate change is expected to increase the frequency and severity of such extreme weather events. Mining companies use water during raw material production and other direct operations. The withdrawal of water is used for dust control; drilling; as slurry in the transportation of products; and during direct operations when freshwater is consumed for cooling, boiler and rinsing activities. Waste through discharge of water is high when runoff and wastewater containing dust, sediments and metals, and toxic chemicals occur. Drainage water from mines also requires treatment before discharge takes place. Wastewater generation containing heavy metals and other potentially toxic chemicals are also part of the direct operations of mines [11].

1.3. Theoretical Foundation

Stakeholder theory's basic premise is that a company's success is dependent upon the successful management of all the relationships with its stakeholders and without the support of these groups the company would cease to exist [12]. Stakeholder theory is one of the key approaches, if not the most commonly used, in social, environmental, and sustainability management research [13,14].

Stakeholder theory suggests a way to address the ever varying demands brought about by different groups having legitimate stakes of changing degrees on the company during uncertain times. These characterise the dynamic nature of the business environment of today [12]. Stakeholders include amongst others: shareholders; employees; customers; local communities; government and local authorities; suppliers; and NGOs.

Social responsibility acknowledgement indicates that a company recognises the fragile relationship between itself and its stakeholders. By being socially responsible, a company should keep its stakeholders informed. This goal can be attained by means of increased environmental disclosure [15].

There has been increased pressure on companies to move away from stand-alone financial and sustainability reports towards a more integrated approach. Some companies started voluntary publishing sustainability reports, yet these reports lacked reporting standards. This lack of standards led to the formation of the Global Reporting Initiative (GRI) in 1997 [16]. In South Africa, enforced integrated reporting in compliance with the King III Report across all listed companies was introduced in 2010 by the JSE [16].

A qualitative research choice was used in this study. Nine mining companies specifically with a primary listing on the JSE were selected. The sustainability/integrated/annual reports for 2013 were reviewed using the Ceres Aqua Gauge™ as the framework.

The premise of this research is that the selected South African mining companies have not realised the seriousness of the water crisis in South Africa, and the effects it will have on their businesses in the future. This research will evaluate which activities the selected mining companies are undertaking to alleviate water risks for their products, operations, supply chains and stakeholders. The evaluation will also include how the companies are measuring, managing, engaging with stakeholders and disclosing this scarce resource, being indicative of the stakeholder theory.

The remainder of this article is structured as follows: Section 2 provides a literature review covering the main drivers of water risk in South Africa, the importance of water in the mining sector, and similar research conducted from a global and South African perspective. Section 3 discusses the research methodology, while Section 4 presents the research findings. Section 5 provides conclusions and Section 6 recommends directions for future research in this area.

2. Literature Review

The literature review focuses on the main drivers of water risks in South Africa, the importance of water sustainability in the mining sector, and facilitating the protection of South Africa's water sources. The literature review concludes with a discussion of two previous studies conducted in the mining sector, setting the foundation for the research reported on in this article.

A considerable number of South Africa's key economic activities occur in areas where water availability is limited and the declining of water quality which includes AMD, is an additional concern. Poor municipal management and deteriorating infrastructure increases the risk of unreliable water supply and inadequate quality. These challenges have potential supply and financial impacts on business [5]. As much as 30% of South Africa's water source areas overlap with coalfields. Even more concerning is that more than 50% of Mpumalanga (a province in the northeast of South Africa) is under either a prospecting or mining licence for coal. Arguably, this state of affairs could result in widespread AMD pollution [17].

Accordingly, companies may need to be aware of external risks that could affect their current and future operations.

2.1. The Main Drivers of Water Risk in South Africa are [18]:

- lack of water resources;
- water quality constraints;
- climate change;
- demographic changes;
- unsustainable land use practices; and
- governance and institutional challenges.

These drivers are discussed in more detail in the following subsections.

2.1.1. Lack of Water Resources

It may be critical to view water differently to e.g., carbon or any other natural resource for several reasons. Firstly, the short- and long-term future availability of water is uncertain as water's availability is variable in time and space [19]. Secondly, water is a finite, yet renewable resource. The availability is physically inhibited by the infrastructure availability and legally constrained in many places by intricate historical water rights systems. Thirdly, it is also non-substitutable, and while there may be a substitute for carbon in energy production, only water can be used for drinking and irrigation. Fourthly, since water is bulky and costly to move in volumes that are typically required for production, it is essentially a regional resource. Finally, water is fundamental to life, human dignity, and all ecosystems [19]. Having access to water is a universal human right and is crucial to leading life with dignity; simultaneously, water security is vital in the mining industry. Therefore, the operational requirements of mining and the human rights of the local community in which the mines operate intersect in complex and sometimes conflicting ways [20].

