

**A FRAMEWORK FOR ECO-EFFICIENCY AND FINANCIAL PERFORMANCE IN  
FOOD AND BEVERAGE COMPANIES LISTED IN THE JOHANNESBURG STOCK  
EXCHANGE**

by

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THESIS

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## DECLARATION

I declare that **“A FRAMEWORK FOR ECO-EFFICIENCY AND FINANCIAL PERFORMANCE IN FOOD AND BEVERAGE COMPANIES LISTED IN THE JOHANNESBURG STOCK EXCHANGE”** thesis as submitted to the University is my own work and that I have never submitted this thesis to any University. I have acknowledged and referenced all the material and sources contained in this thesis.

A handwritten signature in black ink, appearing to read 'Dimakatso Hellen Malapa', written over a large, stylized circular scribble.

**Dimakatso Hellen Malapa**  
**Full Names**

**18 December 2024**  
**Date**

## DEDICATION

I dedicate this thesis to my daddy Mr Makgwadu, my mommy Mrs Mantshonyane, my brothers Solomon, Samson, Moses and Lefa Mathews and my two sisters Christinah, and Kgwadu. Thank you for the words of encouragement and the support. To my nephews and nieces, I have laid a foundation for you. Take the baton.

***Dikgomo wee!!!!***

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## ABSTRACT

The manufacturing sector is generally seen as the greatest polluter, and as a result, there is a growing concern about environmental problems caused by their manufacturing processes. In spite of the global call for industries to engage in eco-efficient practices due to the sector being rated the greatest contributor to environmental pollution, manufacturing companies continue to emit carbon, consume water, energy, and available natural resources excessively, causing a serious peril to the globe. Given that manufacturing industries can benefit financially from eco-efficiency practices, this study therefore examined the relationship between eco-efficiency and financial performance of selected JSE listed food and beverage manufacturing companies. The study employed the multiple linear regression analysis (MLRA) to analyse secondary data from annual integrated reports and the ordinary least square (OLS) method to analyse quantitative primary data from CFOs and EOs of the 14 food and beverage manufacturing companies listed in the Johannesburg Stock Exchange (JSE) in South Africa for 10 years (2012-2021). MLRA results showed a positive yet insignificant relationship between energy conservation and financial performance variables and a positive yet insignificant relationship between water conservation and financial performance variables. In addition, OLS results showed a positive yet insignificant relationship between waste reduction and financial performance variables. The study recommends future research on a broader industrial study. The study further recommends future research on the effect of eco-efficiency variables on other corporate financial and non-financial success indicators. In addition, future researchers can extend the panel years to a period more than 10 years to check if the investments in eco-efficiency might significantly affect financial performance. Lastly, the researcher recommends that the survey be extended to the executive members and the company managers and that other analysis methods be used as an extension to the analysis used in this study.

**Keywords:** *Profitability; Sustainability Accounting; Eco-efficiency; Environmental Management Accounting; Energy conservation; Water conservation, Carbon reduction; Waste reduction; Return on Assets; Share Price; Net Profit; Return on Capital; Financial Performance.*

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## LIST OF ACRONYMS AND ABBREVIATIONS

CAREMM	Carbon emission
CER	Corporate Environmental Responsibility
CFOs	Chief Financial Officers
CFP	Corporate Financial Performance
COE	Cost to Equity
CR	Critical Realism
CSP	Corporate Social Performance
CSR	Corporate Social Responsibility
EIA	Environmental Impact Assessment
EMA	Environmental Management Accounting
EOs	Environmental Officers
EPS	Earnings per share
ENRCON	Energy consumption
FE	Fixed Effects
FP	Financial Performance
GI	Green innovation
GHG	Greenhouse gas
GMM	Generalised Method of Moments
GPI	Green Process Innovation
GPR	Green Performance
GRPI	Green Product Innovation
IEE	Industry Eco-efficiency
IFRS	International Financial Reporting Standards
IPCC	International Panel on Climate Change
JPOI	Johannesburg Plan of Implementation
JSE	Johannesburg Stock Exchange
KP	Kyoto Protocol
MDG	Millennium Development Goals
MLRA	Multiple Linear Regression Analysis

NDS	Nationally Determined Contributions
NEMA	National Environmental Management Act
NFSD	National Framework for Sustainable Development
NP	Net Profit
OLS	Ordinary Least Squares
PA	Paris Agreement
QELROS	Qualified Emission Limitation and Reduction Obligations
RE	Random Effects
ROA	Return on Assets
ROC	Return on Capital
ROE	Return on Equity
ROIC	Return on Invested Capital
SDGs	Sustainable Development Goals
SP	Share Price
SRI	Socially Responsible Investment
UN	United Nations
WASGEN	Waste generated
WATCON	Water consumption
WSSD	World Summit on Sustainable Development

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1. BACKGROUND**

Corporate is seen as the greatest polluter, and as a result, there is a growing concern about environmental problems resulting from their production activities. For instance, in their process of production, energy consumption, sound emission and waste generated contribute to industry environmental pollution (Gebreeyessus, Mekonnen, Chebude & Alemayehu, 2021). South Africa is among the countries known for their global environmental sustainability advocacy (Younis, Naz, Shah, Nadeem & Longsheng, 2021). The country joined other nations in developing its national environmental regulations that guide environmental operations of manufacturing industries (Hoffmann, 2019; Bag, Pretorius, Gupta & Dwivedi, 2021). Nonetheless, industries continue to pollute the environment through carbon emissions, excessive use of water and energy, and unsustainable use of available natural resources affecting the planet in a negative way (Patnaik, 2018; Zelazna, Bojar & Bojar, 2020). It therefore becomes necessary to find alternative strategies to overcome the environmental challenges faced by businesses in carrying out production activities (Adhikari & Ozarska, 2018; Malek & Desai, 2020).

Eco-efficiency is one avenue that can reposition industry operations and activities to minimise the negative environmental impact of businesses (Sala-Garrido, Mocholi-Arce, Molinos-Senante, Smyrnakis & Maziotis, 2021; Eder, Salhofer & Scheichel, 2021). While, industries commit to environmental protection activities such as engagement in activities that promote eco-efficiency, financial performance can be improved (Meutia, Ramadhani & Adam, 2019; Safitri & Nani, 2021). This study will examine the effect that eco-efficiency variables (energy conservation, water conservation, carbon reduction and waste reduction) have on financial performance of food and beverage manufacturing companies listed in the Johannesburg Stock Exchange (JSE). A framework for financial implications

of eco-efficiency practices will be developed, which will help industries to engage in practices that promote and enhance eco-efficiency, by conserving energy and water, and lessening carbon emission and amount of waste generated. Additionally, the sustainable development agenda for 2030, launched by the United Nations (UN), calls for environmentally sustainable production and consumption, and addresses the environmental challenges and other negative impacts resulting from processes of production (Di Marco, Baker, Daszak, De Barro, Eskew, Godde, Harwood, Herrero, Hoskins, Johnson & Karesh, 2020). Due to its potential to minimise exhaustion of resources and to lessen pollution, eco-efficiency is considered a practical tool for sustainable development (Matsumoto & Chen, 2021). In addition, the Paris Agreement was contracted at the United Nations Climate Change Conference with the goals to limit global warming by minimising greenhouse gas emissions and set net zero emission targets from industries' operations (Streck, Keenlyside & Von Unger, 2016). Without addressing the issue of industry environmental sustainability by becoming eco-efficient, achieving the objectives of sustainable development goal 12 (SDG 12) will remain a buzzword.

Industry environmental sustainability refers to proactive approaches to protect the environment by being environmentally compliant (Dzomonda & Fatoki, 2020). Industries can use eco-efficiency as one of the strategies for environmental compliance. Industry eco-efficiency (IEE) therefore involves producing more items using natural resources in a manner that is sustainable and keeping environmental effects as low as possible (Sala-Garrido *et al.*, 2021; Eder *et al.*, 2021). To be precise, IEE involves the production of more products using less energy and water, emitting less amounts of carbon and reducing waste. While improving environmental stewardship and sustainability through eco-efficiency, industries should strive to achieve good financial performance and productivity. Financial performance (FP) determines the financial outcome of an entity at financial year end, and it can be either a profit or a loss (Farah, Farrukh & Faizan, 2016; Matar & Eneizan, 2018). The ratios such as leverage, solvency, liquidity, and profitability can be used as a point of reference for financial performance (Fatihudin, 2018; Popa, Popa,

Bogdan & Simut, 2021). Financial performance in this study will be represented by return on assets (ROA), share price (SP), net profit (NP) and return on capital (ROC).

Some researchers have tested the nexus between eco-efficiency and financial performance and found dissimilar results (Miroshnychenko, Barontini & Testa, 2017; Alheet, 2019; Chukwuma, Ishola & Folajimi, 2019; Pham, Do, Doan, Nguyen & Pham, 2021). Several studies conducted relating to eco-efficiency in the South African context focused on cleaner production, environmental sustainability commitment, sustainability practices and their impact on financial performance (Olalekan & Jumoke, 2017; Masocha, 2019; Dzomonda & Fatoki, 2020; Maama, Doorasamy & Rajaram, 2021). But no study had documented any framework for financial implications of the combined eco-efficiency variables, namely energy conservation, water conservation, carbon reduction and waste reduction in the South African context. This study will, therefore, develop a framework for financial implications of eco-efficiency practices by examining effects that eco-efficiency variables have on financial performance of JSE listed food and beverage manufacturing companies.

## **1.2. PROBLEM STATEMENT**

In view of growing concerns about emerging environmental problems resulting from industrial activities, eco-efficiency has become a subject of interest among scholars throughout the world (Rybczewska-Błażejowska & Masternak-Janus, 2021). The confronting challenge is that manufacturing industries around the world, as the main consumers of natural resources, continue to contribute to the environmental pollution through carbon emissions, excessive use of water and energy and excessive use of available natural resources, causing a serious menace to the globe (Patnaik, 2018; Zelazna, *et al.*, 2020; Gebreeyessus *et al.*, 2021). Despite the global call for manufacturing industries to engage in eco-efficient practices as the sector is considered a key contributor to the production of waste and carbon emissions and huge energy consumption, most manufacturing industries are still hesitant towards environmental sustainability (Baah, Opoku-Agyeman, Acquah, Agyabeng-Mensah, Afum, Faibil, &

Abdoulaye, 2021a). This hesitancy is mainly due to the fact that new technology costs might be high and profit returns might be insufficient (Jaiswal & Kumar, 2018).

Many studies have documented that manufacturing industries are high polluters to the environment. For example, Fang, Bai and Bilan (2020) assert that manufacturing industries pollute the environment, consume excessive amount of energy, and emit carbon. Furthermore, Beekaroo, Callychurn and Hurreeram (2019) postulate that industries continue to harm the environment, overuse natural resources, and generate an insurmountable amount of waste. In addition, Li (2020) and Wang (2020) postulate that manufacturing companies are key consumers of water, leading to water shortages. On the other hand, La Scalia, Saeli, Adelfio and Micale (2021) allude that, large volumes of waste pose significant challenges for their treatment and disposal, as well as financial loss and energy emissions. Cosgrove, Rivas Duarte, Littlewood and Wilgeroth (2018) and Reinhardt, Bergmann, Münnich, Rein and Putz (2020) also postulate that consumption of energy in the manufacturing industries is high and that some manufacturing activities produce a substantial environmental footprint due to the use of energy. The study of Tian, Xiong, Ma and Ji (2018) and Shi and Li (2019) found that manufacturing industries consume large amounts of energy and contribute a large proportion of carbon emissions.

Due to unsustainability in industrial production, some scholars have advocated for investments in energy and water saving, carbon emission reduction and waste reduction strategies to minimise environmental impacts. For example, Cai, Lai, Liu, Wei, Ma, Jia, Jiang and Lv (2019) proposed some strategies to effectively enhance energy efficiency and minimise waste generated, and it was found that manufacturing companies that adopted these strategies achieved better financial results through energy conservation and waste reductions. In addition, some studies proposed the reuse and recycle strategies as sustainable solutions for reducing waste generated, reducing energy consumption as well as producing small amounts of environmental footprint (Shirvanimoghaddam, Motamed, Ramakrishna & Naebe, 2020). Furthermore, the study of Warner, Lamm, Beattie, White and Fisher (2018) suggested that companies can enhance water conservation by using strategies such as rainwater and water re-usage, among others.

On the other hand, Yacob, Wong and Khor (2019) suggested that manufacturing companies can improve water preservation through strategies such as water re-usage and water reduction by fitting devices that control and monitor water consumption. Moreover, other scholars allude that manufacturing industries can benefit financially from eco-efficiency practices. For example, Meutia *et al.* (2019) assert that, if manufacturing companies engage in the production of goods and rendering of services that promote environmental protection thereby enhancing eco-efficiency, they will achieve better financial performance. In addition, Safitri and Nani (2021) postulate that, in carrying out efficiency in the ecological field, companies' profitability can increase. Also, Kurnianta and Dianawati (2021) postulate that the minimisation of emissions, which resembles the application of eco-efficiency, will boost the business image in the public, which will in turn have an impact on company value, thereby influencing investors to become interested in the company.

A significant number of research studies such as those of Brouwers, Schoubben and Van Hulle (2018); Alexopoulos, Kounetas and Tzelepis (2018) and Leyva-de la Hiz, Ferron-Vilchez and Aragon-Correa (2019) have already looked at the financial implications of individual variables of eco-efficiency. Despite the existing research on how individual eco-efficiency variables link with financial performance, there is a need to combine the four eco-efficiency variables to establish their relationship with financial performance. Based on the researcher's review, little previous research exists on the effect of combined eco-efficiency variables on financial performance; as the researcher found no evidence of parallel previous research which has used a combination of the four eco-efficiency variables (energy conservation, water conservation, carbon reduction, and waste reduction) within the JSE listed food and beverage manufacturing companies, to assess their financial implications and to propose a framework; hence a gap exists in the literature. This study will fill the above gap in literature and knowledge by examining the effect that eco-efficiency variables have on financial performance. Established from the results from literature review and results from the analysis, this study will develop a framework for financial implications of these combined variables since existing researchers have not developed such a framework.

## **1.3. RESEARCH AIM AND OBJECTIVES**

### **1.3.1. Research aim**

This research thesis is built on the premise that industries are polluting the environment through high energy and water usage, huge amounts of carbon emitted, and waste generated. Therefore, the study sought to examine how the four eco-efficiency variables affect financial performance.

### **1.3.2. Research objectives**

Based on the problem above, the objectives of this research were:

- i. To examine the relationship between eco-efficiency and return on assets (ROA).
- ii. To assess the relationship between eco-efficiency and share price (SP).
- iii. To measure the relationship between eco-efficiency and net profit (NP).
- iv. To evaluate the relationship between eco-efficiency and return on capital (ROC).
- v. To develop a framework for financial implications of eco-efficiency practices.

### **1.3.3. Research questions**

Drawing from the problem above, the research questions underlying this study were:

- i. What is the relationship between eco-efficiency and return on assets (ROA)?
- ii. How does eco-efficiency relate to share price (SP)?
- iii. What is the relationship between eco-efficiency and net profit (NP)?
- iv. What relationship exists between eco-efficiency and return on capital (ROC)?
- v. What framework can be developed for financial implications of eco-efficiency practices?

### **1.3.4. Research hypotheses**

Stemming from the research questions above, the following research hypotheses were developed:

#### **Hypothesis 1**

H1<sub>0</sub>: There is no significant relationship between eco-efficiency and return on assets.

H1<sub>a</sub>: There is a significant relationship between eco-efficiency and return on assets.

#### **Hypothesis 2**

H2<sub>0</sub>: There is no significant relationship between eco-efficiency and share price.

H2<sub>a</sub>: There is a significant relationship between eco-efficiency and share price.

#### **Hypothesis 3**

H3<sub>0</sub>: There is no significant relationship between eco-efficiency and net profit.

H3<sub>a</sub>: There is a significant relationship between eco-efficiency and net profit.

#### **Hypothesis 4**

H4<sub>0</sub>: There is no significant relationship between eco-efficiency and return on capital.

H4<sub>a</sub>: There is a significant relationship between eco-efficiency and return on capital.

### **1.4. SIGNIFICANCE OF THE STUDY**

The main objective of this research is to develop a framework for financial implications of eco-efficiency practices for food and beverage manufacturing companies. The study is significant in that the framework will motivate manufacturing industries to engage in eco-efficiency practices and to improve existing environmental investments and practices. Additionally, the framework will assist with instilling a thought of engaging in eco-efficiency practices in companies that engage in unsustainable business practices so that they contribute towards the achievement of SDG 12 (UNEP, 2021). Moreover, the study results might prove to the manufacturing companies that application of eco-efficiency offers a competitive advantage as green-minded consumers and investors will likely associate with the green company, leading to great financial yields (Yu, Khan & Liu, 2020;

Velte, Stawinoga & Lueg, 2020, Gangi, Daniele & Varrone, 2020; Hoang, Przychodzen, Przychodzen & Segbotangni, 2020). Other researchers had conducted their analysis up to random effects in their analysis, but this study has extended the analysis to general method of moments (GMM).

This research will additionally pave ways for future studies, encouraging researchers to reveal more avenues, also bringing about different and enhanced methods of carrying out research in the context of eco-efficiency and financial performance. In addition, the study will add to literature and the body of knowledge on financial implications of eco-efficiency practices. This study is hoped to bridge the knowledge gap in the literature on the issues around eco-efficiency.

In addition, findings of this research may increase society's awareness of the part that some manufacturing companies play in protecting the environment and that might persuade the society to accept the manufacturing companies.

## **1.5. OUTLINE OF THE THESIS**

The thesis will unfold as follows:

### **Chapter 2: Theoretical Framework**

Chapter two discusses the theoretical framework used, which consists of the Stakeholder theory and the Institutional theory. Both the theories are discussed in alignment with each eco-efficiency variable.

### **Chapter 3: Literature review (African and International Literature)**

Chapter three focuses on the conceptual review, an African literature review of empirical studies on how eco-efficiency variables affect financial performance. African literature on the relationship between energy conservation and financial performance, water conservation and financial performance, carbon reduction and financial performance and waste reduction and financial performance is reviewed, with findings from previous

African studies. Literature on other financial variables affecting financial performance is also reviewed.

Chapter three further focuses on an international literature review of empirical studies on how eco-efficiency variables affect financial performance. International literature on the association between energy conservation and financial performance, water conservation and financial performance, carbon reduction and financial performance and waste reduction and financial performance is reviewed, with findings from previous international studies.

#### **Chapter 4: Research Methodology**

Chapter four presents and explains the research methodology employed. The research methodology comprises the research paradigm, research method and design, area of study, study population, sample, sampling method and sample size, data collection and analysis methods. The chapter further discusses the issues of ethical considerations and research limitations.

#### **Chapter 5: Data analysis and discussion of findings**

Chapter five discusses the main research results based on the research objectives. The results comprise the panel data multiple-linear regression analysis and ordinary least square regression analysis. The researcher therefore proposes a framework for financial implications of eco-efficiency practices for food and beverage manufacturing companies listed in the JSE.

#### **Chapter 6: Summary of findings, conclusion, and recommendations**

Chapter six provides a presentation of the summary of findings on both secondary data analysis and primary data analysis. The chapter further highlights the contribution to knowledge as well as the limitations to the study. The recommendations for further research and recommendations for knowledge and practice are presented in this chapter. The last sections present a summary of the study and the conclusion of the study respectively.

## **1.6. SUMMARY OF THE CHAPTER**

The chapter presented the background and the problem statement. Furthermore, the chapter described the study aim, study objectives, research questions and hypotheses. The significance of the study and the outline of the thesis were also presented in this chapter.

### **DEFINITION OF KEY TERMS**

#### **Eco-efficiency**

Eco-efficiency involves the production of extra goods with minimal utilisation of natural resources and a lesser amount of pollution to the environment (Sala-Garrido *et al.*, 2021; Eder *et al.*, 2021). Companies that are eco-efficient are likely to boost company image, thereby gaining better financial performance (Meutia *et al.*, 2019; Kurnianta & Dianawati, 2021).

#### **Environmental Pollution**

Environmental pollution refers to the contamination of different constituents of the atmosphere, which can damage the environment (Baroudi, Al Alam, Fajloun & Millet, 2020). It primarily includes air, sound, water, and soil pollution (Mandal, 2020).

#### **Industry Environmental Sustainable Production**

Industry environmental sustainable production is the process of sustaining the manufacturing of products and services that cause less or no pollution, that consume less energy and water, and that do not emit carbon (Pang & Zhang, 2019; Gomes, Silva & Sarkis, 2020). Industries that engage in sustainable production and manufacture products in a way that environmental impacts are kept as minimal as possible, are considered socially responsible to the stakeholders, at the same time these industries benefit economically (Sartal, Bellas, Mejías & García-Collado, 2020).

## **Industry environmental sustainability**

Industry environmental sustainability is the companies' use of proactive strategies to protect the environment by being environmentally compliant (Dzomonda & Fatoki, 2020). Companies that are environmentally compliant, gain a competitive advantage, leading to better financial performance, as green customers associate with green companies (Yu *et al.*, 2020).

## **Profitability**

Profit refers to the remaining income after deducting company expenses from the sales in the given reporting period (Alarussi & Alhaderi, 2018). Profitability is therefore the proportion of assets return, which expresses the corporation's degree of throughput comparative to total assets from an overall business viewpoint and is often used for financial analysis (Deboi, Kurmakhadov & Li, 2021).

## **Water Conservation**

Water conservation refers to an increase in the technical efficiency of water usage (Pieper, 2021). Water is considered a chief role player in sustainable production, as its conservation is necessary for wise resource development (Mekasha, Seyoum, Mupangwa, Lemma, Senbeta & Tello, 2020).

## **Energy conservation**

Energy conservation involves using the least amount of energy possible by minimizing energy consumption (Uddin, Wei, Chi & Ni, 2021). Various authors with various perspectives have defined this concept of energy conservation differently, due to its multidimensional contexts and attributes (Umoh & Bande, 2021).

## **Carbon emissions**

Carbon emissions refer to unwanted output resulting from excessive use of energy (Lv, Liu, Cheng & Andreoni, 2021). These emissions are generated by various sources during

the use of a unit of energy and during combustion (Adebayo, Udemba, Ahmed & Kirikkaleli, 2021).

### **Waste reduction**

Waste reduction is the company's ability to produce small quantities with minimal waste generated but still meet customers' demands (Amodeo & Klimas, 2021). Some researchers refer to waste reduction as a strategy used by companies to take responsibility for reducing waste generated (Kim, Hall & Kim, 2020).

### **Financial performance**

Financial performance (FP) measures the financial outcome of firms at year end (Tapang & Azubike, 2018). The outcome of a company's accomplishment is expressed in terms of profits or losses (Mohsin, Ahmed & Streimikiene, 2020).

### **Return on Assets (ROA)**

Return on assets is defined by the proportion of a business's net income to its total assets (Khuong, Liem & Minh, 2020). This financial indicator is used to measure whether a company can use its assets effectively to achieve profitability or not (Nuraini, 2021). Investors are likely to invest in the company in larger numbers when this ratio is higher (Purba & Bimantara, 2020).

## **CHAPTER TWO**

### **THEORETICAL FOUNDATION**

#### **2.1. INTRODUCTION**

This chapter discusses in detail the theoretical foundation, which comprises two theories, namely: the stakeholder theory and the institutional theory. To continue, section 2.2 presents the stakeholder theory; section 2.2.1 presents the stakeholder theory and energy conservation, and section 2.2.2 presents the stakeholder theory and water conservation. Section 2.2.3 presents the stakeholder theory and carbon reduction; and section 2.2.4 presents the stakeholder theory and waste reduction. Section 2.2.5 discusses some notable stakeholders affected by business activities. Section 2.3 introduces the institutional theory and section 2.3.1 presents the institutional theory and energy conservation. Section 2.3.2 presents the institutional theory and water conservation while section 2.3.3 presents the institutional theory and carbon reduction, and section 2.3.4 presents the institutional theory and waste reduction. Section 2.4 presents the preliminary research conceptual framework. The chapter summary is presented at the end of this chapter.

#### **2.2. STAKEHOLDER THEORY**

This study adopted the stakeholder theory. This theory denotes that parties whom the company activities affect are corporate stakeholders. The stakeholder theory comprises three types, namely: normative, descriptive, and instrumental stakeholder theories (Donaldson & Preston, 1995; Freeman, Phillips & Sisodia, 2020; Dmytriiev, Freeman & Hörisch, 2021; Rahman, Zahid & Muhammad, 2022). Normative stakeholder theory describes how managers should act based on ethical or moral principles (Kamal, 2021). Descriptive stakeholder theory explores how organisations interact with stakeholders, whereas the instrumental stakeholder theory's concentrations is on how corporate goals are achieved (Jacobson & Gruzd, 2020).

A set of diverse corporate stakeholders to work with the company to achieve goals needs to be identified. This diverse set of stakeholders may be internal or external (Marcinkowska, 2013; Paranamanna & Dissanayake, 2021; Lu, Liang, Zhang, Rong, Guan, Mazeikaite & Streimikis, 2021). The environment is among primary stakeholders because it is supposed to be sustained as its exhaustion or damage will affect those depending on it for survival (Haigh and Griffiths, 2009; Faeth & Kittler, 2020; Ionescu, Feleagă & Bătae, 2020). Globally, manufacturing industries have contributed and will continue to contribute to the environmental pollution through huge amounts of carbon emissions, excessive use of water and energy, huge amounts of waste generated and excessive use of available natural resources (Patnaik, 2018; Zelazna *et al.*, 2020; Gebreeyessus *et al.*, 2021). Notably, the environment cannot speak like other stakeholders; however, it is important to reduce the negative impact resulting from unsustainable business practices (Hall, Daneke & Lenox, 2010; Tseng, Lim, Helmi Ali, Christianti & Juladacha, 2021; Ab Wahab, 2021). The stakeholder theory advocates and suggests ways in which a company should be managed in the interests of its entire stakeholders (Freeman, 1984; Diez-Cañamero, Bishara, Otegi-Olaso, Minguez & Fernández, 2020). If corporates consider stakeholders' interests in their policies, operations and practices, all corporate stakeholders will feel recognised and that creates value (Haigh and Griffiths, 2009; Kurznack, Schoenmaker & Schramade, 2021).

The stakeholder theory further postulates that some firms create value for their stakeholders by meeting their expectations and that enhances financial performance (Huge-Brodin, Sweeney & Evangelista, 2020; Tran & Adomako, 2021). For example, by creating value for company employees as internal stakeholders, the company can achieve high productivity and gain loyalty and in turn, financial performance is enhanced (Mitra & Gaur, 2020; Karmani & Boussaada, 2021, Sila, 2022). Moreover, shareholders as stakeholders expect to get higher dividends from their investments, and thus they expect businesses to perform better. However, when a company satisfies the needs and interests of its external stakeholders, it may not benefit immediately but only in the long run (Singal, 2014; Raza, Rather, Iqbal & Bhutta, 2020; Park & Jang, 2021).

The justification for adopting the stakeholder theory was for the reason that stakeholders such as consumers, suppliers, shareholders, and the environment can put more pressure on the companies to produce eco-friendly products. These pressures are the firms' motivating factors to produce green or environmentally friendly products to meet the demand of these corporate stakeholders. Additionally, to recognise the environment as one of the corporate stakeholders, industries should engage in eco-efficient activities, as the firms' survival is dependent on meeting societal and environmental expectations. Consequently, if manufacturing companies are known for pollutants and cannot implement eco-efficient practices in their processes of production, they might lose green-minded suppliers and customers and that will affect financial performance.

### **2.2.1. Stakeholder Theory and Energy conservation**

The stakeholder theory posits that companies should meet the expectations of their stakeholders as a way of creating value (Huge-Brodin *et al.*, 2020; Tran & Adomako, 2021). Moreover, this theory postulates that business activities and operations should be conceptualised as stakeholder relationships that can serve as ways for creating value (Freeman *et al.*, 2020). One of the ways for creating such value to stakeholders can be engagement in eco-efficiency activities such as energy conservation, which will in turn benefit both the stakeholders and the company. Such benefits include among others, less environmental pollution, customer loyalty, competitive advantage, and financial performance. The stakeholder theory has been widely used by many scholars in their studies. For example, Salehi, Filimonau, Ghaderi and Hamzehzadeh (2021) used the stakeholder theory in assessing energy conservation in large-sized hotels in developing countries. Additionally, in evaluating the causes of climate change disclosure practices, de Grosbois and Fennell (2022) applied the stakeholder theory as one of the theories under theoretical foundation. Moreover, Dan and Shen (2022) used the stakeholder theory with other theories in their study. The next section presents the stakeholder theory and water conservation.

### **2.2.2. Stakeholder Theory and Water conservation**

The stakeholder theory advocates and proposes ways in which business entities should be operated to fulfil the needs of investors (Diez-Cañamero *et al.*, 2020). The excessive use of water causes serious problems to the environment such as pollution and water scarcity, which will negatively affect the stakeholders. Such stakeholders can include societal and environmental residents, for example: societies and communities (Li, 2020; Wang, 2020; Gebreeyessus *et al.*, 2021). Companies might be found to be in contradiction with the stakeholder theory if they overuse water. Many researchers have used the stakeholder theory in collaboration with other theories in water conservation and water efficiency studies. For instance, Fu and Jacobs (2022) employed the stakeholder theory in evaluating the effects of corporate social performance (CSP) with water efficiency as a variable, on financial performance (FP). In addition, the study of Sudha (2020) adopted the stakeholder theory in examining how corporate environmental performance associates with financial performance, employing eco-efficiency metrics, with water efficiency as one of the variables. Moreover, Le and Ikram (2022) used the stakeholder theory to evaluate whether sustainability innovation and firm competitiveness helps in improving firm performance, with water conservation as one of the sustainability innovation measurements. These researchers applied the stakeholder theory to check how firm competitiveness can assist in enhancing the performance of SMEs. The next section discusses the stakeholder theory and carbon reduction.

### **2.2.3. Stakeholder Theory and Carbon reduction**

Stakeholder theory embraces that it is vital for companies to maintain moral relationships with stakeholders by fulfilling their expectations and conducting themselves in the best manner towards company stakeholders (Wicaksono & Setiawan, 2022). Another way of meeting stakeholder expectation is through carbon reduction, which will in turn benefit both the stakeholders and the companies. The environment as a stakeholder will benefit from carbon reduction, as the environmental impact will be minimised. The company will also benefit, as the reduction will lead them into using energy efficiency strategies and minimising the use of energy, hence cost effectiveness. Moreover, customers as external

stakeholders might turn to patronise the company by buying frequently from them, hence improved financial performance. The study of Khalil and Nimmanunta (2022) used the stakeholder theory to explain how conventional innovation and green innovation affect firm value. In addition, Chan (2021) adopted the stakeholder theory in examining how stakeholders influence environmental management approaches of firms such as decrease in carbon footprint. The study of Dan and Shen (2022) also used the stakeholder theory. The next section presents the stakeholder theory and waste reduction.

