Determining the level of comparability of quantified environmental information of mining companies

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ABSTRACT

The earth's natural resources are under strain. Companies are often criticised for making profits at the expense of the environment. Stakeholders are therefore becoming increasingly concerned about the environmental impact that companies have on limited natural resources. As a result, stakeholders now require that companies report environmental information of high quality in an attempt to improve environmental performance.

An important principle used to improve the quality of environmental reporting is comparability. Comparability refers to the fact that environmental reporting should be consistent to assist stakeholders to compare the environmental performance of different companies.

The aim of this study is to determine the level of comparability of quantified environmental elements that companies disclose. A total of 31 different environmental elements were considered, including land area impacted, coal usage, water discharged and greenhouse gas emissions. The study used a checklist that was developed through a detailed literature study. This checklist was applied to 12 South Africa mining companies that have significant environmental impacts. Results from the checklist were inserted into a comparability classification model that was derived from literature. The model classified the level of comparability of each of the disclosed environmental elements into four categories (namely strong, moderate, weak and limited).

The main findings of the research show that less than 13% of the environmental elements assessed indicate a strong level of comparability. Close to 60% of the elements indicate a weak to limited level of comparability. It was also evident that energy and emission disclosures receive more attention than other environmental disclosures. The lack of third-party assurances, which influences the reliability and quality of disclosures, was also identified as a major concern. To improve the comparability of quantitative environmental information, it is proposed that current international guidelines be modified. Guidelines should be more specific in terms of what information corporations disclose, and when information should be assured.

Keywords: Environmental reporting, environmental intensity, sustainability report, Global Reporting Initiative, greenhouse gas emissions, environmental management, South African mining, triple bottom line, reliability, comparability.

ACRONYMS AND ABBREVIATIONS

CDP	Carbon Disclosure Project
CO_2	carbon dioxide
GDP	Gross Domestic Product
GHG	greenhouse gas
GJ	gigajoule
GRI	Global Reporting Initiative
GWh	gigawatt hour
ha	hectare
JSE	Johannesburg Stock Exchange
kl	kilolitre
MWh	megawatt hour
NOx	nitrogen oxide
NPI	National Pollutant Inventory
PGM	Platinum Group Metals
SOx	sulphur oxide
SRI	socially responsible investing
tCO_2	total carbon dioxide

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CHAPTER 1 – NATURE AND SCOPE OF THE STUDY

1.1 Introduction

Damage to the natural environment is a global concern, with large multinational industrial corporations being major contributors to this damage (Korten, 1998). They are responsible for releasing a number of toxins into the environment, as well as degrading the earth's ecosystem through their operations. High levels of pollution have caused serious human health issues and long-lasting damage to the natural environment (Shi, Wang, Huisingh & Wang, 2014).

In the past, large environmental impacts mostly occurred infrequently and in isolated instances, meaning that in general they could be easily handled and rectified. However, in the last few decades, damage to the environment has grown to a widespread epidemic, with repercussions that cannot be easily rectified and that are, in many cases, irreversible. For this reason, the quality and health of the natural environment have become global concerns, forcing corporations, nations and the public to start quantifying their impacts on the environment. (Khuntia, 2014)

1.2 South African mining sector

In general, mining is very energy intensive and is a significant greenhouse gas (GHG) emitter. It consumes between 4% and 7% of energy globally (Azapagic, 2004) and is known to have a noticeable impact on the landscape as well as on the underground environment. Its high dependence on non-renewable resources, as well as the environmental effects of its operations – such as air pollution, and the dumping of effluents and solid waste – are concerning (Acheampong & Lens, 2014; Dhal, Thatoi, Das & Pandey, 2013; Kuyucak & Akcil, 2013).

South Africa's mining sector is a significant contributor to Gross Domestic Product (GDP) but is responsible for a large portion of the country's GHG emissions, as it consumes more than 15% of total national electricity (Eskom, 2016). One notable concern, especially in South Africa, is mine acid drain water and the dumping of effluents, which contain hazardous substances that could have irreversible impacts on the environment (Oelofse, 2008; Tyagi, 2016). According to Smit and Dikgwatlhe (2015), mining companies are under pressure to implement good environmental accounting principles due to the damaging effect of their operations on the environment. Smit and Dikgwatlhe further highlight that one of the main components of environmental accounting is to produce well-documented and audited environmental reports.

1.3 Sustainability and environmental reporting

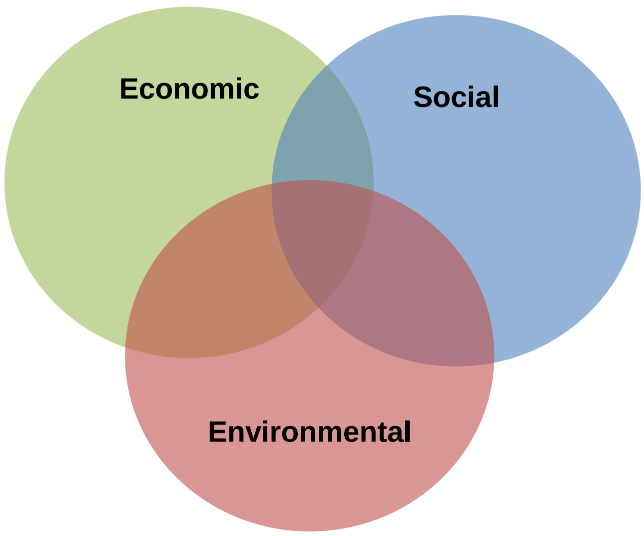
As a result of the known impacts that industries such as mining have on the environment, stakeholders have become increasingly concerned about the sustainability of businesses in this sector (Mudd, 2008). These stakeholders include investors, the public, employees and government. A sustainable company ensures that its objectives include sustainable development through economic, social and environmental performance (Labuschagne, Brent & Van Erck, 2005). Investors in companies have also changed their focus to long-term investments rather than short-term gains. Studies prove that investors now also consider sustainability as part of their investment decisions, and this includes the impact that a company has on the environment. Vos and Reddy (2014) call this “socially responsible investing” (SRI).

A study conducted by Kolk (2008) states that some stakeholders now request that environmental regulations be introduced within corporations to enable increased environmental performance. The study further discusses how a number of companies spend large amounts of resources and time to address climate change issues, and some of them even choose to disclose environmental information voluntarily. A number of companies worldwide have therefore opted to make sustainability reports (which include environmental information) available on an annual basis as part of good corporate governance. These sustainability reports aim to hold companies accountable for their impacts on the environment (Dawkins & Fraas, 2011). Some studies, such as that of

Flammer (2013), have found that companies that publish sustainability reports are seen as environmentally responsible, and benefit from significant stock price increases.

As a result of the need for sustainability reports, some reporting frameworks, mandatory disclosures and guidelines have been established. Integrated Reporting is one such initiative that was mandated by the King III Report on Corporate Governance for South Africa (Ernst & Young, 2012). Integrated Reporting is a concise communication medium that companies use to communicate their impact on economic, social and environmental aspects (also known as the triple bottom line) (International Integrated Reporting Council, 2013). It also covers a combination of financial and non-financial performances (such as environmental impacts), and is aimed at providing information to a number of stakeholders in order to assist them to make informed investment decisions (Rensburg & Botha, 2014). Figure 1.1 is an illustration of the integrated effects of the triple bottom line.

Figure 1.1: Triple bottom line illustration



Source: Adapted from Kannegiesser, Günther and Autenrieb, 2015

Another popular sustainability reporting guideline, adopted by thousands of companies around the world, is the Global Reporting Initiative (GRI) guideline. The objective of the GRI is to assist companies to understand and communicate their impact on sustainability elements such as climate change (G4 Sustainability Reporting Guidelines, 2015). Carbon

Disclosure Project (CDP) is a non-profit organisation that collects and discloses the environmental information of corporations (Ben-Amar, Chang & McIlkenny, 2015). CDP developed a standardised reporting procedure to assist large companies to communicate their climate-related activities (risks or opportunities) to investors (Kolk, Levy & Pinkse, 2008). Both the GRI and CDP standards are intended to complement the annual Integrated Reporting of corporations (Matisoff, Noonan & O'Brien, 2013; Hoffman, 2016).

1.4 Quantitative and comparable environmental disclosure

According to the GRI's G4 Sustainability Reporting Guidelines, the quality of the sustainability report is *inter alia* defined by the comparability of the report (G4 Sustainability Reporting Guidelines, 2015). The guidelines further explain that comparability refers to the manner in which the company's triple-bottom-line information is presented. The information should be presented in such a way that stakeholders can analyse the performance over time. It is also important that the information or performance is reported in such a way that it can be compared to that of other similar companies with relative ease. A study done on oil and gas companies found that the adoption of the GRI G3 Sustainability Reporting Guidelines led to the improvement of comparability between corporations (Alazzani & Wan-Hussin, 2013). However, the study did not present any detail regarding comparability of the quantitative information disclosed.

In a study conducted by De Franco, Kothari and Verdi (2011) on financial comparability, the authors highlight the importance of quantitative information to improve the comparability of financial reports. They also propose that, similar to financial statements, environmental reports also need to include quantitative data. However, according to Roca and Searcy (2012), corporations have placed a lot of emphasis on the qualitative information disclosed in sustainability reports. Also, little research has been done on the disclosure of quantitative information in sustainability reports.

Marx and Van Dyk (2011) also highlight the importance of quantitative environmental disclosure, and link it to environmental performance. The study explains that if two companies, one with good environmental performance and one with bad performance, were to disclose their environmental impacts, the one with good environmental performance will voluntarily disclose its quantitative measures and compare them with industry benchmarks. However, the company with poor performance will disclose the minimum amount of quantitative information, and could substitute quantitative with qualitative information.

In another study conducted by Al-Tuwaijri, Christensen and Hughes (2004), the authors believe that quantitative disclosures are more “objective and informative” to stakeholders than qualitative disclosures. They reason that qualitative disclosures are susceptible to “greenwashing”, where corporations place a “spin” on the information disclosed due to the corporations’ below-average environmental performance. The study also develops an environmental performance measure, where it assigns the greatest weight to quantitative information disclosed by corporations.

Previous research based on surveys (Hasseldine, Salama & Toms, 2005) also establishes that qualitative disclosures are strongly linked to reputation improvements. This means that a company can enhance its reputation if qualitative environmental information is more effectively disclosed.

1.5 Previous research

A number of environmental reporting standards and guidelines are provided and are currently being used by industry. However, studies conducted worldwide indicate that there are quite a few issues regarding the standards and guidelines that companies use.

According to Fonseca, McAllister and Fitzpatrick (2012), a number of studies contest the value and effectiveness of sustainability reporting. However, the authors also mention that only a few scholars "scratched below the surface of criticism in order to consider how to improve the effectiveness" of frameworks such as the GRI. This study was based on literature reviews and structured interviews, and suggests some changes to the high-level GRI framework for sustainability reporting for mining companies. The study does not investigate the content of the comparability of sustainability reporting at all.

Furthermore, a study conducted by De Villiers, Rinaldi and Unerman (2014) shows that Integrated Reporting is rapidly developing and is understood differently by different stakeholders; therefore, different indicators are disclosed that affect the comparability of reports. The study suggests that there is a need to clarify policies and practices in this regard.

In 2006, Langer conducted a comparative analysis of sustainability reports of multinational companies in Australia, focusing on sustainability reporting differences. Langer found that there were significant differences between the reports issued by the different corporations he studied. These differences were also found to have influenced the usability of reports, as well as the comparability between the different companies, which further impacted the benchmarking and ranking of organisations.

A number of studies also investigated the content that companies disclose in their sustainability and integrated reports. Unerman (2000) studied at least 20 of them. These studies focus on what companies disclose, and analyse the sustainability reports according to the number of words, sentences, pages and documents (Al-Tuwaijri *et al*., 2004). Based on this information, industry benchmarks are identified, while a company's perceived environmental management performance is determined based on the type and amount of information disclosed. However, none of these studies analyse the quantitative information that companies disclose.

Furthermore, Clarkson, Overell and Chapple (2011) examined how environmental data is disclosed and if it correlates to the environmental performance of the companies. The study found that companies that include detailed environmental disclosures perform better environmentally than companies that disclose little information. However, the study used quantitative information gathered from the National Pollutant Inventory (NPI) for Australian companies, and this database is only available to Australian companies (see National Pollutant Inventory, 2015).