As an example of insecure supplies of water in South Africa relating to the mining sector, Anglo American was unable to mine a rich seam of platinum in the Limpopo Province owing to the lack of water in the area [21]. The Waterberg region in Limpopo has 40% of South Africa's coal resources, yet the scarcity of water in the area could prove the main restriction to mining these resources. Meeting

water demand for power generation is likely to be a significant challenge as much of the additional power capacity will be generated from coal [5].

2.1.2. Water Quality Constraints

Poor water quality in South Africa is mainly caused by city and industrial effluent discharge into river systems, poorly maintained waste-water treatment works, salinity from irrigation return flows, acid mine drainage, and inadequate sanitation amenities in informal settlements [18]. Furthermore, poor water quality has major consequences for businesses because of increasing treatment costs. The health of workers can also be negatively impacted by drinking poor quality water, which in turn, affects the productivity of labour-intensive operations such as mines. South Africa's municipal infrastructure has not kept up with growing populations, and this together with inadequate investment in maintenance, have resulted in higher levels of water pollution [18]. In total, 2×10^9 kg of sewage and other effluents drain into the world's water every day, and in developing countries, 70% of industrial waste is dumped untreated daily [10]. It may, therefore, appear that not only is the lack of water a risk to companies, but also the poor quality of available water.

2.1.3. Climate Change

Climate change is expected to intensify the risks associated with water scarcity and quality. Water is the principal medium through which climate change will affect ecosystems and, in turn, people's livelihoods, and wellbeing [18]. The impact of climate change on South Africa's water is already felt in the form of changes in rainfall and in the severity and frequency of flooding and droughts [5]. There are a number of ways in which climate change can affect the mining industry, for example, mining is reliant on expensive equipment and complex infrastructure which can be affected by a changing climate. The efficiency of major equipment can be reduced by increased temperatures, which in turn may require additional and unplanned capital expenditure. Increases in temperature, changes in rainfall and droughts could affect post-closure activities of mines which include the rehabilitation of the mined area and long-term water quality monitoring. Mining companies should be responsible for preventing AMD which includes post-closure water pumping over long timeframes, exceeding hundreds of years as argued by Mine Environment Neutral Drainage Program (MEND); and Murphy and Caldwell cited by [22].

2.1.4. Demographic Changes

Demographic changes in South Africa will present both business risks and opportunities. The demographic changes will come about from an expanding middle class, in which urban areas will be the most affected. Future household water demand is expected to grow from 2.1 billion m³ per year in 2005 to 3.2 billion m³ by 2030. Furthermore, industrial use is expected to increase from 1.5 billion m³ per year to 3.5 billion m³ in 2030 [18].

2.1.5. Unsustainable Land Use Practices

Unsustainable land use practices in South Africa are a major threat to ecosystems, and the livelihood of local communities and business. Invasive alien trees are said to consume more than 7% of South Africa's available water resources and in some catchment areas, this figure could even be as high as 20%. As invasive alien trees can consume between 7% and 20% of South African water, the removal of these trees may be a significant contributor to saving water, which companies can become involved in [18]. This initiative may not just be for the forestry and paper industry, but for all sectors where alien trees have been identified during their respective operations.

2.1.6. Governance and Institutional Challenges

Compliance, monitoring, enforcement and infrastructure maintenance are all the responsibility of local authorities. However, in South Africa, they often lack the skills and capacity to execute their duties. Furthermore, failing wastewater treatment works resulting in raw sewage leaking into river systems are the main contributors to water pollution. The lack of qualified municipal engineers in South Africa, and the long-term planning capacity to maintain and upgrade water infrastructure are all major risks [18].

With the introduction of the integrated water resource management (IWRM) principles this has resulted in changes to South African legislation which has necessitated new approaches to water management by mining companies [23]. IWRM influences water pricing; provides for water pollution charges; prioritises water users; has detailed mining and water-related components; and requires water licensing as part of the license to mine. These IWRM principles have altered perceptions of the value of water in the mining industry by increasing awareness that water resources and the management thereof are crucial for economic productivity and growth [24].