#### **2.2.4. Stakeholder Theory and Waste reduction**

Waste generated in the production process pollutes the environment and the inhabitants suffer (Gebreeyessus *et al.*, 2021). Waste management therefore becomes necessary for manufacturing companies in an attempt to minimise the environmental impact resulting from own business activities and at the same time, enhance financial performance (Yu *et al.*, 2020). Several authors have used the stakeholder theory in their studies. For example, Baah *et al.* (2021a) used the stakeholder theory in measuring the influence of stakeholder pressures on companies' implementation of green methods of production. Additionally, Baah, Agyabeng-Mensah, Afum and Mncwango (2021b) used the stakeholder theory in conjunction with the institutional theory in their study. Moreover, Boakye, Tingbani, Ahinful and Nsor-Ambala (2021) adopted the stakeholder theory among other theories to elucidate how environmental management performance relates to financial performance of public-listed firms.

#### **2.2.5. Other stakeholders that affect and are affected by business activities.**

A few of the noteworthy stakeholders presented in this section are green customers, company shareholders, employees, and the natural environment.

##### *Green customers as stakeholders*

Green consumption has become fashionable globally and companies have made it a priority. Customers are aware of green companies, and they associate with companies that produces environmentally friendly products (Purwanto, Fahmi, Irwansyah, Hadinegoro, Rochmad, Syahril & Sulastri, 2022). Company engagement in environmentally friendly

production influences the behaviour of most customers, which results into buying from the green company regularly, thereby improving financial performance of a company. This implies that customers tend to develop green consumption behaviour. Nguyen, Nguyen, Tring, Tran and Cao (2020) define green consumption behaviour as consumer activities that do not contaminate the environment nor exhaust natural resources. The cost of producing green products comes at a high price but when customers believe that a green product will contribute to sustainable development, they are not reluctant to pay, hence improved financial performance (Gelderman, Schijns, Lambrechts & Vijgen, 2021). This implies that companies that do not produce green products might lose green-minded customers, and that might then lead to loss of revenue and profits; and that will affect financial performance in a negative way.

#### *Company Shareholders as stakeholders*

Shareholders' returns, as shareholders are the most dominant stakeholders in a business, are prioritised above other stakeholders' interests (Ainsworth, 2021). This implies that, although a company has a variety of stakeholders with different interests, priority is given to the shareholders. The stakeholder theory speculates that, while companies' focus is on the maximisation of enterprise value, they should also realise the maximisation of shareholders' interests (Xu, 2022). Like other stakeholders, shareholders support company environmental management which is believed to impact share prices in the company positively (Ratnaningtyas, Chandrarin & Subiyantoro, 2021).

#### *Employees as stakeholders*

Someone hired by a company, who is compensated in exchange for their services is referred to as an employee (South African Government Gazette, 2017). Companies should promote recruitment of employees with green behaviour and align their behaviour to pay and allow promotion through green human resource management (GHRM) (Hameed, Khan, Islam, Sheikh & Naeem, 2020). Companies' GHRM practices influence employee behaviour and promoting green management techniques influences organisational sustainability. Green training is one of the green practices that helps

employees to deal with environmental issues and maintain sustainable management (Gill, Kazmi & Ali, 2021). Some companies use green performance (GPR) that shapes the behaviour of company employees associated with green objectives and employees are stimulated to proactively take part in environmentally friendly practices (Pham, Tučková & Jabbour, 2019; Mousa & Othman, 2020). GPR aims at encouraging and praising the green practices by employees. Other companies use green rewards to appreciate their employees' environmentally friendly practices, strategies, and solutions (Yong, Yusliza, Ramayah, Chiappetta Jabbour, Sehnem & Mani, 2019). When companies appraise and reward employees for green practices, it mirrors the employees' value creation, leading to increased productivity and enhanced profitability. As such, good employees might be retained.

#### *The natural environment as a stakeholder*

The natural environment is negatively affected by industries' processes through unsustainable use of available natural resources affecting the planet in a negative way (Patnaik, 2018; Zelazna, Bojar & Bojar, 2020). Green credit is one of the strategies that might change highly polluting firms' business behaviour (Yao, Pan, Sensoy, Uddin & Cheng, 2021). Due to financial constraints, manufacturing companies might seek assistance from financial institutions. Credit is granted to the manufacturer if their carbon emission is less than the specified carbon cap  $T$ , as enforced by the government (An, Li, Song & Chen, 2021). He, Zhang, Zhong, Wang and Wang (2019) and Xu and Li (2020) assert that green credit is among the greatest and most significant green financial tools developed by the government with the aim of motivating financial establishments to apportion financial resources and direct capital flow to clean manufacturing sectors. Zhang, Li, Qi, and Shao (2021) argue that green credit's ability to reduce pollutant emissions is reliant on the company's strategies for curbing emissions.

In other countries, institutions responsible for governance put in place principles and guidelines for all industries (Abid, Ikram, Wu & Ferasso, 2021). Regardless of any enforcements and laws regulating environmental protection, manufacturing companies can improve environmental performance by adopting eco-efficiency in their processes of

production. Eco-efficiency involves producing more goods with less utilisation of natural resources, leading to a pollution-free environment (Sala-Garrido *et al.*, 2021; Eder *et al.*, 2021). Like other stakeholders, the natural environment needs to be protected from pollution and degradation to protect human health and for the benefit of current and future generations.

### **2.3. INSTITUTIONAL THEORY**

Institutional theory is the theory that is applied when examining whether companies adopt environmentally friendly practices in the businesses (Berrone, Fosfuri, Gelabert & Gomez-Mejia, 2013; Zhu and Geng, 2013; Parada, Gimeno, Samara & Saris, 2020). This theory postulates that the social context from which organisations operate, influences firms' behaviour, causing them to adopt related practices and structures (Hinings, Gegenhuber & Greenwood, 2018; Li, Liao & Albitar, 2020). In other words, this theory proclaims that firms should adopt green initiatives to gain acceptance from the society within which they operate. This theory further states that developing formal structures in an organisation can be affected by the environment and social surrounding, which are stronger as compared with pressures from the market (Ebrahimi & Koh, 2021). This implies that, beside social and environmental pressures, there are other institutional pressures causing the organisation to adopt good practices. The studies of Dimaggio and Powell (1983), Chaudhry and Amir (2020) and Wang, Li, and Qi (2020) posit that institutional pressure such as coercive, normative, and mimetic, influence firms' decision-making. With coercive pressure, companies are bound to action environmental regulations and standards and should avoid sanctions and punishments that might be imposed by the authorities (Latif, Mahmood, Tze San, Mohd Said & Bakhsh, 2020; Dai, Xie & Chu, 2021).

Additionally, there is normative pressure, which also influences decision making of the firm. Normative pressure encourages companies to embrace Environmental Management Accounting (EMA) (Dimaggio & Powell, 1983; Latif *et al.*, 2020). When EMA is embraced and adopted, there might be a possibility for companies to do business with pro-environment companies and countries and it will help them build a good public

reputation locally and internationally and that can improve financial performance (Rehman Khan & Yu, 2021). Lastly, there is mimetic pressure, which arises when there is competition among firms with the aim of achieving greater performance (Latan, Jabbour, de Sousa Jabbour, Wamba, & Shahbaz, 2018; Latif *et al.*, 2020; Amoako, Adam, Tackie & Arthur, 2021). This study adopted the institutional theory to elucidate the way in which manufacturing companies utilise natural resources to avoid depletion and pollution and improve eco-efficient practices and achieve a competitive edge and enhance financial performance. The next section presents the institutional theory and energy conservation.

### **2.3.1. Institutional Theory and Energy conservation**

External pressures affect corporates and as such, corporates have to deal with these pressures and risks for the sustainability of the business (Bag *et al.*, 2021). Among ways of dealing with these pressures are to engage in good environmental practices. These pressures from stakeholders and other external factors encourage companies to practice green production. This is an indication that perceptions and trust of stakeholders are of great importance for companies in an attempt to realise continued competitive advantage and greater financial performance. Baah *et al.* (2021a) associated the institutional theory with green production practices as well as company reputation when examining the correlations between variables. Additionally, Ning, Jie, and Li (2021) adopted the institutional theory in gauging the extent to which institutional pressures affect corporate green innovation. Moreover, Gupta and Gupta (2021) examined environmental performance of firms, with institutional theory as a theoretical perspective. The next section presents the institutional theory and water conservation.

### **2.3.2. Institutional Theory and Water conservation**

Baah, Afum, Agyabeng-Mensah and Agyeman (2022) adopted the institutional and stakeholder theories to provide the foundation for the adoption of circular economy practices which revolve around improving the use of resources such as water. Furthermore, Yuan and Cao (2022) used the institutional theory as one of the theories in

elucidating the effect of pressures enforced by different institutions on corporate green innovation. In addition, Gupta, and Gupta (2021) based their study on the institutional theory. The next section discusses the institutional theory and carbon reduction.

### **2.3.3. Institutional Theory and Carbon reduction**

Aslam, Elmagrhi, Rehman and Ntim (2021) used the institutional theory to explain how corporate environmental performance can be improved when companies engage in good environmental management practices such as reducing carbon emissions, which will lead to improved corporate financial performance. In addition, Ali, Ersöz, Kaur, Altaf and Weber (2021) analysed low carbon performance of firms in developing nations. These researchers based their research on the concepts of institutional and contingency theories to explore how uncertainties of external business environment affect intricacies of internal business environment. Moreover, Ivic, Saviolidis and Johannsdottir (2021) adopted the institutional theory to explain factors that drive sustainability practices in the mining companies. The next section presents the institutional theory and waste reduction.

### **2.3.4. Institutional Theory and Waste reduction**

Baah *et al.* (2021b) examined how legitimacy and regulatory stakeholder needs stimulate environmental and corporate social responsibilities such as waste reduction. The abovementioned researchers based their study on both the stakeholder and institutional theories. Additionally, Gupta and Gupta (2021) used the institutional theory to inspect the influence among variables, with environmental practices as a latent variable measured by waste reduction among others. Moreover, Bag *et al.* (2021) used the institutional theory alongside the resource-based view philosophy to explain the manner in which enterprises use real resources and worker skills to prosper technology and improve sustainable production processes. The next section presents the preliminary research conceptual framework.

## 2.4. PRELIMINARY RESEARCH CONCEPTUAL FRAMEWORK

This section presents the major theme from the theoretical framework that underpins the research objectives. There are two core corporate stakeholders, which are the environment and the investors (owners of the business). Therefore, the researcher presents below (Figure 2.1), the preliminary research conceptual framework that is the umbrella for the research objectives. This represents the preliminary research model in a visual format. Based on this preliminary research conceptual framework, the main research conceptual framework is formulated in chapter 3 section 3.6 (Figure 3.2).

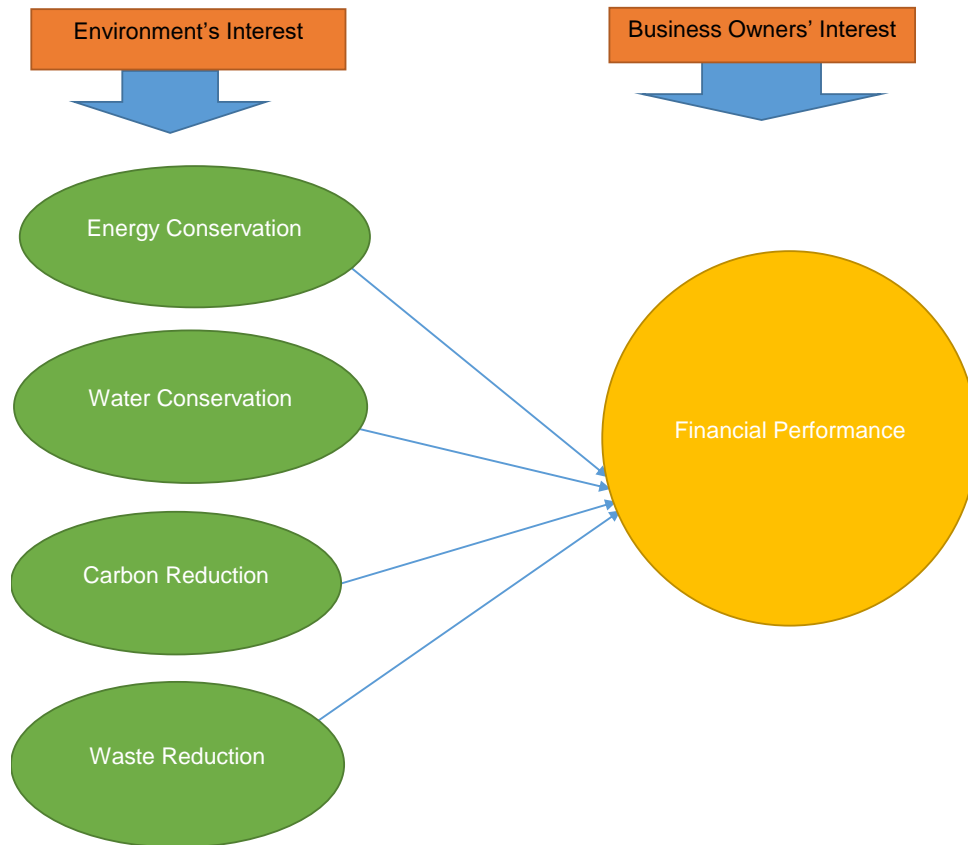


Figure 2.1. Preliminary research conceptual framework (Eco-efficiency linkage with Financial Performance)  
Source: Researcher's preliminary research conceptual framework

## **2.5. SUMMARY OF THE CHAPTER**

This chapter provided a short examination on the two theories: the stakeholder theory and the institutional theory. The chapter presented each eco-efficiency variable and its alignment with the theories as follows: Stakeholder theory and energy conservation, stakeholder theory and water conservation, stakeholder theory and carbon reduction, stakeholder theory and waste reduction. In addition, internal and external stakeholders affected by business activities formed part of the discussion. The chapter further presented the institutional theory with individual eco-efficiency variables as follows: Institutional theory and energy conservation, institutional theory and water conservation, institutional theory and carbon reduction and institutional theory and waste reduction. Lastly, the preliminary research conceptual framework was discussed. The succeeding chapter will present the conceptual review and a detailed review of African and international literature on eco-efficiency practices and financial performance.

## **CHAPTER THREE**

### **CONCEPTUAL AND EMPIRICAL LITERATURE REVIEW**

#### **3.1. INTRODUCTION**

The previous chapter presented a discussion of the theories that reinforce this study. Chapter 3 consequently presents the conceptual review and the literature review. The conceptual review covers the concept of sustainable development, the South African framework for sustainable development, and the context of green economy in South Africa. Some green activities are also discussed in this section. Additionally, the South African constitution as well as the National Environmental Management Act are discussed. The conceptual review further presents a summary of the sustainable development goals. Some international environmental agreements, namely, the Kyoto protocol and the Paris agreement, are briefly discussed. Existing African and international literature on how eco-efficiency variables affect financial performance is reviewed. Additionally, literature on other Accounting variables affecting financial performance is reviewed. Since this study addresses the second phase of eco-efficiency, which is, to produce more using less energy and water and emitting less carbon and waste, this literature dwells more on energy conservation, water conservation, carbon reduction and waste reduction, hence this study reviews literature on the aforementioned variables and their effect on financial performance. In each section, the first paragraph provides a synthesis of common ideas in the related empirical literature, followed by a detailed analysis and critical discussion by previous researchers (methods, analysis, findings, and comparisons). The last section presents the main research conceptual framework and the summary of the chapter.

## **3.2. CONCEPTUAL REVIEW**

### **3.2.1. Sustainable Development**

Sustainable development entails consistently enhancing the standard of living and welfare of people, predominantly the poverty-stricken and those most afflicted by inequality. Resource efficiency and intergenerational fairness are fundamental ideals (Department of Environmental Affairs and Tourism, 2008). The next generation should not confront an unsustainable future as a result of the current generation's deteriorating environmental assets, social assets, economic assets, and reduced wealth. A majority of the Millennium Development Goals (MDGs) and Johannesburg Plan of Implementation (JPOI) goals revolve around human well-being, equity, and sustainable livelihoods. The health of ecosystems and natural resources is critical to many social and economic development goals.

### **3.2.2. The South African Framework for Sustainable Development**

The Johannesburg Plan of Implementation (JPOI) is a result of the World Summit on Sustainable Development (WSSD) which took place in September, the year 2002. This plan of implementation has set forth 37 goals to assist in achieving sustainability, including the MDGs (DEAT, 2008). South Africa has a myriad of stratagems and programs aimed at incorporating sustainable development considerations but lacks a coherent and comprehensive national sustainable development strategy. The aim of the National Framework for Sustainable Development (NFSD) is to make up for this deficit by instituting a comprehensive framework for South African sustainable development.

Furthermore, this framework is aimed at proclaiming the idea of South Africa for sustainable development and to find tactical interpositions so as to redirect South Africa's development trail en route to sustainability (DEAT, 2008). Rather than presenting detailed strategies and actions, it proposes trends, a set of implementation actions, strategic priority areas and principles that permit and guide action plan and national strategy development. The framework will serve as the foundation for a lifelong procedure for integrating sustainability as a critical aspect of the development debate, as well as

supporting international economic and social goals and demonstrating the obligation of South Africa to apply the principles as developed at meeting discussions, conferences, and summits.

All social partners including all national institutions at national, state, and local level will use the strategic framework to create a coherent and mutually dependable system that will promote sustainable development nationwide. Additionally, in refining and refocusing policies and decision-making systems, authorities will use the framework (DEAT, 2008). The process was facilitated by the development of a dependable set of sustainable development pointers.

### **3.2.3. The Context of Green Economy in South Africa**

Green economy is viewed as a route to sustainable development on which the interconnectedness between economic progress, social protection, and natural biosphere is emphasised. The country's plan is to certify that green economy agendas are reinforced by an action plan that is practical and implementable, emphasising how significant it is to build on existing programmes, initiatives, practices, and native knowledge in main sectors, as well as the fact that government cannot accomplish and fund a fair shift to a green economy. This implies that both the corporate sector and civic society must play a role in the shift to a green economy.

### **3.2.4. Green activities**

Different stakeholders support companies that engage in green activities with the goal of remaining sustainable. This subtopic highlights the categories of green activities that businesses can participate in, such as the ISO 14001, the green processes, and prevention of pollution.

#### **3.2.4.1. ISO 14001**

ISO 14001 as an intercontinental rule that is certifiable, provides a framework that is structured to assist companies in controlling environmental impact resulting from their

manufacturing processes (Arocena Garro, Orcos Sanchez & Zouaghi, 2020). Companies can use this process-based standard in implementing an environmental management system (Arocena Garro, Orcos Sanchez & Zouaghi, 2023). Consequently, companies that aim to improve green image, address environmental issues, lower operational expenses, and boost its competitive edge and performance can adopt ISO 14001 (Duque-Grisales, Aguilera-Caracuel, Guerrero-Villegas & García-Sánchez, 2020). In other words, some companies are able to improve their environmental and financial performance by adopting and implementing ISO 14001 and consistently monitoring how company activities impact the environment. Furthermore, Arocena Garro *et al.* (2020) assert that ISO 14001 helps companies to reduce carbon emissions and can boost corporate profitability. Companies should therefore not only be profit-oriented at the expense of human health but instead attempt, with the aid of ISO 14001 guidelines, to reduce carbon emissions and other impacts for the inhabitants of planet Earth to benefit. The study of Seroka-Stolka and Fijorek (2022) shows that companies that attempts to adopt and make efforts to implement environmental management systems of ISO 14001 are likely to move their environmental competitiveness to an advanced level as compared to those companies that do not have the ISO 14001 standards in place.

However, there are some bureaucratic requirements that exist when an ISO is adopted, such as the costs associated with the standard and the level of investment required for its implementation (Carrillo-Labela, Fort & Parras-Rosa, 2020). Furthermore, bureaucratic procedures are seen as a barrier because of the unnecessary paperwork, the time required to adopt the standard, and the frequent audits that must be undertaken. Despite the benefits, motives, and barriers of adopting an ISO, firms should introduce ISO standards in an attempt to show value by lessening environmental impacts resulting from their business activities.

#### **3.2.4.2. Green Innovations**

Green innovation (GI), also known as eco-innovation, is a widely recognised phenomenon that permits companies to lessen their negative environmental impact. It is divided into two types: green process innovation and green product innovation. Green process

innovation and green product innovation have offered enterprises numerous opportunities to mobilise resources to protect the natural environment and promote prosperity (Awan, Arnold & Gölgeci, 2021). GI has advanced into a crucial tool for companies that seek to expand market share and remain sustainable. Furthermore, when a company is successful with their GIs, that strengthens the market position of the company, attracts clients, offers green services, and gains a competitive edge, leading to an improved financial performance (Takalo & Tooranloo, 2021). Due to these benefits, GI remains a permanent agenda item of many company managers. This implies that, while putting plans in place for maximising profit, managers should also think of ways to minimise how their business activities contribute towards environmental problems. The two types of GI are briefly discussed below.

#### **3.2.4.2.1. Green process innovation**

Green process innovation (GPI) involves integrating new ideas into industrial processes and commercial systems to create environmentally sustainable products (Xie, Hoang & Zhu, 2022). GPI entails minimising energy usage, water usage, and carbon emissions while increasing energy and resource efficiency in the production process. In other words, GPI can play an essential role in reducing the environmental impacts resulting from production processes and operations while attempting to maximise profits. Xie *et al.* (2022) revealed that green process innovation has an impact on firm financial performance. The relationship becomes positive as GPI increases and negative when GPI decreases. This implies that, the more the green process innovation, the more the companies stand chances of enhancing financial performance. Kasraoui, Ben-Ahmed and Feidi (2024) also found a positive influence of green innovation scores on the firm's performance.

#### **3.2.4.2.2. Green product innovation**

Green product innovation (GRPI) entails being aware of emerging environmental challenges, and so inventing and changing prevailing goods, services, and processes to protect the environment against the damage caused by company activities (Ali, Ashfaq, Begum & Ali, 2020). GRPI is a type of green innovation that enhances economic development and advancement (Begum, Ashfaq, Xia & Awan, 2022). It entails modifying

products, services, methods, and advanced technologies to reduce environmental harm and maximise natural resource utilisation (Xie, Huo & Zou, 2019). GRPI helps firms decrease production costs and time while also providing more efficient products. Specific GRPIs attract customers who are not reluctant to go for green products and services and that might boost company revenue which might in turn make the company more effectual and gainful (Ahmed, Mozammel & Zaman, 2020; Ali *et al.*, 2020).

### **3.2.4.3. Prevention of pollution**

Pollution prevention refers to any measure that reduces, eliminates, or stops pollution before it occurs (US EPA, 2022). Pollution prevention is viewed as one of the inventive ways for reducing environmental damage. South Africa's Department of Environmental Affairs and Tourism specifies pollution prevention policies, such as Extended Producer Responsibility (EPR), aimed for sustainable firm development (DEAT, 2005). Furthermore, Business for Social Responsibility (2001) presents some of the benefits for embracing EPR as follows:

**Reduction in production costs:** Companies can reuse the resources to make new goods, thereby reducing raw material consumption and production costs.

**Customer loyalty:** Companies which take responsibility and handle environmental issues win the trust of their customers and retain them for a long time, resulting in greater quantity of items sold, leading to higher profits.

**Reduction in production time:** When an entire product is used in a new generation product, some stages are not regarded during production, resulting in a faster manufacturing process, higher productivity, and a shorter period for the product to reach the consumer market.

**Creating new market prospects:** Companies that use an EPR strategy can drive product design invention and delivery, resulting in new marketing prospects.

### 3.2.5. The Constitution of South Africa (Act 108 Of 1996)

A constitution of any country is an important law that has to be abided by and any obligation imposed by it, has to be fulfilled. These constitutions have different sections, which deals with different rights of every citizen in countries. Section 24 (a) of the constitution of South Africa regarding the environment, stipulates that everyone has a privilege to an environment that is safe for human health. In addition, Section 24 (b) stipulates that everyone has an entitlement to an environment that is free from damage so that both the present and next generations benefit, by establishing acceptable laws and taking other suitable activities that: (i) avoid environmental harm and pollution; (ii) encourage conservation and (iii) ensure environmentally sound development, while encouraging legitimate economic development.

### 3.2.6. National Environment Management Act (NEMA)

Figure 3.1 presents the NEMA family of environmental law. However, not all the Acts and regulations from the NEMA family have a direct bearing on this study.

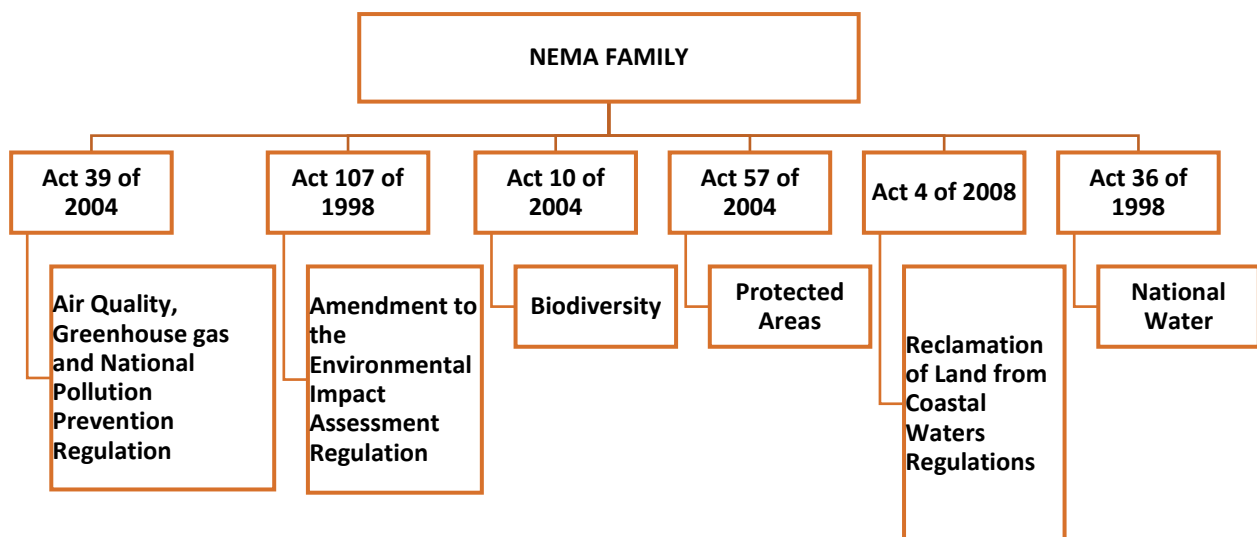


Figure 3.1. The NEMA family of environmental law

Source: Researcher's construct of the NEMA Family

The following Acts and regulations have a direct impact on the study as discussed below:

### **Greenhouse Gas (GHG)**

NEMA (Act 39 of 2002) defines greenhouse gas as any of the following gases:

“Carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), sulphur hexafluoride (SF<sub>6</sub>), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs); as well as any additional greenhouse gas that is listed under the United Nations Framework Convention on Climate Change, relevant to the Republic of South Africa, and included in a list of additional greenhouse gases identified” (South African Government Gazette, 2017). The intergovernmental Panel on Climate Change (IPCC), as the team responsible for evaluating any matter connected to climate transformation, has provided a list of all business activities where companies have to provide information regarding GHS emissions resulting from their business activities. According to the IPCC, the food and beverage sector has a responsibility to report on GHG when their emission exceeds a threshold of 10mw (th).

### **National Pollution Prevention Regulation**

The purpose of this regulation is to prescribe anti-pollution requirements programmes that greenhouse gases that are avowed as priority air pollutants must be observed in terms of Section 29 (3) of the country’s constitution (South African Government Gazette, 2017). This regulation further stipulates pollution prevention plan period and their period of submission to the Minister.

### **3.2.7. Sustainable Development Goals (SDGs)**

In 2015, 193 country leaders approved the 2030 Agenda for Sustainable Development goals as a direction for global development in the forthcoming years. In addition, the roots of the SDGs can be seen at the 2012 United Nations (UN) Conference on Sustainable Development (Rio+20) that took place in Rio de Janeiro in Brazil. The conference

produced a document named: The Future We Want (UN, 2012), which developed a set of Sustainable Development Goals listed below:

- SDG 1 which calls for ending poverty by 2030 (United Nations, 2019).
- SDG 2 which aims to end hunger by 2030 (United Nations, 2019).
- SDG 3 which is aimed at ensuring health and well-being for all at all stages of life (United Nations, 2019).
- SDG 4 which aims to promote inclusivity, a just quality education as well as deep-rooted learning opportunities for everyone (United Nations, 2019).
- SDG 5 which is aimed at promoting gender equality by empowering all women (United Nations, 2019).
- SDG 6 which will make sure that water that is available, can be sustainably managed and that everyone has access to sanitation services (United Nations, 2019).
- The goal of SDG 7 is to provide access to affordable, dependable, maintainable, and contemporary energy to all individuals (United Nations, 2019).
- SDG 8 which is aimed at promoting an economic growth that is sustainable and making sure that everyone has a good quality job (United Nations, 2019).
- SDG 9 which aims to build an infrastructure that is strong, to promote an industrialisation that is inclusive and sustainable and to foster inventions (United Nations, 2019).
- SDG 10 which aims to address variations in income resulting from factors such as age group, gender, infirmity, ethnic group, origin, race, economic status, or other factors in a country (United Nations, 2019).
- SDG 11 which aims to make human settlements and cities non-violent, inclusive, harmless, and sustainable because worldwide, a majority of cities experience major trials in managing hasty urbanisation (United Nations, 2019).
- SDG 12 which is aimed at enhancing and promoting sustainable consumption and production (United Nations, 2019).
- SDG 13 which calls for crucial action to be taken to address the issue of climate change and its influences on the natural environment (United Nations, 2019).

- SDG 14 which promotes nature conservation for sustainable development (United Nations, 2019).
- SDG 15 highlights the importance of safeguarding, renewing, and responsibly utilising land ecosystems, managing forests in a sustainable way, fighting against desertification, reversing degradation of land, and preserving biodiversity (United Nations, 2019).
- SDG 16 that aims to build an effective system that promotes peace, justice, accountability, effectiveness, and all-encompassing institutions (United Nations, 2019).
- SDG 17 which calls for the strengthening of universal partnerships that are aimed at supporting and attaining the ambitious goals of the Agenda 2030 (United Nations, 2019).

The above set of sustainable development goals as proposed, are the drivers of the sustainability agenda. Nonetheless, of all the goals, only SDG 12, focusing on sustainable production and consumption, has a direct bearing on this study.

### **3.2.8. SOME INTERNATIONAL ENVIRONMENTAL AGREEMENT**

#### **3.2.8.1. The Kyoto Protocol (KP)**

The Kyoto Protocol (KP) 1997, which went into effect in 2005, was the initial ancillary agreement to the United Nations Framework Convention on Climate Change (UNFCCC, 2022). The KP created legally binding targets for the European Union (EU) and 37 high-income nations to reduce GHG emissions with at least a 5% average below 1990 levels from the year 2009 to the year 2012. It eradicated the requirement for emerging states to reduce GHG emissions.

Both the United States and Canada departed the protocol before the initial term for commitment elapsed. Their refusal to accede to quantitative GHG reduction commitments was among their grounds for leaving the KP, at least in part. Japan, Australia, and other parties made the decision to pursue a contract that includes pledges on similar terms for

all the parties when deliberating the second KP commitment period. This resulted in a directive to create a protocol, an additional legal instrument, or an agreed-upon resolution having legal effect under the UNFCCC that will apply to all parties no later than 2015, which was deliberated at the COP17 in 2011 in Durban, South Africa.