Boiral and Henri (2017) also evaluated the comparability of 12 diverse mining organisations, including mines that mine gold, coal, iron, copper and nickel. The study uses a broad systematic evaluation method (both qualitative and quantitative) and includes all aspects of sustainability as per the GRI. The outcome of the study was that sustainability disclosure cannot be compared within such a broad spectrum of analysis. A limitation of this study is that it only provides high-level feedback, and limited detail is provided regarding specific quantitative environmental disclosures.

According to Roca and Searcy (2012), corporations have placed a lot of emphasis on the qualitative information disclosed in sustainability reports. However, little research has been done regarding the quantitative information disclosed in sustainability reports. The above-mentioned studies prove that there is a gap in the literature. The aim of this study is therefore to fill this gap and to study the quantitative environmental disclosures presented by large mining companies in South Africa. The study will focus on the quantitative information reported, and determine the comparability of the figures to similar companies.

1.6 Problem statement

It was determined that only 14.3% of stakeholders perceive environmental reports to be trustworthy (Kamala, 2014). The reason for this is that qualitative disclosures are susceptible to “greenwashing”, and that corporations can place a “spin” on the information disclosed if its environmental performance is below average (Al-Tuwaijri *et al.*, 2004). This highlights the importance of quantitative environmental disclosures.

Furthermore, companies’ environmental disclosures can often not be compared to one another, as reports do not follow the same guidelines or are incomplete. Previous studies found that different measurement scales (units) were used when quantifying environmental impacts (Boiral & Henri, 2017) and that the lack of assurances by independent auditors influences the comparability of environmental disclosures.

A number of studies have broadly evaluated the environmental information presented by mining companies. However, little research has been done regarding the quantitative information disclosed in sustainability reports. Furthermore, no literature could be found that determines or analyses the level of comparability of mines’ quantitative environmental disclosures. There is therefore a need to firstly research, and secondly determine the level of comparability of quantifiable environmental information disclosed by South African mines.

1.7 Research objectives

In order to address the problem statement, a main as well as secondary objectives were defined.

1.7.1 Main objective

The main objective of this research is to determine the level of comparability of the quantifiable environmental information disclosed by South African mines. This study will focus on the level of comparability of companies, rather than an analysis of a specific company's performance over time.

1.7.2 Secondary objectives

The secondary objectives are divided into literature objectives and empirical objectives.

Literature objectives

The secondary objectives of literature are:

- To study existing environmental standards, guidelines and frameworks applicable to mines.
- To determine the main characteristics of comparable disclosures of similar companies.
- To determine the type of quantifiable environmental information South African mining companies should disclose.
- To determine the type of measures (units) that South African mining companies should use to disclose their quantitative environmental information.

Empirical objectives

The secondary objectives as part of the empirical research are:

- To explain the research method.
- To develop a quantitative environmental disclosure checklist from literature.
- To apply this checklist, and to determine the level of comparability of quantitative environmental disclosures of identified mines.
- To compare the quantifiable environmental intensities of South African mining companies.
- To suggest a quantifiable environmental information reporting standard for South African mining companies.

1.8 Limitations of this study

Limitations to this study include:

- The study is limited to the South African gold and platinum mining industry.
- The study focused on the quantitative environmental information that companies disclose.
- The study focused on three comparability elements to compare the information disclosed by mining companies. However, comparability in a broader sense also includes other factors.
- The study only focuses on environmental data provided in integrated reports disclosed on the respective company websites.

1.9 Research methodology

The research method is divided into two elements, namely a literature review and an empirical study.

1.9.1 Literature review

The goal of the literature review is to gain insight into the current environmental reporting standards and frameworks applicable to mining companies in South Africa. The literature review will also study the impacts that mining companies have on the natural environment. The important mining environmental parameters are expected to be: energy usage, GHG emissions, the amount of water used, oil usage and fuel usage (diesel and petrol), as well as cyanide usage (in the case of gold mines).

This study will also aim to identify the main characteristics of quality reporting, and will focus on previous studies conducted to determine the comparability of environmental information disclosed by large corporations. The purpose of the literature review is, therefore, to gain as much knowledge as possible to determine the level of comparability of quantified environmental information of mining companies.

The following sources will be studied to gain the necessary knowledge:

1. Scientific journals.
2. Integrated reports of companies.
3. Existing environmental frameworks and standards.
4. Previous dissertations.
5. Textbooks.

1.9.2 Empirical research

Annual integrated reports of companies are regarded as the official communication medium between companies and stakeholders in terms of sustainability information (Hoffman, 2016). For this reason, the environmental information reported by mining companies in their latest annual integrated reports will be evaluated and compared. In order to gather the quantifiable environmental disclosures of companies' integrated reports, predefined checklists will be developed, with the assistance of information gathered from the literature review. These checklists will then be applied to all the integrated reports of the companies listed in Section 1.9.3, in order to gather the relevant information for the study.

After the data has been gathered, the results will be analysed and the level of comparability for all the environmental elements will be determined. The results will also be analysed in order to determine and compare each of the mining companies' contribution towards comparability.

1.9.3 Study population and sample

The study population of research participants will include mining companies listed on the JSE. Due to the different environmental impacts that the various types of mining companies have, the study will focus on one specific type of mining process, namely deep-level mining (a depth of more than 500 m). Considering this constraint, it will mostly be large gold and platinum mining groups in South Africa that will form part of the study population.

The population will include all platinum and gold classified mining companies that were part of the Chamber of Mines of South Africa on February 2017 (Chamber of Mines of South Africa, 2017):

1. AngloGold Ashanti.
2. Sibanye Gold.
3. Gold Fields.
4. Harmony Gold.
5. Pan African Resources.
6. DRDGOLD.
7. Anglo American Platinum.
8. Lonmin.
9. Impala Platinum.
10. Bafokeng Rasimone Platinum.
11. Wesizwe Platinum.

    Northam Platinum.

Note that some of the members have change since the evaluation data and that the due to the lack of environmental information in the sustainability reports located at the respected mining companies' websites, the following mining companies were not considered as part of the study population:

1. Bauba Platinum.
2. Ivanhoe Mines.
3. Platinum Group Metals.
4. Mvelo Minerals.

1.9.4 Ethical considerations

Only information in the public domain will be used to conduct the study. No confidentiality or ethical issues are applicable.

1.10 Overview of this dissertation.

In **Chapter 1**, an introduction to the problem and background regarding environmental reporting and disclosure were provided.

Chapter 2 conducts a literature review regarding the problem identified in Chapter 1. Environmental impacts and elements disclosed by mining corporations to outside stakeholders are also studied. The information provided in this chapter will further be used to develop a checklist to evaluate the quantitative information provided by companies.

In **Chapter 3** the checklist developed in Chapter 2 are applied to South Africa mining companies that have significant environmental impacts. The results from the checklist are then inserted into a comparability classification model that was also derived from literature.

Chapter 4 discusses the results obtained in Chapter 3 in detail. This chapter also concludes the complete thesis and ends with several suggestions for further work in this field.

1.11 Conclusion

Stakeholders of large corporations, such as mining companies, are becoming increasingly concerned about the sustainability of companies. A number of studies indicate that investors would pay a premium to invest in what they perceive to be a “sustainable” company. One of the key elements that plays a major role in the sustainability of a company is its impact on the natural environment.

As a result of the pressure that companies are under to do business in an environmentally sustainable way, a number of reporting standards have been developed. Companies also make use of sustainability reporting to disclose information to relevant stakeholders. Two important elements that play a significant role in the quality of environmental reports are the disclosure of quantitative information and the comparability thereof (see Section 1.4).

In order for the disclosed environmental information to be comparable, the relevant information should be presented in such a way that stakeholders can compare results with similar companies. In this study, the level of comparability of quantifiable environmental information of mining companies will therefore be investigated and determined.

In the next chapter, a literature review will be conducted in order to obtain the much-needed knowledge to execute the study.

CHAPTER 2 – ENVIRONMENTAL DISCLOSURE IN MINES

2.1 Introduction

In the previous chapter, an introduction was given on the impacts that companies have on the environment. These environmental impacts play a major role in the sustainability of companies, and therefore employees, investors, customers and governmental bodies request more environmental information from corporations. For this reason, environmental information needs to be reported to stakeholders on a regular basis.

A number of studies question the relevance and accuracy of environmental information disclosed by corporations, and highlight the importance of quantitative environmental disclosures (Al-Tuwaijri et al., 2004). The reason as stated in the research is that quantitative information is regarded as a more accurate measure for comparing the environmental impacts of corporations than qualitative information (Al-Tuwaijri *et al.*, 2004). Quantitative information can also be used to compare the environmental performance of a specific company over time.

In Chapter 2, the major impacts that mines have on the natural environment are studied and captured. It is also expected that these impacts or elements be disclosed by mining corporations to outside stakeholders. This chapter will also study existing environmental frameworks applicable to mines, and previous research on comparability and quantitative environmental disclosures. The aim of this chapter is, first, to identify the fundamentals needed to compare quantitative environmental disclosures of similar companies. Second, the aim is to develop a checklist of important quantitative environmental information needed to evaluate the comparability of South African mines.

2.2 Sustainability reporting frameworks and guidelines

Stakeholders not involved in the operation of a company (so-called "outsiders") do not have access to the company's environmental records or procedures. They, therefore, rely on other means of communication in order to determine if a specific company acts responsibly or not (Rensburg & Botha, 2014). This communication *inter alia* includes annual reporting, during which companies disclose their environmental impacts, how they intend to mitigate these impacts, and whether they have achieved their set goals. The theory behind these types of disclosures is that companies now open themselves up to critique from stakeholders, who will keep them accountable and force them to improve their environmental impacts (Rensburg & Botha, 2014).

Most of the environmental impacts caused by corporations are classified as indirect impacts (De Villiers, 2003), which means that they cannot be directly linked to the corporation and do not have an immediate effect on the local environment. An example includes the release of carbon emissions as a result of electricity usage. Although the electrical energy is consumed on the premises of the corporation, most of the carbon is emitted at a power station that could be 400 kilometres away. Therefore, if these impacts are not continuously monitored and companies are not held responsible for their actions, the companies could abuse natural resources, which could have a negative effect on society – if not now, then in the long run (Khuntia, 2014).

According to Khuntia (2014), benefits of corporate environmental reporting include the following:

- Improves the company's reputation.
- Lowers the cost of sustainability.
- Assists in differentiation among competitors.
- Assists with listing on national and international stock exchanges.
- Attracts finances.
- Improves the company's brand.

In order for companies to get the abovementioned benefits, and to assist companies to manage and accurately report on their environmental impacts, a number of guidelines and standards have been developed. Government also enforces certain regulations on mines in order to regulate the impacts that mines have on the environment (De Villiers *et al.*, 2014). The most common reporting guideline used by companies internationally is the GRI's G4 Sustainability Reporting Guidelines. It is used by almost 80% of the largest corporations in 41 countries (Gurtoo & Antony, 2007). This guideline is also considered to be the most detailed, mature and reliable guideline available (Boiral & Henri, 2017). For these reasons, the latest GRI G4 guideline was used in this study to evaluate environmental impact disclosures.

The GRI was launched in the 1990s with the vision to "create a future where sustainability is integral to every organisation's decision making". The GRI is an independent organisation that aims to aid corporations and governmental entities to understand, manage and report on their sustainability factors. According to Marx and Van Dyk (2011), the GRI guidelines make use of reporting principles to define the reporting content and enhance the quality of sustainability reporting. The latest GRI G4 report (*G4 Sustainability Reporting Guidelines*, 2015) suggests that the following six principles be applied by companies in order to improve the quality of their reporting:

- Balance – the report should include the negative as well as the positive impacts of sustainability performance.
- Accuracy – the reported information should be sufficiently accurate relative to the context in which it is used. Information can be expressed in many different ways, including quantitatively.
- Timeliness – the report should be issued timeously in order for the relevant stakeholders to make decisions.
- Clarity – information should be understandable to the targeted stakeholders.
- Reliability – the quality of the disclosed information should be subjected to examination. The sources used to calculate the figures, as well as the conversion factors, should be disclosed.

- Comparability – the reporting content should be ***consistent*** to enable stakeholders to analyse the changes in performance over time and to compare the information to that provided by other ***similar corporations***.