2.2. The Importance of Water Sustainability in the Mining Sector

Water plays a vital role in the mining sector as it serves as an industrial input when mining for metals and minerals. Therefore, water can cause a great deal of conflict between mining companies and local communities. For open-pit mining methods, which are used in most large-scale mining operations today, water is used as a cooling and lubricating agent for cutting and drilling machines; the transporting and processing of ore; managing waste tailings; and suppressing dust [10]. Acid runoff, coal sludge spills or cyanide can severely affect freshwater resources. Closed mines should be pumped and treated indefinitely to prevent contamination of surface and ground water, which can cause major long-term environmental liabilities for mining companies [10]. Another problem with AMD is that the contaminated water decants from the lowest surface opening of a mine. AMD can surface not in close proximity to the responsible mine making it difficult to predict where and when the AMD will ultimately surface, illustrating another part of the AMD problem [25].

Four areas of risk that are linked to water have been catalogued and have been adapted by the Chartered Institute of Management Accountants [21,26]:

1. *Financial risks:* Companies could be expected to pay for the water treatment costs and the cost of continued pumping of unused mines.
2. *Physical risks:* These include limited water availability, poor quality, supply chain impacts, flooding, wastewater discharges, and groundwater contamination.
3. *Reputational risks:* An example of this would be lawsuits by local communities for polluting their drinking water, thereby damaging the mining company's image.
4. *Regulatory risks:* The government could impose new permitting standards or more stringent wastewater standards. It may, therefore, be necessary for companies to conduct risk assessments that identify and quantify water-related business risks.

The above risk areas could be used to assess which business risks mining companies may face as a result of AMD.

In order to establish reliability and validity for this research, and to have research to compare with and differentiate against, two similar research studies will be discussed next.

2.3. Findings of Two Previous Studies Conducted in the Mining Sector

2.3.1. The Carbon Disclosure Project (CDP) South Africa's Water Report [5]

In 2010, the CDP launched its water programme, known as the CDP Water Disclosure. It offers international and South African companies the opportunity to publicly report on how they are managing their water risks, taking advantage of opportunities, and contributing to the overall

management of the earth's freshwater resources. South Africa is one of the first countries to take part in the CDP's water information request. This is due in part to the increasing appreciation by the businesses operating in the region of the growing strategic value of water. The CDP Water Programme project utilised a questionnaire that was sent to the 100 largest companies on the JSE, considered to be water intensive. Since this project appeared to be similar to the topic of the current research, it was deemed an appropriate source to use as a benchmark.

Unfortunately for the current research, the CDP water program combined a number of sectors namely: chemicals; construction material; containers and packaging; metals and mining; paper and forest products; and oil and gas. Combining the sectors makes the comparison of the three research projects challenging.

Key findings for 2013 for materials and energy: includes chemicals, energy, mining and oil and gas sectors:

The response rate was 60%, with the vast majority of responses being mining companies, but, one chemical, one forestry and one energy company also responded. African Rainbow Minerals and Assore declined to participate in the 2013 CDP Water Programme. The sector has the highest response rate on many indicators, however in relation to the supply chain this sector lags behind. All respondents have a water policy in place, and all except one has board oversight. A total of 75% have quantitative targets. This sector faces considerable water-related risks and shows a remarkable awareness of such risks. The supply chain is less understood than for direct operations. Half of the respondents identify risks in the supply chain, and only 25% (3) require key suppliers to report on water risks. Only one company paid a fine for breaching discharge regulations. All of the companies in the sector, apart from Northam, identified water-related business opportunities. These relate to cost savings and increased brand value, and not to new products or services.

2.3.2. The 2008 Global Study [10]

The 2008 Global Study was conducted on 100 of the largest publicly traded companies from eight water-intensive sectors, based on their 2008 annual revenues and market capitalisations. Geographic exposure was also taken into account in the selection and the companies' 2008 corporate reporting information was used for this study.

This study found that the mining sector showed the strongest water risk disclosure of all the sectors surveyed. Thirteen mining companies were included in the 2008 Global Study, but none of them were included in the study for this article. Ten out of the 13 companies reported on their water usage, four companies broke down water use data to the site level, and six companies disclosed information on wastewater discharge. All companies reported on their water-related risks. Six of the 13 companies set quantitative targets to improve on water use. Eight companies provided information on water-specific strategies and policies. Only one of the mining companies disclosed that it engaged with its suppliers on water-related risks. Ten of the 13 companies reported engaging with their stakeholders on water related risks.