### **3.2.8.2. The Paris Agreement (PA)**

The Paris Agreement (PA) is the additional settlement as per the UNFCCC. This agreement was intended to ultimately substitute the KP which was the main secondary body for processes and activities of the UNFCCC. Obama Administration officials explained that the agreement is not a contract that requires Senate consideration and approval for endorsement, and meetings of other relevant agencies. The United States announced its departure from the PA, but that departure was not expected to be effected until November 4, 2020, at the earliest. Up to that point, the United States was to join ventures with other parties. After the departure took effect, the United States was still to partake by observing, although the observation was based on a restricted basis. The PA was meant to bind all the parties legally, but not all of the terms it contains were binding. PA calls on participants to make commitments that are not binding in Nationally Determined Contributions (NDCs) to diminish the emission of greenhouse gas and to enhance removals. The NDCs can also develop climate change adaptation goals and work together to achieve these goals. This includes mobilising financial and other support. A few good clauses, such as verification and reporting, are mandatory, while others are endorsements.

### **3.2.9. KING IV CODE**

The King IV Code is a set of guidelines not enforced by law, that details the ethics and standards for company's sustainability reporting and governance (IoDSA, 2016). This code further echoes that companies seldom put the much-needed attention on societal and environmental impacts as they are more focused on the economic benefit (IoDSA, 2016). This implies that there are imbalances among dimensions of the triple bottom line which are the economic dimension, the social dimension, and the environmental

dimension. Furthermore, contained in this code, are the principles and practices related to stakeholder-inclusivity approaches (IoDSA, 2016). As per IoDSA (2016), the responsibility for maintaining the relationship with stakeholders lies with the company management and, to succeed in that, companies should comprehend the company stakeholder desires and prospects. Understanding stakeholder needs, interests, and expectations enables strategic managers to build more effective strategies (IoDSA, 2016). To this end, this relationship with stakeholders must be retained as a permanent agenda to keep the firm's board of directors informed about the existing company-to-stakeholders relationship state (IoDSA, 2016).

### **3.2.10. Understanding the concept of Energy Conservation**

Energy conservation refers to reducing the amount of energy consumed by utilising only the services that require the least amount of energy (Uddin, Wei, Chi & Ni, 2021). Energy is needed for contemporary manufacturing though it produces massive emissions, and as such, developing and implementing energy conservation strategies to minimise the use of energy in the manufacturing sector become crucial (Li, Huang, Zou, Gao & Liu, 2020; Clairand, Briceño-León, Escrivá-Escrivá & Pantaleo, 2020; Javaid, Haleem, Singh, Suman & Rab, 2021; Lan & Hu, 2021). In their studies, Li *et al.* (2020), Clairand *et al.* (2020) and Javaid *et al.* (2021) suggest the development of policies for energy efficiency, which will encourage manufacturing companies to adopt energy efficiency strategies in their processes. While some researchers propose energy efficiency methods or strategies, others find that manufacturing companies that engage in production processes that consume less energy achieve good financial performance (Atif, Hossain, Alam & Goergen; 2021; Shah, Yusuf, Zain, Rosli & Azman, 2021).

### **3.2.11. Understanding the concept of Water Conservation**

Pieper (2021) defines water conservation as an increase in the technical efficiency of water usage. Manufacturing companies consume huge amounts of water in the process of converting raw material into goods that are ready for consumption (Sharma, Sodhi, Bhakar, Kaur, Pallakonda, Sarkar & Singh, 2020; Revollo-Fernández, Rodríguez-Tapia

& Morales-Novelo, 2020; Chamberland, Bouyer, Benoit, Provault, Bérubé, Doyen & Pouliot, 2020). The amount of water used in the production process differs from manufacturing company to manufacturing company depending on what is being produced and the processes a product undergoes (Gecim, Aydin, Tavsanoglu, Erkok & Kalemtes, 2021). For instance, Engida, Mekonnen, Wu, Xu and Wu (2020) and Sehnem, de Sousa Jabbour, da Conceição, Weber and Julkovski (2021) assert that the brewing process in beverage manufacturing companies consumes huge amounts of water, while Hamdan, Ramli, Zaman Huri, Abd Rahman and Abdullah (2021) find the process of producing cultured meat to consume less water. Consequently, when huge amounts of water are used in production processes, there might be water scarcity (Li, 2020; Wang, 2020). In their studies, Rosegrant, Cai and Cline (2020) and Marulanda-Grisales and Figueroa-Duarte (2021) suggest that manufacturing companies can overcome the challenge of water scarcity by investing in technologies that save water and training the companies' employees on how to use water effectively in the production process. While some researchers suggest strategies for conserving water, others allude that water conservation yields great benefits such as better financial performance. For example, Montazar (2021) posits that water conservation is fundamental in ensuring a balance of sustainability and profitability and that those adopting water saving strategies and practices gain higher profits.

### **3.2.12. Understanding the concepts of Carbon Emission and Carbon Reduction**

Carbon emissions refer to unwanted output resulting from an immoderate use of energy (Lv *et al.*, 2021). These emissions are generated through various sources in the course of using a unit of electricity and during combustion (Adebayo *et al.*, 2021). Wu, Hao and Ren (2020) and Wu, Xu, Ren, Hao and Yan (2020) view carbon taxes as environmental regulations that are effective for reducing emissions and that these taxes can stimulate public response towards green innovation. While Wu *et al.* (2020) propose carbon reduction strategies, Kurnianta and Dianawati (2021) find that when carbon emissions are minimised, company image becomes boosted in the general public's eyes, thereby influencing investors and customers to invest in the company and that might improve profitability.

### **3.2.13. Understanding the concept of Waste Reduction**

Waste generation refers to the rejected materials that have been generated by residential and production activities, which comes at an economic and environmental cost for their treatment and removal (Nazari, Xu & Ray, 2021). La Scalia *et al.* (2021) assert that industrial activities generate enormous amounts of waste, causing immense problems in its treatment and disposal and causing economic losses.

Reducing waste generated by manufacturing companies is perceived as a good waste management approach. According to Kim, Hall, and Kim (2020), manufacturing companies can use waste reduction as a strategy to take responsibility for reducing waste generated through their business activities. Waste reduction therefore refers to a company's capability to manufacture small quantities with less waste sent to landfill while still meeting customer demands (Amodeo & Klimas, 2021). While Shirvanimoghaddam *et al.* (2020) propose reuse and recycle strategies as long-term solutions for reducing waste, Kabirifar, Mojtahedi, Wang and Tam (2020) and Kakwani and Kalbar (2020) propose strategies such as reduce, reuse, recycle, reclaim, recover, and restore for managing waste generated. Researchers such as Yu *et al.* (2020) have found that companies that manage waste through these strategies, have improved their financial performance.

### **3.3. AFRICAN LITERATURE PERSPECTIVES ON ECO-EFFICIENCY AND FINANCIAL PERFORMANCE**

This section provides a literature review from an African perspective on the impact of eco-efficiency factors on financial performance.

#### **3.3.1. The effect of energy conservation on financial performance**

Energy conservation has become a subject of interest and African scholars have looked at how it affects financial performance in different business sectors. Different directions and different strength of relationship among energy conservation and financial performance has been established from extant literature. For instance, Maama *et al.* (2021) found a significant positive relationship between cleaner production and company's performance in the South African sugar industry. In addition, Agyabeng-Mensah, Afum and Ahenkorah (2020) also discovered that financial performance is significantly positively impacted by environmental performance and social performance in Ghanaian industries, with energy conservation as one of the variables.

While Maama *et al.* (2021) and Agyabeng-Mensah *et al.* (2020) found energy conservation to be a positive predictor of financial performance, Dzomonda (2021) found that financial performance, represented by earnings per share (EPS) was negatively and significantly affected when companies attempted to attain energy efficiency within the short term. However, a long-term positive effect was established. The aforementioned authors have an agreement that energy conservation affects financial performance although they disagree on the significance and strength of the relationship. The difference in this variation is due to the use of different research approaches, sectors, and sample sizes. Regardless of this difference, publicly listed companies should consider enhancing investment initiatives for reasons other than just compliance, but also for improving operational efficiency and driving positive financial performance.

#### **3.3.2. The effect of water conservation on financial performance**

Different scholars have looked at the relationship between water conservation and financial performance and found different results. For example, Dzomonda and Fatoki

(2021) examined how water use efficiency affects financial performance in firms listed in the JSE and found that water efficiency is a positive and significant predictor of financial performance, represented by share price. In addition, Madime and Gonçalves (2022) demonstrated that eco-efficiency practices positively influence financial performance. These researchers agree that a relationship exists between water conservation and financial performance although the directions of the relationship differ. All these researchers used different sample sizes, methods of data analysis and different sectors and that might have accounted for the difference in results. Regardless of the different directions of these relationships as well as the costs associated with the creation and execution of water conservation plans, manufacturing firms should not be discouraged, but instead, invest more in water conservation to minimise water use, in an attempt to avoid water scarcity and pollution.

### **3.3.3. The relationship between carbon reduction and financial performance**

Without a doubt, the manufacturing industry is the leading source of air pollution, emitting tons of gases and chemicals that degrade air quality (Zahoor, Latif, Khan & Hou, 2022). Climate change is among serious encounters faced in the 21<sup>st</sup> century and to mitigate this problem, renewable energy has been introduced to assist firms to produce sustainable energy that eliminates carbon (Ivanovski & Marinucci, 2021). In their study, Garzón-Jiménez and Zorio-Grima (2021) alluded that, in an attempt to minimise pollution and for a sustainable planet, companies may utilise voluntary carbon disclosures to their advantage. In contrast, Franco, Caroli, Cappa and Del Chiappa (2020) argue that poor corporate social responsibility (CSR) performance may pose reputational risks, which might impact corporate financial performance (CFP) negatively, when combined with the cost of implementing socially responsible actions. This implies that CSR has both benefits and costs for businesses, and simply carrying out social and environmental activities is insufficient to increase CFP. Nonetheless, there is a connection between carbon reduction and financial performance.

Previous researchers have studied carbon reduction and financial performance. For example, according to Ganda (2022a), Tobin's Q, firm value, and return on assets showed

a significant and positive correlation with carbon performance. Conversely, a negative and significant correlation was observed. To be more precise, results revealed a negative but significant relationship between carbon performance and firm value as well as return on assets. In addition, Ganda (2022b) established a negative, yet significant correlation between carbon and firm financial debt. However, Garzón-Jiménez and Zorio-Grima (2021) discovered a significant positive correlation between carbon emissions and cost to equity (COE). On the other hand, Shahbaz, Li, Dong and Dong (2022) found an insignificant influence of financial inclusion on carbon dioxide in regions with higher carbon dioxide emissions. All the aforementioned studies have a mutual agreement that carbon reduction and financial performance are associated, but they disagree on whether the direction of the association among the aforementioned variables is negative or positive.

Ganda (2022a) used 107 CDP JSE listed companies for 5 years and used the two-step generalised method of moments (GMM) panel process for analysing data. Ganda (2022b) also considered 107 listed companies for a period of 5 years and Garzón-Jiménez and Zorio-Grima (2021) used 929 firms sampled from the Morgan Stanley Emerging Market Index over a period of 6 years. The fact that these researchers used different firms, and different time frames, might have contributed towards the differences in the direction of the relationship between carbon reduction and financial performance. Nevertheless, the fact that an ambition of companies is to maximise profits for better financial performance, manufacturing companies need to minimise environmental impact resulting from production activities in order to take part in achieving goal 12 for sustainable production and consumption.

#### **3.3.4. The effect of waste reduction on financial performance**

Numerous research from an African perspective had been carried out on the relationship between waste reduction and financial performance, with different outcomes regarding their direction of relationship. For instance, Fakoya (2020) found an insignificant effect of any investments in harmful solid waste reduction on return on assets. In addition, Ihenyen and Ikegima (2022) evaluated how environmental Accounting influences

financial performance using waste management cost as a variable for environmental management and return on equity as a variable for financial performance and found a significant positive relationship. However, Shabbir and Wisdom (2020) used the Duke II modified econometric model and Kanpanga, which included waste management cost as a variable, to establish whether a potential relationship exists among environmental investments, corporate social responsibility, and financial performance in manufacturing firms of Nigeria. Results revealed that internal environmental investments are significant positive indicators of firms' financial performance while external environmental investments were discovered as positive yet insignificant indicators of firms' financial performance.

Although these researchers found different outcomes, they agree that waste reduction does affect financial performance. The difference in the direction of the relationship may have resulted from the different sample sizes, methods of analysis and interpretation and sectors used by these researchers. Regardless of the relationships waste reduction has with financial performance and the benefits manufacturing companies stand to achieve, waste generated should be minimised to reduce the negative environmental impact so as to contribute towards achieving goal 12 of the sustainable development.

### **3.4. INTERNATIONAL LITERATURE PERSPECTIVES ON ECO-EFFICIENCY AND FINANCIAL PERFORMANCE**

This part presents a review of literature from an international viewpoint regarding how eco-efficiency factors affect financial performance.

#### **3.4.1. The effect of energy conservation on financial performance**

Atif *et al.* (2021) studied the relationships among board gender diversity and financial performance, and energy consumption and financial performance and found that if strategies and policies for enhancing energy efficiency are in place and implemented, good financial performance might be achieved. Furthermore, Shah, Yusuf, Zain, Rosli and Azman (2021) found that, when a company is able to attain similar production output using less energy, it achieves better financial performance. In other words, there might be a relationship existing between the reduction in energy use and financial performance.

Over the years, different hypotheses and research questions have emerged from researchers aimed at addressing the effect that energy conservation has on financial performance. These hypotheses and questions suggest a negative, weak, neutral, positive, or strong relationship between the abovementioned variables (Moon & Min, 2020; Chen & Ma, 2021; Shah *et al.*, 2021). Chen and Ma (2021) studied all energy-listed firms in China using quantitative method and regression in their analysis while Shah *et al.* (2021) studied a sample of 10 green technology companies using quantitative method, and the empirical analysis-based regression model. Moon and Min (2020) sampled from different sectors and used quantitative method and ANOVA analysis. Faisal, Ahmad, Riaz and Rahman (2021) used questionnaires in evaluating the extent to which resource efficiency actions affect firm performance. While these studies acknowledge a correlation between energy conservation and financial performance, they differ in their interpretations of the nature and extent of this relationship. Regardless of how energy conservation affects financial performance, it is still crucial that manufacturing companies engage in activities that do not harm the natural environment by consuming less energy or by using energy conservation strategies that minimise energy usage. The

next section reviews international literature on the effect of water conservation on financial performance.

### **3.4.2. The effect of water conservation on financial performance**

Manufacturing companies consume many natural resources such as water when converting unprocessed material into final products (Sharma *et al.*, 2020; Revollo-Fernández *et al.*, 2020; Chamberland *et al.*, 2020). The volume of water used in the production process differs from manufacturing company to manufacturing company depending on what is being produced and the processes a product undergoes (Gecim *et al.*, 2021). For instance, Engida *et al.* (2020) and Sehnem *et al.* (2021) assert that the brewing process in beverage manufacturing companies needs huge amounts of water, while Hamdan *et al.* (2021) find that the process of producing cultured meat does not use a lot of water. Consequently, when huge amounts of water are used in production processes, there might be water scarcity (Li, 2020; Wang, 2020). In their studies, Rosegrant *et al.* (2020) and Marulanda-Grisales and Figueroa-Duarte (2021) suggest that manufacturing companies can overcome the challenge of water scarcity by using water saving strategies. While some researchers suggest strategies for conserving water, others allude that water conservation yields great benefits such as better financial performance (Montazar, 2021). This implies that there might be a correlation between water conservation and financial performance.

Different scholars have scrutinised how water conservation affects financial performance and found different results (Sudha, 2020; Dzomonda & Fatoki, 2021; Lahouel, Zaid, Song & Yang, 2021). Majid, Naseem, Rehman and Ikram (2020) used survey questionnaires when investigating how engagement in eco-efficient activities affects financial performance of small and medium businesses in Europe. These researchers agree that a relationship exists between water efficiency and financial performance although the directions of the relationship differ. All these researchers used different sample sizes, methods of data analysis and different sectors and that might have accounted for the difference in results. Regardless of the different directions of the connection that is likely to occur between water conservation and financial performance

and the costs of adopting water conservation strategies, manufacturing companies should not be hesitant to invest in water conservation as it might minimise water scarcity challenges and environmental pollution. The next section presents a discussion on how carbon reduction relates to financial performance from an international perspective.

### **3.4.3. The relationship between carbon reduction and financial performance**

In their production processes, manufacturing industries continue to contribute towards environmental pollution through huge amounts of carbon emission, posing a menace to the environment such as global warming (Patnaik, 2018; Zelazna *et al.*, 2020; Wu, Xu, Ren, Hao & Yan, 2020b; Mishra, Wu & Sarkar, 2020; Gebreeyessus *et al.*, 2021; Ma, Zhao & Zhu, 2021). The study of Strielkowski, Firsova, Lukashenko, Raudeliūnienė and Tvaronavičienė (2021) suggest that manufacturing companies can reduce global warming by reducing huge carbon dioxide emissions resulting from excessive energy use and refraining from using technologies that result in climate change and global warming. While Velte *et al.* (2020), Gangi *et al.* (2020) and Hoang *et al.* (2020) suggest the use of carbon performance as a starting point for companies to gain stronger competitive advantage and better financial performance, Li *et al.* (2020) assert that corporate environmental responsibility (CER) is a disadvantage as it gives rise to costs and reduction in financial performance. However, an inverse relationship exists between carbon reduction and financial performance.

Previous researchers have found carbon reduction to have an association with financial performance, although the direction of the relationships is different. The study of Liu, Kim, Lee and Yoo (2022), Kumari and Patel (2020), Aslam *et al.* (2021) and Del Pilar Rodríguez-García, Galindo-Manrique, Cortez-Alejandro and Méndez-Sáenz (2022) suggest that there is a correlation between carbon reduction and financial performance. Kumari and Patel (2020) examined how both direct and indirect carbon emission influence financial performance and found both emissions to be negative, yet significant predictors of financial performance represented by ROE, ROA, ROIC and ROS. Additionally, Aslam *et al.* (2021) analysed the effect of EMPs on FP and found a positive association. Del Pilar Rodríguez-García *et al.* (2022) examined the relationship between carbon emission

representing eco-efficiency and Tobin's  $q$  representing financial performance and found a positive relationship. However, Liu *et al.* (2022) found that sustainable management activities insignificantly influence financial performance. All the aforementioned studies have a joint agreement that there could be an existing correlation between carbon reduction and financial performance, but they disagree on the direction and significance of this connection. The use of different sample sizes, methods of analysis and different types of firms might have accounted for the variations in the direction of the relationship between carbon reduction and financial performance. Notwithstanding the fact that competitive advantage and better financial performance might be achieved through reduced carbon emissions, manufacturing companies need to avoid climatological changes and global warming resulting from production activities by being socially responsible.

#### **3.4.4. The effect of waste reduction on financial performance**

Manufacturing processes of transforming raw materials into finished goods produce waste items that contribute to environmental pollution causing serious harm to the environment and those living in it (Gebreyessus *et al.*, 2021). The studies of Kabirifar *et al.* (2020) and Kakwani and Kalbar (2020) assert that manufacturing companies can use strategies such as reduce, reuse, recycle, reclaim, recover and restore in their production processes to manage waste generated. According to Baah, Opoku-Agyeman, Acquah, Issau and Abdoulaye (2020) and Jannah *et al.* (2020), if the aforementioned strategies are properly implemented, usage of raw material and waste will be minimised, and all costs incurred in production processes will be minimised, eventually leading to improved financial performance. For example, Yu *et al.* (2020) found that consumers tend to be satisfied with such practices leading them into buying from the company repeatedly and that enhances financial performance. Therefore, a possible relationship exists between waste reduction and financial performance.

There has been extensive research on the association between waste reduction and financial performance, with varying conclusions about which way the variables should be aligned (Baah *et al.*, 2020; Baah *et al.*, 2021b; Boakye *et al.*, 2021). Baah *et al.* (2020)

hypothesised that environmental performance positively influences financial performance and found that good environmental performance is likely to lead companies to goodwill, social and moral capital, stakeholder endorsement, increased market, and improved brands, all of which might lead to increased sales and high financial gains. On the other hand, Baah *et al.* (2021b) found environmental performance to be a negative and insignificant predictor of financial performance. Boakye *et al.* (2021) discovered an inverse u-shaped correlation between environmental management performance and financial performance.

Despite the difference in results, these authors agree that waste reduction does affect financial performance. The variation in the direction of the relationship may have resulted from the use of different sample sizes, methods of analysis and interpretation and sectors used by these researchers. Nonetheless how minimising waste influences financial performance and the benefits manufacturing companies stand to gain, sustainable production practices are mandatory and, as such, manufacturing firms are perceived to be under legal obligation to reconfigure production practices to promote sustainability. Moreover, enhancing production processes by lessening waste and guaranteeing effectual use of raw material minimises the costs of production and the production of greener products might attract environmentally conscious customers, eventually leading to better financial performance (Baah *et al.*, 2020). The next section discusses some Accounting variables that affect financial performance.

### **3.5. SOME ACCOUNTING VARIABLES AFFECTING FINANCIAL PERFORMANCE**

Although this research focuses on how eco-efficiency variables affect financial performance variables, previous research indicates other Accounting variables that affect financial performance. Besides return on assets, share price, net profit, and return on capital, financial performance is affected by many variables. Such variables include among others, sales revenue, earnings per share, operating costs and net profit (Suzan, 2020; Boakye *et al.*, 2021; Sinta, Kembaren & Fadli, 2021; Senan, Anagreh, Al-Dalaien, Almugari, Khaled & Al-Homaidi, 2021). However, sales revenue has been used by many studies as a variable for financial performance. For instance, Nguyen (2022); Santos,

Lisboa and Eugénio (2022) and Wasan, Mulchandani and Mulchandani (2022) have used sales revenue as one of the determining factors for financial performance in their studies. Besides, in Accounting, companies cannot achieve profits without sales revenue (Tudose, Rusu & Avasilcai, 2022). In other words, company survival can be guaranteed if sales are made and that may lead to more profits. Given that sales revenue is dominant in literature as a determinant of financial performance, this study will therefore use sales revenue as a control variable for all the objectives.

### **3.6. MAIN RESEARCH CONCEPTUAL FRAMEWORK**

Based on the preliminary research conceptual framework presented in chapter 2 section 2.4 (Figure 2.1), the researcher expands the preliminary research conceptual framework by considering the themes arising from eco-efficiency themes and financial performance themes arising from literature. These themes combined with the themes from the theories are now used to extend the preliminary research conceptual framework (Figure 2.1) to main research conceptual framework (Figure 3.2). In Figure 3.2, eco-efficiency variables appear on the left, which the researcher has hypothesised as influencing financial performance variables, which are on the right side of the framework. Based on literature, the researcher has used sales revenue as a control variable.

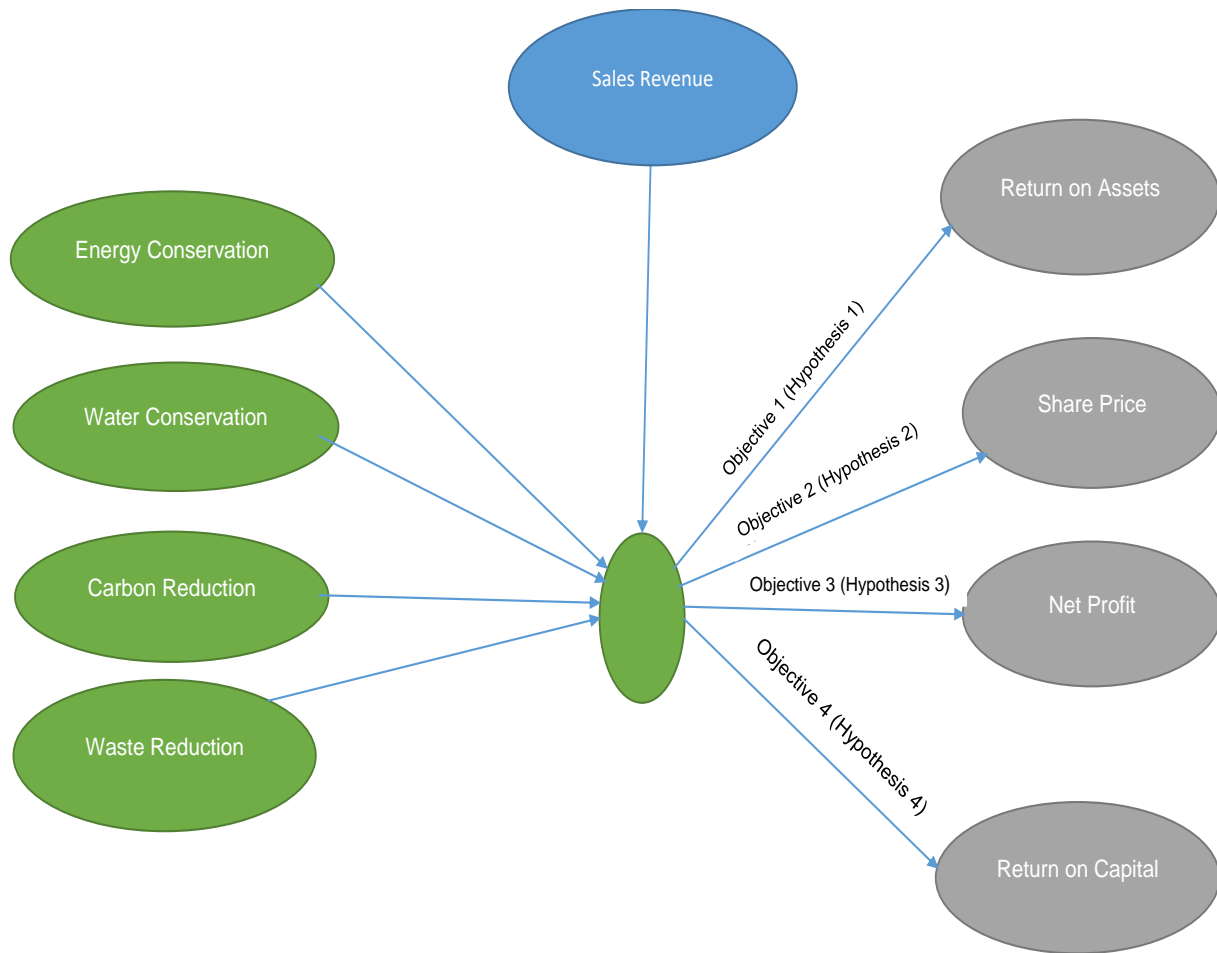


Figure 3.2 Main research conceptual framework (Link between eco-efficiency variables and financial performance variables)

Source: Author's main conceptual research framework

### 3.7. SUMMARY OF THE CHAPTER

This chapter presented the conceptual review covering the South African framework for sustainable development, the context of green economy, the constitution of the Republic of South Africa and the National Environmental Management Act. The chapter further presented a summary of the sustainable development goals, the Kyoto protocol, and the Paris agreement. The concepts of energy conservation, water conservation, carbon reduction and waste reduction were presented, followed by a review of literature on the effect of the aforementioned eco-efficiency variables on financial performance from an

African and international perspective. In addition, some variables affecting financial performance were briefly discussed. The last two sections presented the main research conceptual framework and the summary of the chapter. The next chapter details the overall research methodology.

## **CHAPTER FOUR**

### **RESEARCH METHODOLOGY**

#### **4.1. INTRODUCTION**

The preceding chapter presented a conceptual review to acquire a thorough understanding of the concepts of sustainable development and frameworks developed for sustainability, green economy, and among others, green activities. The previous chapter further discussed in detail the eco-efficiency variables used in this study. The chapter also reviewed literature on how eco-efficiency variables affect financial performance variables. The review covered both the African and international literature on the effect of energy conservation on financial performance, water conservation on financial performance, carbon reduction on financial performance and waste reduction on financial performance.

Chapter 4 discusses the overall research methodology that has been adopted in addressing research objectives and hypotheses. Section 4.2 presents the research onion. Section 4.3 discusses the research paradigm to be employed in this study. Sections 4.4 provides a detailed discussion of the research method while section 4.5 discusses the research design. Furthermore, section 4.6 discusses the study area and section 4.7 discusses the population of this study. Section 4.8 presents the sample, sampling method and sample size used in this study. Data collection procedure and tools and data analysis are presented in sections 4.9 and 4.10 respectively. Section 4.11 discussed reliability and validity. Sections 4.12 and 4.13 present the ethical considerations and the summary of the chapter in that order.