The last principle of the GRI, which states that disclosures should allow stakeholders to evaluate the performance of similar corporations, has triggered this investigation. Furthermore, in a study done by De Franco *et al.* (2011), the authors found that quantitative disclosures enhance the comparability of performance between corporations.

The GRI also places significant emphasis on the disclosure of quantitative information. The GRI G4 guideline (*G4 Sustainability Reporting Guidelines*, 2015) states that if an aspect (indicator) contributes significantly to the economic, environmental and social impact of the company, quantitative assessments should be provided and discussed in detail.

From the abovementioned section, it is therefore evident that comparability and quantitative sustainability disclosure go hand in hand and are essential for quality sustainability reporting. For this reason, these two factors will be evaluated in more detail in the next section.

2.3 Comparability of environmental information

As discussed in the previous section, according to the GRI (*G4 Sustainability Reporting Guidelines*, 2015), comparability is one of the six principles of quality sustainability reporting. Wegener, Labelle and Jerman (2015) also consider comparability as one of two key properties of environmental reporting that is often taken for granted and therefore deserves more attention.

The comparability principle more specifically refers to the need for an organisation to select, compile and report information consistently. Doing so enables stakeholders to analyse and compare the environmental performance of the organisation to other similar companies.

In order to determine the important fundamentals needed to compare qualitative and quantitative disclosures of different organisations, previous studies regarding this subject were considered. The literature indicates that there are multiple fundamentals that need to be considered with regard to the comparability of reporting. These can be summarised as follows, and are discussed in more detail below:

- Compliance with GRI indicators.
- Measures of disclosed information.
- Assurance of the disclosed information.
- Environmental performance intensities.

2.3.1 Type of information disclosed

In a study done by Boiral and Henri (2017), the authors evaluate the comparability of 12 diverse mining organisations' sustainability reports published between 2007 and 2008. The study includes a broad systematic evaluation method (both qualitative and quantitative) and includes all aspects of sustainability as per the latest GRI G4 guideline. The outcome of the study indicates that the reports could not be compared within this broad spectrum of analysis. The study further indicates that although it was expected that the different mining companies would disclose the same type of information, the reports did not follow the same guidelines and therefore did not report on the same quantitative indicators. Furthermore, most reports did not follow the GRI G3 indicators, or were incomplete.

A study done by Fonseca (2010) reported that the GRI G3 guideline was designed to make disclosures understandable and simple, and that due to this simplification, "cherry-picking" issues are introduced. This means that companies can decide what type of quantitative indicators they wish to disclose, which leads to manipulation of the sustainability reporting. This further leads to comparability issues.

These two studies indicate that the type of information disclosed by different companies has a direct impact on the comparability of quantitative performance disclosures.

2.3.2 Measurement scales

Measurement scales refer to the unit (tonnes, litres, hectares, etc.) in which quantitative environmental performance is reported. The study done by Boiral and Henri (2017) notes that different measurement scales (units) were used when quantifying environmental impacts. This results in comparability issues, as the quantitative performance disclosures cannot be easily compared with similar corporations. For example, some companies disclose monetary values in Dollars, whereas others use Pounds. Water consumption has also been disclosed in both litres and cubic metres by different companies.

In order to address the risks and opportunities regarding the measurement of sustainability disclosures, the Bellagio Sustainability Assessment and Measurement Principles (BellagioSTAMP) were developed. The aim of these principles is to provide a high-level guideline for measuring and assessing sustainability performance (Pintér, Hardi, Martinuzzi & Hall, 2012). The fourth BellagioSTAMP principle acknowledges the challenges of different measurements and scales, and states that measurements should be standardised as far as possible in order to enhance comparability between the different quantitative sustainability indicators used by organisations.

These studies acknowledge that different measurement scales have a direct impact on the comparability of environmental disclosures, and should therefore be considered when assessing the comparability of quantitative environmental disclosures.

2.3.3 Assurances

A study conducted in 2014 by Kamala states that the quality of sustainability reports, specifically with regard to environmental reporting, is questionable and does not improve comparability between different companies. The study further determined that only 14.3% of stakeholders perceive environmental reports to be trustworthy, and the majority of stakeholders suggest that the reports should be verified by independent auditors (Kamala, 2014).

In order to ensure that company reports are credible, a number of guidelines and commissions – such as the GRI, the European Commission and the King III Code – suggest that environmental disclosures be assured (Vos & Reddy, 2014). This requires companies to get an independent auditor involved to ensure that the processes followed to obtain the disclosed information are correct, and that the information is credible (Hassan & Ibrahim, 2012). The main aim of sustainability assurance is to help corporations comply with regulations and guidelines, and conform to internal company policies. Furthermore, during the assurances, the assurers should also prove that they are independent and that the results are objective.

In a study done by Marx and Van Dyk (2011), it was found that environmental assurances are not consistently applied throughout companies, and that only a limited number of companies obtained independent assurances on their sustainability reporting. The companies claim that this is mainly due to the GRI G3 not providing enough detail about this topic. The end result is that the comparability of the reported disclosures is undermined. This is confirmed by Herda, Taylor and Winterbotham (2014), who state that assurances of sustainability disclosures are an important step to develop “consistent and comparable sustainability reports”.

It should however be noted that sustainability reports are often not assured in their complete form; only a few selected indicators that are perceived as valuable are assured. In most cases these indicators are seen as the key performance indicators.

2.3.4 Performance intensities

In environmental reporting, the following terms: intensities ratios, intensities or normalised impacts (hereafter called intensities) refer to a quantitative environmental impact in the context of a company-specific metric. Intensities normalise the environmental impacts of a company according to the size of the company. Intensities are calculated by dividing the specific usage or output by the company-specific measure. These measures can include production, services and sales. In the case of industries, the most common measure used is production intensities (per unit produced). These units could include the number of tonnes processed or the amount of coal produced (*G4 Sustainability Reporting Guidelines*, 2015).

By making use of intensities, the usage or outputs of a company are normalised according to the size of the company or process, which helps contextualise the company's activities and compare it to other companies. Intensities are an effective way in which quantitative measures are displayed. Intensities are often used to compare or benchmark industries or companies in the same sector, and are therefore an important component to compare the quantitative environmental performance of companies (Norgate & Haque, 2010; Northey, Haque & Mudd, 2013).

In a study done by Mudd (2010), the author benchmarks a number of key environmental impacts of gold mines in Australia. The study makes use of environmental values reported in the mining companies' sustainability reports, and divides these values by the total amount of gold produced by the mining companies. However, the study does not report any details regarding the level (ease) of comparability of the quantitative information. The outcome was that, in general, per kilogram of gold produced, mines:

- Consume 634 kl of water.
- Consume 145 gigajoule (GJ) of energy.
- Emit more than 13.9 tCO_2.
- Consume 198 kg of cyanide.

These kinds of benchmarks have the advantage of improving comparability with similar corporations. Mudd (2012) also published a similar study regarding the intensities of platinum mines in Southern Africa. Data obtained for this study includes information disclosed in sustainability reports, as well as data obtained from the mines directly. Mudd identifies the following as significant environmental indicators, and also derives their intensities, per kilogram of platinum group metals (PGM), as follows:

- 1.04 m^3 of water.
- 222 GJ of energy.
- Emitting more than 51.2 tCO_2.

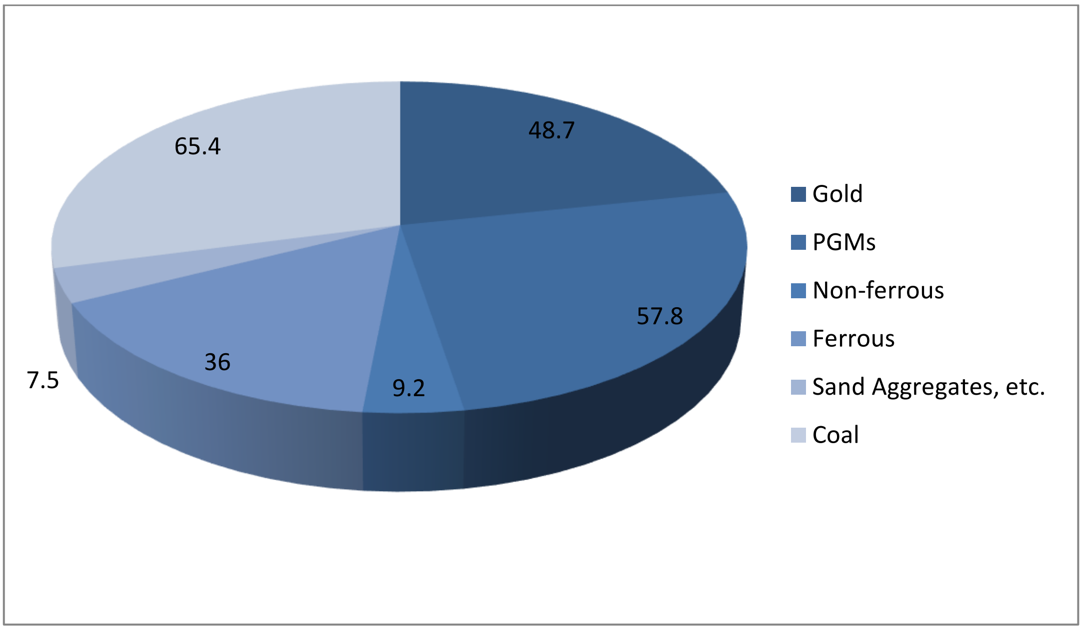
The study also mentions that mine waste and biodiversity are important environmental factors that need to be reported. However, due to the limited data disclosed in the sustainability reports, these indicators could not be evaluated.

2.4 Environmental impacts of mines in South Africa

According to the Chamber of Mines of South Africa (2016), mining in South Africa provides more than 400 000 direct jobs to mostly South African citizens. Through these jobs, more than R4.5-million dependants are supported. In addition to this, mining also contributes 7.1% of South African GDP.

Figure 2.1 shows the value of the different minerals extracted by mines in South Africa. Note the dominance of the PGM and gold sectors. These two groups account for almost 50% of the total value of South African minerals mined. The two sectors also have similar effects on the environment due to the depth from which these minerals need to be extracted (Mudd, 2010; Mudd, 2012).

Figure 2.1: Value of South African mineral outputs in Rand-billions



Source: Minnitt, 2014

Similar to all corporations, South African mines use natural resources to execute their activities. The environmental impacts related to mining can be organised into a number of divisions (Roche & Mudd, 2014), including land disturbances, noise pollution, tailings, impact on water resources, ecosystem disturbances, as well as air and water pollution.

In order to evaluate the environmental impacts that gold and platinum mines have on the environment, the GRI G4 environmental reporting principles were considered. As discussed in Section 2.2, the GRI G4 provides the most comprehensive guideline for sustainability disclosures, and most mining companies use it as a reporting guideline (Mudd, 2012).

According to Norgate and Haque (2010), there are a number of environmental concerns that mining companies have to deal with. However, the three major ones are energy, GHG emissions and water consumption. In his study on the platinum mining industry, Mudd (2012) evaluates the GRI indicators and identifies the following environmental indicators (defined as EN in the GRI) as "most significant":

- EN8 – total water withdrawal by source.

- EN9 – water sources significantly affected by the withdrawal of water.
- EN10 – percentage and total volume of water recycled and reused.
- EN16 – total direct and indirect GHG emissions by weight.
- EN21 – total water discharge by quality and destination.
- EN22 – total weight of waste by type and disposal method.

Mudd also mentions that platinum mining companies in South Africa are at the forefront when it comes to providing valuable information to assess environmental sustainability aspects, with Anglo American Platinum illustrating the best-quality reporting of data and analysis (Mudd, 2012).

In 2013, the GRI published a mining and metals sector supplement (Global Reporting Initiative, 2013) to cover key aspects that are not covered in the G4 guideline. However, the supplement is still criticised for not being specific enough as it was developed for a wide range of industries and mining sectors (Boiral & Henri, 2017). Therefore, in this study, each of the GRI G4 indicators (including the metals and mining supplement (Mining and Metals Sector Disclosure, 2013)) was analysed, together with literature specific to platinum and gold mining, in order to determine the most important quantitative information that needs to be disclosed in the South African context.