From the literature review, it is evident that there are many risks relating to water scarcity, which could affect the South African mining industry.

3. Methodology

To address the research objective a qualitative research choice was used whereby text and documents from the selected mining company reports were analysed. Purposive sampling was used whereby nine mining companies, specifically those with a primary listing on the JSE [27] were chosen. The South African context was decided on since other countries generally have different water related laws and regulations. Every country has its own water scarcity challenges and stakeholder pressures, and if a company has a primary listing in another country, it may well have an impact and influence on the South African division.

The empirical work was used to determine if and how the selected mining companies were measuring and managing their water risk; engaging with their stakeholders; and disclosing thereof in their operations, supply chains, and products. The final selection of mining companies was made based on those with the highest market capitalisation figures [28]. The selected mining companies evaluated in this article are provided in Table 1.

Table 1. Names of selected mining companies and reports used for this article.

Name of Company	Report Type Used
African Rainbow Minerals	Sustainability Report 2013
Anglo American Platinum Limited (Amplats)	Sustainability Report 2013
Anglo Gold Ashanti	Sustainability Report 2013
Assore	Integrated Annual Report 2013
Exxaro	Integrated Annual Report and Supplementary Info Report 2013
Gold Fields	Integrated Annual Report 2013
Impala Platinum Holdings (Implats)	Sustainability Report 2013
Kumba Iron Ore	Sustainability Report 2013
Northam Platinum Limited	Sustainability Report 2013

Secondary data from each of the selected mining companies by way of their published reports for 2013 were downloaded. All the downloaded company reports were analysed for any information on water. Once the word “water” was found, it had to be evaluated to ascertain under which activity in the Ceres Aqua Gauge™ it should be classified. A content analysis was performed on the downloaded company reports using the qualitative data analysis software, Atlas.ti. (Version 7.5.10). A thematic analysis was used, whereby codes were created by taking key words and phrases from the Ceres Aqua Gauge™.

The Ceres Aqua Gauge™ is a framework for assessing the corporate management of water risk and uses an Excel spread sheet, and terms that are consistent with other water tools and initiatives, like the Ceres Roadmap for Sustainability, the World Business Council for Sustainable Development, the CDP Water Survey, and the United Nations [29]. The Ceres Aqua Gauge™ also has links to the CDP water programme and the GRI, which can be seen in Table A2 (Appendix A).

This gauge has four main activities: *measurement*, *management*, *stakeholder engagement*, and *disclosure*. Measurement is further divided into data gathering and risk assessment. Management is partitioned under the headings, governance and accountability; policies and standards; and business planning. For each activity, a company’s progress can be assessed against the following four stages:

1. *No action*: There is no evidence that the company has taken any action in this area.
2. *Initial steps*: Action has been taken, but the company is only beginning to implement the practice.
3. *Advanced progress*: Action has been taken and good progress towards leading practice has been made, however, gaps still exist in the company’s approach.
4. *Leading practice*: Action is consistent with what leading companies are doing and are aspiring to do in this area [29].

According to the descriptions for each activity in the Ceres Aqua Gauge™, the context of each quotation from the respective mining companies’ reports were analysed and evaluated to determine whether the company had *no action*, *initial steps*, *advanced progress*, or *leading practice*. Then, the four stages were given scores as follows:

- no action = 0
- initial steps = 1
- advanced progress = 2
- leading practice = 3

This was done in order to establish which, of the nine mining companies were the better performers in each of the activities in Ceres Aqua Gauge™.

Limitations were that if the information pertaining to the activities in the Ceres Aqua Gauge™ could not be found in the company's reports, the option *no evidence* was selected. However, this does not mean the company does not undertake the activity, but merely that it does not disclose the activity.

4. Findings and Discussion

The findings of this study are discussed next in accordance with the headings used in the Ceres Aqua Gauge™.

4.1. Measurement

Measurement entails the collection and monitoring of data on a number of key areas in the business. Below are the findings of the measurement activities for the nine mining companies.

4.1.1. Data Gathering

This sub-section assesses whether the company is collecting and monitoring information on water consumption and discharge, and if and how the company's production processes are affecting water sources. It investigates which external factors could affect the current and future water supply for the company. It also determines whether stakeholders' perceptions and the reputation of the company are monitored, and finally, how its water-intensive suppliers are managing water-related issues.