#### **4.2. RESEARCH ONION**

According to Saunders, Thornhill and Lewis (2018) and Jasim, Thabet and Thabit (2021), the researcher ought to present a research onion. Melnikovas (2018) alludes that employing the research onion to describe the study's research process has been widely acknowledged as a logical approach to creating the best possible research design. The

research onion has been extensively employed in earlier empirical research in developing the framework for the study process (Mutezo, 2015). Therefore, this study's research onion is as follows:

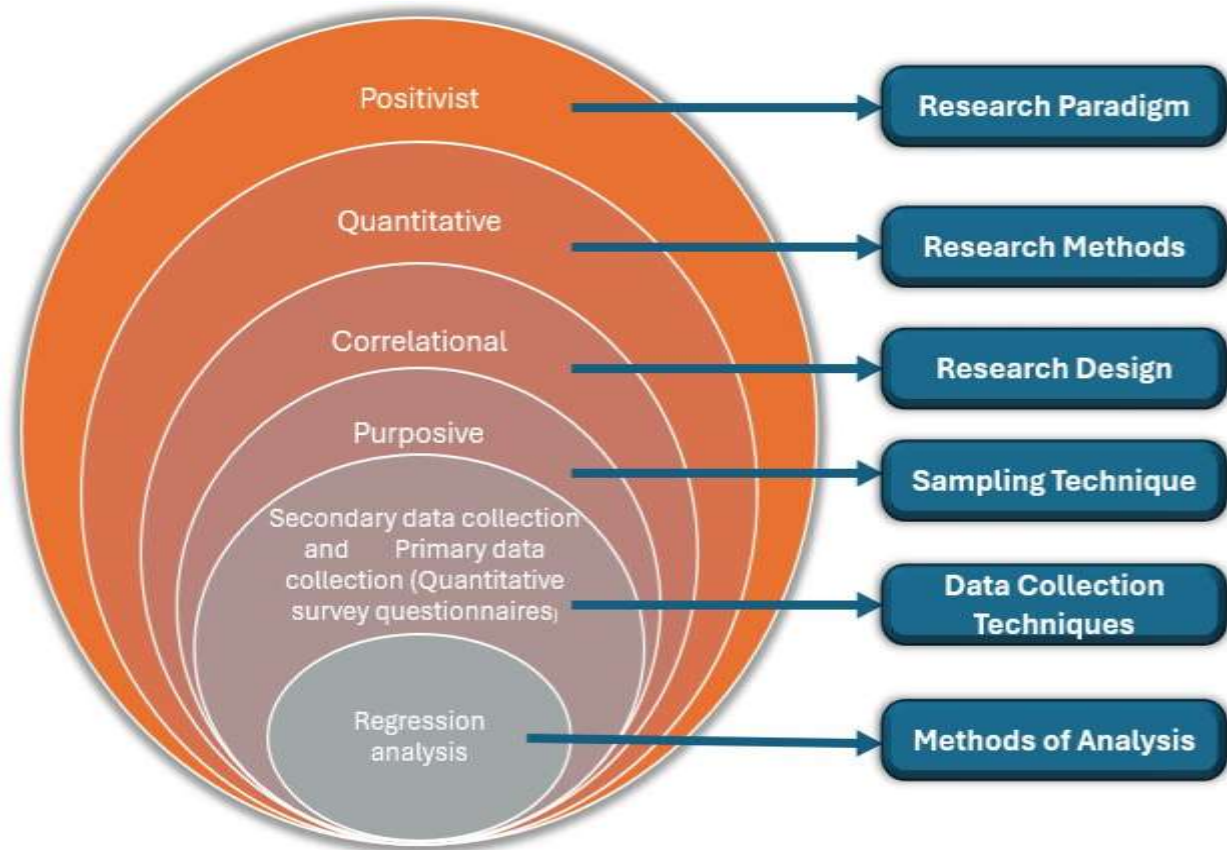


Figure 4.1. Research onion

Source: Author's research onion

### 4.3. RESEARCH PARADIGM

Research paradigms are mutual beliefs and agreements about ways in which the world and its allied phenomena ought to be comprehended and construed (Bogna, Raineri & Dell, 2020; Ganiyu, Ebohon & Ajayi, 2021). Park, Konge and Artino (2020) allude that comprehending paradigm-specific assumptions brings about the quality of outcomes that aim at supporting scientific studies and identify gaps in producing sound evidence. Figure 4.2 shows some popular research paradigms often used in Accounting research: the interpretivist, the pragmatist, the critical realism, and the positivist research paradigms. These research paradigms are briefly discussed below:

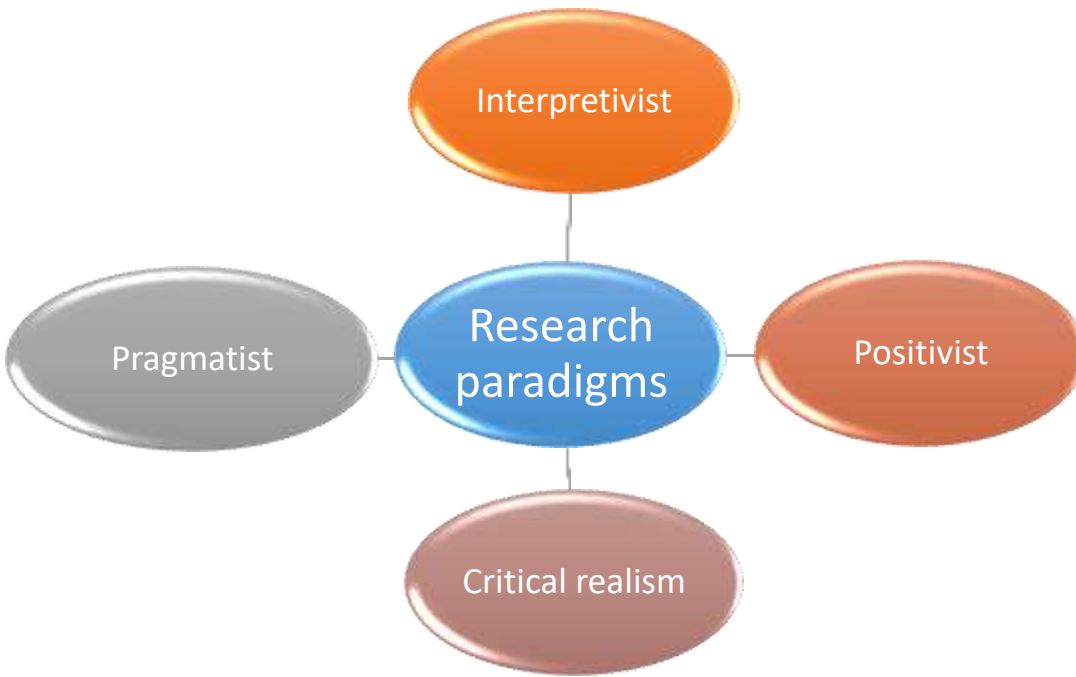


Figure 4.2. Some popular research paradigms used in Accounting

Source: Author's construct

#### 4.3.1. The interpretivist research paradigm

The interpretivist research paradigm is a theoretical viewpoint that was developed in contradiction to positivism to comprehend and explicate human and social reality (Al-Ababneh, 2020). Interpretivism highlights that generalisation of universal patterns must not conceal the complexity of the society (Junjie & Yingxin, 2022). This study paradigm also considers the intricacy of each individual in the world and their relevant explanations. Interpretivists' methodologies allow them to produce qualitative data (Kumatongo & Muzata, 2021). Even though numerical data may be produced during the process, it cannot be relied on as per this paradigm. The purpose of qualitative research is not to make judgments or conclusions from numerical data. According to this research paradigm, reality cannot be comprehended via the lens of natural science but rather necessitates researchers to thoroughly and actively involve and engage themselves with the partakers in order to have a good understanding of ways in which they perceive reality, which essentially elucidates their ontology (Saunders, Lewis & Thornhill, 2019).

### **4.3.2. The pragmatist research paradigm**

The pragmatist research paradigm is a philosophical approach that predicts and solves problems by focusing on the vital role of opinions, words, and conditions (Mumtaz, 2021). In addition, the pragmatist research paradigm was established to do away with what was referred to as the "paradigm war" among the positivists and the interpretivists (Ugwu, Ekere & Onoh, 2021). This paradigm originated among philosophers who believed that it was neither feasible to ascertain social reality as it was formed under the positivist paradigm nor to comprehend the "truth" of the real world by just a particular scientific approach, as recommended by the positivist paradigm (Kivunja & Kuyini, 2017). Pragmatist research paradigm advocates for a mixed methods approach which combines quantitative and qualitative research methods (Ugwu *et al.*, 2021).

### **4.3.3. Critical realism research paradigm**

Critical realism (CR) research paradigm seeks to provide explanations by accentuations of what individuals can do within the social context in which they behave. CR compares reality to an iceberg, with most of it hidden from view (Stutchbury, 2022). In addition, critical realists hold that reality is independent on what is perceived to be the truth. In other words, critical realists embrace a form of epistemological constructivism and relativism while expressing a real-world that is independent of own perceptions, theories, and structures. This research paradigm further assesses reality from the critical viewpoint (Erciyas, 2020). Additionally, critical realism research paradigm gives researchers the freedom to look beyond the empirical layer of data and investigate the causes and conditions of events (Tran, Cameron, Montague, Nuenjohn & Fan, 2022). The study of Lawani (2021) asserts that reality is categorised into three, namely: the real, the actual, and the empirical. The category "real" consists of deep systems and objects that are physically, socially, and internally connected. The mechanisms, occurrences, perceptions, and causal powers inherent in these objects or creatures as they independently exist, are part of the total reality that is within the real. All events occurring as structures and their effect as a result of causal mechanisms activation are constituted in the domain of the actual, whether or not they are visible. The last domain is the

empirical domain which states that occurrences may be perceived or measured and experienced (Lawani, 2021).

#### **4.3.4. The positivist research paradigm**

The positivist research paradigm lays the conceptual foundation for the development of social sciences, which deviates from the natural sciences' guiding principles (Setiawan, 2022). In addition, Park *et al.* (2020) allude that the positivist paradigm is based on the notion that there is one concrete reality that exists, one that is clearly comprehended, acknowledged, and quantified. The positivist research paradigm further postulates that knowledge is gained through collecting data and facts that the researcher can objectively verify quantitatively (Dawadi, Shrestha & Giri, 2021). In order to discover the truth, positivist research prioritises the detachment between the researcher and the subject of study (Young & Ryan, 2020). Furthermore, the positivist research develops through research that validates or supports a hypothesis. However, the positivist research paradigm holds that knowledge is neutral and can be calculable (Antwi & Hamza, 2015). In other words, knowledge must be created objectively, independent of the values of the researchers or participants, and when properly developed, it becomes the truth, which is positive, precise, and congruent with reality.

#### **Research paradigm adopted in this study**

This study adopts the positivist research paradigm. This research paradigm was chosen because: (i) it is based on the existence of mathematical or statistical relationships between variables and, (ii) the research sought to measure the relationship between eco-efficiency variables and financial performance variables (collected in a numerical format) as indicated in the research objectives and hypothesis. Moreover, since this study intended on employing a quantitative research methodology for data collection and analysis, the positivist paradigm was relevant.

#### **4.4. RESEARCH METHOD**

Research methods comprise three main types, namely, quantitative, qualitative and mixed research methods. Figure 4.3 shows three key forms of research methods, namely, the quantitative, the qualitative and the mixed methods. The three methods are briefly discussed below:

##### *Quantitative research method*

Quantitative research method involves the measuring of quantity, and it is expressed in terms of Rands and numbers (Alharahsheh & Pius, 2020). Quantitative research relies on numeric data obtained from observations to describe and understand the phenomena being investigated. This technique uses both factual and descriptive statements that elucidate the cases' actual meaning, rather than what they should mean (Taherdoost, 2022). In addition, this method of investigation employs empirical analysis to determine how well a policy or program meets a given norm or criterion. Furthermore, mathematical approaches are employed to analyse the numerical data that has been collected.

##### *Qualitative research method*

A full definition of qualitative research method comprises all of its forms, including phenomenological, ethnographical, realistic, anthropological, and case study approaches and some positivists refer to this method as narrative telling (Hameed, 2020). This method uses several empirical resources such as life experiences, case studies and stories to demonstrate the practices and predicaments that human beings are faced with in their lives, by concentrating on their deep meaning and reasons that numbers cannot define (Taherdoost, 2022). Qualitative research method therefore aims to collect data that does not relate to numbers (Chivanga & Monyai, 2021). Qualitative research is aimed at collecting original, first-person word-based data and analyse it using certain interpretive tools. Because this research method is exploratory, it is a suitable tactic when researching a topic with limited readily available data (Taherdoost, 2022). In other words, the qualitative method has the potential to unearth new insights, conceptions, and theories.

### *Mixed research method*

Mixed research method combines both quantitative and qualitative methods to provide a deep understanding into the research phenomena that none of the aforementioned methods can provide (Dawadi *et al.*, 2021). In other words, mixed research methods combine qualitative and quantitative methodologies to get a better comprehension of the subject, and that is dependent on the study aims and the kind of identified research problem. In some research disciplines, inclusive of the social discipline and the health discipline, combining both qualitative and quantitative approaches can help researchers overcome difficult study settings.

Given that either qualitative or quantitative approaches may be insufficient for a study, mixed methods might be effective because they have benefits of both (Taherdoost, 2022). Mixed research method has many benefits. One of the benefits is "complementary strengths," which denotes leveraging the advantages of one research approach to reinforce or to provide backup to the other. According to mixed researchers, adopting only the quantitative or only the qualitative research, is constrained and inadequate for a number of research issues. Thus, other research issues might not be resolved by one research method. Another benefit among others is, triangulation when seeking to support and expand study findings to fully understand the phenomenon under study, by using many data gathering procedures and analysis to examine the same phenomenon (Maarouf, 2019).

Researchers such as Ngulube and Ngulube (2022) have uttered the reasons for the adoption of mixed research methodology in research as follows: (i) either qualitative or quantitative, may not be sufficient to provide a different viewpoint on the research subject, (ii) a qualitative approach must be used to explain quantitative results because: without identifying the underlying reasons of the patterns, a quantitative research may identify trends and patterns of a certain occurrence and (iii) Qualitative results must be extrapolated to a wider population based on a quantitative approach in order to reveal the causes behind the trends.

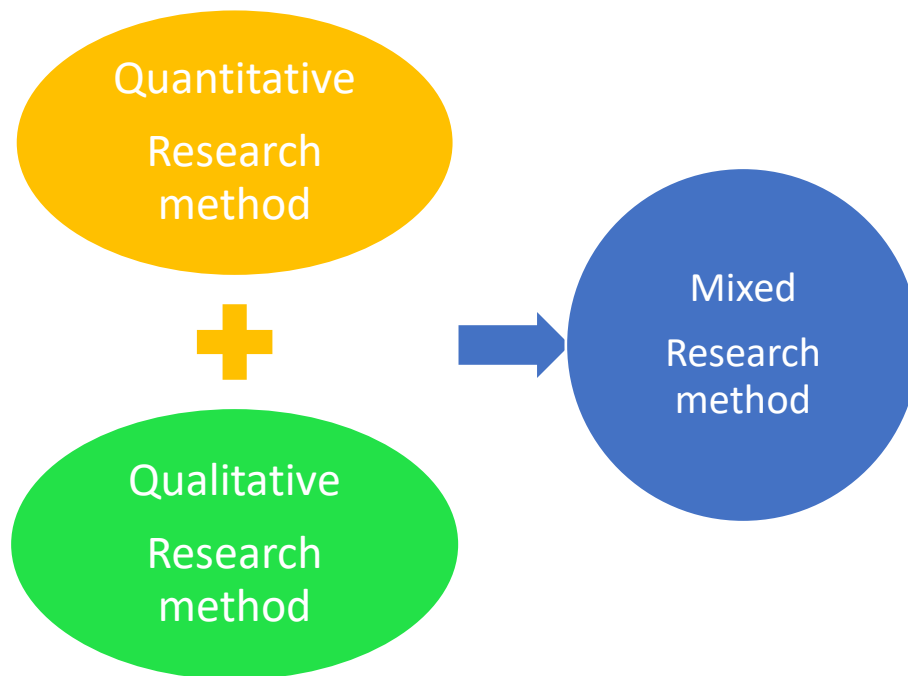


Figure 4.3. Main types of research methods

Source: Author's own construct

### **Research method adopted in this study**

This study adopted the quantitative research method to establish the relationship between eco-efficiency variables (energy conservation, water conservation, carbon reduction and waste reduction) and financial performance variables (ROA, SP, NP & ROC). The justifications for adopting the quantitative research method are: (i) the research sought to measure the association between quantitative variables and (ii) the research paradigm in this study is positivist, which involves the statistical measurement of relationships between variables.

### **4.5. RESEARCH DESIGN**

A research design acts as a blueprint for collecting, analysing, and interpreting data in a research study and it defines the sphere of generalisability; that is, whether research interpretation can be generalised to the whole population, smaller or larger part of the population or to different situations (Asenahabi, 2019; Osuagwu, 2020). Research

designs comprise various types, for example, descriptive, cross-sectional, exploratory, cohort, experimental, longitudinal, correlational and non-experimental (Asenahabi, 2019; Pawar, 2020). To accomplish the goal of this study, the researcher employed the correlational research design. The correlational research design was deemed appropriate since this study examined the relationship between eco-efficiency variables and financial performance variables. Figure 4.4 shows the steps followed in correlational research.



Figure 4.4: Correlational research steps

Source: Author's own construct

## 4.6. STUDY AREA

The study area in research refers to the location to be studied, where data that is relevant to the research will be collected. The study area for this research is Johannesburg where the Johannesburg Stock Exchange (JSE) is located. The justification for choosing this study area is that the researcher planned to use sustainability and financial information regarding eco-efficiency variables and financial performance variables contained in the published annual integrated reports of food and beverage manufacturing companies listed in the JSE.

#### **4.7. POPULATION OF STUDY**

Population is a group of potential participants or entities from where a sample can be selected for research (Casteel & Bridier, 2021). The researcher planned to use all 16 food and beverage manufacturing companies listed in the JSE at the time the study was conducted. However, 2 of the 16 food and beverage manufacturing companies did not have complete year to year data, therefore the researcher used 14 companies which had complete data for all the variables for all the years to be studied. This study's unit of analysis was each food and beverage manufacturing company listed in the JSE index. The justification for choosing this population is that these companies' production activities contribute to environmental pollution (Zelazna *et al.*, 2020).

#### **4.8. SAMPLE, SAMPLING METHOD AND SAMPLE SIZE**

A research sample refers to part of the whole population that the study is interested in (Turner, 2020). There are two basic techniques for sampling, namely: probability and non-probability sampling techniques (Pace, 2021). This study will use a non-probability sampling technique called purposive sampling. The justification for choosing this sampling technique is that the researcher purposively studied all the 14 sampled food and beverage manufacturing companies listed in the JSE. In addition, the justifications for using all the 14 sampled food and beverage manufacturing companies are: (i) that the sample size is small and workable; (ii) to avoid issues of representative sample; (iii) to avoid loss of necessary information and (iv) to avoid sampling errors associated with different sampling techniques.

#### **4.9. DATA COLLECTION**

Data collection is divided into two major methods namely, primary and secondary data collection methods (Pandey & Pandey, 2021). While the primary data collection method involves gathering raw data through surveys, interviews, experiments, and others (Pandey, Ogunmola, Enbeyle, Abdullahi, Pandey & Pramanik, 2021), secondary data collection method involves the gathering of data that has been documented either by primary researchers or organisations (Cerar, Nell & Reiche, 2021).

This study used two types of data (secondary and primary data). Both the secondary and the primary data were collected in a numerical (quantitative) form. Quantitative secondary data were collected for a period of ten years from companies' annual integrated reports, which are freely available to the public. Quantitative primary data were collected using survey questionnaires.

### *Secondary data collection*

The major data for this study were through secondary data collected from the companies' annual integrated reports because such reports contain the variables of analysis in this study which are eco-efficiency variables (energy consumption, water consumption, carbon emissions and waste generated) and financial performance variables (return on assets, share price, net profit, and return on capital). The following data were collected and used to represent financial performance (which is the dependent variable):

- Return on Assets (in percentage) at end of the reporting period.
- Share price (in Rand amount) at end of the reporting period.
- Net profit (in Rand amount) at end of the reporting period.
- Return on capital (in percentage) at end of the reporting period.

In addition, the following data were collected and used to represent eco-efficiency (which is the independent variable):

- For energy conservation - Energy consumption (in kilowatts of energy) per year.
- For water conservation - Water consumption (in kilolitres of water) per year.
- For carbon reduction - Carbon emission (in tonnes of carbon dioxide) per year.
- For waste reduction - Waste generated (in kilograms of waste) per year.

It is worth noting that the researcher checked if energy was conserved through energy consumption data obtained from the annual reports. In the same vein, water conservation was determined by the amount of water consumed. Lastly, carbon reduction and waste reduction were measured through the amount of carbon emitted and the amount of waste generated.

Moreover, financial performance is affected by many factors other than independent variables and those factors are referred to as control variables. The data for the control

variable was collected from the annual integrated reports of the sample of companies as follows:

- Sales revenue (in Rand amount) at the end of the reporting period.

*Primary data collection (Quantitative survey questionnaire)*

As an addition to the major source of data, which is the secondary data, the researcher also collected primary data through a survey questionnaire which was designed quantitatively using a Likert scale of 1 to 4. The quantitative scale enabled respondents to indicate the numerical values, which they attach to the variables of this study. The researcher planned to collect quantitative primary data from 32 participants, that is, 16 chief financial officers (CFOs) and 16 environmental officers (EOs) from the 16 food and beverage manufacturing companies listed in the JSE. That is, 1 CFO and 1 EO per company. However, only 28 questionnaires were completed and received, that is 14 from CFOs and 14 from EOs. The usefulness of the inclusion of the primary data collection was to conduct a follow-up quantitative analysis after quantitative secondary data analysis, to check if the CFOs' and the EOs' numerical rating of how eco-efficiency variables relate to financial performance variables, may align to the results from secondary data analysis. The questionnaire comprised five sections (See Appendix C). The questionnaire has been structured as follows:

1. Section A included the demographic information of the participants.
2. Section B included statements relating to eco-efficiency and return on assets (ROA).
3. Section C included statements relating to eco-efficiency and share price (SP).
4. Section D included statements relating to eco-efficiency and net profit (NP).
5. Section E included statements relating to eco-efficiency and return on capital (ROC).

Secondary data collection technique

The researcher collected secondary data of JSE listed food and beverage manufacturing companies from annual integrated reports for the financial period 2012-2021. Data

collected was recorded on an Excel spreadsheet. The final step was to import the collected data to STATA software and E-views 9 to analyse secondary data. The test performed using STATA were the Descriptive statistics, Correlation matrix, Unit root, Wooldridge test for autocorrelation, Regress, Hausman and the GMM. Tests for normality and cointegration were performed using E-views.

#### Primary data collection procedure

The researcher developed and distributed an electronic version of the quantitative survey questionnaire. One of the advantages of using an electronic questionnaire is that responses are automatically and electronically saved on an excel spreadsheet. Some companies' email addresses were not published and as such, the researcher had to use the general info email addresses to get correspondence for the CFOs and the EOs. For companies whose email addresses were published, the survey questionnaires were sent to secretaries and personal assistants to the CFOs and EOs who were responsible to distribute them to the relevant participants.

#### **4.10. DATA ANALYSIS**

A panel data multiple linear regression analysis (MLRA) was used in this study to analyse the secondary data that were gathered. The reason for using panel data is that secondary data were collected from 14 companies over a period of ten (10) years from 2012 to 2021, which gave a total of 140 observations (which is: 14 x 10 years). MLRA is a method used to identify any linear relationship between variables (McCarthy, McCarthy & Ceccucci, 2022). This analysis was deemed suitable in this study because the researcher sought to test the relationship between quantitative variables and the positivist research paradigm was used, which involves the statistical measurement of the relationship between variables. Pham *et al.* (2021), Indriastuti and Chariri (2021) and Soedjatmiko, Tjahjadi and Soewarno (2021) used MLRA to establish the association between environmental sustainability practices and financial performance. The use of this approach provided an interaction effect that measured how eco-efficiency variables affect financial performance variables. The data collected was transferred to STATA software to generate results for

analysis. Dzomonda and Fatoki (2020) and Molla (2021) also used STATA software in their research. In this study, the econometrics models were performed using multiple linear regression equations as stated in the next section.

### **Analysis of secondary data (First level of analysis)**

In this study, eco-efficiency is the independent variable represented by energy conservation, water conservation, carbon reduction and waste reduction as supported by literature (Chen & Ma, 2021; Lahouel *et al.*, 2021; Khalil and Nimmanunta, 2021; Boakye *et al.*, 2021). The dependent variable is financial performance represented by return on assets, share price, net profit and return on capital. The researcher intended using one control variable per dependent variable as follows:

Table 4.1: Dependent variables, independent variables and the control variable used in the analysis model

<b>Objective</b>	<b>Dependent Variables</b>	<b>Independent Variables</b>	<b>Control Variable</b>
<b>Objective 1</b>	ROA	<ul style="list-style-type: none"> <li>• ENRCON</li> <li>• WATCON</li> <li>• CAREMM</li> <li>• WASGEN</li> </ul>	<ul style="list-style-type: none"> <li>• SALREV</li> </ul>
<b>Objective 2</b>	SP	<ul style="list-style-type: none"> <li>• ENRCON</li> <li>• WATCON</li> <li>• CAREMM</li> <li>• WASGEN</li> </ul>	<ul style="list-style-type: none"> <li>• SALREV</li> </ul>
<b>Objective 3</b>	NP	<ul style="list-style-type: none"> <li>• ENRCON</li> <li>• WATCON</li> <li>• CAREMM</li> <li>• WASGEN</li> </ul>	<ul style="list-style-type: none"> <li>• SALREV</li> </ul>
<b>Objective 4</b>	ROC	<ul style="list-style-type: none"> <li>• ENRCON</li> <li>• WATCON</li> <li>• CAREMM</li> <li>• WASGEN</li> </ul>	<ul style="list-style-type: none"> <li>• SALREV</li> </ul>

WHERE:

ROA = Return on Assets

SP = Share Price

NP = Net profit  
 ROC = Return on Capital  
 ENRCON = Energy consumption  
 WATCON = Water consumption  
 CAREMM= Carbon emission  
 WASGEN= Waste generated  
 SALREV = Sales revenue

All the above listed variables were used to formulate the following analysis model for each research objective:

Objective 1: To examine the relationship between eco-efficiency and return on assets (ROA).

H1<sub>0</sub>: There is no significant relationship between eco-efficiency and return on assets.

Analysis model for objective 1 and hypothesis 1:

$$ROA_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

Objective 2: To assess the relationship between eco-efficiency and share price (SP).

H2<sub>0</sub>: There is no significant relationship between eco-efficiency and share price.

Analysis model for objective 2 and hypothesis 2:

$$SP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (2)$$

Objective 3: To measure the relationship between eco-efficiency and net profit (NP).

H3<sub>0</sub>: There is no significant relationship between eco-efficiency and net profit.

Analysis model for objective 3 and hypothesis 3:

$$NP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (3)$$

Objective 4: To evaluate the relationship between eco-efficiency and return on capital (ROC).

H4<sub>0</sub>: There is no significant relationship between eco-efficiency and return on capital.

$$ROC_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (4)$$

WHERE:

ROA = Return on Assets (Dependent variable for objective 1)

SP = Share Price (Dependent variable for objective 2)

NP = Net profit (Dependent variable for objective 3)

ROC = Return on Capital (Dependent variable for objective 4)

ENRCON = Energy consumption; WATCON = Water consumption; CAREMM= Carbon emission; WASGEN= Waste generated (Independent variables for objectives 1,2,3 &4)

SALREV = Sales revenue (Control variable)

$\varepsilon$  = error term

$\alpha$  = constant

$\beta$  = Beta coefficients are used to explain the explanatory variable's partial elasticities.

$it$  = the  $i$  represents company and the  $t$  represents the year

Table 4.2: Operational measure of variables

<b>Independent variables</b>	<b>Measurement</b>	<b>Source of data</b>
<b>Energy consumption</b>	Kilowatts of energy used per annum of each company (indicated in the companies' annual integrated reports)	From published annual integrated reports.
<b>Water consumption</b>	Kilolitres of water used per annum of each company (indicated in the companies' annual integrated reports).	From published annual integrated reports.
<b>Carbon emission</b>	Tonnes of carbon emitted per annum of each company (indicated in the companies' annual integrated reports).	From published annual integrated reports.
<b>Waste generated</b>	Kilograms of waste generated per annum of each company (indicated in the companies' annual integrated reports).	From published annual integrated reports.
<b>Dependent variables</b>	<b>Measurement</b>	<b>Source of data</b>
<b>Return on Assets</b>	<p>Percentage of return on assets at the end of the year for each company (indicated in the companies' annual integrated reports).</p> <p>The formula for Return on assets is presented as follows:</p> $ROA = \frac{Net\ Income \times 100}{Total\ Assets}$	From published annual integrated reports.

<b>Share price</b>	Share price in Rand amount for each company (indicated in the companies' annual integrated reports)	From published annual integrated reports.
<b>Net profit</b>	Net profit in Rand amount per annum for each company (indicated in the companies' annual integrated reports)	From published annual integrated reports.
<b>Return on capital</b>	<p>Percentage of return on capital at the end of the year for each company (indicated in the companies' annual integrated reports). The formula for return on capital is presented as follows:</p> $ROC = \frac{(Net\ Income - Dividends)}{(Debt + Equity)}$	From published annual integrated reports.
<b>Control variable</b>	<b>Measurement</b>	<b>Source of data</b>
<b>Sales revenue</b>	Amount of sales revenue of each company per annum (indicated in the companies' annual integrated reports).	From published annual integrated reports.

## Analysis of primary data (second level of analysis)

This section presented the second level of analysis by using the primary data collected from the quantitative survey questionnaires.

*Analysis of primary data (quantitative questionnaires).*

In addition to the first level of analysis, which used secondary data, a second level of analysis was conducted for primary data collected through quantitative survey questionnaires. Primary data were analysed using the ordinary least square because the variables in the questionnaire were structured to receive quantitative answers. The survey questionnaire reflected all the variables used in the secondary data analysis. Therefore, the model for primary data analysis is the same model used in the first level of analysis, presented as follows:

$$ROA_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

$$SP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (2)$$

$$NP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (3)$$

$$ROC_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (4)$$

(The description of the notations in the models is as described on page 66)

### 4.10.1. ESTIMATION TECHNIQUES FOR SECONDARY DATA

Over a period of time, panel data offer statistical information about every research unit. It combines cross-sectional and time series data to provide further insights into the phenomenon under study (Dopierała, Mosionek-Schweda, Laskowicz & Ilczuk, 2022).

The study supports the technique because of its flexibility to permit the investigation of several categories throughout time, not to mention the autonomy of observation it gives. The methodological technique starts with a brief overview of tests to be performed in the analysis process. A brief discussion will cover descriptive statistics, correlation matrix, unit root, cointegration, diagnostic, heteroscedasticity, autocorrelation, normality, and regression.

#### 4.10.1.1. Descriptive analysis

To begin with the analysis, it is important to first analyse the behaviour of the dataset through descriptive analysis. Milanzi (2021) describes descriptive analysis as a tabular graphical presentation of data distribution with the purpose of inspecting the central distribution of the dataset. Lane *et al.* (2019) also posit that performance of descriptive analysis is again important to identify how spread the data is and to measure the variability of the data set.

#### 4.10.1.2. Correlation analysis

Correlation analysis was performed to expose any association among the variables in the proposed regressions. More formally, Gogtay and Thatte (2017) indicate that correlation analysis is a concept for denoting connections between quantitative variables. These researchers further indicate that the correlation coefficient which ranges between +1 and -1 does not only measure the “strength” or the “extent” of association between the variables but it also reveals its direction. Figure 4.5 shows the spectrum of the correlation coefficient:



Figure 4.5: Spectrum of the correlation coefficient

Source: Gogtay and Thatte (2017)

As depicted in Figure 4.5, a correlation coefficient of +1 signifies a positive relationship between two variables, -1 signifies a negative relationship, and 0 indicates no relationship between the variables being studied.

#### **4.10.1.3. Stationarity/Unit root test**

The unit root test, commonly known as the stationarity test, is an important method for evaluating series' stationarity in time series analysis (Zuo, 2019). The most popular unit root tests include the fisher PP, Breitung nonparametric, the fisher ADF and the KPSS stationarity test. Mohamed and Çelen (2022), for example, posit that the unit root test is thus significant in determining whether the variables have a trend that is either stochastic or deterministic and that it is also considered an initial step in testing for co-integration and correlation. It is vital to note that the results can be presented informally or officially upon establishing that a unit root exists. Informal unit root testing is carried out by inspecting graphs visually, whereas formal tests employ a variety of test methods.

#### **4.10.1.4. Cointegration tests**

Assessing the presence of a sustained correlation between the variables through cointegration tests is a crucial task. This study uses the Pedroni panel cointegration tests to evaluate cointegration. Eleven statistics are used in the Pedroni panel cointegration test, which pits the alternate hypothesis of cointegration among the variables in the estimated model against the null hypothesis of no cointegration. Based on the null hypothesis, there is no presence of cointegration. Cointegration is observed as per the alternate hypothesis. The P-value is set at 0.05 and if panel values are less than 0.05, the null hypothesis is rejected.