In order to structure the next discussion, the environmental impacts were categorised as follows:

1. Materials used.
2. Energy.
3. Water.
4. Emissions.
5. Waste.
6. Impact on land.
7. Environmental expenditures.

2.5 Different environmental impacts of mines

2.5.1 Materials used

"Materials used" refers to the weight of the materials used to produce the company's primary products. This also includes the amount of recycled materials used in the process (*G4 Sustainability Reporting Guidelines*, 2015).

However, the GRI G4 guideline (*G4 Sustainability Reporting Guidelines*, 2015) does not specify which type of materials should be disclosed, what measurement scale should be used, or the methodology that could be followed to determine the important materials that should be disclosed. It is therefore left to the corporations to decide what impact to report on. For this reason, a number of studies have been consulted in order to determine the most important materials that the gold and platinum sector needs to disclose.

The most comprehensive study relating to the use of materials in the South African deep-level mining industry was conducted by Cortie, McEwan and Enright in 1996. Although this study was done more than 20 years ago, it is still relevant as the impacts of mining on the environment remain the same (Roche & Mudd, 2014). The study indicates that materials consumed in mines make up 40% of all items consumed. Of these materials, timber (16.1%) as well as iron and steel (15.5%) are mostly consumed. Cement is also used to a lesser degree as shotcrete to re-enforce underground tunnels. Due to the large amount of cement, iron and steel used, the abovementioned study reports these consumption figures in tonnes.

The gold refining process is also known to consume large amounts of cyanide. As pointed out by Mudd (2010), 198 kg of cyanide is needed to produce one kilogram of gold. The annual total amount of cyanide is however expressed in tonnes. The process is also dependant on caustic soda and hydrochloric acid to regulate the alkaline/acid levels (ph) of the solution. It is therefore assumed that these elements are also expressed in tonnes.

The GRI G4 guideline also requires companies to disclose the amount of recycled materials consumed. In mining, several materials can be recycled or re-used. The most common and significant materials that are re-used in mines include metal and timber (Gold Fields, 2016).

2.5.2 Energy

The GRI G4 energy guideline (*G4 Sustainability Reporting Guidelines*, 2015) is much more comprehensive than that of materials used. The guideline specifies that corporations should report on the total fuel and energy (renewables as well as non-renewables) used in their processes. Furthermore, the energy intensities, as well as energy reduction, should be disclosed. The guideline goes as far as to specify the measurement units (watt-hours, joules or multiples) that could be used to indicate the impacts. However, this impacts the level of comparability, as discussed in the previous section. As far as energy intensities are concerned, according to Mudd (2012) and Roche and Mudd (2014), these figures should be disclosed in gigajoule per kilogram of gold or PGMs produced.

Other major sources of energy used in South African deep-level mining include petrol (expressed in litres), diesel (litres) and explosives (tonnes) (Gold Fields, 2016). Large amounts of coal are also used in the platinum smelting process (tonnes) (Mudd, 2012).

Of all these energy sources, electricity is mostly consumed. In South Africa, mining is responsible for more than 15% of total electricity consumption, expressed in gigawatt hours (GWh) (Eskom, 2016). However, since more than 90% of South Africa's electricity is produced by coal-fired power stations (Fisher & Downes, 2014), mining is also indirectly responsible for a large amount of carbon dioxide pollution.

2.5.3 Water

The impact of mining on water resources is probably one of the most discussed topics. Mines do not only need large amounts of water resources to operate, but they also contaminate this much-needed resource, which often has a significant impact on the downstream environment (Northey, Mudd, Saarivuori, Wessman-Jääskeläinen & Haque, 2016).

Mining is responsible for contaminating water with hazardous minerals and metals, which affect the water in such a way that it is acidified, and this could result in water ph levels reaching 2 to 3. This contaminated water ends up in streams and kills living organisms, which further affects the quality of water resources (Roche & Mudd, 2014).

Similar to energy impact, the water section of the GRI G4 (*G4 Sustainability Reporting Guidelines*, 2015) gives reporting specifics that are less open to interpretation. The GRI G4 guideline states that corporations should specify the total amount of water (usually in litres (Mudd, 2010; Northey *et al.*, 2013)) used, as well as the source of the water. These sources are defined as:

- Surface water (wetlands, rivers and oceans among others).
- Ground water (such as boreholes or fissure water).
- Rain water collected.
- Waste water from other corporations.
- Municipal water, including potable water.

Furthermore, the GRI G4 guideline also stipulates that corporations should report on the amount of water recycled in both percentage and quantity.

2.5.4 Emissions

The GRI G4 guideline (G4 Sustainability Reporting Guidelines, 2015) specifies that corporations should report on their GHG emissions (in tonnes), as well as on ozone-depleting substances such as nitrogen oxide (NOX), sulphur oxide (SOX) and other significant air emissions. The guideline specifies that the emissions should be further broken down into:

- Scope 1 – direct GHG emissions.
- Scope 2 – energy indirect emissions such as electricity.
- Scope 3 – other indirect emissions such as travel and material transportation.

It is further proposed that the GHG emission intensity ratio should be reported, and that corporations should indicate which types of emissions (scope 1, 2 or 3) are included in the calculations. These figures could be disclosed in tonnes of CO_2 per kilogram of gold or PGMs produced (Mudd, 2012; Roche & Mudd, 2014).

Due to the high consumption of electrical energy in mines, scope 2 emissions are expected to be the most significant contributor to GHG emissions. However, a study done by Brand (2014) states that deep-level South African mines are also exposed to methane. These methane pockets are released as the mines are developed and can take years to drain. Methane has just as much impact on climate change as carbon dioxide (Brand, 2014).

2.5.5 Waste

According to the GRI G4 guideline (*G4 Sustainability Reporting Guidelines*, 2015), the total amount of waste disposed of – both hazardous and non-hazardous – should be reported. This includes a number of waste-disposal methods, including landfills, on-site storage and recycling. Corporations should also report on all significant spills that occur, and should include information on the location of the spill, the volume of spilled material, the type of material and the impact of the spill.

Most mine waste is produced in the form of waste dumps and tailings. “Waste dumps” refers to the rock that does not contain any gold or PGM, and that is dumped on the surface after being extracted from the mine. “Tailings” refers to ore-containing rock that is processed; after the PGMs or gold are extracted, this rock is pumped into dams

(Rösner & Van Schalkwyk, 2000). A number of mines in South Africa are also busy reprocessing or recycling old mine dumps in order to retrieve the remaining ore that was not previously extracted (Masilo, Beatrix & Rapson, 2017). Generally, less than 1% of the total rock mined contains gold or PGMs. The amount of rock waste produced is therefore significant and is expressed in tonnes (Mudd, 2012).

2.5.6 Impact on land

Under the biodiversity section of the GRI G4 guideline (*G4 Sustainability Reporting Guidelines*, 2015), companies need to report quantitatively on the positive and negative impacts of their operations on biodiversity. Companies therefore need to report on the magnitude and location of the habitats or land areas disturbed, as well as the habitats that have been restored.

The amount of land directly disturbed is a key generic environmental impact indicator (Murguía & Bringezu, 2016). Figure 2.2 illustrates the disturbances that mining has on the landscape near the town of Thabazimbi in South Africa.

Figure 2.2: Example of the effect of mining on the environmental landscape

Source: Google Maps, 2017

According to South African law, mines are allocated a limit on the maximum amount of land that can be disturbed (Murguía & Bringezu, 2016). This is called the "mining right area" and is usually measured in hectares. In order for mines not to breach these limits, areas are often audited and managed. The land is also rehabilitated so that extra capacity is created under the licenced mining right area.

2.5.7 Environmental expenditures

Under section G4-EN31, the GRI G4 guideline (*G4 Sustainability Reporting Guidelines*, 2015) specifies that companies should disclose their total environmental expenditures quantitatively. This includes waste disposal, treatment, remediation costs, as well as prevention and environmental management costs.

In South Africa, the law further requires mines to make financial provisions and guarantees (expressed in Rands) to undertake remediation of the environmental impacts brought about by the mines (Masilo *et al.*, 2017). The provision should be large enough to cover all the costs involved in restoring the environment if the mine were to close down. It is therefore important that these two aspects, namely annual environmental expenditure and environmental remediation guarantees, be included in environmental disclosures.

2.6 Summary of platinum and gold mining quantitative disclosures

Figure 2.3 and Figure 2.4 summarise the important quantitative environmental elements, as well as the measurement scales that are expected to be used by gold and platinum mines. These models were configured using the environmental discussion in Chapter 2, and will be used to assess each mining company's disclosures, in order to determine the comparability of the quantitative environmental disclosures.

Note that the expected disclosures for platinum and gold mining companies are almost identical, apart from the following two aspects: the additional materials used by gold mines in the refining process, and the fact that platinum mines use coal as a source of energy in the smelting process. More detail regarding the elements are discussed in Chapter 3.

Figure 2.3: Gold mining environmental elements

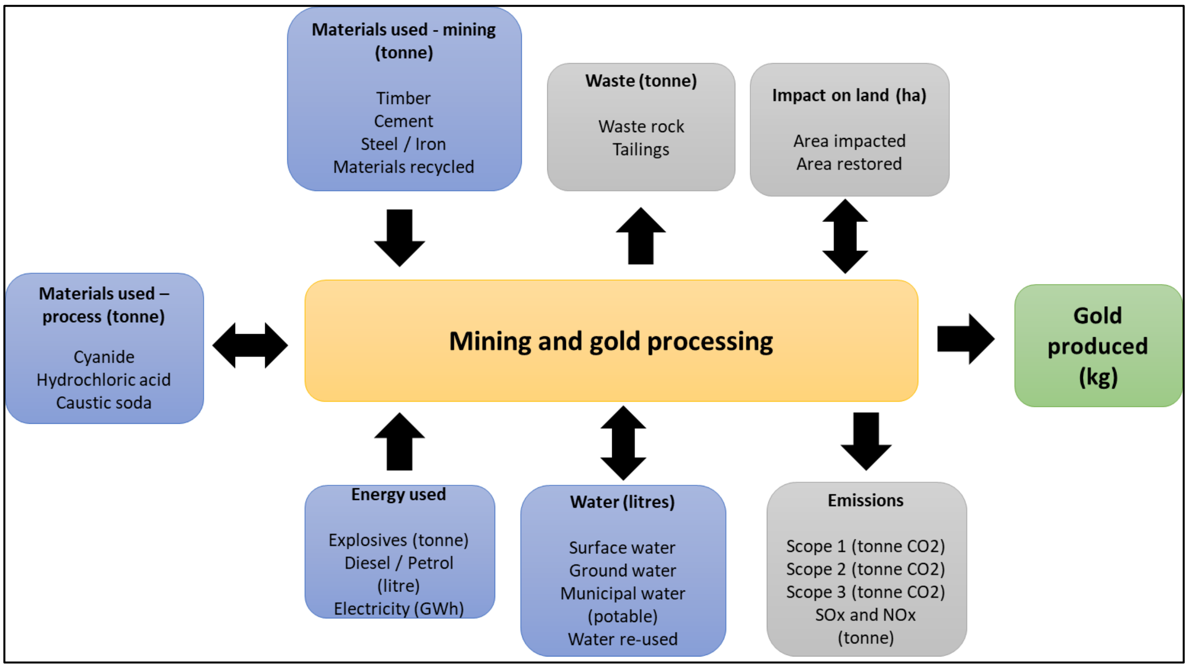
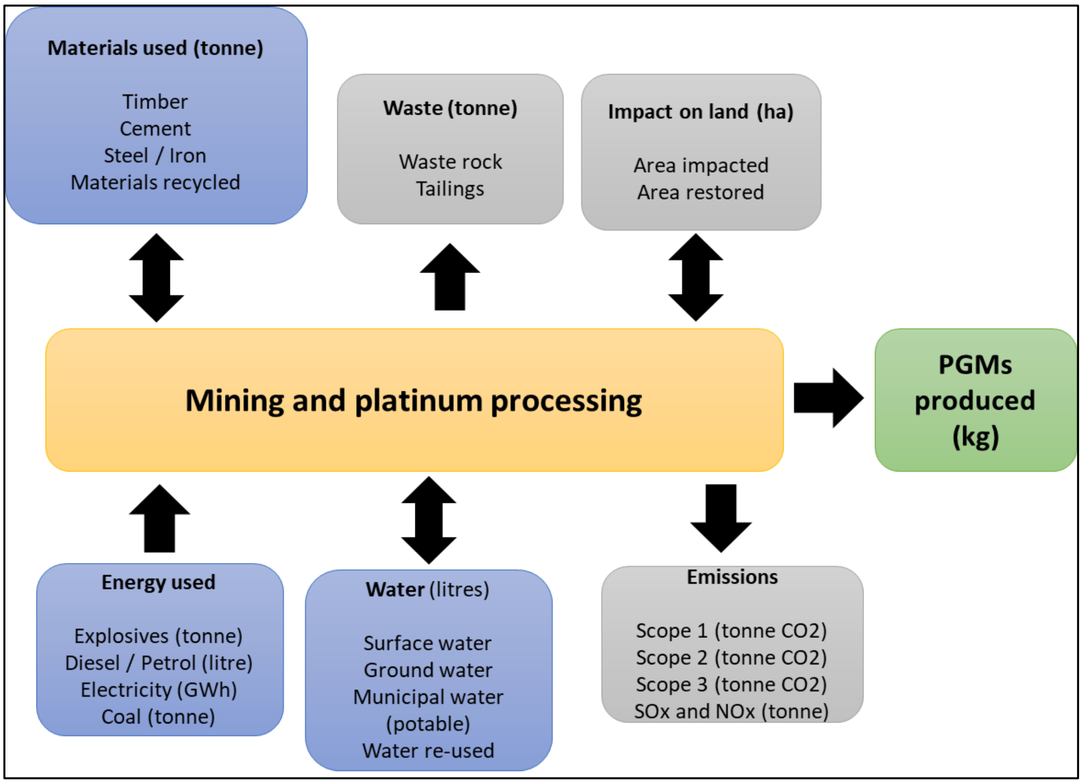