Of the nine mining companies in this research, all were found to have disclosed their water consumption. For the disclosure of the company's environmental and social impacts on direct sources, all nine companies were found to have performed this activity, and all the companies reported on AMD. All of the companies reported that they monitor external factors like climate change which could affect direct water sources. Furthermore, under this activity all nine mining companies reported to be encountering problems with obtaining their water use licences from the Department of Water and Sanitation (DWS). All mining companies engage with their stakeholders, to a greater or lesser extent. However, for the activities of collecting and monitoring suppliers' water management practices, no evidence of these activities was present in any of the nine mining companies' reports.

4.1.2. Risk Assessment

Once the company has gathered all the necessary data as per the previous section, the next step is to assess its risk exposure in both direct operations and the supply chain. Various tools and methodologies can be used, for example amongst others the water footprint assessment.

All the companies (100%) were found to be identifying water-related risks in their direct operations.

Amplats reported that they introduced a new water programme called the Water Efficiency Target Tool (WETT). This tool will not only help the company identify water-related risks in its direct operations, but also foster an in-depth understanding of current and potential future water risks.

With respect to identifying and quantifying water related-risks in the supply chain, none of the selected mining companies reported to be undertaking this activity. However, under the measurement category, Amplats (Johannesburg, South Africa) and Gold Fields (Johannesburg, South Africa) achieved the highest scores as these companies scored leading practice in many of the activities, with Kumba (Centurion, South Africa) at a close third place.

4.2. Management

Management of water-related issues consists of three sub-categories of activities, namely: governance and accountability; policies and standards; and business planning. The findings of these management activities for the nine mining companies in this research, are presented next.

4.2.1. Governance and Accountability

For a company to take water-related issues seriously, there should be board-level commitment and senior management involvement. Financial incentives could also be linked to senior executives' sustainability scorecards. The last point with respect to governance and accountability is to ensure that the company "walks the talk" on water-related issues.

The two activities regarding board-level oversight of water-related issues, and whether senior executives are directly involved in the management of water-related activities, were difficult to verify. None of the mining companies showed evidence for these two activities, however, from the initiatives undertaken and money invested, it can be assumed that the individual company's boards and senior management do have oversight of water-related issues in their respective companies.

For the next activity, regarding whether the company "walks the talk", all of the companies were shown to be doing this, by saving water, implementing wastewater reductions, helping the community, and so forth.

4.2.2. Policies and Standards

Setting policies, performance standards, and goals helps guide a company on water issues; raises awareness; and helps measure and drive performance. The company needs to look wider than its own facilities, and take into account its water sources and who it shares this water with. Lastly, the company's supply chain performance standards and goal setting are addressed in this sub-section.

All companies (100%) were found to have a water policy and to be recognising the importance of water, some to a greater extent than others. Of the companies, 78% had set reduction targets for water consumption, and the figure for target setting for wastewater discharge reductions was at 67%. All the companies had plans to address local watershed risks. None of the companies reported any activity of addressing sustainable water management in their suppliers' codes of conduct. Regarding the question of whether companies consider water in business planning and investment decisions, 63% of them do, to a greater or lesser extent. A total of 53% of the companies do consider water in product design and development and 67% of the selected companies do identify water-related business opportunities, however, these were mostly related to reducing costs and improved stakeholder relationships, and not new business opportunities.

4.2.3. Business Planning

This sub-section evaluates whether a company incorporates water in its long-term planning by way of including water risks and opportunities in investment decision making; budgeting; and product design and development.

Regarding the question of whether companies consider water in business planning and investment decisions, 89% of the mining companies do, to a greater or lesser extent. A total of 89% of the companies do consider water in product design and development and 67% of the selected companies do identify water-related business opportunities, but these were mostly related to reducing costs and improving stakeholder relationships, and not creating new business opportunities.

The Ceres Aqua Gauge™ [29] tool states that "Business opportunities can include new products and processes, as well as the benefits from better stewardship of water either in reduced costs, enhanced brand equity, improved stakeholder relations or other business benefits."

Examples identified from the mining companies' reports for this activity include:

Implats improved its stakeholder relations in 2013 by completing a water infrastructure project for 4000 people in the Greater Tubatse area at a cost of R12 million.