#### **4.10.1.5. Diagnostic tests**

The diagnostic tests guarantee that the provided linear regression estimates can be relied on as they are considered accurate (Oryani, Kamyab, Moridian, Azizi, Rezanian & Chelliapan, 2022). However, unlike with time series, where it is compulsory to perform all diagnostic tests, panel studies do not require all diagnostic tests because of the

advantages a panel study has, to give an example, a higher number of observations and the possibility to prevent heteroscedasticity. For example, Ncanywa and Mabusela (2019) performed diagnostic tests in their studies. This study employs VAR residual heteroscedasticity tests to check for heteroscedasticity, Wooldridge test for autocorrelation and Jarque-Bera tests with Kurtosis statistics to test for normality.

#### **4.10.1.6. Heteroscedasticity**

When a predicted variable's standard deviations vary widely across independent variable values or when compared to previous time periods, it is said to exhibit heteroscedasticity (Youssef, 2022). Upon visual inspection, the tell-tale hallmark of heteroscedasticity is that the residual errors will tend to fan out with time. Furthermore, heteroscedasticity can distort findings and weaken the reliability of hypothesis tests (Heston, 2023). In this regard, it is important to test for robustness to heteroscedasticity by performing the VAR residual heteroscedasticity tests in E-views. In case the calculated probability value is lower than the p-value of 0.05, the null hypothesis of heteroscedasticity is accepted. If the p-value is greater than 0.05, the panel has homoscedasticity which is desirable.

#### **4.10.1.7. Wooldridge Autocorrelation**

The Wooldridge autocorrelation test is a robust test based on the first-difference model's ordinary least square residuals. It makes fewer assumptions about how heterogeneous individual effects behave in first-order serial correlation for panel data. The panel data model's errors were examined in this study using the Wooldridge test to identify first-order autocorrelation. This test type is required to improve the reliability of the regression results because the number of observations can cause autocorrelation, which can affect the validity of the panel least squares regression. Zardoub and Sboui (2023) also used the Wooldridge test in their study.

#### **4.10.1.8. Normality**

Normality tests aid in establishing normal distribution of data. Many methods have been developed to assess normality (Khatun, 2021). For example: assessing the joint

distribution of univariate test statistics, the generalised method of moments (GMM), utilising cross-moments in test procedures, multivariate extensions of skewness and kurtosis, extension of Jarque-Bera test, the multivariate Jarque-Bera test, the multivariate omnibus test, omnibus k2 statistic test, modified multivariate Jarque-Bera test, transformed skewness and kurtosis test, henze-zirkler's multivariate normality test, mardia's mvn test, royston's multivariate normality test and others not mentioned in this study. The researcher will perform the Skewness/Kurtosis tests in conjunction with Jarque-Bera in E-views to confirm non-violation of normality.

#### **4.10.2. REGRESSION ANALYSIS**

This section presents a brief discussion of the models to be tested for all the hypotheses.

##### **4.10.2.1. Random effects**

The random effect (RE) model assumes that the specific effect of an individual is a random variable, independent of the explanatory factors from past, present, and future time periods. Schmidheiny and Basel (2011) show that the RE model can be reliably projected by both the RE and the fixed effect estimators. Most notably, the RE estimator is preferable when there is certainty that the individual-specific effect is truly an unrelated factor.

##### **4.10.2.2. Fixed effect model**

Fixed effect (FE) is appropriate when exploring the correlation between predictors and the response variable within an entity over a period. According to Pillai (2016) the FE model is considered for application under the following assumptions: (i) Slope coefficients are constant, but intercept changes across cross sections; (ii) All coefficients (intercept and slope) change among cross-sections. (iii) Slope coefficients are constant, but the intercept changes across cross sections and time series; (iv) Slope coefficients remain constant, whereas the intercept fluctuates throughout time; (v) All coefficients (intercept and slope) change with cross-section and time series, and (vi) All coefficients (intercept and slope) change with time.

#### **4.10.2.3. Generalised methods of moments**

Generalised methods of moments (GMM) produce heteroscedasticity and autocorrelation consistent estimations, as well as controls for time-invariant country-specific effects that are not observed and disregard any indogeneity in the panel model. GMM estimators choose values that lower the regression's quadratic framework. This strategy is useful for addressing model over-identified setups (Ganda, 2022a). Furthermore, in circumstances where the count of variables matches the count of moment conditions, the GMM approach minimises the method of moments. GMM has major advantages over maximum likelihood because it permits estimation within the constraints given by the theory that there is no need to incorporate distributional assumptions that are not required by the theory. Khan, Nouman and Ullah (2023) used the GMM approach in assessing the impact of one variable on the other. In addition, Agradi, Adom and Vezzulli (2022) used GMM to check the relationship between variables. The aforementioned authors sought to establish the association between variables. Similar to these studies, the researcher seeks to measure how eco-efficiency affects financial performance.

#### **4.11. RELIABILITY AND VALIDITY**

The concepts of reliability and validity are intertwined as they demonstrate various aspects of the instrument for measuring (Sürücü & Maslakci, 2020). In general, an instrument for measuring does not have to be valid to be considered reliable. However, if an instrument for measuring is valid, it stands a high chance of being reliable. Reliability alone is not adequate to ensure validity. The researcher was thorough in applying each research process step to examine the relationship between eco-efficiency variables and financial performance variables.

##### **4.11.1 Reliability**

Reliability is a way to assess how consistently the values being measured are obtained through repeated measurements using the same device and conditions (Sürücü & Maslakci, 2020). In other words, reliability is when the measuring tool is able to produce same outcomes when used in different situations. Reliability is a feature of both the

measuring tool and the measuring tool's outcomes. In confirming the reliability in this study, data were collected secondarily from published annual integrated reports of JSE listed food and beverage manufacturing companies through the companies' websites and primarily from the sampled companies' CFOs and EOs through survey questionnaires. All JSE listed companies are compelled to publish annual integrated reports and those reports are audited. This therefore provides assurance that the data sources can be relied on. Those who audit the report makes sure that the reports are in line with the requirements of the International Financial Reporting Standard (IFRS) and that cannot be doubted.

Furthermore, the researcher used the STATA and EViews software data analysis tools to detect potential relationships between eco-efficiency and financial performance. These software packages are used to examine complex relationships. Dzomonda and Fatoki (2020) have used STATA in their study and have arrived at reliable results. In addition, Mogashwa (2023) used EViews as a statistical software and arrived at reliable results. As a result, based on the arguments presented, the researcher can confidently assert that reliability was carefully considered throughout the entire research process, leading to reliable results.

#### **4.11.2 Validity**

The degree of validity determines whether or not what is being measured corresponds to what needs to be measured (Chetwynd, 2022). In this study, the researcher guaranteed validity by using secondary data that were obtained from the annual integrated reports of JSE listed food and beverage manufacturing companies and primary quantitative data collected from the CFOs and EOs of the sample of companies. It is hoped that data obtained from published annual integrated reports, and data obtained primarily from the CFOs and the EOs of the sample of companies, can be relied on for use by other researchers. To further confirm the validity of results, the timespan ought to be appropriate. The researcher chose the period of ten (10) years from 2012 to 2021 hoping that any amendments to eco-efficiency legislations and regulations may have been considered. Chen and Ma (2021), Ganda (2022a), and Ganda (2022b) used published

information in their studies and arrived at valid study results. The researcher, therefore, drew conclusions from the previous research, and current research informed suggestions that were pertinent to food and beverage manufacturing companies.

Furthermore, a quantitative research technique was adopted to measure the relationships between eco-efficiency variables and financial performance variables. Researchers such as Fakoya (2020) and Dzomonda and Ngwakwe (2022) also employed the quantitative research method in their research. Therefore, the researcher may declare in confidence that the validity element was observed during the entire research process, which eventually resulted in study results that are valid.

#### **4.12. ETHICAL CONSIDERATIONS**

Research guidelines from the University of Limpopo provided guidance for the study in terms of policies, procedures, and ethical standards. Furthermore, as required, the Turfloop Research and Ethics Committee (TREC) provided the necessary ethical certificate. Major data were collected secondarily from published annual integrated reports of sampled companies, that are publicly and readily available through the companies' websites, which are not protected by copyright. The researcher has not used incorrect or misleading data and has not altered any information. Furthermore, the researcher did not use collected information for personal achievements. The sources used were acknowledged and suitable methods of referencing were employed.

In addition, this study considered the following ethical issues for primary data collection:

- **Ethical clearance:** Ethical clearance was obtained from Turfloop Research and Ethics Committee (TREC) as required for primary data research.
- **Permission to study:** Permission to study was requested in writing from all the sampled food and beverage companies listed in the JSE (Appendix A).
- **Informed consent:** The researcher asked for informed consent (Appendix B).
- **Voluntary participation:** The researcher exercised transparency and honesty by explaining the “no compensation element” to the participants. Assurance was given that withdrawal is allowed at any time, should there be a wish to do so.

- **Confidentiality:** The researcher exercised academic confidentiality by not sharing information gathered with anyone.
- **Anonymity:** Participants were guaranteed anonymity as no names and identity were mentioned at any stage of this research.
- **No harm:** Data collected was kept confidential and anonymous to protect participants from being identified and harmed.
- **No risk:** The researcher declared that the data collection process will cause no risk or harm to the participants.
- **Respect for the participants:** The researcher treated participants with respect by sending respectful emails and making follow-ups with respect.
- **Dissemination of results:** Result of the study was shared with stakeholders.
- **Benefits to society:** It is hoped that corporate eco-efficiency will assist society with carbon reduction, environmental protection, and sustainable development.

#### 4.13. SUMMARY OF THE CHAPTER

This chapter presented the overall research methodology. The researcher presented the research onion to unpack the whole research methodology. Various research paradigms used in Accounting were presented and discussed and the positivist research paradigm was chosen over others with a justification. Research methods, namely: the quantitative research method, the qualitative research method and the mixed research methods were briefly discussed. The research design was presented, with the correlational research design chosen over other research designs because the researcher sought to measure the connection between eco-efficiency variables and financial performance variables. The study area was Johannesburg and was presented in this chapter. The study population and the sampling method were also discussed in the chapter. Data collection was presented and discussed with justifications for collecting both primary data and secondary data quantitatively. The chapter further discussed how data were analysed in this study. The reliability and validity elements were also presented in this chapter. Additionally, this chapter presented the ethical considerations where it was stated that an ethical certificate was required and obtained from the Turfloop Research Ethics Committee although

majority of the data were freely obtained from the websites. The researcher explained all the ethical issues relating to primary research such as permission to study, informed consent, voluntary participation, confidentiality, anonymity, no harm, no risk, respect for the participants, dissemination of results and benefits to society.

## **CHAPTER FIVE**

### **DATA ANALYSIS AND DISCUSSION OF FINDINGS**

#### **5.1. INTRODUCTION**

Chapter 4 presented a detailed discussion of the overall research methodology. In this chapter, the analysis and findings based on the research problem and questions as presented in chapter 1, are discussed. Section 5.2 presents and discusses the secondary data analysis (first level of analysis). Section 5.3 presents the primary data analysis (second level of analysis). Section 5.4 presents the proposed framework. The last section, section 5.5 presents the summary of the chapter.

#### **5.2. FIRST LEVEL OF ANALYSIS (SECONDARY DATA)**

This section presents a discussion of results for the first level of analysis. The analysis utilised data that were obtained secondarily from annual integrated reports of 14 JSE listed food and beverage manufacturing companies for a period of 10 years. The variables, energy conservation and water conservation are the efforts by companies to reduce energy consumption and water consumption; hence data used for the aforementioned variables were consumptions as reported in the annual integrated reports. In the same vein, the variables, carbon reduction and waste reduction are the efforts by companies to reduce carbon emission and waste generated, and data were collected for these variables as reported in the annual integrated reports. It is therefore worth noting that it is the concepts of energy conservation, water conservation, carbon reduction and waste reduction that will be used in the analysis, discussion, and summaries of results to align with the aim of this study. The aim of this study, as explained in chapter 1, was to examine the effect that the four eco-efficiency variables have on financial performance.

## Regression model for secondary data analysis

Objective 1: To examine the relationship between eco-efficiency and return on assets (ROA).

H1<sub>0</sub>: There is no significant relationship between eco-efficiency and return on assets.

Analysis model for objective 1 and hypothesis 1:

$$ROA_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

Objective 2: To assess the relationship between eco-efficiency and share price (SP).

H2<sub>0</sub>: There is no significant relationship between eco-efficiency and share price.

Analysis model for objective 2 and hypothesis 2:

$$SP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (2)$$

Objective 3: To measure the relationship between eco-efficiency and net profit (NP).

H3<sub>0</sub>: There is no significant relationship between eco-efficiency and net profit.

Analysis model for objective 3 and hypothesis 3:

$$NP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (3)$$

Objective 4: To evaluate the relationship between eco-efficiency and return on capital (ROC).

H4<sub>0</sub>: There is no significant relationship between eco-efficiency and return on capital.

$$ROC_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (4)$$

(The description of the notations in the models is as described on page 66)

### 5.2.1. Descriptive analysis

Table 5.1 presents the summary statistics of the variables used in the study. ROA represents return on assets, SP represents share price, NP represents net profit and ROC represents return on capital, E Cons represents energy consumption, W Cons represents water consumption, carbon represents carbon emission and Waste represents waste generated and sales is a control variable representing sales revenue. However, it should be noted that it is the concepts of energy conservation, water conservation, carbon reduction and waste reduction that will be used in the analysis, discussion, and summaries of results to align with the aim of this study. There were 140 annual integrated reports observed, for 14 JSE listed food and beverage manufacturing companies for a period of 10 years (2012 to 2021) as Table 5.1 depicts. The mean for ROA, SP, NP, and ROC as dependent variables are 11,770; 72,721; 12,425; and 13,645 respectively, whereas the mean for independent variables: energy conservation, water conservation, carbon reduction and waste reduction are 17,968; 13,358; 12,755; and 14,730 respectively. Moreover, the mean for the control variable, sales revenue is 18,298. By comparing growth rates, these findings indicate that SP is more resilient than ROA, NP and ROC in JSE listed food and beverage manufacturing companies for the period 2012 to 2021.

Standard deviation is a descriptive statistic that provides an estimation of the spread of values around the sample mean, therefore describing the sample (Andrade, 2020). Results showed standard deviations for dependent variables ROA, SP, NP and ROC as 11,057; 79,317; 26,610; and 11,242 respectively. When a standard deviation exceeds the mean, it is considered widely dispersed. Table 5.1 depicts a standard deviation of 11,057 which is below the mean of 11,770 for ROA. This therefore means that ROA is not widely dispersed. However, results showed the standard deviation for SP as 79,317 which is more than the mean of 72,721 implying that SP is widely dispersed. Also, the standard deviation for NP is 26,610 which is greater than the mean of 12,425. This implies that NP is widely dispersed. The standard deviation for ROC is 11,242 which is less than the mean of 13,645 implying that ROC is not widely dispersed.

In addition, the standard deviations for energy conservation, water conservation, carbon reduction and waste reduction are 2,629; 5,252; 1,876; and 3,011 respectively. For the control variable, sales revenue, the standard deviation is 2,751. The standard deviations for energy conservation, water conservation, carbon reduction and waste reduction are less than their mean. This is an indication that the abovementioned independent variables are not widely dispersed. In the same vein as the other variables which are not widely dispersed, the standard deviation for the control variable, sales revenue, is less than the mean. This implies that sales revenue is also not widely dispersed.

Table 5.1 further shows the minimum for ROA, SP, NP and ROC as -13,380; 5,780; -82,344; and -17,160 respectively, whereas the minimum for energy conservation, water conservation, carbon reduction and waste reduction are shown as 12,210; -5,032; 6,995; and 7,837 respectively. Sales revenue as a control variable shows a minimum of 14,436. These figures show the lowest data values for the variables. The maximum for ROA, SP, NP, and ROC are shown as 62,250; 414,450; 115,216; and 67,200. Furthermore, the maximum for energy conservation, water conservation, carbon reduction and waste reduction are 24,201; 20,792; 18,325; and 22,968. Sales revenue shows a maximum of 23,609. These figures show the greatest data value for the variables.

Table 5.1. Summary Statistics

	ROA	SP	NP	ROC	E Cons	W Cons	Carbon	Waste	Sales
<b>Mean</b>	11,770	72,721	12,425	13,645	17,968	13,358	12,755	14,730	18,298
<b>Standard Error</b>	0,935	6,704	2,249	0,950	0,222	0,444	0,159	0,254	0,233
<b>Median</b>	9,020	46,675	0,121	12,400	18,084	13,894	12,701	14,314	17,149
<b>Std Dev</b>	11,057	79,317	26,610	11,242	2,629	5,252	1,876	3,011	2,751
<b>Kurtosis</b>	3,504	5,722	4,341	3,003	-0,064	5,910	2,907	1,086	-0,907
<b>Skewness</b>	1,411	2,250	1,584	0,763	-0,025	-2,310	0,270	0,560	0,603
<b>Range</b>	75,630	408,670	197,559	84,360	11,991	25,824	11,330	15,130	9,173
<b>Minimum</b>	-13,380	5,780	-82,344	-17,160	12,210	-5,032	6,995	7,837	14,436
<b>Maximum</b>	62,250	414,450	115,216	67,200	24,201	20,792	18,325	22,968	23,609
<b>Count</b>	140	140	140	140	140	140	140	140	140

Source: STATA software

### 5.2.2. Correlation Matrix

This section presents the correlation matrix. The correlation matrix determines the association between an independent variable and its corresponding values, as well as the relationship between independent variables. (Gogtay & Thatte, 2017). Table 5.2 presents the correlation matrix. With regards to the linear relationship, a correlation matrix between 0.90 and 1 depicts a very strong relationship between variables, while a correlation matrix between 0.70 and 0.89 illustrates a strong correlation between variables. In addition, a correlation matrix between 0.40 and 0.69 reveals a moderate correlation between variables and the relationship is weak if it is between 0.10 and 0.39. Lastly, the correlation between variables is considered extremely weak if the correlation matrix is from 0.00 to 0.10 (Schober, Boer & Schwarte, 2018). Table 5.2 shows 1.000 for all variables and that proves that independent variables are correlated to themselves. Energy conservation shows a positive yet weak correlation with SP shown as 0,108 and a positive yet extremely weak correlation with ROA and ROC shown as 0,093 and 0,058 respectively. However, the correlation between energy conservation and NP is negative and extremely weak, shown as -0,029. In addition, water conservation is positively correlated with all the dependent variables shown as 0,177; 0,229; 0,110 and 0,250 respectively, although the correlation is weak. As with water conservation, the correlation between carbon reduction and ROA, SP, NP, and ROC is also positive but weak shown as 0,146; 0,136; 0,144; and 0,165 respectively. Results further revealed a positive yet weak correlation between waste reduction and ROA, SP, and ROC shown as 0,151; 0,253; and 0,102 respectively and a negative and extremely weak correlation between waste reduction and NP shown as -0,011. Lastly, sales revenue showed a negative correlation with all the dependent variables shown as -0.219, -0.080; -0.429; and -0.228 respectively. The correlation between sales revenue and ROA and sales revenue and ROC is weak. Furthermore, the correlation between sales revenue and SP is extremely weak while it is moderate with NP. The correlation analysis indicated that most variables exhibited correlations ranging from extremely weak to moderate, suggesting that the panel data were devoid of multicollinearity.

Table 5.2: Pearson Correlation

	<i>ROA</i>	<i>SP</i>	<i>NP</i>	<i>ROC</i>	<i>E Cons</i>	<i>W Cons</i>	<i>Carbon</i>	<i>Waste</i>	<i>Sales</i>
<i>ROA</i>	1								
<i>SP</i>	0,325	1							
<i>NP</i>	0,198	-0,038	1						
<i>ROC</i>	0,596	0,357	0,146	1					
<i>E Cons</i>	0,093	0,108	-0,029	0,058	1				
<i>W Cons</i>	0,177	0,229	0,110	0,250	-0,148	1			
<i>Carbon</i>	0,146	0,136	0,144	0,165	0,181	-0,075	1		
<i>Waste</i>	0,151	0,253	-0,011	0,102	0,251	-0,120	0,235	1	
<i>Sales</i>	-0,219	-0,080	-0,429	-0,228	0,039	0,173	-0,044	0,004	1

Source: STATA software

### 5.2.3. Unit root test

The study employs the Levin-Lin-Chu unit-root test to assess the stationarity of the panels utilised in the analysis. The results are presented in Table 5.3. Panels are non-stationary, according to the null hypothesis, while panels are stationary, according to the alternative hypothesis. Significance level is set at 0,05 (5%). Any value under 5% is deemed significant, leading to the acceptance of the alternative hypothesis and the rejection of the null hypothesis. Table 5.3 demonstrates that p-values for all panels (except water conservation) are below 5%. According to the prevalence of support for the alternative hypothesis that the panels are stationary, it is imperative to reject the null hypothesis. The existence of stationarity implies that there is no unit root, which is preferred because a data set that contains unit root usually leads to misleading interpretations (Brooks, 2019).

Table 5.3: Unit root test for stationarity

Panels	Energy consumption	Water Consumption	Carbon Emission	Waste Generated	Sales
P-Value	0,0000	0,0946	0,0000	0,0000	0,0000

Source: Author's computation

### 5.2.4. Cointegration tests

The Pedroni panel cointegration test employs eleven statistics to test the alternative null of cointegration among the variables in the estimated model against the null hypothesis

of no cointegration (Gómez Rodríguez, Ríos Bolívar & Zambrano Reyes, 2022). Seven panels are classified as statistics while four are classified as weighted statistics. Accordingly, Tables 5.4, 5.5, 5.6 and 5.7 show abridged results of the cointegration results for ROA, SP, NP, and ROC models respectively.

Table 5.4 shows results for eleven statistics. The p-value is set at 5%. Cointegration is acknowledged by the alternative hypothesis, whereas the null hypothesis asserts that there is no cointegration. In case the value is below 0.05, the cointegration alternative hypothesis is accepted. Reading from Table 5.4, six statistics out of eleven are less than 0.05. Predominance makes it impossible to accept the null hypothesis that supports non-cointegration. Hence, it can be deduced that there exists a long-term association, as the alternative hypothesis supporting cointegration is accepted.

Table 5.4: Summary of Pedroni panel cointegration test for ROA

<i>Panel</i>	<b>Probability</b>	
	Statistics	Weighted statistics
<b>Panel v-Statistics</b>	0.9882	0.9683
<b>Panel rho-statistics</b>	1.0000	0.9999
<b>Panel PP-statistics</b>	0.0003	0.0001
<b>Panel ADF statistics</b>	0.0384	0.0096
<b>Group</b>		
<b>Group rho-Statistics</b>	1.0000	-
<b>Group-PP-Statistics</b>	0.0000	-
<b>Group ADF Statistics</b>	0.0102	-

Source: Author's computation

Similar to Table 5.4, the results presented in Table 5.5, indicate that the null hypothesis of absence of cointegration in the SP model should be rejected, signifying the existence of a sustained relationship between the variables. This decision is made based on majority, as six out of eleven statistics reject the null hypothesis with values below 0.05.

Table 5.5: Summary of Pedroni panel cointegration test for SP

<i>Panel</i>	<b>Probability</b>	
	Statistics	Weighted statistics
<b>Panel v-Statistics</b>	0.0705	0.8529
<b>Panel rho-statistics</b>	1.0000	0.9998
<b>Panel PP-statistics</b>	0.0000	0.0000
<b>Panel ADF statistics</b>	0.0033	0.0000
<b>Group</b>		
<b>Group rho-Statistics</b>	1.0000	-
<b>Group-PP-Statistics</b>	0.0000	-
<b>Group ADF Statistics</b>	0.0000	-

Source: Author's computation

The results in Table 5.6 for the NP model reveal the prevalence of a long run correlation between the variables wherein six statistics reject the null hypothesis of no cointegration with values less than 0.05.

Table 5.6: Summary of Pedroni panel cointegration test for NP

<i>Panel</i>	<b>Probability</b>	
	Statistics	Weighted statistics
<b>Panel v-Statistics</b>	0.9804	0.9567
<b>Panel rho-statistics</b>	1.0000	0.9999
<b>Panel PP-statistics</b>	0.0000	0.0000
<b>Panel ADF statistics</b>	0.0207	0.0006
<b>Group</b>		
<b>Group rho-Statistics</b>	1.0000	-
<b>Group-PP-Statistics</b>	0.0000	-
<b>Group ADF Statistics</b>	0.0000	-

Source: Author's computation

Results in Table 5.7 also illustrate a sustained association between the variables for the ROC model. Similar to the other three models, those are: the ROA, the SP, and the NP models, six statistics rejected the idea that there is no cointegration and instead accepted the idea of cointegration, indicating a long run association between the variables.

Table 5.7: Summary of Pedroni panel cointegration test for ROC

<i>Panel</i>	<b>Probability</b>	
	Statistics	Weighted statistics
<b>Panel v-Statistics</b>	0.5026	0.7262
<b>Panel rho-statistics</b>	0.9986	0.9982
<b>Panel PP-statistics</b>	0.0000	0.0000
<b>Panel ADF statistics</b>	0.0000	0.0000
<b>Group</b>		
<b>Group rho-Statistics</b>	1.0000	-
<b>Group-PP-Statistics</b>	0.0000	-
<b>Group ADF Statistics</b>	0.0000	-

Source: Author's computation

### 5.2.5. DIAGNOSTIC TESTS

Diagnostic tests are necessary because panel data models can produce inaccurate results, especially when there is failure to evaluate the implications of threats resulting from failure to pay attention to regression assumptions on model findings. In line with other studies such as those of Mogashwa (2023) and Rahman and Anis (2023), the researcher performed diagnostic tests on panel data to identify existing abnormalities as well as misspecifications that could cause estimators to be unreliable and biased. In this study, the researcher performed the VAR residual test to check for heteroscedasticity, Wooldridge test for autocorrelation and the Jarque-Bera in collaboration with the Kurtosis for normality testing.

#### 5.2.5.1. VAR residual heteroscedasticity tests

The study used the VAR residual heteroscedasticity tests to check if the data is not affected by heteroscedasticity. The VAR residual heteroscedasticity tests have a null hypothesis of heteroscedasticity pitted in contradiction of the alternative hypothesis of homoscedasticity. It is worth noting that the desired outcome is homoscedasticity in the estimated model and that is achieved when the computed probability value is above 0.05. However, reading from results in Table 5.8, the null hypothesis of heteroscedasticity is

accepted for all the models given that the computed probability values are all less than 0.05. It is therefore concluded that all the models are heteroscedastic (See Appendix F).

Table 5.8: Abridged Results of Heteroscedasticity

TEST NAME	Probability value	Decision
<b>Heteroscedasticity with Cross Terms</b>		
- ROA model	- 0.0000	Accept Null
- SP model	- 0.0074	Accept Null
- NP model	- 0.0011	Accept Null
- ROC model	- 0.0088	Accept Null

Source: E-views Outcomes

### 5.2.5.2. Autocorrelation tests

If the p-value is greater than 0.05, then the null hypothesis is not rejected and is accepted as the appropriate explanation for the observed data. Alternatively, when the p-value falls below 0.05, it is deemed to be not significant and therefore, rejected. The null hypothesis posits the absence of first-order autocorrelation and is contradicted by the alternative hypothesis claiming the existence of such autocorrelation. With the exception of the ROA model, all other models have p-values above 0.05. Consequently, the null hypothesis is accepted for these models, suggesting the absence of first-order autocorrelation. Autocorrelation is only observed in the ROA model. However, based on dominance, the researcher concludes that no autocorrelation exists among the variables used in the panel data. The Wooldridge test results per model are presented in Tables 5.9, 5.10, 5.11 and 5.12 as follows:

Table 5.9: Wooldridge test results in panel data where ROA is a dependent variable

<b>F(1,13)</b>	<b>12.333</b>
<b>Prob &gt; F</b>	0.0033

Source: STATA software

Table 5.10: Wooldridge test results in panel data where SP is a dependent variable

<b>F(1,13)</b>	<b>2.471</b>
<b>Prob &gt; F</b>	0.1400

Source: STATA software

Table 5.11: Wooldridge test results in panel data where NP is a dependent variable

<b>F(1,13)</b>	<b>4.103</b>
<b>Prob &gt; F</b>	0.0639

Source: STATA software

Table 5.12: Wooldridge test results in panel data where ROC is a dependent variable

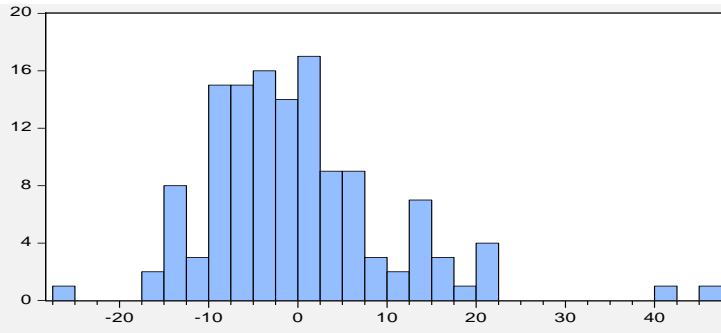
<b>F(1,13)</b>	<b>0.000</b>
<b>Prob &gt; F</b>	0.9975

Source: STATA software

### 5.2.5.3. Normality tests

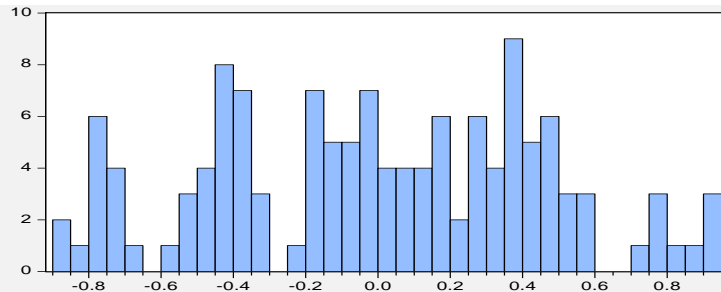
Figure 5.1 presents normality tests results. Panel A shows results for the ROA model and the SP model results are presented in panel B while for the NP model, results are presented in panel C and for the ROC model, results are presented in panel D. For normal distribution of results, the probability value of the Jarque-Bera should be insignificant and Kurtosis should take a value of approximately 3. Reading from Figure 5.1, it is unveiled that the residuals are normally distributed for the SP and NP models, given that the probability value of Jarque-Bera for both these two models are more than the probability value of 0.05. However, it is established that there is no normal distribution of residuals for the ROA and ROC models.