Figure 2.4: Platinum mining environmental elements



2.7 Conclusion

In this chapter, background was given regarding the need for sustainability reporting and the theory behind it. An important factor that increases the quality of sustainable reporting is the comparability principle. This principle refers to the fact that sustainability disclosures should be comparable to similar corporations. Furthermore, past research (De Franco *et al.*, 2011) has also found that quantitative disclosures improve the comparability of performance between corporations, and that quantitative disclosures are more “objective and informative” to stakeholders than qualitative disclosures (Al-Tuwaijri *et al.*, 2004). The GRI G4 guideline (*G4 Sustainability Reporting Guidelines*, 2015) also places significant emphasis on the disclosure of quantitative information.

To evaluate the comparability of quantitative environmental disclosures, four key components of quantitative comparability were defined. These are: compliance with different GRI G4 indicators, measurement scales used, assurances of disclosed information, and the quantification of environmental disclosures in terms of intensities (impact per product produced).

It was also found that the GRI G4 guideline (*G4 Sustainability Reporting Guidelines*, 2015) is one of the most complete and often-used sustainability reporting guidelines available. This guideline was then used, together with other literature available, to identify the most important quantitative environmental elements that gold and platinum mines need to report on. Quantitative environmental disclosure models were then developed for the gold and platinum mining industries. These reporting models will be applied in the next chapter to identify the level of comparability between South African platinum and gold mines.

CHAPTER 3 – EMPIRICAL STUDY

3.1 Introduction

The objective of this study is to evaluate the level of comparability of quantitative environmental information by analysing the annual reports of South African gold and platinum mining companies. The aim is therefore to determine which of the quantitative environmental elements disclosed by the different mining companies can be compared with relative ease.

In this Chapter, 31 different environmental elements applicable to mines were evaluated. These elements include land area impacted, coal usage, water discharged, greenhouse gas emissions, etc. The literature study in Chapter 2 was also used to develop a comparability checklist. This checklist was applied to 12 mining corporations in South Africa that have significant environmental impacts. Results from the checklist were then inserted into a comparability classification model. The model classifies the level of comparability of each of the disclosed environmental elements into four categories (strong, moderate, weak and limited).

3.2 Research method

Manual content analysis was used to analyse the quantitative environmental data published in annual reports of the selected mining companies. Content analysis refers to a mixed research technique that can be applied to references in order to extract the context and intentions contained in messages. Previous studies indicate that content analysis is regarded as a suitable method for this type of research (Smit & Van Zyl, 2016). The reason for this is that information is usually disclosed in tables, figures, graphs and text. By making use of content analysis, all the information as presented in the annual reports can be captured.

This study uses a checklist, developed from the literature study, as a measuring instrument. The checklist contains specific statements and questions regarding quantitative environmental indicators. The GRI G4 guideline, as well as other literature, was studied in order to identify important quantitative environmental indicators that platinum and gold mines are expected to report on. The important quantifiable environmental indicators most relevant to the gold and platinum mining companies are separated into seven main categories and are provided in Table 3.1. This table can also be used as a guideline by gold and platinum mines to determine which quantifiable environmental disclosures they need to report on.

Table 3.1: Main environmental categories and quantitative elements

Quantitative elements	G4 code indicator	Expected measurement scale
Materials used		
Cyanide	EN1	Tonnes
Caustic soda	EN1	Tonnes
Hydrochloric acid	EN1	Tonnes
Timber	EN1	Tonnes
Cement	EN1	Tonnes
Steel	EN1	Tonnes
Recycled materials used	EN2	Tonnes
Energy		
Electricity	EN3	MWh
Petrol and diesel	EN3	Litres
Explosives	EN3	Tonnes
Coal	EN3	Tonnes
Energy intensity ratio	EN5	GJ / tonne
Water		
Surface water	EN8	Litres
Ground water	EN8	Litres
Municipal water supply	EN8	Litres
Total volume of water recycled	EN10	Litres
Total volume of water recycled (%)	EN10	%
Water discharged	EN22	Litres
Emissions		
Scope 1	EN15	Tonne CO_2
Scope 2	EN16	Tonne CO_2
Scope 3	EN17	Tonne CO_2
GHG intensity ratio	EN18	Tonne CO_2 / Tonne mined
SO_X	EN21	Tonnes
NO_X	EN21	Tonnes
Waste		
Waste dumps	EN23 MM3	Tonnes
Tailings	EN23 MM3	Tonnes
Hazardous waste	EN23 MM3	Tonnes
Impact on land		
Area impacted	EN12 MM1	ha
Area restored	EN12 MM1	ha
Environmental expenditures		
Environmental expenditures	EN31	Rand-million
Restoration funding set aside	EN31	Rand-million

From Table 3.1 it can be seen that there are seven main categories, namely materials used, energy, water, emissions, waste, impact on land and environmental expenditures. Each of these categories has a number of environmental elements, such as cyanide, caustic soda, and so forth. Next to each of these elements, the relevant GRI code indicator and the expected measurement scale are provided. A list of the GRI codes and specific indicator descriptions are listed in Table 3.2. Note that only indicators that require quantitative disclosures and that are directly related to mining activities are considered. Therefore, indicators such as "energy outside the organisation" and "water sources significantly affected by the withdrawal of water" have been excluded.

Table 3.2: GRI G4 code indicator and description

G4 code	Description
EN1	Materials used by weight or volume
EN2	Percentage of materials used that are recycled input materials
EN3	Energy consumption within the organisation
EN5	Energy intensity
EN8	Total water withdrawal from source
EN10	Percentage and total volume of water recycled and reused
EN12 MM1	Amount of land (owned or leased, and managed for production activities or extractive use) disturbed or rehabilitated
EN15	Direct GHG emissions (scope 1)
EN16	Direct GHG emissions (scope 2)
EN17	Direct GHG emissions (scope 3)
EN18	GHG emissions intensity
EN21	NO_x, SO_x and other significant air emissions
EN22	Total water discharge by quality and destination
EN23 MM3	Total amount of overburden, rock, tailings and sludges, and their associated risks
EN31	Total environmental protection expenditures and investments by type

The three key comparability factors – namely the type of information disclosed, the measurement scale used, and assurance for each of the quantitative environmental elements – form part of the checklist. These factors were derived from literature and assess the comparability of the quantitative environmental information that companies disclose. Again, it should be highlighted that the purpose of including these factors is to assist in identifying the similarities or differences between the information that companies disclose, rather than comparing a specific company's performance over time.

The first comparability factor assesses whether the elements are quantified. Boiral and Henri (2017) found that this factor directly influences the comparability of information disclosed. The second factor assesses whether different measurement scales are used to quantify the elements. Boiral and Henri (2017) found that the use of different measurement scales complicates the comparability of quantitative information. The last factor relates to third-party assurance. Kamala (2014) states that stakeholders perceive disclosures to be unreliable, and suggests that disclosures should be verified by independent auditors in order to make the information trustworthy, credible and objective. Marx and Van Dyk (2011) further state that by assuring disclosures, stakeholders will put more trust in the information, which in turn will increase comparability.

Annual reports were studied and evaluated against the checklist to determine the level of comparability of the environmental disclosures. A systematic and methodical approach was used to ensure that results are accurate. Furthermore, the reports were re-evaluated twice to ensure that the indicator checklist was completed as thoroughly as possible. The study therefore made use of a formal procedure to populate the checklist that was developed through the literature review.

The samples used consist of platinum and gold mining companies in South Africa. The reason for selecting these mining sectors as samples is that gold and platinum mining companies represent 48% of the total South African mineral output in Rand value (Minnitt, 2014). They also use similar mining methods to extract ore, and thus are expected to have the same impact on the environment. Furthermore, Mudd (2012) states that "the PGM (platinum) sector is arguably a world leader in the area of sustainability reporting in the mining industry". Therefore, it can be expected that the empirical analysis will present a best-case scenario.

In order to select the most prominent platinum and gold mining companies in South Africa, all gold and platinum companies that are members of the Chamber of Mines of South Africa were used as samples. The Chamber of Mines of South Africa is a mining-industry employer organisation and claims that the biggest mining companies in South Africa form part of the organisation (Chamber of Mines of South Africa, 2017). Lastly, all the companies are also registered at the GRI.

The latest annual reports of the sampled companies were downloaded from their relevant websites. A list of the mining companies, together with the period covered, is shown in Table 3.3.

Table 3.3: Details of mining companies

	Mining company	Sector	Report end date
1	AngloGold Ashanti (AGA)	Gold	1 Jan 2016 to 31 Dec 2016
2	Sibanye Gold (SG)	Gold	1 Jan 2016 to 31 Dec 2016
3	Gold Fields (GF)	Gold	1 Jan 2016 to 31 Dec 2016
4	Harmony Gold (HAR)	Gold	1 Jul 2015 to 30 Jun 2016
5	Pan African Resources (PAR)	Gold	1 Jul 2015 to 30 Jun 2016
6	DRDGOLD (DRD)	Gold	1 Jul 2015 to 30 Jun 2016
7	Anglo American Platinum (AAP)	Platinum	1 Jan 2016 to 31 Dec 2016
8	Lonmin (LP)	Platinum	1 Oct 2015 to 30 Sep 2016
9	Impala Platinum (IP)	Platinum	1 Jan 2016 to 31 Dec 2016
10	Bafokeng Rasimone Platinum (BRP)	Platinum	1 Jan 2016 to 31 Dec 2016
11	Wesizwe Platinum (WP)	Platinum	1 Jan 2016 to 31 Dec 2016
12	Northam Platinum (NP)	Platinum	1 Jul 2015 to 30 Jun 2016

3.3 Comparability results of elements

3.3.1 Overview analysis

- **Objective**

  The objective of the overview analysis was to develop a “first impression” regarding whether or not the quantitative environmental information is comparable.

- **Method**

  The seven main environmental categories were analysed based on the checklist that was developed. If quantitative information was provided for any of the main categories, the relevant block, indicated in Table 3.4, was marked with an “x”.

- **Results**

  The results of the seven main categories analysed are shown in Table 3.4.

Table 3.4: Analysis of main categories

Main categories	Mines											
	HAR	AGA	SG	GF	PAR	DRD	LP	IP	NP	AAP	BRP	WP
Materials used	x	x	x	x	x	x	x	x	x	x		
Energy	x	x	x	x	x	x	x	x	x	x	x	x
Water	x	x	x	x	x	x	x	x	x	x	x	x
Impact on land	x	x	x	x	x	x	x	x	x	x	x	x
Emissions	x	x	x	x	x	x	x	x	x	x	x	x
Waste	x	x	x	x	x		x	x	x	x		x
Environmental expenditures	x	x	x	x	x	x	x	x	x	x		

- **Analysis of results**
  - Most of the blocks are marked with an “x”. This indicates that, in a broad sense, the reports contain some quantitative information regarding the main categories.