In 2011, at its Sishen mine, Kumba commissioned a state-of-the-art bioremediation facility at a cost of R23 million. This facility uses bacteria to "eat" soil contaminated by diesel. All sludge produced at Sishen mine now goes through this new bioremediation facility. Contaminated soil is taken from separation pits, where the soil settles and the water and oil separate. The oil is recycled and the water

is reused in the plant. In 2013, through its water management initiatives, Kumba saved 7.7 million m³, against its water-saving target of 2.5 million m³. Kumba is using an environmentally friendly product for dust suppression at its mines. After this product has been applied to the mine's roads, it creates a dust-free road for two to three months. At Kumba's Kolomela mine it uses approximately 120 L/m² of water on treated roads, compared to 1500 L/m² needed on untreated roads annually. This qualified for advanced progress.

In 2013, Exxaro reduced its water withdrawals by 33%. Innovative passive water treatment systems are being evaluated by Exxaro's Research and Development department in collaboration with the University of the Free State to find a long-term solution to water management. Exxaro is also working on a project with other mining companies to develop appropriate technology to deal with waste from water treatment plants, therefore, advance progress was selected.

In 2011, Amplats introduced a new water programme (WETT) in the company, aimed at aligning water targets across the Group. Amplats has set a medium-term water use target up to the year 2020. They furthermore worked with a number of interested parties on a number of projects, one of the largest being the construction of the De Hoop dam on the Steelpoort River to supply water to mines and communities in the area, which ought to improve stakeholder relations.

For Gold Fields, its Liquid Gold project is a long-term strategy for developing and implementing sustainable business solutions for water management. In 2014, as part of its Liquid Gold project, the plan was to commission two new reverse osmosis plants at its South Deep facility to treat process water. It would be possible to use this water in its facilities, which would reduce the use of potable water from 250,000 KL per month to 160,000 KL per month.

In this, the management section, Gold Fields scored the highest points and Amplats in a close second place. Assore did not score well in this section of the Ceres Aqua Gauge™.

4.3. Stakeholder Engagement

Engaging with stakeholders can help a company identify water-related risks and the impacts the company could have on water sources. It is necessary to understand what level of interest and power the company's stakeholders have, since this will help decide how to deal with the different types of stakeholders. The Ceres Aqua Gauge™ has identified a number of stakeholders namely: local communities; employees; suppliers; local, regional and national government or regulators; NGOs; other industries/companies/water users; and customers.

Engagement by the companies with their local communities was 89%; African Rainbow Minerals, Amplats, Ashanti, Gold Fields and Kumba all reported a number of projects where they assist the local community. With regard to engagement: with employees, only at 22%; with suppliers, 0%; with local, regional and national government, the highest score at 100%; with NGOs at 89%; with other industries/companies/water users at 77%; and, lastly, with customers none of the mining companies report to be employing this.

For the scores of stakeholder engagement Amplats scored the highest, and Anglo Gold Ashanti, Exxaro, Gold Fields, Kumba and Northam had similar scores.

4.4. Disclosure

The Ceres Aqua Gauge™ encourages companies to disclose their water-related information, both qualitatively and quantitatively, as this is a way for a company to communicate with its various stakeholders and to show transparency. The last step in the disclosure section is to ask whether the water-related information has been verified by an independent third party. Next, the findings of the disclosure activities for the nine mining companies are presented.

For the first and second activities in this category, namely: whether the company makes water-related information publicly available, and whether the company includes water data in published financial reports, 100% was scored for both activities by the selected mining companies. The third and last activity, namely, whether the company provides third-party assurance or audits

water-related information, was challenging to verify. However, 22% of the companies reported undertaking this activity.

The mining company with the highest score for disclosure was Gold Fields as this company does report to provide third party assurance of water related information. Kumba does also report to provide third party assurance on water related information.

It is evident from the above that the premise of this research that the selected South African mining companies had not grasped the seriousness of the water crisis or the effects it would have on their businesses in the future, was refuted. However, most concerning was the activities relating to supply chain water management, and in all the selected mining companies, this area needs to be addressed.

When taking into account all the activities from the Ceres Aqua Gauge™, Amplats scored the highest with Gold Fields in second place, and Kumba in third place. The detailed Ceres Aqua Gauge™ with the scores for each mining company can be seen in Table A1 Appendix.

In summary from the two other studies discussed in the literature review, namely, the CDP's South Africa Water Report of 2013 and the 2008 Global Study, both stated that the mining sector showed the strongest water risk disclosure, which is what this study also established during the analysis. This also demonstrates transparency and commitment of the selected mining companies to their stakeholders by reporting on their water-related risks.

However, one area that is not being reported on in any of the three research studies is the lack of engagement of the mining companies and their suppliers on water scarcity.