### PANEL A: ROA MODEL



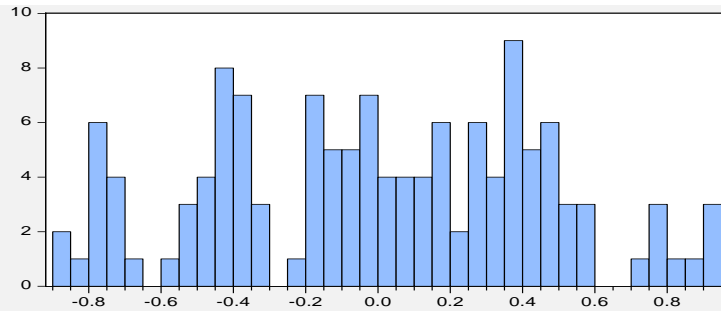
Series: Standardized Residuals	
Sample 2012 2021	
Observations 131	
Mean	4.58e-16
Median	-1.841627
Maximum	46.69558
Minimum	-25.73013
Std. Dev.	10.38883
Skewness	1.290969
Kurtosis	6.587709
Jarque-Bera	106.6452
Probability	0.000000

### PANEL B: SP MODEL



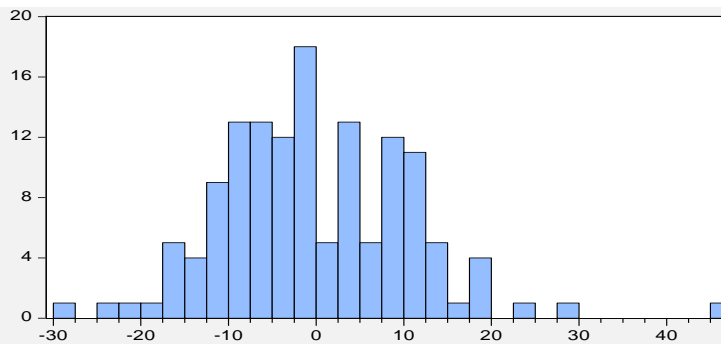
Series: Standardized Residuals	
Sample 2012 2021	
Observations 130	
Mean	-3.24e-16
Median	0.000626
Maximum	0.941124
Minimum	-0.879988
Std. Dev.	0.452367
Skewness	-0.041826
Kurtosis	2.239010
Jarque-Bera	3.174727
Probability	0.204464

### PANEL C: NP MODEL



Series: Standardized Residuals	
Sample 2012 2021	
Observations 130	
Mean	-3.24e-16
Median	0.000626
Maximum	0.941124
Minimum	-0.879988
Std. Dev.	0.452367
Skewness	-0.041826
Kurtosis	2.239010
Jarque-Bera	3.174727
Probability	0.204464

### PANEL D: ROC MODEL



Series: Standardized Residuals	
Sample 2012 2021	
Observations 137	
Mean	3.97e-15
Median	-0.732778
Maximum	45.74927
Minimum	-27.85572
Std. Dev.	10.71906
Skewness	0.577854
Kurtosis	4.613284
Jarque-Bera	22.48138
Probability	0.000013

Figure 5.1: Normality test results for all panels (ROA, SP, NP & ROC)

Source: E-Views 9.0 output

### 5.2.6. Hausman tests

Hausman distinguishes between FE and RE models in panel data. Tables 5.13 to 5.16 present the Hausman test results for the ROA, SP, NP, and ROC models respectively. In the event that the p-value is less than 0.05, it is appropriate to reject the null hypothesis. If the p-value exceeds 0.05, it is appropriate to accept the null hypothesis. According to the alternative hypothesis, the fixed effects model is the preferred model, while according to the null hypothesis, the random effects model is preferred. Hausman test results show a p-value of 0,5857 for ROA; 0,9196 for SP; 0,5169 for NP; and 0,0207 for ROC. The p-values for all the dependent variables except for ROC are higher than 0,05. Based on dominance, the researcher chooses RE to be the appropriate model to be used.

Table 5.13: Hausman Test where ROA is a dependent variable

	Coefficients		(b-B)	Standard Error
	(b)	(B)	Difference	
	FE	RE		
<b>LogEnergy</b>	-.1219149	.0545564	-.0673586	.0947721
<b>LogWater</b>	1.142282	.6063437	.5359385	.5713364
<b>LogCarbon</b>	.1527403	.3672574	-.2145171	.1984118
<b>LogWaste</b>	-.587264	-.2323592	-.3549048	.1984118
<b>LogSales</b>	-.8578007	-.9909188	.133118	.8665627

Source: STATA software

b = consistent with Ho and Ha

B = inconsistent with Ha, consistent with Ho

Test: Ho: Differences not systematic in coefficient

$$\chi^2(3) = (b-B)'[(V_b - V_B)^{-1}](b-B)$$

$$= 3.75$$

$$\text{Prob} > \chi^2 = 0.5857$$

Table 5.14: Hausman Test where SP is a dependent variable

	Coefficients		(b-B)	Standard Error
	(b)	(B)	Difference	
	FE	RE		
<b>LogEnergy</b>	-0.0771052	.0850873	-.1621925	.3255874
<b>LogWater</b>	3.262965	3.273229	-.0102639	1.951949
<b>LogCarbon</b>	2.909029	3.082475	-.1734464	.8124215
<b>LogWaste</b>	-1.489407	-.9798816	-.5095257	.6363239
<b>LogSales</b>	-3.235568	-3.29557	.600011	2.790222

Source: STATA software

b = consistent with Ho and Ha

B = inconsistent with Ha, consistent with Ho

Test: Ho: Differences not systematic in coefficient

$$\chi^2(3) = (b-B)'[(V_b - V_B)^{-1}] (b-B)$$

$$= 1.44$$

$$\text{Prob} > \chi^2 = 0.9196$$

Table 5.15: Hausman Test where NP is a dependent variable

	Coefficients		(b-B)	Standard Error
	(b)	(B)	Difference	
	FE	RE		
<b>LogEnergy</b>	.6424584	.705593	-.0631346	.1589367
<b>LogWater</b>	-.5729104	.2618159	-.8347263	1.0657754
<b>LogCarbon</b>	-.50349	.1546737	-.2050226	.4550981
<b>LogWaste</b>	.0176068	-.1694665	.1870733	.3494892
<b>LogSales</b>	.6192986	-1.962006	2.581304	1.580629

Source: STATA software

b = consistent with Ho and Ha

B = inconsistent with Ha, consistent with Ho

Test: Ho: Differences not systematic in coefficient

$$\chi^2(3) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

$$= 4.23$$

$$\text{Prob}>\chi^2 = 0.5169$$

Table 5.16: Hausman Test where ROC is a dependent variable

	Coefficients		(b-B)	Standard Error
	(b)	(B)	Difference	
	FE	RE		
<b>LogEnergy</b>	.1779354	.0871009	.0908345	.0345258
<b>LogWater</b>	1.205516	.8676006	.3379157	.5233941
<b>LogCarbon</b>	-.1571852	.1092344	-.2664195	.1981359
<b>LogWaste</b>	-.1911148	.0170013	-.2081161	.1595099
<b>LogSales</b>	-5.429949	-2.802073	-2.627877	.7841819

Source: STATA software

b = consistent with Ho and Ha

B = inconsistent with Ha, consistent with Ho

Test: Ho: Differences not systematic in coefficient

$$\chi^2(3) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

$$= 13.30$$

$$\text{Prob}>\chi^2 = 0.0207$$

### 5.2.7. Random effect results

The findings in Model 1 indicate that there is a negative and statistically insignificant relationship between energy conservation and ROA. Conversely, water conservation is positively related to ROA, but the relationship is also statistically insignificant. Furthermore, carbon reduction is positively yet insignificantly related to ROA while waste reduction is negatively and insignificantly associated with ROA. Sales revenue as a control variable has an insignificant negative impact on ROA.

The results in Model 2 show that energy conservation is positively, and insignificantly related to SP. Water conservation and carbon reduction are also positively and insignificantly related to SP. However, the results show that waste reduction and sales revenue are negatively and insignificantly associated with SP.

The results in Model 3 show that energy conservation is positively and insignificantly related to NP. Water conservation is also positively and insignificantly related to NP. The results further show carbon reduction to be positively yet insignificantly associated with NP. However, the relationship between waste reduction and NP is negative and insignificant. Lastly, the relationship between sales revenue and NP is negative and insignificant.

The results in Model 4 show that energy conservation is positively and insignificantly related to ROC. Water conservation is positively and significantly associated with ROC while carbon reduction and waste reduction are positively and insignificantly related to ROC. However, the relationship between sales revenue and ROC is negative and insignificant.

Table 5.17: Random effect results for all models

	<b>Model 1: ROA</b>	<b>Model 2: SP</b>	<b>Model 3: NP</b>	<b>Model 4: ROC</b>
<b>Energy Cons</b>	-0,055 (0,321)	0,085 (1,515)	0,706 (0,659)	0,087 (0,315)
<b>Water Cons</b>	0,606 (0,376)	3,273 (2,497)	0,262 (0,887)	0,868** (0,381)
<b>Carbon Em</b>	0,367 (0,596)	3,082 (2,923)	0,155 (1,247)	0,109 (0,587)
<b>Waste Gen</b>	-0,232 (0,357)	-0,980 (1,781)	-0,169 (0,750)	0,017 (0,352)
<b>Sales</b>	-0,991 (0,688)	-3,296 (4,299)	-1,962 (1,590)	-2,802 (0,693)
<b>_cons</b>	21,521 (16,123)	62,888 (94,725)	32,675 (36,082)	50,120 (16,119)
<b>Number of obs</b>	140	140	140	140
<b>Number of groups</b>	14	14	14	14
<b>R-sq</b>	0,1313	0,0718	0,3102	0,1682
<b>Prob&gt;chi2</b>	0,4256	0,6047	0,7618	0,0013
<b>Prob&gt;F</b>				
<b>Prob&gt;chibar2</b>				

Source: STATA software

The dependent variables are return on assets (ROA), share price (SP), Net profit (NP) and return on capital (ROC). Energy Cons is energy consumption, Water Cons represents water consumption, Carbon Em represents carbon emission, Waste Gen represents waste generated. Finally, Sales is a control variable representing sales revenue. The concepts of energy conservation, water conservation, carbon reduction and waste reduction will be used in the analysis, discussion, and summaries of results to align with the aim of this study. Standard errors are shown in parenthesis, while \*, \*\*, \*\*\* represent significance at 1%, 5%, and 10% levels, respectively.

Although RE was preferred, there were problems of non-normality and heteroscedasticity in panel data which are not catered for in RE. The analysis was then extended to GMM for robustness of the analysis and to cater for non-normality and heteroscedasticity.

### **5.2.8. Extended analysis using Generalised Methods of Moments**

GMM is renowned for eliminating all indigeneity from the panel model, taking into consideration unobserved time-invariant country-specific effects (Barros, Bergmann, Castro & Silveira, 2020). Despite RE being a preferred model over FE as revealed by Hausman tests, it holds some limitations. For instance, it is assumed that the RE are normally distributed; however, this is not always the situation. In this study, normality was partially violated as 50% of the residuals were normally distributed and the other 50% were not normally distributed. Figure 5.1 unveiled that 50% normally distributed data were for the SP and NP models. However, data for the ROA and ROC models were not normally distributed. In addition, reading from Table 5.8, it shows that all the panels are heteroscedastic, which is not preferred. To counter the problems of non-normality and heteroscedasticity in panel data, the study employs GMM which has an advantage of handling serial correlation, heteroscedasticity, and non-normal distribution problems (Xaisongkham & Liu, 2022). Moreover, it is believed that this estimator can eliminate standard errors and is more robust to heteroscedasticity in panel data (Akinbode & Bolarinwa, 2020). GMM provides a straightforward way to test the specification of the model and therefore provides high level of reliability.

### **5.2.9. Generalised method of moments results**

This section presents GMM results for all the models used in this study. Results from Model 1 in Table 5.18 show that energy conservation is positively and insignificantly related to ROA. Water conservation is also positively related to ROA. This relationship is statistically insignificant. However, the results show that carbon reduction and waste reduction are negatively associated with ROA. The relationship between carbon reduction and ROA is statistically significant while for waste reduction and ROA, the relationship is insignificant. The control variable, sales revenue, has a negative and an insignificant impact on ROA.

The results from Model 2 in Table 5.18 show that energy conservation is positively and insignificantly related to SP. Water conservation is also positively and insignificantly

related to SP. However, the results show that carbon reduction and waste reduction are negatively and insignificantly associated with SP. The control variable, sales revenue, has a negative and an insignificant impact on SP.

The results from Model 3 in Table 5.18 show that energy conservation is positively and insignificantly related to NP. Water conservation is also positively and insignificantly related to NP. The results further show carbon reduction to be positively yet insignificantly associated with NP. The correlation between waste reduction and NP is insignificant and negative. Ultimately, the connection between sales revenue and NP is also negative and insignificant.

The results from Model 4 in Table 5.18 show that energy conservation is positively and insignificantly related to ROC. Water conservation is also positively and insignificantly related to ROC. The results further show waste reduction to have a positive yet insignificant relationship with ROC. However, the relationship between carbon reduction and ROC is negative and insignificant. Sales revenue has a negative and significant relationship with ROC.

Table 5.18: GMM results for all models

	<b>Model 1: ROA</b>	<b>Model 2: SP</b>	<b>Model 3: NP</b>	<b>Model 4: ROC</b>
<b>Dependent (constant)</b>	0.251** (0,115)	0,569*** (0,105)	0,205** (0,094)	0,122 (0,230)
<b>Energy Cons</b>	0,384 (0,424)	3,533 (4,937)	0,967 (0,597)	0,129 (0,301)
<b>Water Cons</b>	1,454 (1,126)	8,810 (10,286)	0,566 (1,594)	2,069 (1,847)
<b>Carbon Em</b>	-1,469* (0,866)	-5,521 (4,575)	1,203 (2,105)	-0,931 (0,781)
<b>Waste Gen</b>	-0,735 (0,489)	-2,172 (5,550)	-0,609 (0,381)	0,035 (0,514)
<b>Sales</b>	-0,463 (1,909)	-6,461 (11,808)	-0,373 (1,217)	-4,263** (1,820)
<b>_cons</b>	20,292 (39,014)	69,681 (227,886)	-14,235 (39,214)	71,126 (18,467)
<b>Number of obs</b>	140	140	140	140
<b>Number of groups</b>	14	14	14	14
<b>R-sq</b>				
<b>Prob&gt;chi2</b>	0,0295	0,0000	0,000	0,0000
<b>Prob&gt;F</b>				
<b>Prob&gt;chibar2</b>				

Source: STATA software

The dependent variables are return on assets (ROA), share price (SP), Net profit (NP) and return on capital (ROC). Energy Cons is energy consumption, Water Cons represents water consumption, Carbon Em represents carbon emission, Waste Gen represents waste generated. Finally, Sales is a control variable representing sales revenue. The concepts of energy conservation, water conservation, carbon reduction and waste reduction will be used in the analysis, discussion, and summaries of results to align with the aim of this study. Standard errors are shown in parenthesis, while \*, \*\*, \*\*\* represent significance at 1%, 5%, and 10% levels, respectively.

### 5.2.10. Discussion of results for secondary data

This section unfolds as follows: Subsection 5.2.10.1 discusses results for objective 1. Subsection 5.2.10.2 provides a discussion of the results for objective 2. Subsection 5.2.10.3 provides a discussion of the results for objective 3. Subsection 5.2.10.4 presents

a discussion of the results for objective 4. The eloquent analysis of variables measuring eco-efficiency, that is, energy conservation, water conservation, carbon reduction and waste reduction are analysed based on the individual indicators identified rather than using the average. This individual analysis of variables is aimed to observe individual effects and segregating the significance of each individual indicator.

#### **5.2.10.1. Discussion of results for objective 1 (Hypothesis 1)**

The results in model 1 show that energy conservation is positively yet insignificantly associated with the ROA. Despite the insignificant relationship revealed from GMM, these results are in line with those of Agyabeng-Mensah *et al.* (2020), Dzomonda (2021) and Maama *et al.* (2021) which found energy conservation to have a positive influence on financial performance although the influence was significant. Furthermore, these findings align with the stakeholder theory, which posits that companies should meet the expectations of their stakeholders as a way of creating value. Conserving energy can be used as one of the strategies for creating such value to stakeholders, which might in turn benefit both the stakeholders and the company in the form of less environmental pollution, increased customer loyalty, competitive advantage, and enhanced financial performance. Additionally, the results agree with the institutional theory which postulates that companies should engage in green production in the pursuit to attain a sustained competitive advantage and greater financial performance. In contrast, Dzomonda (2021) found that attaining energy efficiency negatively and significantly influence financial performance. Despite the insignificant relationship found between energy conservation and financial performance, food and beverage manufacturing companies need to guard the natural environment against pollution and degradation to protect human health and also ensuring that both the current and the future generation benefit. Furthermore, some goals, specifically for social and economic development, hinge on the health of ecosystems and natural resources.

Water conservation is also positively and insignificantly related to ROA. The findings in this study align with those of Madime and Gonçalves (2022) which demonstrated that environmental management practices positively influence financial performance. The

aforementioned authors discovered a positive but weak and insignificant connection between the variables. Furthermore, these results support the stakeholder theory which advocates and proposes strategies on how a company ought to be managed to meet expectations of its stakeholders. This theory posits that excessive use of water causes serious problems to the environment such as pollution and water scarcity, which will negatively affect the stakeholders. Additionally, these results support the institutional theory as used by some researchers such as Gupta and Gupta (2021) and Yuan and Cao (2022) when investigating the effect of independent variables on dependent variables. However, Jaiswal and Kumar (2018) allude that the cost of new technology might be high, and profits might be minimised.

GMM results further revealed that carbon reduction is negatively and insignificantly related to ROA. The findings of this study are consistent with those of Kumari and Patel (2020) which measured the correlation between carbon footprints and financial performance and discovered an insignificant negative relationship. The findings, though, are different from those of Garzón-Jiménez and Zorio-Grima (2021), which discovered a significant positive correlation between carbon emissions and financial performance. Moreover, the Stakeholder theory postulates that, for companies to maintain good relationships with companies' stakeholders, they should meet their expectations and treat them in the best manner and carbon reduction can be among the strategies for creating such value. Beside the economic benefits that companies stand to gain, the environment should stand a chance of being free from pollution and degradation thereby making the next generation not to face social, economic, and environmental assets that are degraded and a diminished wealth. Moreover, with the goals to limit global warming by minimising greenhouse gas emissions and set net zero emission targets from industries' operations as contained in the signed Paris Agreement, companies need to be eco-efficient.

Results further show that waste reduction is negatively and insignificantly related to ROA. The results are in alignment with those of Baah *et al.* (2021b) which found environmental performance to be negatively and insignificantly associated with financial performance. Nevertheless, these findings differ from those of Fakoya (2020), which discovered an insignificant positive correlation between reduction in hazardous solid waste and return

on assets. Furthermore, the research conducted by Ihenyen and Ikegima (2022) revealed a significant and positive relationship between waste management practices and company financial performance. The control variable, sales revenue has a negative and insignificant impact on ROA. The stakeholder theory hypothesises that some firms create value for their stakeholders by meeting their expectations and that enhances financial performance (Huge-Brodin *et al.*, 2021). The null hypothesis, H1<sub>0</sub>, claims that there is no significant relationship between eco-efficiency and return on assets (ROA), whereas the alternative hypothesis, H1<sub>a</sub>, proposes the opposite. The acceptance of the null hypothesis is warranted as it is determined that all eco-efficiency variables examined in this study are not significantly linked to ROA. Despite the insignificant relationship found between the aforementioned variables, food and beverage manufacturing companies should control the ways in which natural resources are utilised to avoid depletion and pollution and improve eco-efficient practices in order to gain competitive advantage and enhance financial performance. In addition, different needs of different stakeholder inclusive of the natural environment should be addressed. The next section discusses results for objective 2.

#### **5.2.10.2. Discussion of results for objective 2 (Hypothesis 2)**

The results in model 2 show that energy conservation is positively but insignificantly related to SP. These results are in line with those of Dzomonda (2021) and Maama *et al.* (2021) which found energy conservation to have a positive influence on financial performance although the influence was significant. In contrast, Shah *et al.* (2021) suggest that energy conservation has a negative yet statistically significant effect on financial performance. Beside the goal of improving financial performance of a company, there are other benefits among others, pollution-free environment, increased customer loyalty and added competitive advantage as posited by the stakeholder theory. Some customers, suppliers and investors are green-minded and are likely to associate with green companies, leading to great financial yields.

The results further show that water conservation is positively but insignificantly associated with SP. These results support those of Madime and Gonçalves (2022) which found a

positive yet insignificant relationship among the variables. In addition, Dzomonda and Fatoki (2021) found that water efficiency positively and significantly affects financial performance, represented by share price. However, scholars such as Jaiswal and Kumar (2018) suggest that using new technologies might affect the returns of the company negatively. To add more, companies which use excessive amounts of water may be found to be in contradiction with the stakeholder theory, which argues that the excessive use of water causes serious problems to the environment such as pollution and water scarcity, which will negatively affect the stakeholders.

Carbon reduction is found to be negatively and insignificantly linked to SP. These results support those of Shah *et al.* (2021) which suggested that carbon reduction has a negative effect on financial performance, although the relationship is statistically significant. However, these results contrast with those of Garzón-Jiménez and Zorio-Grima (2021) which found a significant and positive correlation between carbon emissions and financial performance. Furthermore, these results contradict those of Ganda (2022b) which also found a significant positive correlation between carbon reduction and financial performance. While some studies such as those of Garzón-Jiménez and Zorio-Grima (2021) suggest that companies should use voluntary carbon disclosures advantageously to lessen pollution levels in order to lower the cost of capital, resulting in a more sustainable planet, others such as Franco *et al.* (2020) argue that poor corporate social responsibility (CSR) performance may pose reputational risks, which, when combined with the cost associated with the implementation of socially responsible actions, negatively affect corporate financial performance. However, manufacturing industries should reduce carbon emission because those emissions pose a menace to the environment such as global warming as their production processes emit a large amount of carbon. The study of Strielkowski *et al.* (2021) recommend that manufacturing companies can lessen global warming by minimising the amount of carbon dioxide emissions which is resultant from excessive energy use.

Waste reduction is found to be negatively and insignificantly related to SP. These results are in support of those of Baah *et al.* (2021b) which revealed that environmental performance is negatively and insignificantly correlated with financial performance. In

contrast, the study of Ihenyen and Ikegima (2022) found a significant positive relationship when evaluating how environmental Accounting affects financial performance using waste management cost as a variable. The control variable, sales revenue, has an insignificant negative impact on SP.

The null hypothesis,  $H_{20}$ , posited that there is no significant relationship between eco-efficiency variables and SP. Conversely, the alternative hypothesis,  $H_{2a}$ , posited that there exists a significant association between eco-efficiency variables and SP. The acceptance of the null hypothesis suggests that there is no statistically significant correlation between eco-efficiency variables and SP. Irrespective of the extent and nature of the relationship between the variables employed in this study, it is imperative for manufacturing companies to strive for the reduction of their environmental footprint resulting from their production activities as some consumers tend to be satisfied with such practices and such an association will lead them into buying from the company repeatedly and that might enhance financial performance in both the short and long run. The next section discusses the results for objective 3.

### **5.2.10.3. Discussion of results for objective 3 (Hypothesis 3)**

The results in model 3 show that energy conservation is positively and insignificantly related to NP. These results are in line with those of Maama *et al.* (2021) which revealed a positive relationship when examining how cleaner production can lead to better environmental and financial performance in the South African sugar industry. The relationship is however significant. In addition, the study of Dzomonda (2021) found a significant and positive correlation between energy efficiency and financial performance of firms listed in the JSE. A positive relationship between energy conservation and NP indicates an alignment with the stakeholder theory which postulates that a company ought to be managed in the interests of its entire group of stakeholders (Diez-Cañamero *et al.*, 2020). Moreover, this positive relationship between the aforementioned variables is also in line with the institutional theory which explicates ways in which manufacturing companies use natural resources to avoid depletion and pollution and improve eco-efficient practices to gain competitive advantage and financial performance. While others

find energy conservation to have a positive effect on profitability, Yücel (2022) finds energy efficiency to be critical for maintaining long-term growth.

Results further show a positive but insignificant relationship between water conservation and NP. These results support those of Madime and Gonçalves (2022) which found a positive but insignificant relationship between variables. However, these results are in contrast with those of Dzomonda and Fatoki (2021) which found a negative and significant relationship between variables.

The results further show carbon reduction to be positively yet insignificantly associated with NP. These results support those of Garzón-Jiménez and Zorio-Grima (2021) which found a positive nexus between carbon emissions and financial performance, although the nexus was significant. However, these results contradict those of Shah *et al.* (2021) which suggested that carbon reduction has a negative yet statistically significant effect on financial performance.

The relationship between waste reduction and NP is negative and insignificant. As postulated by the stakeholder theory, some firms create value for their stakeholders by meeting their expectations and that enhances financial performance (Huge-Brodin *et al.*, 2021). These results are in support of those of Baah *et al.* (2021b) which revealed that environmental performance is negatively and insignificantly correlated with financial performance. On the other hand, Ihenyen and Ikegima (2022) discovered a significant positive correlation between Environmental Accounting and financial performance. Sales revenue is negatively related to NP. The relationship between sales revenue and NP is statistically insignificant.

The null hypothesis,  $H_{3o}$ , suggests an insignificant relationship between eco-efficiency variables and NP, whereas the alternative hypothesis,  $H_{3a}$ , suggests a significant connection between eco-efficiency and NP. The null hypothesis is accepted given that all eco-efficiency variables, including the control variable, are found to be insignificantly associated with NP. Regardless of the strength of the relationships found between eco-efficiency variables and financial performance, manufacturing companies need to engage

more on eco-efficient activities in pursuit to accomplish the objectives of sustainable development goal 12 which is aimed at ensuring patterns of sustainable consumption and production. Moreover, companies ought to focus more on environmental impacts following from business production activities as hypothesised in King IV Code. The next section presents a discussion of results for objective 4.

#### **5.2.10.4. Discussion of results for objective 4 (Hypothesis 4)**

The results in Model 4 show that energy conservation is positively yet insignificantly related to ROC. These results support those of Agyabeng-Mensah *et al.* (2020) which showed energy conservation to have a positive and significant influence on financial performance. However, these results contrast with those of Dzomonda (2021) which revealed that when energy efficiency is attained, it negatively and significantly influences financial performance

Water conservation is also positively yet insignificantly related to ROC. These results are in line with results of Dzomonda and Fatoki (2021) and Yuan and Cao (2022) which found a positive and significant relationship between the independent and the dependent variables. In addition, these results support the stakeholder theory which proposes approaches on how a company should meet expectations of all its stakeholders. This theory theorises that when companies use huge amounts of water, it might cause serious problems to the environment.

The results further show waste reduction to have a positive yet insignificant relationship with ROC. These results confirm those of Ihenyen and Ikegima (2022) which revealed a positive influence of Environmental Accounting on financial performance although the influence is significant. However, the results are in contradiction with those of Baah *et al.* (2021b) which revealed that environmental performance is negatively and insignificantly correlated with financial performance.

GMM results further revealed that carbon reduction is negatively and insignificantly related to ROC. These results contradict those of Garzón-Jiménez and Zorio-Grima (2021) which found a positive and significant relationship between carbon emissions and

financial performance. However, the results support those from the study of Kumari and Patel (2020) which found a negative and insignificant association between carbon footprints and financial performance. Sales revenue has a negative and insignificant relationship with ROC. The null hypothesis, H4<sub>0</sub>, claimed no significant relationship between eco-efficiency variables and ROC, whereas H4<sub>a</sub>, suggested that a significant relationship exists between eco-efficiency variables and ROC. The null hypothesis is accepted given that all eco-efficiency variables, including the control variable, are found to be insignificantly associated with ROC. The following section introduces the second level of analysis.

### 5.3. SECOND LEVEL OF ANALYSIS (PRIMARY DATA)

This section presents the second level of analysis as follows: participants' profiles, descriptive statistics, primary data analysis, and discussion of results.

#### Regression model for primary data analysis

$$ROA_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

$$SP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (2)$$

$$NP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (3)$$

$$ROC_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (4)$$

(The description of the notations in the models is as described on page 66)

## **PARTICIPANTS' DEMOGRAPHIC PROFILE**

Figure 5.2 presents the demographic profile of the 28 respondents from 14 sampled companies. Panel A of Figure 5.2 depicts gender, while panel B and C portray information about age and educational qualification of respondents respectively. Males accounted for 57%, from which 10 occupy positions of EOs and 8 are CFOs. Females accounted for 14% wherein only 1 was an EO. In panel B, it is indicated that the majority of the respondents are aged 30-39 and 40-49 years. Regarding educational background, it is established that 61% of the participants holds a post-graduate qualification, 21% possesses a bachelor's degree and 18% holds only matric together with additional certificates. The succeeding section presents the descriptive statistics of the respondents on what influences financial performance represented by ROA, SP, NP and ROC.

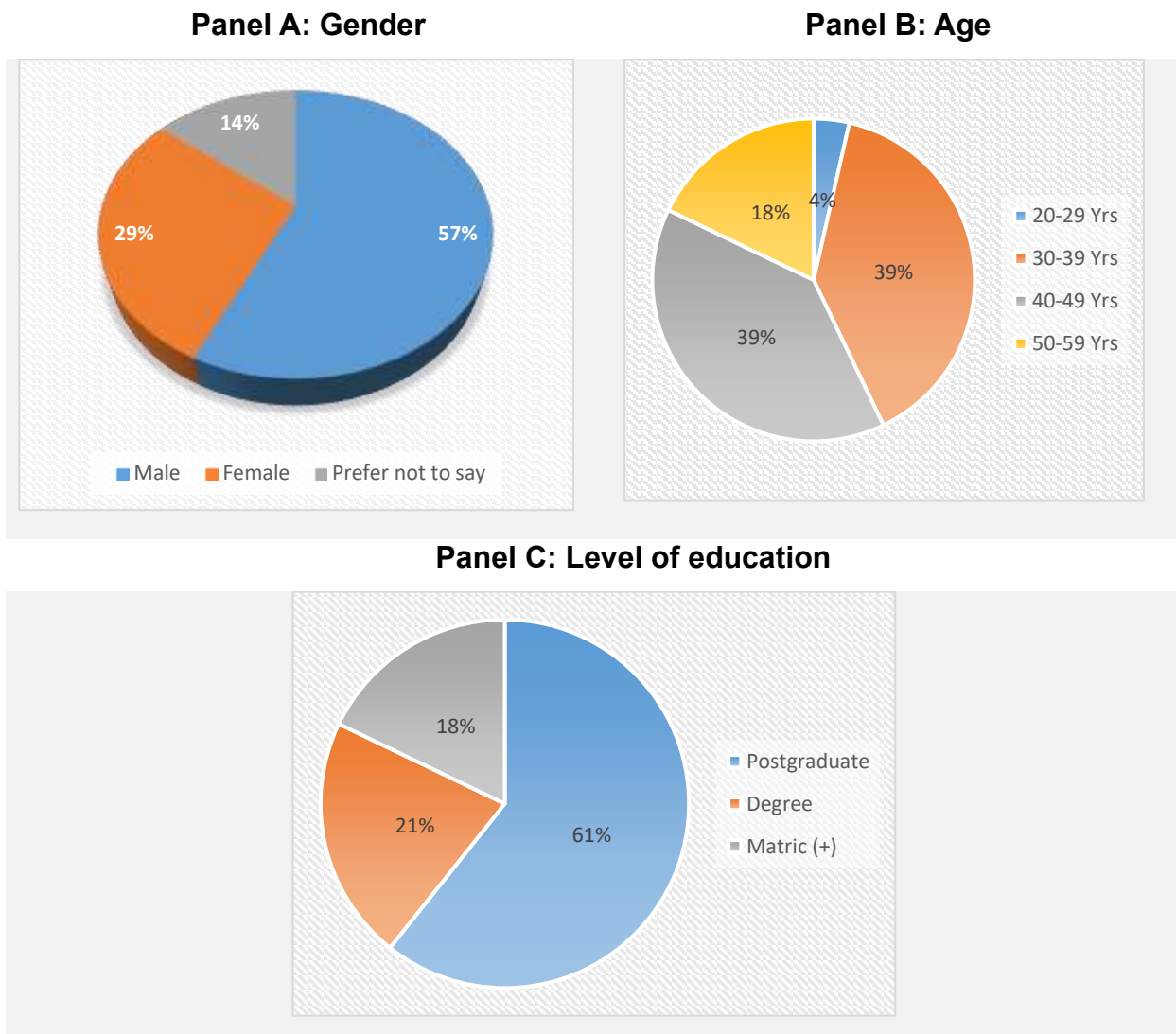


Figure: 5.2: Participants profile

Source: Author's compilation

### 5.3.1. Descriptive statistics of respondents' views regarding what influences ROA

Table 5.19 presents the descriptive statistics of the views of the respondents on what influences ROA. The perceptions of the impact were measured using a Likert scale from 1 to 4, where 1 was low and 4 was very high. Table 5.19 shows that the number of survey questionnaires completed was 28 for 14 JSE listed food and beverage manufacturing companies. The mean for independent variables: energy conservation, water conservation, carbon reduction and waste reduction are 2,536; 2,357; 2,179; and 2,429 respectively. Moreover, the mean for the control variable sales revenue is 2,964. These

results, as per CFOs' and EOs' numerical ratings of how eco-efficiency variables and sales revenue influence ROA, show that sales revenue has the most influence as compared with energy conservation, water conservation, carbon reduction and waste reduction in JSE listed food and beverage manufacturing companies.