- Only DRDGOLD (DRD), Bafokeng Rasimone Platinum (BRP) and Wesizwe Platinum (WP) did not provide quantitative reporting on all of the main categories.
- The first impression analysis therefore indicated that the seven environmental categories are quantified.

A more detailed analysis was then performed on the 31 elements in each of the seven main categories.

3.3.2 Overall comparability of elements

- **Objective**

  The objective of this analysis was to evaluate the total comparability level of each of the 31 quantifiable elements.

  -

- **Method**

As discussed earlier, each of the elements was analysed according to the three comparability factors. While conducting the content analysis on the annual reports, a checklist (see example in

Table 3.5) was completed to evaluate each of the elements based on the three comparability factors. If the mine:

  - Quantitatively reported on a specific element, the relevant block was marked with an “x”.
  - Used the expected measurement scale (as indicated in Table 3.1), the relevant block was marked with an “o”.
  - Assured the element’s quantitative value, the relevant block was marked with a “+”.

“N/A” indicates that the specific element is not relevant to the mining company.

After the checklist was completed, the number of “xs”, “os” and “+s” for each element was accumulated and reported.

Table 3.5: Extract from checklist

	Element
Mining company	**Electricity**
HAR	x o +
AGA	
SG	x o +
GF	x o +
PAR	x o +
DRD	x o +
LP	x o +
IP	x o +
NP	x o +
AAP	x
BRP	
WP	x o +
No. ticks per element	28/36
Average percentage of element	78%

The number of boxes ticked was converted into a percentage metric based on the total number of checkboxes. Therefore, if only 18 of the 36 checkboxes were ticked, the percentage metric would indicate 50%.

In order to determine the total comparability level for each of the 31 quantifiable elements, a comparability score and level of comparability were modelled. To convert the percentage metric into a score, the percentage metric of each of the elements was converted to a score between 1 and 4, similar to a study done by Smit and Van Zyl (2016). This method simplifies the analysis.

- For a percentage metric less than 25%, a score of 1 was given. This indicates a limited level of comparability.
- A percentage metric between 25% and 50% was given a score of 2. This indicates a weak level of comparability.
- A percentage metric between 51% and 80% was given a score of 3. This indicates a moderate level of comparability.

- A score of 4 was given if the percentage metric was above 80%. This indicates a strong level of comparability.

Table 3.6 lists the scores and classification of comparability.

Table 3.6: Scores and classification of results

Percentage metric	Score	Comparability level
<25%	1	Limited
Between 25% and 50%	2	Weak
Between 51% and 80%	3	Moderate
>80%	4	Strong

- **Results**

  Table 3.7 lists the scores and comparability of all the elements. The elements were also ranked based on their comparability level, from best to worst.

Table 3.7: Scores and comparability level of elements

Element	Boxes ticked	% of boxes ticked	Score	Comparability level
Scope 1	35/36	97%	4	strong
Scope 2	35/36	97%	4	strong
Petrol and diesel	15/18	83%	4	strong
Municipal water supply	29/36	81%	4	strong
Electricity	28/36	78%	3	moderate
Ground water	23/36	64%	3	moderate
Cyanide	22/36	61%	3	moderate
Total volume of water recycled	22/36	61%	3	moderate
Scope 3	10/18	56%	3	moderate
Coal	18/36	50%	2	weak
Surface water	18/36	50%	2	weak
Tailings	17/36	47%	2	weak
Caustic soda	16/36	44%	2	weak
NO_X	16/36	44%	2	weak
Waste dumps	16/36	44%	2	weak
Environmental expenditures	15/36	42%	2	weak
Total volume of water recycled (%)	14/36	39%	2	weak
Area impacted	14/36	39%	2	weak
Explosives	13/36	36%	2	weak
Restoration funding set aside	13/36	36%	2	weak
Area restored	12/36	33%	2	weak
Energy intensity ratio	12/36	33%	2	weak
SO_X	11/36	31%	2	weak
Hydrochloric acid	10/36	28%	2	weak
GHG intensity ratio	10/36	28%	2	weak
Timber	7/36	19%	1	limited
Hazardous waste	6/36	17%	1	limited
Water discharged	5/36	14%	1	limited
Cement	4/36	11%	1	limited
Recycled materials used	4/36	11%	1	limited
Steel	2/36	6%	1	limited

- **Analysis of results**
  - The average checkboxes ticked was 44%, while the average comparability score was 2.2 out of 4.
  - The percentage of boxes ticked for the elements ranged from 6% to 97%.
  - Scope 1 and 2 showed the highest level of comparability (35 of 36 boxes ticked).

- Scope 1, scope 2, petrol and diesel, and municipal water supply showed a strong level of comparability.
- Steel showed the lowest comparability level (2 of 36 boxes ticked).
- Four of the 31 elements (13%) showed a strong level of comparability.
- Five of the 31 elements (16%) showed a moderate level of comparability.
- Sixteen of the 31 elements (50%) showed a weak level of comparability.
- Six of the 31 elements (19%) showed a limited level of comparability. These elements include steel, recycled materials used, cement, water discharged, hazardous waste and timber.
- Both of the intensity ratios listed, i.e. the energy and GHG intensity ratio, showed a weak level of comparability. As indicated in literature, these two elements are important for comparing the performances of different mining companies.

3.4 Total comparability of main categories

- **Objective**

  The objective of this analysis was to evaluate the total comparability level of the seven main categories.

- **Method**

  To determine the total comparability level of each of the seven main categories, the number of boxes ticked for each of the main categories was converted to a percentage metric, similar to Section 3.3.2.

- **Results**

  Table 3.8 illustrates the comparability of the main categories. The comparability was ranked from highest to lowest, based on the percentage of boxes ticked.

Table 3.8: Comparability of main categories

Element	Boxes ticked	% of boxes ticked
Energy	95/162	58%
Emissions	126/216	58%
Water	109/216	50%
Impact on land	30/72	42%
Environmental expenditures	28/72	39%
Waste	39/108	36%
Materials used	46/216	21%

- **Analysis of results**
  - The average checkboxes ticked was 44%.
  - The main categories of energy and emissions showed the strongest level of comparability (58% of boxes ticked).
  - Materials used showed the weakest level of comparability, as only 21% of the boxes were ticked.
  - Emissions, water and materials used are the categories with the most boxes (216).

3.4.1 Materials used

- **Objective**

  The objective of this analysis, which consists of seven elements for gold mining companies and five elements for platinum mining companies, was to evaluate the comparability level of the materials used as part of the reported information.

- **Method**

  From literature, "materials used" refers to all materials that have an impact on the environment and are used to produce, in this case, gold and PGMs. The checklist developed contains seven quantitative elements to assess gold mining companies, and five for platinum mining companies. As discussed earlier, each of the elements was analysed according to the three comparability factors.

- **Results**

  Table 3.9 shows the results for the materials used in production.

Table 3.9: Materials used checklist

	Elements																				
Mining company	**Cyanide**			**Caustic soda**			**Hydrochloric acid**			**Timber**			**Cement**			**Steel**			**Recycled materials used**		
HAR	x	o																			
AGA	x	o		x	o		x	o													
SG	x	o		x	o		x	o		x	o		x	o							
GF	x	o	+	x	o		x	o					x	o					x	o	
PAR										x	o										
DRD	x	o		x	o		x	o								x	o				
LP		N/A			N/A					x	o								x	o	
IP		N/A			N/A																
NP		N/A			N/A		x	o		x											
AAP		N/A			N/A																
BRP		N/A			N/A																
WP		N/A			N/A																
No. of x, o or + per element	5/6	5/6	1/6	4/6	4/6	0/6	5/12	5/12	0/12	4/12	3/12	0/12	2/12	2/12	0/12	1/12	1/12	0/12	2/12	2/12	0/12
Percentages	83%	83%	17%	67%	67%	0%	42%	42%	0%	33%	25%	0%	17%	17%	0%	8%	8%	0%	17%	17%	0%
Average percentage of element	61%			44%			28%			19%			11%			6%			11%		

- **Analysis of results**
  - From Table 3.9 it can be seen that the companies disclose different elements randomly.
  - Cyanide was the only element that was assured, and Gold Fields was the only company to have done so.
  - Steel showed the worst comparability, as only one company (DRDGOLD) disclosed information regarding this element.
  - In the case of cement and recycled materials used, only two companies disclosed quantitative information.
  - Northam Platinum was the only company that disclosed quantitative information but did not use the expected measurement scale. This company used cubic metres as a measurement scale instead of the expected tonnes.
  - When considering the average percentage of the elements, cyanide scored the highest at 61%, while steel only scored 6%.

3.4.2 Energy

- **Objective**

  The objective of this analysis, which consists of four elements for gold mining companies and five elements for platinum mining companies, was to evaluate the comparability level of the energy elements reported by the mining companies. Energy inputs that should be reported on include electricity, petrol and diesel, explosives, coal and the energy intensity ratio.

- **Results**

  Table 3.10 shows the results of the checklist for the energy elements.

Table 3.10: Energy checklist

	Elements														
Mining company	**Electricity**			**Petrol and diesel**			**Explosives**			**Coal**			**Energy intensity ratio**		
HAR	x	o	+	x	o						N/A		x		
AGA				x	o		x	o			N/A		x	o	+
SG	x	o	+	x		+	x	o			N/A		x		
GF	x	o	+	x		+	x	o			N/A		x	o	+
PAR	x	o	+	x	o		x	o			N/A				
DRD	x	o	+	x	o	+					N/A				
LP	x	o	+	x	o	+				x	o	+	x		
IP	x	o	+	x	o	+				x	o	+	x	o	
NP	x	o	+	x		+	x	o	+						
AAP	x			x	o	+				x	o	+			
BRP				x	o	+	x	o							
WP	x	o	+	x	o	+									
No. of x, o or + per element	10/12	9/12	9/12	12/12	9/12	9/12	6/12	6/12	1/12	3/6	3/6	3/6	6/12	3/12	2/12
Percentages	83%	75%	75%	100%	75%	75%	50%	50%	8%	50%	50%	50%	50%	25%	17%
Average percentage of element		78%			75%			36%			50%			31%	

- **Analysis of results**
  - Petrol and diesel was the only element that was disclosed by all companies. Nine of the 12 companies used the correct measurement scale, and nine of the 12 companies assured their petrol and diesel data.
  - Some companies reported electricity as well as petrol and diesel usage in joules (instead of litres).
  - Ten of the 12 companies disclosed their electricity data quantitatively, while nine of the 12 companies used the correct measurement scale and assured the elements. Some companies reported electricity in joules (instead of watt-hours).
  - Only half (six out of 12) of the companies disclosed explosives and energy intensity ratio.
  - Three of the six platinum mining companies disclosed their coal values quantitatively.
  - The average percentages of electricity as well as petrol and diesel were relatively high, at 78% and 75% respectively.
  - The average percentage of energy intensity ratio was only 31%.

3.4.3 Water

- **Objective**

  The objective of this analysis, which consists of six elements, was to evaluate the comparability level of reported information on water. The water elements include surface water, ground water, municipal water supply, total volume of water recycled, total volume of water recycled (%) and water discharged.

- **Results**

  Table 3.11 shows the results of the checklist for the water elements.

Table 3.11: Water checklist

	Elements																	
Mining company	**Surface water**			**Ground water**			**Municipal water supply**			**Total volume of water recycled**			**Total volume of water recycled (%)**			**Water discharged**		
HAR	x		+	x		+	x		+	x			x					
AGA	x	o	+	x	o	+	x	o	+	x	o	+	x	o	+			
SG				x	o	+	x	o	+									
GF	x	o	+	x	o	+				x	o	+	x	o	+	x	o	+
PAR	x			x			x											
DRD	x	o	+				x	o	+	x	o		x	o				
LP							x	o	+	x	o							
IP	x	o	+	x	o	+	x	o	+	x	o		x	o				
NP				x	o		x	o		x	o	+	x	o	+			
AAP	x	o	+	x	o	+	x	o	+	x	o					x	o	
BRP							x	o	+	x	o							
WP				x	o	+	x	o	+									
No. of x, o or + per element	7/12	5/12	6/12	9/12	7/12	7/12	11/12	9/12	9/12	9/12	8/12	3/12	6/12	5/12	3/12	2/12	2/12	1/12
Percentages	58%	42%	50%	75%	58%	58%	92%	75%	75%	75%	67%	25%	50%	42%	25%	17%	17%	8%
Average percentage of element	50%			64%			81%			56%			39%			14%		

- **Analysis of results**
  - Municipal water supply was reported by 11 of the 12 mining companies, while nine of the companies used the expected measurement scale, and nine of the companies assured the element.
  - Nine of the 12 companies reported on ground water, while seven of them used the expected measurement scale and assured the element.
  - The total volume of water recycled was reported by six companies, while only three companies assured the element.
  - Water discharged was reported by two of the companies, while only one of the companies assured the figures.
  - In terms of average percentages, municipal water supply showed the highest percentage at 81%, while water discharged scored a poor 17%.