5. Conclusions

This study examined whether the selected mining companies were recognising the importance of water in their businesses and whether they were showing a commitment to combating the issue of water scarcity in South Africa.

From the evaluation of the nine mining companies using the main four activities of measurement, management, stakeholder engagement and disclosure, these companies were found to show good water stewardship. Hence, in line with stakeholder theory, mining companies are showing transparency and accountability towards their stakeholders. However, the area of water and supply chain management in the mining sector was found to be neglected. Similar results were reported by the CDP's South Africa Water Report of 2013 and the 2008 Global Study.

This research contributes to increasing the awareness of water scarcity and poor water quality in South Africa and the contribution that the mining sector has made and still needs to make.

6. Recommendations for Future Research

Many of the mining companies evaluated in this research mentioned in their reports that obtaining or renewing a new water use licence from the DWS was challenging and time consuming. This is a risk for the continued operation of companies and could hamper foreign companies from expanding and investing in South Africa. Hence, this could be an area for possible future research.

Research on other environmental elements could also be done, such as climate change and carbon emissions. A further problem that came to light in this research was the lack of information companies are disclosing on suppliers' water-related risks, warranting further research.

Besides industry being categorised into high, medium and low water intensity, countries and their watersheds are also categorised in this way, therefore, future research could investigate where companies' suppliers are located and how this could pose a risk.

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Appendix A. Ceres Aqua Gauge™ Findings of Selected Mining Companies

Table A1. Key areas of corporate water risk management identified in the Ceres Aqua Gauge™—Mining sector for 2013. **NE = no evidence of action (score = 0); AP = advanced progress (score = 2); IS = initial steps (score = 1); LP = leading practice (score = 3).**

Company	African Rainbow	Amplats	Ashanti	Assore	Exxaro	Gold Fields	Implats	Kumba	Northam	
	2013									
1. MEASUREMENT										
Data gathering										
1.1	Its own regulatory compliance, water use and discharge	2	3	2	1	2	3	2	3	2
1.2	Its own environmental and social impacts on direct water sources	2	3	2	1	1	2	1	3	2
1.3	External factors—such as economic and social development, impacts of other users, climate change and public policy—affecting direct water sources	2	3	2	1	1	3	1	2	2
1.4	Stakeholder perceptions and concerns relating to water issues	2	2	1	1	2	3	1	2	2
1.5	The effectiveness of suppliers' water management practices	0	0	0	0	0	0	0	0	0
Risk assessment										
1.6	Water-related risks in direct operations	2	3	2	1	1	2	1	1	1
1.7	Water-related risks in the supply chain	0	0	0	0	0	0	0	0	0
Total Measurement		10	14	9	5	7	13	6	11	9
2. MANAGEMENT										
Governance and accountability										
2.1	Clarifies board responsibilities for oversight of water	1	1	1	1	1	1	1	1	1
2.2	Involves senior executives directly in management of water-related issues	1	1	1	1	1	1	1	1	1
2.3	Aligns public policy positions and lobbying with water stewardship goals	1	2	1	0	1	2	1	2	1
Policies and standards										
2.4	Has a publicly available water policy and recognises the importance of water to the business	2	3	2	1	1	3	1	2	2
2.5	Sets performance standards and goals on water withdrawals/consumption for direct operations	0	2	2	0	2	2	2	2	2
2.6	Sets performance standards and goals on wastewater discharge for direct operations	0	1	1	0	1	2	0	2	2
2.7	Requires direct operations to develop plans to address local watershed risks	2	2	2	1	2	2	1	2	2
2.8	Addresses sustainable water management in supplier standards and codes, and in procurement and contracting practices	0	0	0	0	0	0	0	0	0
Business planning										
2.9	Considers water in business planning and investment decision-making	2	2	2	0	1	2	1	1	1
2.10	Considers water in product design and development	1	2	2	0	1	2	1	1	1
2.11	Identifies water-related business opportunities	1	2	0	0	2	3	2	2	0
Total Management		11	18	14	4	13	20	11	16	13
3. STAKEHOLDER ENGAGEMENT										
3.1	Requires engagement with local communities on water-related issues at existing or potential new operations	2	2	2	1	2	2	0	2	1
3.2	Engages with employees on water issues	0	2	0	0	0	0	0	0	2
3.3	Works with suppliers to help them improve water management	0	0	0	0	0	0	0	0	0
3.4	Engages openly with local, regional and national governments or regulators to advance sustainable water policies and management	2	3	2	1	2	2	1	3	2
3.5	Engages with NGOs and community organisations on water issues	2	3	2	0	2	3	1	3	2
3.6	Engages with other industries/companies/water users	0	3	2	0	2	2	0	1	1
3.7	Educates customers to minimise product impacts	0	0	0	0	0	0	0	0	0
Total Stakeholder Engagement		6	13	8	2	8	9	2	9	8
4. DISCLOSURE										
4.1	Makes water-related information publicly available	1	3	1	1	1	3	1	2	1
4.2	Includes water data and analysis in published financial filings/reports	1	1	1	1	1	1	1	1	1
4.3	Provides third-party assurance or audits water-related information	0	0	0	0	0	1	0	1	0
Total Disclosure		2	4	2	2	2	5	2	4	2
GRAND TOTAL		29	49	33	13	30	47	21	40	32