The standard deviations for energy conservation, water conservation, carbon reduction and waste reduction are 0,744; 0,731; 0,772; and 0,690 respectively. Additionally, for the control variable, sales revenue, the standard deviation is 0,793. The standard deviations for all the independent variables, including the control variable, is less than their mean. This is an indication that all the independent variables and the control variable are not widely dispersed. Table 5.19 further shows the minimum for energy conservation, water conservation, carbon reduction and waste reduction as 1 for each. Sales revenue as a control variable also shows a minimum of 1. These numbers indicate the minimum data values for the variables. Furthermore, the maximum for energy conservation, water conservation, carbon reduction and waste reduction are 4;3;3; and 3 respectively. Sales revenue shows a maximum of 4. These numbers indicate the highest possible value for both dependent and independent variables. The next section presents the descriptive statistics of respondents' view of what influences share price.

Table 5.19: Summary statistics of views regarding ROA

<b>ROA</b>	<b>Energy Red</b>	<b>Water Red</b>	<b>Carbon Red</b>	<b>Waste Red</b>	<b>Sales</b>
<b>Mean</b>	2,536	2,357	2,179	2,429	2,964
<b>Median</b>	3	2,5	2	3	3
<b>Mode</b>	3	3	2	3	3
<b>Standard Deviation</b>	0,744	0,731	0,772	0,690	0,793
<b>Range</b>	3	2	2	2	3
<b>Minimum</b>	1	1	1	1	1
<b>Maximum</b>	4	3	3	3	4
<b>Count</b>	28	28	28	28	28

Source: STATA software

### 5.3.2. Descriptive statistics of respondents' views regarding what influences SP

Table 5.20 presents the descriptive statistics of the views of the respondents as to what influences SP. The perceptions of the impact were measured using a Likert scale from 1 to 4, where 1 was low and 4 was very high, as with that of ROA. The mean for energy conservation, water conservation, carbon reduction and waste reduction are 2,250; 2,836; 2,179; and 2,143 respectively. Moreover, the mean for the control variable, sales revenue, is 2,750. These results, as per CFOs' and EOs' numerical ratings of how eco-efficiency variables and sales revenue influence SP, show that water reduction has the most influence as compared with energy conservation, carbon reduction, waste reduction and sales revenue in JSE listed food and beverage manufacturing companies.

The standard deviations for energy conservation, water conservation, carbon reduction and waste reduction are 0,967; 0,763; 0,905; and 0,932 respectively. Additionally, for the control variable, sales revenue, the standard deviation is 0,752. The standard deviations for all the independent variables including the control variable, are less than the mean. This is an indication that all the independent variables, inclusive of the control variable are not widely dispersed. Table 5.20 further shows the minimum for energy conservation, water conservation, carbon reduction and waste reduction as 1 for each. Sales revenue as a control variable also shows a minimum of 1. Furthermore, the maximum for independent variables, energy conservation, water conservation, carbon reduction and waste reduction are 4;3;4; and 4 respectively. Sales revenue shows a maximum of 4. In the same way, the minimum values indicate the lowest data point for both the dependent and independent variables, while the maximum values indicate the highest data point for variables. The next section presents the descriptive statistics of respondents' view of what influenced net profit.

Table 5.20: Summary statistics of views regarding SP

SP	Energy Red	Water Red	Carbon Red	Waste Red	Sales
Mean	2,250	2,286	2,179	2,143	2,750
Median	2	2	2	2	3
Mode	2	3	2	3	3
Standard Deviation	0,967	0,763	0,905	0,932	0,752
Range	3	2	3	3	3
Minimum	1	1	1	1	1
Maximum	4	3	4	4	4
Count	28	28	28	28	28

Source: STATA software

### 5.3.3. Descriptive statistics of respondents' views regarding what influences NP

Table 5.21 presents the descriptive statistics of the views of the respondents to what influences NP. The perceptions of the impact were measured using a Likert scale from 1 to 4, where 1 was low and 4 was very high. The mean for energy conservation, water conservation, carbon reduction and waste reduction were 2,571; 2,429; 2,321; and 2,643 respectively. Moreover, the mean for the control variable, sales revenue, was 3,107. These results, as per CFOs' and EOs' numerical ratings of how eco-efficiency variables and sales revenue influence NP, show that sales revenue has the most influence as compared with energy conservation, water conservation, carbon reduction and waste reduction in JSE listed food and beverage manufacturing companies.

The standard deviations for energy conservation, water conservation, carbon reduction and waste reduction are 0,836; 0,790; 0,819; and 0,731 respectively. Additionally, for the control variable, sales revenue, the standard deviation is 0,685. The standard deviations for all the independent variables, including the control variable, are less than the mean. This is an indication that all the independent variables and the control variables are not widely dispersed. Table 5.21 further shows the minimum for energy conservation, water conservation, carbon reduction and waste reduction as 1 for each. Sales revenue as a control variable shows a minimum of 2. Furthermore, the maximum for energy conservation, water conservation, carbon reduction and waste reduction are 4 for each.

Sales revenue also shows a maximum of 4. The next section presents the descriptive statistics of respondents' view of what influenced ROC.

Table 5.21: Summary statistics of views regarding NP

NP	Energy Red	Water Red	Carbon Red	Waste Red	Sales
Mean	2,571	2,429	2,321	2,643	3,107
Median	3	3	2	3	3
Mode	3	3	3	3	3
Standard Deviation	0,836	0,790	0,819	0,731	0,685
Range	3	3	3	3	2
Minimum	1	1	1	1	2
Maximum	4	4	4	4	4
Count	28	28	28	28	28

Source: STATA software

#### 5.3.4. Descriptive statistics of respondents' views regarding what influences ROC

Table 5.22 presents the descriptive statistics of the views of the respondents to what influences ROC. The perceptions of the impact were measured using a Likert scale from 1 to 4, where 1 was low and 4 was very high. Table 5.22 shows that the number of survey questionnaires retrieved was 28 for 14 JSE listed food and beverage manufacturing companies. The mean for energy conservation, water conservation, carbon reduction and waste reduction are 2,536; 2,357; 2,179; and 2,429 respectively. Moreover, the mean for the control variable, sales revenue, is 2,964. These results as per CFOs' and EOs' numerical ratings of how eco-efficiency variables and sales revenue influence ROC show that sales revenue has the most influence as compared with energy conservation, water conservation, carbon reduction and waste reduction in JSE listed food and beverage manufacturing companies.

The standard deviations for energy conservation, water conservation, carbon reduction and waste reduction are 0,744; 0,731; 0,772; and 0,690 respectively. Additionally, for the control variable, sales revenue, the standard deviation is 0,793. The standard deviations for all the independent variables including the control variable are less than their mean. This is an indication that all the independent variables and the control variable are not

widely dispersed. Table 5.22 further shows the minimum for energy conservation, water conservation, carbon reduction and waste reduction, as 1 for each. Sales revenue as a control variable also shows a minimum of 1. Furthermore, the maximum for energy conservation, water conservation, carbon reduction and waste reduction, are 4;3;3; and 3 respectively. Sales revenue shows a maximum of 4. The next section presents the regression results for quantitative primary data.

Table 5.22: Summary statistics of views regarding ROC

ROC	Energy Red	Water Red	Carbon Red	Waste Red	Sales
Mean	2,536	2,357	2,179	2,429	2,964
Median	3	2,5	2	3	3
Mode	3	3	2	3	3
Standard Deviation	0,744	0,731	0,772	0,690	0,793
Range	3	2	2	2	3
Minimum	1	1	1	1	1
Maximum	4	3	3	3	4
Count	28	28	28	28	28

Source: STATA software

### 5.3.5. Ordinary least square results for primary data

This section presents the ordinary least square results for the primary data collected through survey questionnaires from 14 CFOs and 14 EOs of the sampled JSE listed food and beverage manufacturing companies. It is however important to note that for the regressed variables which are ROA, SP, NP, and ROC, data were obtained from the sampled companies' financial statements for the year 2021. This kind of regression, according to the best knowledge of the researcher, is guided by existing literature as the writing of this thesis seem to be a pioneer, hence it further contributes towards the novelty of this study. Therefore, the model for quantitative questionnaire analysis is the same model used in the first level of analysis, presented as follows:

$$ROA_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

$$SP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (2)$$

$$NP_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (3)$$

$$ROC_{it} = \alpha_i + \beta_1 ENRCON_{it} + \beta_2 WATCON_{it} + \beta_3 CAREMM_{it} + \beta_4 WASGEN_{it} + \beta_5 SALREV_{it} + \varepsilon_{it} \dots \dots \dots (4)$$

(The description of the notations in the models is as described on page 66)

**5.3.5.1. Eco-efficiency and return on assets (ROA)**

Participants used a Likert scale from 1 to 4, where 1 was low and 4 was very high, to rate how they perceive eco-efficiency variables and sales revenue to assist in improving ROA growth. Results from Table 5.23 indicate that energy reduction, carbon reduction, and sales revenue are negatively related to ROA while waste reduction and water reduction are found to be positively related to ROA. To be more precise, the results show that 1% in energy reduction, carbon reduction, and sales revenue will worsen the company’s ROA by 4.22%, 1.42% and 5.20% accordingly, while a 1% in waste reduction and water reduction improve ROA by 2.21% and 8.50% respectively. Nonetheless, all coefficients in the Table 5.23 are statistically insignificant as their p-values are greater than 0.05. Given that 50% of the eco-efficiency variables have positive coefficients, the researcher therefore concludes that a positive relationship exists. The other 50% for variables with negative coefficients, which results in an outflow of cash and that negatively affects ROA, might be because the 10 years under study might be the period in which companies are investing in eco-efficiency practices and ploughing back might be experienced in the long run.

As indicated in chapter 4, the inclusion of the primary data analysis was to conduct a follow-up on the secondary data analysis. These results are not consistent with those from the secondary data analysis, objective 1, which sought to examine the relationship between eco-efficiency variables and ROA and revealed that two eco-efficiency variables

positively yet insignificantly associated with ROA are energy conservation and water conservation. With primary data analysis, waste reduction and water reduction are the only variables with a positive and insignificant influence on ROA.

Table 5.23: Estimates of eco-efficiency variables on ROA

Variable	Coefficient	Standard error	T-statistics	Probability value
<b>Energy reduction</b>	-0.042182	0.058591	0.719929	0.4791
<b>Carbon reduction</b>	-0.014170	0.062028	-0.228442	0.8214
<b>Waste reduction</b>	0.085039	0.062028	1.328540	0.1976
<b>Water reduction</b>	0.022112	0.054203	0.407948	0.6873
<b>Sales revenue</b>	-0.052034	0.063280	-0.822280	0.4197
<b>Constant</b>	0.993743	0.522793	1.900833	0.0705

Source: Author's compilation

### 5.3.5.2. Eco-efficiency and Share Price (SP)

Participants used a Likert scale from 1 to 4, where 1 was low and 4 was very high, to rate how they perceive eco-efficiency variables and sales revenue to assist in improving SP. Results from Table 5.24 indicate that all eco-efficiency variables including the control variable, sales revenue, are negatively related to SP. This implies that 1% in energy reduction, water reduction, carbon reduction, waste reduction and sales revenue will worsen the company's SP by 8.55%, 0.12%, 3.40%, 5.60%, and 22.71% accordingly. Moreover, the coefficients for all eco-efficiency variables are statistically insignificant as their p-values are greater than the 0.05. Although the coefficient for sales revenue is negative, the relationship is statistically significant as the probability value is 0.0173 which is less than the p-value of 0.05.

These findings are inconsistent with those obtained from secondary data analysis for objective 2 which revealed that energy conservation and water conservation are positively related to SP. This means that 1% change in energy conservation and water conservation will improve SP. Results from primary data analysis show that none of the eco-efficiency variables including the control variable sales revenue, are positively associated with SP. These negative and insignificant results may imply that, in some circumstances, short-term financial gains may not be apparent but may emerge in the long run, or that certain

factors mitigate the favourable effects of eco-efficiency methods. These findings further imply that, in some situations, manufacturing companies may experience operational hurdles or increased expenditures while implementing eco-efficiency techniques, which may have a temporary impact on their financial performance.

Table 5.24: Estimates of eco-efficiency variables on SP

Variable	Coefficient	Standard error	T-statistics	Probability value
<b>Energy reduction</b>	-0.085535	0.081684	-1.047138	0.3064
<b>Water reduction</b>	-0.001260	0.075567	-0.016669	0.9869
<b>Carbon reduction</b>	-0.033720	0.086476	-0.389939	0.7003
<b>Waste reduction</b>	-0.055512	0.089238	-0.622069	0.5403
<b>Sales revenue</b>	-0.227128	0.088221	-2.574530	0.0173
<b>Constant</b>	2.759161	0.728846	3.785658	0.0010

Source: Author's compilation

### 5.3.5.3. Eco-efficiency and Net Profit (NP)

Participants used a Likert scale from 1 to 4, where 1 was low and 4 was very high to rate how they perceive eco-efficiency variables and sales revenue to assist in improving NP. Results from Table 5.25 indicate that all eco-efficiency variables, including the control variable, sales revenue, are positively associated with NP. This implies that 1% in energy reduction, water reduction, carbon reduction, waste reduction and sales revenue will improve the company's NP by 13.81%, 9.78%, 27.61%, 18.68% and 5.62%. Although the coefficients for all the eco-efficiency variables including the control variable, sales revenue, are positive, the relationships are statistically insignificant as the probability values are reflected as 0.5770, 0.6690, 0.29868, 0.4907 and 0.8329 respectively, greater than the p-value of 0.05.

These results align with results from secondary data analysis for objective 3 where a positive yet an insignificant relationship between all eco-efficiency variables and NP, except with waste reduction, was found. In the same vein, the relationships between eco-efficiency and NP were found to be statistically insignificant.

Table 5.25: Estimates of eco-efficiency variables on NP

Variable	Coefficient	Standard error	T-statistics	Probability value
Energy reduction	0.138168	0.244019	0.566217	0.5770
Water reduction	0.097806	0.225744	0.433259	0.6690
Carbon reduction	0.276057	0.258334	1.068604	0.2968
Waste reduction	0.186849	0.266585	0.700900	0.4907
Sales revenue	0.056281	0.263547	0.213551	0.8329
Constant	5.714635	2.177314	2.624626	0.0155

Source: Author's compilation

#### 5.3.5.4. Eco-efficiency and return on capital (ROC)

Participants used a Likert scale from 1 to 4, where 1 was low and 4 was very high, to rate how they perceive eco-efficiency variables and sales revenue to assist in improving ROC growth. Results from Table 5.26 indicate that all eco-efficiency variables except waste reduction, including the control variable, sales revenue, are negatively associated with ROC. This implies that 1% in energy reduction, water reduction, carbon reduction and sales revenue will worsen the company's ROC by 8.39%, 0.69%, 1.30% and 12.80% respectively. However, any 1% in waste reduction improves company ROC growth by at least 5.55%. The coefficients for all the eco-efficiency variables, except for waste reduction, including the control variable sales revenue, are negative. Moreover, the relationships are statistically insignificant as the probability values reflected as 0.4306, 0.9070, 0.9431, 0.6375 and 0.2694 respectively, are more than the p-value of 0.05.

These findings are inconsistent with those obtained from secondary data analysis for objective 4 which revealed that energy conservation, water conservation and waste reduction are positively yet insignificantly related to ROC. This means that any 1% in energy conservation, water conservation and waste reduction will improve ROC. However, results from primary data analysis show that only waste reduction is positively associated with ROC.

Table 5.26: Estimates of eco-efficiency variables on ROC

Variable	Coefficient	Standard error	T-statistics	Probability value
Energy reduction	-0.083994	0.0104604	-0.802978	0.4306
Water reduction	-0.006982	0.096770	-0.072153	0.9431
Carbon reduction	-0.013083	0.110740	-0.118139	0.9070
Waste reduction	0.054599	0.110740	0.477781	0.6375
Sales revenue	-0.128003	0.112975	-1.133025	0.2694
Constant	1.478986	0.933348	1.584602	0.1273

Source: Author's compilation

### 5.3.5.5. Discussion of results for primary data

The primary data analysis was aimed at validating and confirming the findings from the first level of analysis (secondary data analysis) which used the regression models. The validation and confirmation were done mainly by extorting and regressing the professional views of practitioners on how eco-efficiency practices and sales revenue assist in improving company's financial performance. Results from primary data analysis are inconsistent with results from the secondary data analysis. However, the positive results from the surveys support those of Majid *et al.* (2020) which used survey questionnaires and found a positive relationship when investigating how eco-efficiency actions affect performance of enterprises. In accordance with the stakeholder theory, businesses can create value by satisfying their stakeholders' expectations (Huge-Brodin *et al.*, 2020; Tran & Adomako, 2021). The negative results support the study of Faisal *et al.* (2021) which revealed a negative relationship when evaluating how firm performance is affected by resource efficiency actions. Regardless of different views from company CFOs and EOs from sampled companies and the financial gains companies stand to gain, manufacturing companies can use eco-efficiency as a useful instrument for sustainable development as it can minimise resource depletion and reduce pollution (Matsumoto & Chen, 2021). The next section presents objective 5 of this study.

#### **5.4. DEVELOPMENT OF A FRAMEWORK FOR FINANCIAL IMPLICATIONS OF ECO-EFFICIENCY PRACTICES**

Objective 5 of this study was to develop a framework for financial implications of eco-efficiency practices of JSE listed food and beverage manufacturing companies as highlighted in chapter 1. Based on the results from both the first and second levels of analysis, the researcher proposed a modest framework (Figure 5.3) that food and beverage manufacturing companies may follow when engaging in eco-efficiency practices that might lead to improved financial performance. Drawing from the first level of analysis, energy conservation was found to have a positive yet insignificant relationship with financial performance across all the models (ROA, SP, NP & ROC). Water conservation was also found to have a positive yet insignificant relationship with financial performance across all models. Results further revealed a negative effect of carbon reduction on financial performance across three models. This might have been due to a high costs of carbon investment (Li *et al.* 2020). Waste reduction was also found to have a negative influence across the three models. The negative result might have been because of the costs of new technology which might have been high, affecting the profit returns negatively (Jaiswal & Kumar, 2018). Sales revenue, as a control variable, negatively affected financial performance of JSE listed food and beverage manufacturing companies. Beside sales revenue being one of the predictor variables of financial performance, it has been indicated that financial performance may be affected by many factors such as earnings per share, marketing strategies, operating costs, and net profit (Suzan, 2020; Boakye *et al.*, 2021). It might have been that, in an effort to raise sales, firms might have intensified their marketing efforts which might have ultimately led to sales revenue having a negative impact on financial performance. For example, Mun and Jang (2018) found that companies' sales and profitability are ultimately affected by increased operating costs and advertising costs. In addition, results from the second level of analysis (primary data analysis) revealed that waste reduction positively and insignificantly affects financial performance across three models.

Given that energy conservation, water conservation and waste reduction positively affect financial performance, the researcher dropped carbon reduction and sales revenue in

developing the framework due to their negative influence on financial performance. The first part of the framework shows that, under the lenses of the stakeholder and the institutional theories, companies used the available resources to satisfy the interest of all the company’s stakeholders. The second part presents only variables found to be positively related to financial performance variables used in this study.

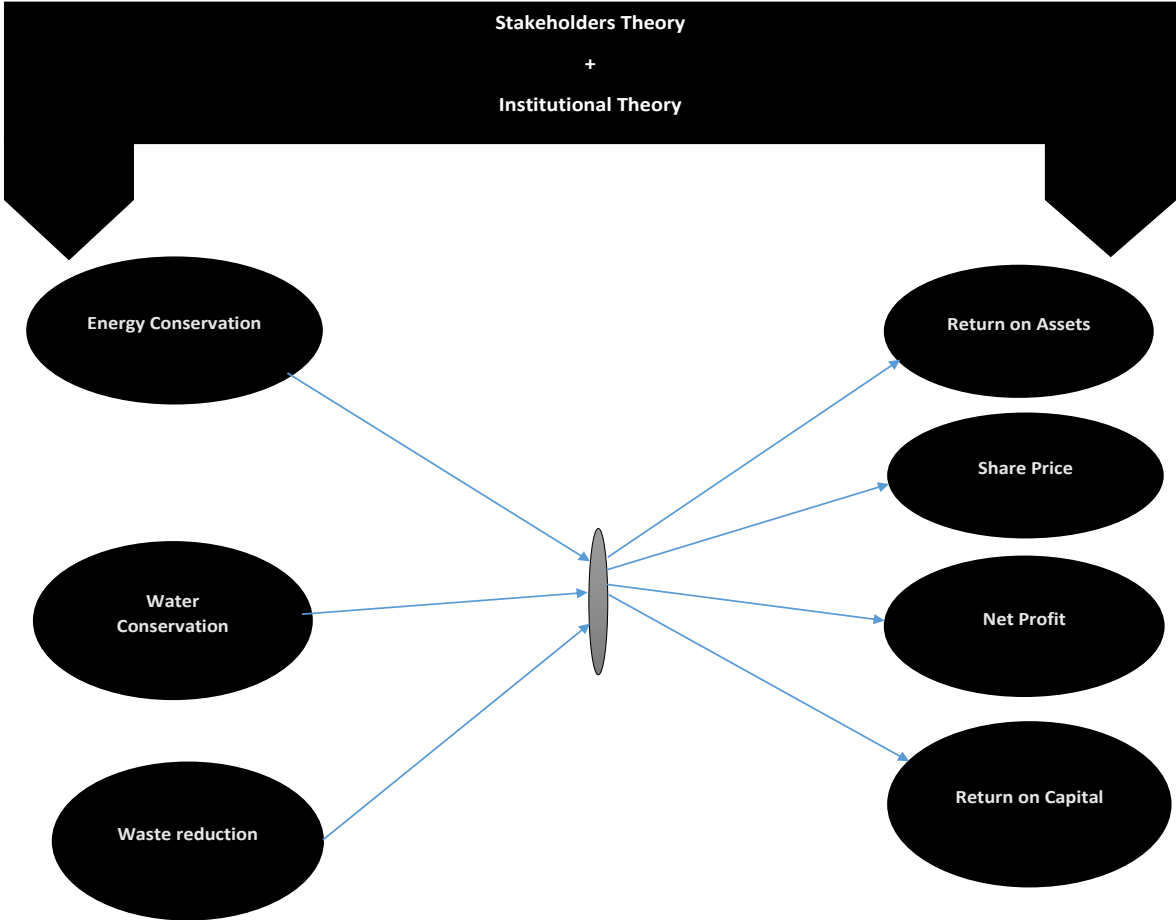


Figure 5.3: A framework for eco-efficiency and financial performance

Source: Author’s original Framework

**5.5. SUMMARY OF THE CHAPTER**

This chapter followed the methodological process described in Chapter 4, focusing on the analysis of both primary and secondary data. Descriptive tests were performed. The correlation matrix was also performed to check for multicollinearity. In addition, the unit root tests were performed to check for the stationarity of panels. Cointegration tests were performed to check for long run relations among variables. Furthermore, diagnostic tests

were performed for regression assumptions. The Hausman tests were performed to select the preferred models with RE being the preferred model. However, due to the limitations that RE has, GMM was used to discuss the results for all the objectives. Results from the primary data analysis (second level of analysis) were presented and discussed. The following chapter presents the summary, conclusion, and recommendations.

## CHAPTER SIX

### SUMMARY, RECOMMENDATIONS AND CONCLUSION

#### 6.1. INTRODUCTION

Chapter 5 presented and discussed the results for the first and second level of analysis. Chapter 6 presents the summary, recommendations, and conclusion. Section 6.2 presents the summary of findings on secondary data analysis per objective as outlined in chapter 1. Section 6.3 presents the summary of findings on primary data analysis. Section 6.4 discusses the contribution to knowledge while section 6.5 presents the limitations of the study. Section 6.6 presents the recommendations for future research and knowledge and practice. Section 6.7 presents the summary of the study while section 6.8 presents the conclusion.

#### 6.2. SUMMARY OF FINDINGS ON SECONDARY DATA ANALYSIS

This section presents a summary of findings according to the research objectives:

##### 6.2.1. Summary of findings for objective 1

*To examine the relationship between eco-efficiency and return on assets (ROA) in JSE listed food and beverage manufacturing companies.*

The preferred method, which was the Random effect (RE), revealed a positive relationship between eco-efficiency and financial performance in the sample of 14 JSE listed food and beverage manufacturing companies, although this preferred method was rejected due to the drawback it holds. Using GMM for secondary data analysis in chapter 5 (Table 5.18), the findings showed a positive and insignificant relationship between energy conservation and ROA in all 14 JSE listed food and beverage manufacturing companies. This analysis further revealed that water conservation positively and insignificantly affects ROA growth in the sample of companies. However, results revealed a negative and insignificant association between carbon reduction and ROA and waste reduction and ROA.

Hence, these results confirm previous research findings, including, amongst others, Agyabeng-Mensah *et al.* (2020), Madime and Gonçalves (2022) and Maama *et al.* (2021), which demonstrated that eco-efficiency practices positively influence financial performance. However, the results contradict those of previous researchers such as Dzomonda (2021) which demonstrated that eco-efficiency practices negatively influence financial performance.

### **6.2.2. Summary of finding for objective 2**

*To assess the relationship between eco-efficiency and share price (SP) in JSE listed food and beverage manufacturing companies.*

The Hausman tests were performed to select the preferred models with RE being the preferred model. However, GMM was used for secondary data analysis as RE had some disadvantages although it was a preferred model. Similarly, GMM results showed that energy conservation and water conservation positively but insignificantly affect SP while carbon reduction and waste reduction were found to be negatively and insignificantly associated with SP.

These results confirm previous research findings, including amongst others, Maama *et al.* (2021) and Madime and Gonçalves (2022) which demonstrated that eco-efficiency practices positively influence financial performance. However, the results contradict those of previous researchers such as Dzomonda (2021) which demonstrated that eco-efficiency practices negatively influence financial performance.

### **6.2.3. Summary of finding for objective 3**

*To measure the relationship between eco-efficiency and net profit (NP) in JSE listed food and beverage manufacturing companies.*

Similarly, GMM results showed that energy conservation, water conservation and carbon reduction positively but insignificantly affect NP while waste reduction was the only eco-efficiency variable found to be insignificantly related to company net profit, with a negative association. Hence, these results confirm previous study findings such as those of

Garzón-Jiménez and Zorio-Grima (2021) and Madime and Gonçalves (2022) which demonstrated that eco-efficiency practices positively influence financial performance.

#### **6.2.4. Summary of finding for objective 4**

*To evaluate the relationship between eco-efficiency and Return on Capital (ROC) in JSE-listed food and beverage manufacturing companies.*

GMM results showed that energy conservation, water conservation and waste reduction positively and insignificantly affect ROC growth while carbon reduction was found to be negatively and insignificantly associated with ROC growth. Similar to findings for objective 3, the results from this study confirm previous research findings from different studies, including, amongst others, the studies of Garzón-Jiménez and Zorio-Grima (2021) and Madime and Gonçalves (2022) which established a positive influence of eco-efficiency practices on financial performance.

### **6.3. SUMMARY OF FINDINGS ON PRIMARY DATA ANALYSIS**

As alluded to in chapter 4, the second level of analysis was to be performed to follow up on the first level of analysis. OLS was used to analyse data from primary quantitative survey questionnaires issued to CFOs and EOs of the 14 sampled manufacturing companies listed in the JSE. OLS results revealed that energy conservation, carbon reduction, and sales revenue have a negative and insignificant relationship with ROA in Model 1. Water conservation and waste reduction were the only factors with an insignificant positive correlation with ROA. In addition, the analysis revealed that energy conservation, water conservation, carbon reduction, waste reduction and sales revenue negatively and insignificantly affected SP in Model 2. With Model 3, all the eco-efficiency variables including the control variable had a positive yet insignificant relationship with NP. Lastly, energy conservation, water conservation, carbon reduction, and sales revenue had a negative relationship with ROC in Model 4. Waste reduction was the only factor with a positive yet insignificant correlation with ROC.

These results contrast with the results from secondary data analysis in that with the secondary data analysis, energy conservation and water conservation were found to be

dominating variables with a positive influence on financial performance variables across all models whereas with primary data analysis, only waste reduction was found to be positively related to financial performance variables. Drawing from the secondary data analysis and primary data analysis, energy conservation, water conservation and waste reduction are positively related to financial performance variables used in this study. To this end, the researcher featured only the variables which were found to have a positive influence on financial performance, to propose a framework and to draw a conclusion because both the first and second level of analysis revealed that investments in energy, investments in water and waste reduction can enhance financial performance if properly maintained.

#### **6.4. CONTRIBUTION TO KNOWLEDGE**

Regardless of the existing research on financial implications of individual eco-efficiency variables, it appears that there is currently no study which regressed the four eco-efficiency variables (energy conservation, water conservation, carbon reduction, and waste reduction) and suggested a framework to understand their financial implications in the context of South Africa. The researcher addressed this gap by developing a framework to understand the financial implication of eco-efficiency practices.

#### ***Suggested framework for eco-efficiency and financial performance in food and beverage companies listed in the JSE***

This study sought to examine the effect that the four eco-efficiency variables have on financial performance. As noted in chapter 5, the study's research objectives were achieved through an analysis of data collected secondarily from published annual integrated reports of sampled companies and quantitative primary data obtained through survey questionnaires. In addition, there was an evaluation of the literature. The review of African and international literature revealed different directions of relationships between individual eco-efficiency variables and financial performance variables. Therefore, this research is the first in the South African context to combine the four eco-efficiency variables to examine their effect on financial performance and closes the gap in literature.