3.4.4 Emissions

- **Objective**

  The objective of this analysis, which consists of six elements, was to evaluate the comparability level of the information reported on emissions. These elements include scope 1, scope 2, scope 3, GHG intensity ratio, SO_X and NO_X.

- **Results**

  Table 3.12 shows the results of the checklist for emissions.

Table 3.12: Emissions checklist

	Elements																	
Mining company	**Scope 1**			**Scope 2**			**Scope 3**			**GHG intensity ratio**			**SO_x**			**NO_x**		
HAR	x	o	+	x	o	+	x	o	+	x	o							
AGA	x	o	+	x	o	+				x	o	+	x	o		x	o	
SG	x	o	+	x	o	+	x	o	+				x	o		x	o	
GF	x	o	+	x	o	+	x	o	+	x	o		x	o		x	o	
PAR	x	o		x	o					x	o							
DRD	x	o	+	x	o	+	x	o					x	o		x	o	
LP	x	o	+	x	o	+	x	o		x								
IP	x	o	+	x	o	+							x	o	+	x	o	+
NP	x	o	+	x	o	+	x	o								x	o	+
AAP	x	o	+	x	o	+										x	o	
BRP	x	o	+	x	o	+	x	o										
WP	x	o	+	x	o	+	x	o										
No. of x, o or + per element	12/12	12/12	11/12	12/12	12/12	11/12	8/12	8/12	3/12	5/12	4/12	1/12	5/12	5/12	1/12	7/12	7/12	2/12
Percentages	100%	100%	92%	100%	100%	92%	67%	67%	25%	42%	33%	8%	42%	42%	8%	58%	58%	17%
Average percentage of element	92%			92%			53%			28%			31%			58%		

- **Analysis of results**
  - Both scope 1 and scope 2 were reported by all the companies and used the expected measurement scale. Only Pan African Resources (PAR) did not assure the figures.
  - All mining companies used the expected measurement scales to quantify elements, except for Lonmin’s GHG intensity ratio.
  - Eight of the companies reported on Scope 3, and three of the companies assured the reported information.
  - Five of the companies reported on the GHG intensity ratio and SO_X, while only one of the companies assured these figures.
  - In terms of the average percentages of the elements, scope 1 and scope 2 showed the highest percentage at 92%, while GHG intensity ratio scored only 28%.

3.4.5 Waste

- **Objective**

  The objective of this analysis was to evaluate the comparability level of information reported on waste, which consists of three elements: waste dumps, tailings and hazardous waste.

- **Results**

  Table 3.13 shows the comparability levels of the waste elements.

Table 3.13: Waste checklist

	Elements								
Mining company	**Waste dumps**			**Tailings**			**Hazardous waste**		
HAR	x	o	+	x		+			
AGA	x	o	+	x	o	+	x	o	+
SG	x	o		x	o				
GF	x	o		x	o				
PAR				x	o				
DRD									
LP	x	o		x	o		x	o	
IP	x	o		x	o				
NP									
AAP	x		+	x		+			
BRP									
WP							x		
No. of x, o or + per element	7/12	6/12	3/12	8/12	6/12	3/12	3/12	2/12	1/12
Percentages	58%	50%	25%	67%	50%	25%	25%	17%	8%
Average percentage of element	44%			47%			17%		

- **Analysis of results**
  - Tailings were reported by eight of the companies, while only three of the companies assured the element.
  - Hazardous waste was reported by only three of the companies, while only one of these companies assured the information.
  - It was found that, in the case of waste dumps and tailings, some mining companies reported the current size of the dumps (accumulated figures) whereas others reported on the amount of waste or tailings that was added during the specific year.
  - The average percentages of waste dumps and tailings are 44% and 47% respectively, while hazardous waste scored a poor 17%.

3.4.6 Impact on land

- **Objective**

  The objective of this analysis was to evaluate the comparability level of information on the impact on land, which consists of two elements: area impacted and area restored.

- **Results**

  Table 3.13 shows the comparability levels of elements related to the impact on land.

Table 3.14: Impact on land checklist

	Elements					
Mining company	**Area impacted**			**Area restored**		
HAR	x	o		x	o	
AGA	x	o	+	x	o	+
SG	x	o				
GF	x	o		x	o	
PAR	x	o		x	o	
DRD						
LP	x			x		
IP				x	o	
NP	x	o				
AAP	x	o				
BRP						
WP	x	o				
No. of x, o or + per element	9/12	8/12	1/12	6/12	5/12	1/12
Percentages	75%	67%	8%	50%	42%	8%
Average percentage of element	50%			33%		

- **Analysis of results**
  - Area impacted was reported by nine of the companies, while only one of the companies assured the element.
  - It was found that, in the case of area impacted and area restored, some mining companies reported the current size of the area (accumulated figures) whereas others reported on the amount of area that was added during the specific year.

- The average percentages of area impacted and area restored are 50% and 33% respectively.

3.4.7 Environmental expenditures

- **Objective**

  The objective of this analysis was to evaluate the comparability level of reported information on environmental expenditures, which consists of two elements: environmental expenditures and restoration funding set aside.

- **Results**

  Table 3.13 shows the comparability levels of the environmental expenditure elements for each of the comparability factors.

Table 3.15: Environmental expenditures checklist

	Elements					
Mining company	Environmental expenditures			Restoration funding set aside		
HAR	x	o		x	o	
AGA	x		+	x		+
SG				x	o	
GF	x			x		
PAR	x	o		x	o	
DRD	x	o				
LP	x	o				
IP				x	o	
NP	x	o				
AAP	x	o		x	o	
BRP						
WP						
No. of x, o or + per element	8/12	6/12	1/12	7/12	5/12	1/12
Percentages	67%	50%	8%	58%	42%	8%
Average percentage of element	67%			58%		

- **Analysis of results**
  - For both environmental expenditures and restoration funding set aside, only AngloGold Ashanti (AGA) assured the values.

- In the case of both environmental expenditures and restoration funding set aside, companies used different currencies. Most of the companies that have international operations reported figures in US Dollars instead of the expected Rands.
- The reported information showed a relatively high comparability, with average percentages of 67% for environmental expenditures and 58% for restoration funding set aside.

3.5 Comparability factor evaluation

- **Objective**

  The objective of this analysis was to evaluate the three key comparability factors, namely quantity reported, expected measurement scale used, and assurance.

- **Method**

  To assess each of the three comparability factors, the number of boxes ticked for each of the comparability factors was converted into a percentage metric, similar to Section 3.3.2.

- **Results**

  Table 3.16 illustrates compliance towards the comparability factors. The comparability factors were ranked from highest to lowest, based on the number of boxes ticked.

Table 3.16: Comparability factors

Comparability factor	Boxes ticked	% of boxes ticked
Quantity reported	201/366	55%
Expected measurement scale used	174/366	48%
Assurance	94/366	26%

The expected measurement scale used and assurance of reported elements were further expressed in terms of a percentage of the reported elements (see Table 3.17).

Table 3.17: Expected measurement scale used and assurance of reported elements

Comparability factor	% of reported elements
Expected measurement scale used	86%
Assurance	47%

- **Analysis of results**
  - "Quantity reported" was the comparability factor that was most complied with, as 55% (201 out of 366) of the elements were reported by mining companies.
  - In terms of the expected measurement scale, 174 (48%) of the 366 boxes were ticked.
  - Assurance was the worst comparability factor complied with, as only 26% of the elements were assured by third-party auditors.
  - Of the elements that were quantitatively disclosed, 86% of them used the expected measurement scale, while less than half of them (47%) were assured.

3.6 Company evaluation

3.6.1 Company contribution towards comparability

- **Objective**

  The objective of this analysis was to assess and rank the various mining companies according to their contribution towards the comparability of quantified environmental information.

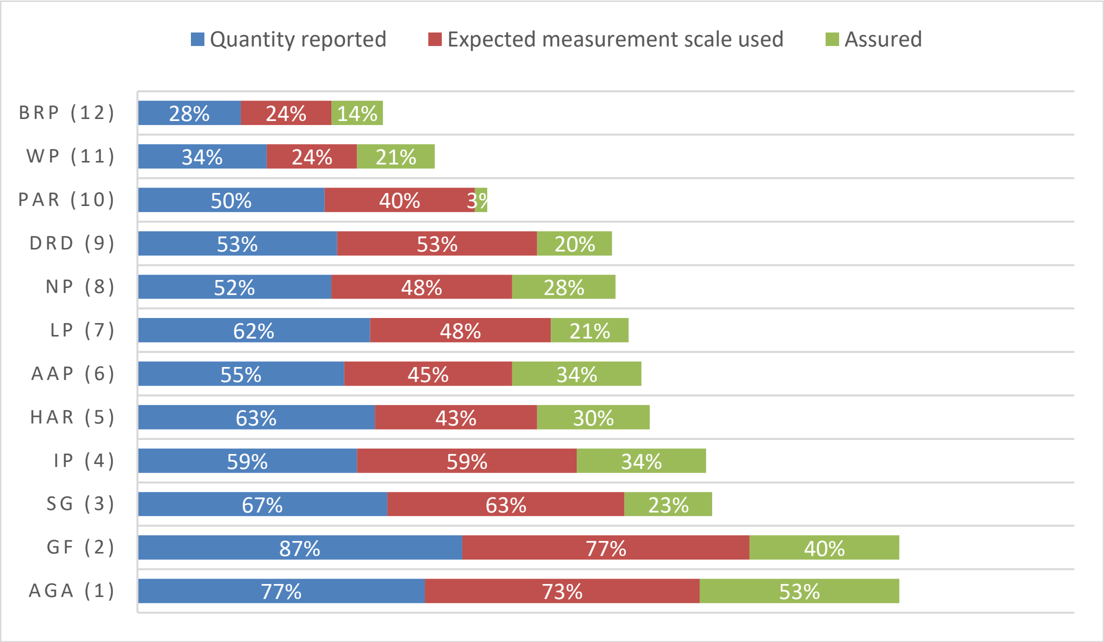
- **Method**

  The checklist was used to determine how many (in a percentage metric) of the specific indicators a specific mining company reported on, how many of these quantified indicators used the expected measurement scale, and how many of the quantified indicators were assured by third parties.

- **Results**

The mining companies' contribution towards comparability is expressed as a percentage metric and is displayed in Figure 3.1. The companies were also ranked according to the total accumulated percentage metric of all three comparability factors.

Figure 3.1: Mining companies and their contribution towards comparability



- **Analysis of results**
  - Gold Fields (GF) was ranked first, followed by AngloGold Ashanti (AGA).
  - The three highest-ranking companies are gold mining companies.
  - The two lowest-ranking companies are platinum mining companies.
  - AngloGold Ashanti (AGA) was the company that assured most of the quantified elements (53%).
  - Pan African Resources (PAR) only assured 3% of the quantified elements.
  - Visually, it seems that there is a good correlation between the number of elements reported and the number of elements assured.

3.6.2 Company size and comparability level

- **Objective**

  The objective of this analysis was to evaluate the relationship between the size of the companies and their ranking in terms of contribution towards comparability.