Table A2. Scorecard for the Ceres Aqua Gauge™ With Links to CDP Water Program and GRI Reporting.

Category	Sub-Category	Description The Company	Activity	Disclosure Reference
MEASUREMENT	Data Gathering	<i>Collect and monitors data related to:</i>	1.1 Its own regulatory compliance, water use, and discharge	CDP Water 2014 (W5) GRI G4 (EN8, EN9, EN10, EN22, EN23, EN24)
			1.2 Its own environmental and social impacts on direct water sources	CDP Water 2014 (W1.3a, W2.4, W3.2b) GRI G4 (EN9, EN12, EN24, EN26)
			1.3 External factors affecting direct water sources	CDP Water 2014 (W2.4, W3.2b)
			1.4 Stakeholder perceptions and concerns relating to water issues	CDP Water 2014 (W2.4, W2.4a, W8.1b)
			1.5 Effectiveness of suppliers' water management practices	CDP Water 2014 (W2.5, W2.5a, W2.5b)
	Risk Assessment	<i>Identifies and quantifies water-related risks for its:</i>	1.6 Direct operations	CDP Water 2014 (W2.1, W2.2, W2.3, W3.1, W3.2a, W3.2b)
			1.7 Supply chain	CDP Water 2014 (W2.1, W3.1, W3.2c, W3.2e)
MANAGEMENT	Governance	<i>Set accountabilities for water through:</i>	2.1 Board of directors	CDP Water 2014 (W6.1)
			2.2 Senior management	CDP Water 2014 (W6.1)
			2.3 Public policy and lobbying positions	CDP Water 2014 (W6.2a)
	Policies and Standards	<i>Set performance standards and goals through</i>	2.4 Publicly available water policy /statement	CDP Water 2014 (W6.2a, W6.3)
			2.5 Standards and goals on water withdrawals/consumption for direct operations	CDP Water 2014 (W8, W8.1a, W8.1b)
			2.6 Standards and goals on wastewater discharge for direct operations	CDP Water 2014 (W8, W8.1a, W8.1b)
			2.7 Plans to address local watershed risks	CDP Water 2014 (W2.2, W3.2b)
			2.8 Supplier standards and codes, procurement and contracting practices	CDP Water 2014 (W6.2a, W6.3)
	Business Planning	<i>Integrates water in decision-making related to:</i>	2.9 Business planning and capital allocation	CDP Water 2014 (W1, W3.1, W3.2, W3.2a W4)
			2.10 Product design and development	CDP Water 2014 (W4.1a, W6.2a)
			2.11 Opportunities identification	CDP Water 2014 (W1.3a, W4.1a, W6.2a)
ENGAGEMENT	Engages with internal and external stakeholders on water-related issues	3.1 Local communities	CDP Water 2014 (W2.4a, W8.1b)	
		3.2 Employees	CDP Water 2014 (W2.4a)	
		3.3 Suppliers	CDP Water 2014 (W2.4a, W2.5, W8.1b)	
		3.4 Government and regulators	CDP Water 2014 (W2.4a, W8.1b)	
		3.5 NGOs and community groups	CDP Water 2014 (W2.4a, W8.1b)	
		3.6 Other industries/water users	CDP Water 2014 (W2.4a)	
		3.7 Customers	CDP Water 2014 (W2.4a, W8.1b)	
DISCLOSURE	Discloses:	4.1 Water-related information	-	
		4.2 Data and analysis related to water in financial filings/reports	-	
		4.3 Audited/assured water-related data	CDP Water 2014 (W5.7)	

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