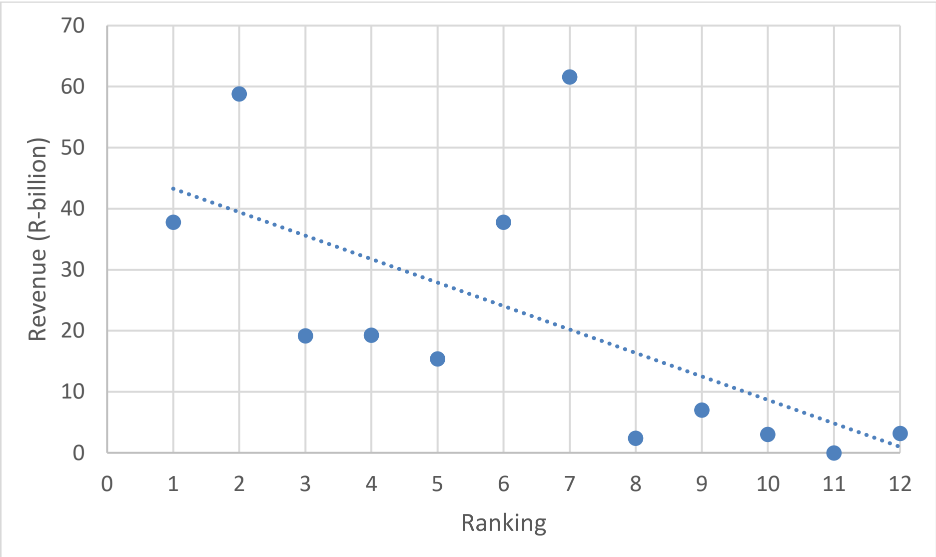
- **Method**

  Regression analysis was used to assess the relationship between the annual revenue of the company and its ranking in terms of contribution towards comparability (see Section 3.6.1).

- **Results**

  Figure 3.2 displays the relationship between revenue and ranking in terms of contribution towards comparability.

Figure 3.2: Relationship between revenue and contribution towards comparability ranking



- **Analysis of results**
  - There seems to be a close relationship between the companies' comparability ranking and their revenue.

- The coefficient of determination was calculated at 0.58, and standard deviation at R17.1-billion.
- The largest outlier identified is Anglo American Platinum (AAP), which ranked 7th while its revenue was the largest of all the companies.

CHAPTER 4 – CONCLUSIONS AND RECOMMENDATIONS

4.1 Introduction

In this final chapter, the level of comparability of quantified environmental information of mining companies is discussed and conclusions are drawn. This is done by comparing findings of the literature and empirical studies presented in Chapter 2 and 3. Furthermore, as proposed in Chapter 1, recommendations are made to enhance the comparability of environmental information. Finally, suggestions regarding future research are proposed.

4.2 Conclusions

In Section 3.3.1, a first impression analysis was conducted. This analysis indicated that the quantitative environmental information seems to be comparable. However, a more detailed analysis revealed that different environmental elements display different levels of comparability.

The results showed that of the 31 environmental elements assessed, only four indicate a strong level of comparability, while 57% of the elements indicate a weak to limited level of comparability. It was also evident that the main categories of energy, emissions and water receive more attention from corporations than other environmental disclosures.

The literature study in Chapter 2 also found that the GRI guideline requires mining corporations to only disclose two environmental intensity ratio elements, namely energy intensity ratio and GHG intensity ratio. This limits the comparability of quantitative information. Stakeholders that want to benchmark other environmental impacts of companies are expected to do the calculations themselves. Furthermore, the analyses also found that the intensity ratios disclosed by corporations indicate a weak level of comparability. This indicates that the two intensity ratio elements specified by the GRI do not receive the attention from corporations they deserve. More details regarding the findings of the study are given in the next section.

4.2.1 Materials used

The category “materials used” shows the lowest comparability of all main categories. Cyanide was the only element in this category to show a moderate level of comparability, while all other elements indicate a weak or limited level of comparability. The reason for the poor comparability performance of this category could be a result of the generic and simplistic approach taken by the GRI G4. This view is shared by Fonseca (2010). The GRI G4 does not specify which materials used by mining companies should be disclosed, and it is therefore left to the mining company to decide. This results in different mining companies reporting on different elements, which influences the comparability negatively.

It was also disappointing to find that timber and steel indicate a weak level of comparability. According to Cortie *et al.* (1996), timber and steel are the most used materials in the deep-level mining industry. To put the large amount of total timber used by mining companies into perspective, the materials used by Gold Fields was analysed (Gold Fields, 2016). The results show that the amount of timber consumed is 10,000 times more (in weight) than the total amount of cyanide consumed. It is therefore crucial information considering the amount of timber and steel used in production.

4.2.2 Energy

The level of comparability of the energy category increases quite significantly compared to the materials used category. Energy shows the highest level of comparability when considering the other main categories. This could be a result of the significant impact that energy has on the environment as confirmed by Norgate and Haque (2010).

It was however alarming to see that the energy intensity ratio shows a weak level of comparability. The energy intensity ratio is the only measure that normalises the energy usage of a mine according to its production output, and is therefore an important element to consider when comparing the electricity consumption of different mining companies (Norgate & Haque, 2010; Northey *et al.*, 2013). Due to the weak level of comparability, it was therefore proven difficult to benchmark companies against each other.

4.2.3 Water

In general, water shows a lower comparability than energy and emissions. What is interesting is that the GRI G4 guideline does not stipulate that water intensity ratios be disclosed, although water is regarded as a major environmental indicator that mines need to consider (Norgate & Haque, 2010). Mines also tend to report more on municipal water supplies rather than on the ground water and surface water they consume. It is also interesting to note that while mines reported on the total volume of water recycled, these same mines did not report the total water recycled in a percentage metric as specified in the GRI G4 guideline.

4.2.4 Emissions

The emissions category shows the same level of comparability as the energy category. Similar to the case of water and energy, Norgate and Haque (2010) consider this to be an important indicator and it seems that mines also perceive this as priority. Furthermore, Scope 1 and scope 2 display the strongest level of comparability of all the elements assessed. Mining companies all used the same measurement scales to quantify their emissions. This could be due to the GRI G4 guideline, which specifically indicates the measurement scale that needs to be used.

4.2.5 Waste, impact on land and environmental expenditures

The main categories of waste, impact on land and environmental expenditures score below average in terms of their comparability level. All the elements that fall under these categories show either a weak or limited comparability. According to South African legislation, mines are required to manage the impacts that they have on land. Mines need to ensure at all times that they do not breach the total amount of area disturbed as per the mining licences given to them (Murguía & Bringezu, 2016). It is therefore reason for concern that some mines do not report on these values. One can possibly assume that either these mines do not manage the amount of land area they disturb, or do not wish to report on these elements due to non-compliance.

4.2.6 Comparability factors

On average, companies only reported 55% of the expected quantitative environmental elements. Of the reported values, 86% used the expected measurement scales. The observations made by Boiral and Henri (2017) are therefore valid. However, the factor that had the biggest influence on the weak comparability levels was third-part assurance. It was found that less than half of the elements that companies reported were assured. This is quite alarming, as 85% of stakeholders perceive disclosures to be unreliable (Kamala, 2014), and considering the lack of assurances, this statement seems to have merit.

4.2.7 Company evaluation

When the companies' contribution towards comparability was evaluated, it was found that the top three positions are held by gold mining companies, and the bottom two positions are held by platinum mining companies. This could indicate that gold mining companies contribute more towards comparability than platinum mining companies. However, when the size of the companies is taken into account, it is revealed that larger companies tend to contribute more towards comparability than smaller companies. As the quality of sustainability reporting is also related to the size of a company (Hahn & Kühnen, 2013), one could argue that there is a correlation between the quality of reporting and comparability.

4.3 Achievement of objectives

To validate the success of the study, the achievement of the objectives defined in Chapter 1 will be evaluated.

4.3.1 Main objective

The main objective of this research was to determine the level of comparability of the quantifiable environmental information disclosed by South African mines. This study focused on the level of comparability of companies, rather than an analysis of a specific company's performance over time.

4.3.2 Secondary objectives

The secondary objectives are divided into literature objectives and empirical objectives. The main objective was achieved by fulfilling the secondary objectives of the study.

Literature objectives

The secondary objectives of literature are:

- To study existing environmental standards, guidelines and frameworks applicable to mines – this was done in Section 2.2.
- To determine the main characteristics of comparable disclosures of similar companies – see Section 2.3.
- To determine the type of quantifiable environmental information that should be disclosed by South African mining companies – see Section 2.4.

- To determine the type of measurements (units) that South African mining companies should use to disclose their quantitative environmental information – see Section 2.4.

Empirical objectives

The secondary objectives as part of the empirical research are:

- To explain the research method – see Section 3.2.
- To develop a quantitative environmental disclosure checklist from literature – see Section 3.2.
- To apply this checklist and to determine the level of comparability of quantitative environmental disclosures of identified mines – see Section 2.5.
- To suggest a quantifiable environmental information reporting standard for South African platinum and gold mining companies – see Table 3.1.

4.4 Recommendations

There is no doubt that the GRI G4 guideline plays a crucial role in the comparability of environmental disclosures. However, in its current simplistic and generic form, it is left to companies to decide what type of information they want to disclose. This could lead to the manipulation of sustainable reporting, which further leads to comparability issues (Fonseca, 2010).

Therefore, it is recommended that the GRI make use of best practices to specify which elements companies need to disclose. A good example is the current GRI G4 emissions reporting guidelines. This section is clear on what information companies need to report on, and what measurement scales should be used.

Regarding gold and platinum mining companies specifically, it is recommended that gold and platinum mining companies should disclose the elements (at least) and standardise on the measurements scales indicated in Table 4.1. This will improve comparability significantly. It is also suggested that companies that do not report on these elements are required to explain their reasons for non-disclosure These reasons should be added to their integrated reporting.

It is critically important that companies expand third-party assurances to all the quantified elements. Furthermore, third-party auditors should also apply the necessary pressure on companies to assure more of their environmental elements. The GRI should also provide more details regarding assurances of elements, and assign more weight to assurances in its scoring mechanism. The result will be that companies that assure more elements will be given a higher rating for their sustainability reports.

It is furthermore proposed that the GRI index provide a web-based and online platform where stakeholders can compare environmental elements of corporations. The platform can for instance be interactive and provide stakeholders with the information easily, instead of stakeholders having to search for information in lengthy integrated company reports.

It is also important to note that the GRI is not the only entity that incentivise companies to improve the quality of disclosed qualitative environmental information. The JSE could also force companies to improve quality of their information by setting certain rules and regulations in place for companies that wishes to list on its exchange.

Table 4.1: Recommended quantitative disclosure and measurement scales for gold and platinum mining companies

Quantitative elements	Measurement scale
Materials used	
Cyanide	Tonnes
Caustic soda	Tonnes
Hydrochloric acid	Tonnes
Timber	Tonnes
Cement	Tonnes
Steel	Tonnes
Recycled materials used	Tonnes
Energy	
Electricity	MWh
Petrol and diesel	Litres
Explosives	Tonnes
Coal	Tonnes
Energy intensity ratio	GJ / tonne
Water	
Surface water	Litres
Ground water	Litres
Municipal water supply	Litres
Total volume of water recycled	Litres
Total volume of water recycled (%)	%
Water discharged	Litres
Emissions	
Scope 1	Tonne CO_2
Scope 2	Tonne CO_2
Scope 3	Tonne CO_2
GHG intensity ratio	Tonne CO_2 / Tonne mined
SO_X	Tonnes
NO_X	Tonnes
Waste	
Waste dumps	Tonnes
Tailings	Tonnes
Hazardous waste	Tonnes
Impact on land	
Area impacted	ha
Area restored	ha
Environmental expenditures	
Environmental expenditures	Rand-million
Restoration funding set aside	Rand-million

4.5 Suggestions for further research

Sustainability reporting and, in particular, environmental reporting are still relatively new when compared to financial reporting. This field therefore deserves significant attention in future research. Based on the limitations, recommendations and conclusions of this study, the following suggestions are made for future research:

- The scope of this study was limited to the South African gold and platinum mining industry. Similar research could be done on other industries, and on industries in other countries.
- The study focused on the quantitative environmental information that companies disclose. The principles of this study can also be applied to other sustainability elements, such as social and economic elements.
- The study focused on three comparability elements to compare the information disclosed by mining companies. However, comparability in a broader sense also includes other factors, such as environmental performance over time. It is therefore suggested that such factors be studied in future.
- Furthermore, in this study, it was found that companies seem to underestimate the importance of assurances when it comes to disclosing environmental information. Future research can therefore determine the benefits of third-party assurances in order to encourage companies to assure more information.

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