Besides the abovementioned research gap, no previous research has suggested a framework for financial implications of four eco-efficiency variables combined. Therefore, this study made an additional contribution through a framework that offers a convenient view of how eco-efficiency practices affect financial performance of businesses. The suggested framework is explicitly presented in chapter 5 (Figure 5.3).

In the proposed framework (Figure 5.3), the stakeholder theory and the institutional theory were included to show the lenses under which the study was guided. The stakeholder theory postulates that companies have to address diverse needs of different stakeholders whereas the institutional theory postulates that companies should engage in eco-efficient initiatives. Accordingly, the eco-efficiency variables shown in Figure 5.3 are those that, through the analysis, were found to have a positive effect on financial performance, although the effect is insignificant. Those variables are energy conservation, water conservation and waste reduction. The subsequent section presents the limitations of the study.

## **6.5. LIMITATIONS OF THE STUDY**

This study focused on examining the effect of eco-efficiency variables on financial performance of JSE listed food and beverage manufacturing companies and therefore results were limited to food and beverage manufacturing companies only. In addition, this study was limited to only four eco-efficiency variables and only four financial performance variables. Therefore, the results were limited to these four eco-efficiency variables.

With the primary data collection, the study was restricted to only the CFOs and the EOs. Managers and other members of the executive did not form part of those who completed the survey; as such, the researcher relied only on the responses from the CFOs and the EOs of the JSE listed food and beverage manufacturing companies. Future researchers may explore more executive officers in their related research.

## **6.6. RECOMMENDATIONS**

The study provides recommendations as follows:

### **6.6.1. Recommendations for further research**

This study examined the effect of eco-efficiency practices on financial performance. Not all the eco-efficiency variables had a positive and significant effect on financial performance, and this might have resulted from the fact that the researcher only used 10 years' panel data. The first 10 years covered in this study might have been the period of investment in the eco-efficiency practices, which resulted in an outflow of cash and that might have led to some of the eco-efficiency variables negatively and insignificantly affecting financial performance, that might not be recovered in the short run, that is, within 10 years.

Future researchers can extend to broader industrial study, to see how their business operations affect the environment as well as how eco-efficiency can assist in improving their company financial performances. The study further recommends future research on the effect of eco-efficiency variables on other corporate financial and non-financial success indicators. In addition, future researchers can extend the study period to more than 10 years to check if the investments in eco-efficiency might significantly affect financial performance as compared to the findings in this study where only a 10 years' study period was used. It is further recommended that additional research in this field extend the survey to the executive members and the company managers. On the same note, future studies can employ other analysis methods as an extension to what the researcher in this study has stopped at.

Based on the suggested framework, future studies can demonstrate and put to test the ideas from the proposed framework (Figure 5.3). Lastly, it is suggested that future research considers evaluating the framework to determine its efficacy and identify any flaws so that suggestions for development can be made.

### **6.6.2. Recommendations for knowledge and practice**

Based on the results, it is recommended that all JSE listed food and beverage manufacturing companies continue with energy conservation, water conservation and waste management practices given that they have a positive impact on the firms' financial performance. Although carbon reduction had a negative impact on financial performance, companies should continue with these reduction practices as they might possibly enhance financial performance in the long run. Also, given that eco-efficiency practices are merely voluntary, it is recommended that they are adopted by all JSE listed food and beverage manufacturing companies as the results indicate potential future financial benefits to those companies that adopt them. This will greatly contribute towards the achievement of SDG 12 and also meet the conditions of the Paris Agreement that contains the goals to limit global warming by minimising greenhouse gas emissions and set net zero emission targets from industries' operations. The next section presents the study summary.

### **6.7. SUMMARY OF THE STUDY**

The aim and objectives of this study were addressed by reviewing relevant existing literature and theoretical frameworks. Chapter 2 discussed the stakeholder theory and the institutional theories. The stakeholder theory encourages companies to address the needs of stakeholders as a way of creating value whereas the institutional theory encourages companies to engage in initiatives that might assist in gaining acceptance from the society within which they operate. It is hoped and believed that such practices lead to increased profits.

Drawing from the literature reviewed in Chapter 3, there are few or no studies about combined eco-efficiency variables and financial performance variables focusing on food and beverage manufacturing companies listed in the JSE. Chapter 3 presented the conceptual review and the empirical review of literature. The conceptual review included among others, the SDG goals, the Kyoto protocol, the Paris agreement, and the King IV Code. The empirical review comprised the African literature review and the international

literature review. Different scholars have revealed different direction of relationships between individual eco-efficiency variables and financial performance variables. The main conceptual research framework was also presented and discussed in chapter 3.

Chapter 4 described the overall research methodology. The adoption of a quantitative method necessitated the positivist paradigm. In this study, the correlational research design was utilised to establish the link between eco-efficiency variables and financial performance variables. The target population was all food and beverage manufacturing companies listed in the JSE. There were about sixteen (16) food and beverage manufacturing companies listed in the JSE at the time of this study. However, only 14 companies had complete year to year data needed for this study. A description of the tests to be conducted was provided in chapter 4.

Chapter 5 presented the analysis of data and results of the study. The first level of analysis was conducted, where secondary data were analysed using panel data utilising the MLRA. The second level of analysis was also conducted where quantitative primary data obtained from the chief financial officers and environmental officers through survey questionnaires were analysed using OLS. This study deemed both MLRA and OLS suitable for measuring the relationship between the dependent and independent variables. For secondary data analysis, different tests were run, and results were discussed, revealing different directions of relationships between eco-efficiency variables and financial performance variables. Among tests run were the descriptive statistics, correlation matrix, unit root and the cointegration tests. In addition, the Hausman tests were conducted to decide on the preferred model. Due to the drawbacks that the preferred model possessed, an extended analysis was conducted using the GMM. For primary data analysis, the descriptive statistics of respondents were presented and discussed. This second level of analysis was conducted as a follow-up to the first level of analysis, where quantitative primary data were analysed using OLS regression. The next section presents the conclusion.

## 6.8. CONCLUSION

This study examined the relationship between eco-efficiency and financial performance of selected JSE listed food and beverage manufacturing companies. Data were collected from the annual integrated reports of a sample of companies for the period 2012 to 2021. The secondary data analysis and the primary data analysis in this study established that some of the eco-efficiency variables had a positive yet insignificant effect on financial performance. The other variables which revealed negative and insignificant results could have been because the 10 years' time frame covered in this study might have been the period of investment in the eco-efficiency practices by the sampled companies. Those investments might have resulted in huge outflow of cash, that might have led to a negative effect on company profits, that might be recovered in the long run.

This research contributes to literature and knowledge on food and beverage manufacturing companies' eco-efficiency practices in the following ways: 1. By recommending further research on a broader industrial study. 2. By suggesting a further investigation on how the four eco-efficiency variables combined can affect other corporate success indicators. 3. By suggesting an extension of the panel years to a period beyond 10 years. 4. By suggesting that future research extend the survey to the executive members and the company managers and that other analysis methods be used as an extension to the analysis used in this study. This study contributes to filling a significant gap in the current understanding of eco-efficiency practices in the South African context. Prior research in South Africa has not examined the financial implications of combined eco-efficiency variables and has not proposed a framework for addressing these issues.

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**APPENDIX A: PERMISSION LETTER**

**PERMISSION LETTER REQUESTING TO CONDUCT A RESEARCH**

University of Limpopo  
Private Bag x1106  
Sovenga  
0727  
23 March 2022

The Manager  
P O BOX ...  
.....  
.....

Dear Sir/Madam

**Request for permission to conduct research**

I am a PHD student in the school of Accountancy at the University of Limpopo. My degree is research based and as such, it is compulsory that I conduct research on the sampled companies. The proposed topic for my research is “A framework for eco-efficiency and financial performance in food and beverage companies listed in the Johannesburg stock exchange”. The proposed study is aimed at examining the effect that the reduction in energy usage, water usage, carbon emissions and waste generated has on the financial performance of the sampled companies. I am requesting for the participation of your company’s CFO and environmental officer for the completion of the questionnaires.

I assure you that I will exercise academic confidentiality by not sharing data collected with anyone. In addition, data will be kept anonymous to protect all participants from being identified and harmed. This research will not in any way interfere with the daily operations of your business since survey questionnaires will be completed online during your spare time.

I have attached copies of my research proposal, ethical clearance letter obtained from our institution’s Research and Ethical clearance department and the consent form.

Hoping for positive feedback.  
Yours Faithfully  
Malapa Dimakatso Hellen

**APPENDIX B: CONSENT FORM**

I Dimakatso Hellen Malapa, a PHD candidate in the school of Accountancy at the University of Limpopo, am required to conduct research, as my thesis is research-based. The proposed title for my research is “A framework for eco-efficiency and financial performance in food and beverage companies listed in the Johannesburg stock exchange”. Your company is hereby invited to take part in this research activity. Data collection will be kept anonymous and as such, do not include your name anywhere on the form. Questions asked in the questionnaire will not in any way put your identity in damage. There are no risks involved in this research; however, the researcher will make sure that participants are protected from any harm by exercising anonymity.

Kindly note that your participation in this project is out of own freewill and there is no compensation attached. There will be no penalty or loss of benefit, should a participant no longer wish to continue taking part. Both the researcher and the participants should exercise confidentiality throughout the process of the research project.

Should you seek any clarity regarding this research project, feel free to contact me at:

Email address: deedee81@webmail.co.za

Telephone number: 015 268 3915

Cellphone number: [REDACTED]

.....

Signature of participant

.....

Date

## **APPENDIX C: RESEARCH QUESTIONNAIRE**

**The title:** “A framework for eco-efficiency and financial performance in food and beverage companies listed in the Johannesburg stock exchange”

### **Instructions**

This survey questionnaire is intended to collect data from your company regarding eco-efficiency variables and their effect on your company' financial performance. Data collection through this survey questionnaire will assist the researcher in determining whether eco-efficiency practices in your company improves financial performance or not. Additionally, the collected data will enable the researcher to identify areas where improvement is needed. Anonymity and confidentiality shall be exercised and as such, you need to give a true reflection of how eco-efficiency variables affect your company's financial performance.

### **The organisation of the survey questionnaire**

This survey questionnaire comprises five sections: Sections A to E. Section A requires information relating to your demography while Section B to E use a scale of 1 – 4 to gather information about eco-efficiency variables and financial performance variables. Please read the statements carefully in order to choose the correct and reliable answer.

- # Read the statements carefully before choosing the answer.
- # Be honest and transparent.
- # Address all the sections.
- # Use ticks (√) to select your answer.

**SECTION A: Demography of the respondent**

This section requires information regarding your demography.

**1. Age**

20-29 years		30-39 years		40-49 years		50-59 years		60-65 years	
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**2. Gender**

Male		Female		Transgender		Other	
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**3. Highest level of education**

Matric		Degree		Degree+	
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**4. Educational Background**

Finance		Auditing		Environmental management		Other	
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**SECTION B: Eco-efficiency and return on asset (ROA)**

**KEY:**

**1 = Low**

**2 = Average**

**3 = High**

**4 = Very High**

		1	2	3	4
5.	Energy reduction assists in my company's return on asset growth.				
6.	Water reduction assists in my company's return on asset growth.				
7.	Carbon reduction assists in my company's return on asset growth.				
8.	Waste reduction assists in my company's return on asset growth.				

**In addition to the eco-efficiency variables above, how will the following variable affect your company's ROA growth?**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
9.	Sales revenue assists in my company's return on asset growth.				

**SECTION C: Eco-efficiency and share price (SP)**

**KEY:**

**1 = Low**

**2 = Average**

**3 = High**

**4 = Very High**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
10.	Energy reduction helps in improving my company's Share Price				
11.	Water reduction helps to improve my company's share price.				
12.	Carbon reduction assists in improving my company's share price.				
13.	Waste reduction assists in improving my company's share price.				

**In addition to the eco-efficiency variables above, how will the following variable affect your company's share price?**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
14.	Sales revenue helps in improving my company's share price.				

**SECTION D: Eco-efficiency and net profit (NP)**

**KEY:**

**1 = Low**

**2 = Average**

**3 = High**

**4 = Very High**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
15.	Energy reduction helps in improving my company's net profit.				
16.	Water reduction helps in improving my company's net profit.				
17.	Carbon reduction assists in improving my company's net profit.				
18.	Waste reduction assists in improving my company's net profit.				

**In addition to the eco-efficiency variables above, how will the following variable affect your company's net profit?**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
20.	Sales revenue assists in improving my company's net profit.				

**SECTION E: Eco-efficiency and return on capital (ROC)**

**KEY:**

- 1 = Low**
- 2 = Average**
- 3 = High**
- 4 = Very High**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
21.	Energy reduction assists in improving my company's return on capital growth.				
22.	Water reduction assists in improving my company's return on capital growth.				
23.	Carbon reduction assists in improving my company's return on capital growth.				
24.	Waste reduction assists in improving my company's return on capital growth.				

**In addition to the eco-efficiency variables above, how will the following variables affect your company's ROC growth?**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
25.	Sales revenue assists in improving my company's return on capital growth.				

## APPENDIX D: SECONDARY DATA COLLECTED

### RESEARCH DATA ON DEPENDENT VARIABLES

Table 6.1: Dependent variables representing financial performance

Firm code	Period	Dependent Variable (Objective 1)	Dependent Variable Objective 2)	Dependent Variable Objective 3)	Dependent Variable Objective 4)
CO code	Years	ROA (%)	SP "000"	NP "000"	ROC (%)
1	2012	32.83	29.61	70809983.1	32.69
1	2013	30.63	32.69	71878691.95	24.1
1	2014	29.28	34.27	58 642 067.25	33.8
1	2015	20.86	36.55	78137446.8	30.63
1	2016	19.78	38.67	83582595.3	19.8
1	2017	28.7	48.12	650497986	7.1
1	2018	6.3	24.25	107276197.5	7.3
1	2019	1.5	34.57	100209747.2	1.5
1	2020	6.5	32.91	112459699.2	6.5
1	2021	7,64	35.51	119498862.3	7.64
2	2012	9.8	90	970860	15.3
2	2013	7.7	121.9	1096509	14.8
2	2014	9.6	140	1524265	17.6
2	2015	8.1	167	1419 661	15
2	2016	7.7	161.8	1531891	15.1
2	2017	6.3	137	1296803	14.3
2	2018	7.4	138.5	1668051	12.3
2	2019	3.74	129.7	909846	13.5
2	2020	4	76.3	394620	5
2	2021	5.7	167	2002489	13.6
3	2012	26.74	256.53	232315000	31
3	2013	25.73	100	228135000	30
3	2014	29.75	100	266818000	44
3	2015	16.54	100	286515000	32
3	2016	25.87	118.28	408276000	22
3	2017	17.9	85.4	479350000	12
3	2018	15	85.55	882241000	21
3	2019	14	71.84	648368000	13
3	2020	14	54.38	816151000	13

Firm code	Period	Dependent Variable (Objective 1)	Dependent Variable Objective 2)	Dependent Variable Objective 3)	Dependent Variable Objective 4)
CO code	Years	ROA (%)	SP "000"	NP "000"	ROC (%)
3	2021	13	80.62	718500000	11
4	2012	8.49	15.29	266767	0.5
4	2013	1.43	15.82	-8183	9.3
4	2014	0.34	17.08	-306737	8.1
4	2015	10.36	17.48	861957	9.5
4	2016	2.46	15.17	182641	1.8
4	2017	5.31	15.6	476307	4.8
4	2018	4.19	18.08	878377	8.1
4	2019	-0.9	16.47	-183962	-0.8
4	2020	-4.26	17.32	-959038	-4.8
4	2021	4.44	17.32	995757	8.5
5	2012	25.14	246.88	2748000	24.1
5	2013	15.51	389.5	2397000	19.4
5	2014	12.3	244.4	1864000	22.7
5	2015	9.43	367.9	3110000	24.8
5	2016	18.6	316.8	3138000	23.4
5	2017	35.3	414.45	2431300	20.3
5	2018	26.6	331.12	3943300	18.6
5	2019	26.1	302.1	4361000	67.2
5	2020	21.1	200.1	1493100	11.2
5	2021	19.3	100.31	1801800	23.2
6	2012	10.76	95.46	1021000000	14
6	2013	10.13	130.03	1079000000	13.3
6	2014	10.07	121.32	1155000000	12.9
6	2015	8	150.9	1047000000	10.3
6	2016	5.99	112.38	1415000000	8
6	2017	3.94	122.68	1265000000	9.4
6	2018	-6.12	114.17	1212000000	2.56
6	2019	-6.31	67.55	913000000	3.61
6	2020	0.72	12.9	583000000	5.66
6	2021	15.4	7.8	510000000	18.05
7	2012	13.8	32.43	333000000	21.4
7	2013	7	58.61	211000000	10.9
7	2014	11.9	57.36	341000000	10.7
7	2015	24.1	65.44	780000000	12.7

Firm code	Period	Dependent Variable (Objective 1)	Dependent Variable Objective 2)	Dependent Variable Objective 3)	Dependent Variable Objective 4)
CO code	Years	ROA (%)	SP "000"	NP "000"	ROC (%)
7	2016	11.3	81.62	372000000	19.5
7	2017	21	95	761000000	4.5
7	2018	33.8	108.2	1431000000	18.8
7	2019	14.2	91.36	648000000	20.4
7	2020	12.4	70.54	561000000	12.6
7	2021	9.7	71.05	474000000	19.8
8	2012	10.45	46.75	478361232	24.32
8	2013	4.43	29.25	(849409488)	-8.01
8	2014	11.82	32	(1686086928)	-17.16
8	2015	15.67	39.25	618413760	4
8	2016	18.35	18.08	52108000	10.5
8	2017	9.04	16.47	68100000	9.1
8	2018	8.5	17.32	95341000	8.9
8	2019	7.1	18.23	72993000	8.2
8	2020	0.62	15.29	6386000	6.9
8	2021	0.33	15.82	3350000	7
9	2012	7.61	86.87	83300405.10	5.61
9	2013	-0.36	103.06	60917026.20	-3.5
9	2014	0.34	113.29	210288402.60	6.6
9	2015	28.62	125.29	183588362.10	8.7
9	2016	18.02	103.77	51520844.70	2.2
9	2017	31.13	95.13	170861652.90	6.13
9	2018	2.45	57.7	105888453.30	3.45
9	2019	4.4	72.71	170638377.30	8.9
9	2020	0.97	57.01	26136653.00	1.34
9	2021	2.81	53.14	86874142.00	5.62
10	2012	3.2	7.99	(23389990.00)	-5.43
10	2013	-13.38	5.78	(286832000.00)	-13.38
10	2014	-1.38	6.8	(847000.00)	-1.38
10	2015	0.06	6.78	126916000.00	2,5
10	2016	5.52	6.8	91354000.00	5.04
10	2017	9	6.98	127617000.00	0.37
10	2018	15.19	6.99	362227000.00	1.42
10	2019	7.62	7.32	189195000.00	3.42
10	2020	6	7.32	154899000.00	4.3

Firm code	Period	Dependent Variable (Objective 1)	Dependent Variable Objective 2)	Dependent Variable Objective 3)	Dependent Variable Objective 4)
CO code	Years	ROA (%)	SP "000"	NP "000"	ROC (%)
10	2021	3.9	7.32	105795000.00	2.86
11	2012	28.42	32.43	972500.00	29.4
11	2013	28.06	58.61	1085800.00	27.4
11	2014	31.07	57.86	1315700.00	27.6
11	2015	27.71	65.44	1332300.00	28.3
11	2016	27.14	81.62	1481200.00	27.9
11	2017	27.79	88.59	1553200.00	28
11	2018	17.68	97.55	1675800.00	28.7
11	2019	16.21	91.36	1604500.00	26.9
11	2020	54.74	70.54	1947300.00	24.8
11	2021	62.25	71.05	1645700.00	27.6
12	2012	9.6	16.05	36776000.00	23.89
12	2013	9.23	14.8	38187000.00	22.78
12	2014	8.2	13.5	82467000.00	26.8
12	2015	8.2	15.5	169778000.00	21
12	2016	10.4	14.98	29351000.00	24.3
12	2017	6.5	15.3	234791000.00	14.5
12	2018	3.6	16.11	154328000.00	9.1
12	2019	4.6	16.7	216256000.00	10.9
12	2020	4.6	17.65	216149000.00	10.6
12	2021	4.3	12.24	216477000.00	9.8
13	2012	2.65	12.92	223013000.00	22
13	2013	1.27	8.65	279627000.00	20
13	2014	7.2	6.2	73531000.00	12.3
13	2015	7.5	5.8	302720000.00	12.5
13	2016	9.07	56.4	131514000.00	19.6
13	2017	9.21	108	266945000.00	18.3
13	2018	6.04	13.75	293133000.00	21
13	2019	9.75	14.55	395513000.00	17
13	2020	7.05	14.26	397848000.00	17
13	2021	6.89	13.8	434185000.00	18
14	2012	14.09	40.5	82184000.00	17.4
14	2013	10.43	41.6	202697000.00	18.3
14	2014	9.57	39.1	43136000.00	32
14	2015	5.52	46.6	61763000.00	5.6

Firm code	Period	Dependent Variable (Objective 1)	Dependent Variable Objective 2)	Dependent Variable Objective 3)	Dependent Variable Objective 4)
CO code	Years	ROA (%)	SP "000"	NP "000"	ROC (%)
14	2016	6.58	45.1	50053000.00	6.6
14	2017	8.53	37.4	96206000.00	8.5
14	2018	3	34.3	(3237000.00)	-0.3
14	2019	1.6	41.9	40685000.00	3.9
14	2020	2.8	30.3	23688000.00	2.2
14	2021	5.1	40.5	42807000.00	4

Table 6.2: Independent variables representing eco-efficiency and the control variable

Firm code	Period	ECO-EFFICIENCY VARIABLES				CONTROL Variable
CO code	Years	Energy consumption (kw)	Water consumption (kl)	Carbon emission (tonnes)	Waste generated (kg)	Sales revenue "000"
1	2012	2863888889	3770000	810000	10886217	261077365.5
1	2013	2825000000	3650000	958467	107954984	261221443
1	2014	2850000000	3690000	925127	6713167076	241464285.8
1	2015	29861111111	3560000	876339	6531730128	226374220.8
1	2016	2755555556	3430000	862163	6531730128	254789597.7
1	2017	427000000	5190000	864000	9434721296	338111504.1
1	2018	415000000	4770000	841000	8346099608	423278826.4
1	2019	2874000000	451000	782000	12655227	443400066.1
1	2020	2568000000	403000	541000	11548462	441018338.4
1	2021	2480000000	376000	495000	10822714	439444250.6
2	2012	7105686	40035	544500	2214619.39	14176047
2	2013	755400	7520000	160531	2464276.63	15,858,158
2	2014	81097201	3967152	151709	2634645.92	17739609
2	2015	79221288	3690863	157382	2890218.007	19588970
2	2016	78884711	4166000	158218	3072598.427	21470120.00
2	2017	807929635	3600038	161713	2546921.16	21940043
2	2018	801102075	3500000	157718	1977753.45	24230765
2	2019	838770695	1 282 360	157710	1870615	26179600
2	2020	75964544	1 007 645	136888	1611160	22370200
2	2021	62397131	1 069 135	134371	1798947	28254500
3	2012	64332153	2 367 249	228648.76	3645975.5	4647951

Firm code	Period	ECO-EFFICIENCY VARIABLES				CONTROL Variable
CO code	Years	Energy consumption (kw)	Water consumption (kl)	Carbon emission (tonnes)	Waste generated (kg)	Sales revenue "000"
3	2013	64957713	934 186	239265.23	411862	4701224
3	2014	70741071	876 398	244090	2863982.2	5039134
3	2015	74220507	909 538.016	265319.01	78917814.9	6168777
3	2016	86510083	818 188	310132	9193297664	8 243 988
3	2017	75862798	414 094	307833	10 133 876	6 807 927
3	2018	77972536	209 578	374135.14	11 546 976	7 657 311
3	2019	72156646	262 578	377034	9 173 288	7 647 415
3	2020	505688889	370 507	217817	11 446 263	8 308 341
3	2021	624589444	307 289	183667	5483024.6	7 633 416
4	2012	25789000	0.008225	505923	393924	7 855 142
4	2013	47860000	0.009221	541119	404212	10 108 812
4	2014	571500000	0.00856	1002215	394625	19 500 842
4	2015	538600000	0.008576	1150473	696718	23 428 206
4	2016	533000000	0.008211	1138690	419119	25 025 159
4	2017	513000000	0.006527	1085549	504395	24 950 655
4	2018	526000000	0.132399	1003749	701607606	24 527 961
4	2019	686000000	0.141424	1052494	726860000	25 887 506
4	2020	696000000	0.129205	1057790	725402155	27 803 611
4	2021	658600000	0.119145	1056388	758182368	31 687 850
5	2012	302112021	4355851	500405	14542251.24	22 771 000
5	2013	325401211	3855412	488700.63	13 157 121.26	27 061 000
5	2014	31112151	3844120	547611	15422141	30 126 000
5	2015	325523087	5 155 728	587047.84	14842413.26	28 690 000
5	2016	316659244	5 115 464	588382.18	12698554.28	31 738 000
5	2017	307118755.7	5079115.08	574994.16	12 171 271.66	28 364 700
5	2018	315383445.6	3971724.26	547003.94	48328840.26	29 232 700
5	2019	29348870	23222256	543777	5.663369318	28 578 900
5	2020	23343334	3 791 666	630775	5.663369318	29 796 100
5	2021	8767778	3 271 342	441182	25.48516193	30 953 900
6	2012	112039000	102581670	96400.66922	273969.8	12 081 000 000
6	2013	244053000	613047000	209988.2409	2797757.74	14 373 000 000
6	2014	10095000	514232000	8685.946463	3954418.28	15 716 000 000
6	2015	124063000	634488000	106746.3671	4374444.8	16 155 000 000
6	2016	19009000	704399000	1635573.99	692182	16 676 000 000
6	2017	239493000	720872000	206064.7228	374667	17 915 000 000

Firm code	Period	ECO-EFFICIENCY VARIABLES				CONTROL Variable
CO code	Years	Energy consumption (kw)	Water consumption (kl)	Carbon emission (tonnes)	Waste generated (kg)	Sales revenue "000"
6	2018	911981000	1057922000	751515	488973	16 982 000 000
6	2019	675396000	955235000	718387	271248	17 505 000 000
6	2020	853420000	1071000000	267917	217724	17 069 000 000
6	2021	606407000	834000000	259586	166922	14 918 000 000
7	2012	293031	1 005 504	83321.93958	17789824.9	8 160 000
7	2013	282364	4 844 802	80288.83001	12721451.6	8 509 000
7	2014	280560	5 618 391	79775.87138	16783824.9	9 602 000
7	2015	21728000	6 168 843	6178251.117	17013342.6	11 266 000
7	2016	318261944.4	1 585 554	90496235.89	18279773	11 954 000
7	2017	305826111.1	5 644 400	86960167.18	11991167.9	12 417 000
7	2018	310916944.4	5 541 502	88407720.87	6022799.5	12 979 000
7	2019	319643055.6	5 733 165	90888948.15	6888253.7	13 485 000
7	2020	317325000	5 759 399	90229820.31	6690487.5	13 932 000
7	2021	318176388.9	6 102 502	90471908.6	5800539.2	15 866 000
8	2012	2356000	245676	332444	455676	31942889.57
8	2013	784000.00	1385000	224110	1065000	15573113568
8	2014	2700000	667000	76327	366503	17539305552
8	2015	2540000	658000	72374	2721.55	14036173488
8	2016	1962933	704000	79611	2533.801	401692000
8	2017	1953631	724000	75383	1234000	410773000
8	2018	2120871	787453	75950	1654000	490870000
8	2019	2229000	662575	66099.26	1625000	575006000
8	2020	6497000	669438	62738.4	1639000	453894000
8	2021	7497000	45913	13 614	1732000	575115000
9	2012	240887.12	400000	505923	1352103	403198521
9	2013	226578	370000	541119	13600223	431908041.9
9	2014	571500	85600	1002215	1452403	875668296.9
9	2015	538600	85600	1150473	1539493	811309105.2
9	2016	200763	320000	1138690	1420912	846902957.1
9	2017	32388888889	309000	323500	3700000	1050213997
9	2018	30583333333	295000	312100	410004	1016257500
9	2019	29055555556	28000	310800	420093	973649072.7
9	2020	27694444444	27000	283700	432000	859086670.6
9	2021	27138888889	266000	300994	430008	1010195590
10	2012	32334555	1212005	33212	765666	2324543

Firm code	Period	ECO-EFFICIENCY VARIABLES				CONTROL Variable
CO code	Years	Energy consumption (kw)	Water consumption (kl)	Carbon emission (tonnes)	Waste generated (kg)	Sales revenue "000"
10	2013	43444660	1121000	23221	656765	3483351
10	2014	32000560	1251000	23433	654323	3560943
10	2015	52057000	1222051	44790.92	1001532	3468312
10	2016	46614000	1042082	1091	902649	3913078
10	2017	42975000	1109368	2058	1837956.3	4051890
10	2018	42415000	1337449	2986	647730	4121901
10	2019	44450000	1413077	2520	674038	4417674
10	2020	49170000	1435349	3082	747520	5095000
10	2021	46813000	1473424	67406	860918	5401000
11	2012	102942232	876674227	230 203.39	765876	8287100
11	2013	104363238	981630.869	238714.33	876456	9218300
11	2014	106484439	1043354 .478	216928.25	987345	10267400
11	2015	99915717	1063057 .427	207924.57	876543	11243700
11	2016	107211709	1094362 .412	255260.03	234567	12188900
11	2017	102473146	927850 .679	244005.43	765489	13184600
11	2018	99633276	717199 .757	235244.26	987654	13437500
11	2019	105411043	530332 .908	243353.96	345643	13150900
11	2020	102393633	500806.371	238557.8	243876	13209700
11	2021	101639745	589855.793	239765.94	24722	13269200
12	2012	2134567	54734569	656777	11234	1876590
12	2013	2348970	54678900	654765	7687	1859089
12	2014	2343543	54654666	765666	12398	2444225
12	2015	2455598	43567888	766888	13267	3022604
12	2016	2345432	45666788	771876	16545	4145902
12	2017	2 543 817	59111343	777 132	15467	4593317
12	2018	2 483 917	69168588	758 243	10098	5109342
12	2019	2 365 635	76093056	771 123	9 185	5413625
12	2020	2296206111	2323807	779296	15 325	5864452
12	2021	2614317222	2148248	851998	20 169	5950023
13	2012	19700000	387000	67567	546756	12700000000
13	2013	20007098	392000	56765	539000	12300000000
13	2014	18765000	400980	76890	546795	13500000000
13	2015	17659000	511000	65487	456545	13600000000
13	2016	24356000	439000	78675	498567	1931979000
13	2017	27300000	355000	80 756	479876	2131054000

<b>Firm code</b>	<b>Period</b>	<b>ECO-EFFICIENCY VARIABLES</b>				<b>CONTROL Variable</b>
<b>CO code</b>	<b>Years</b>	<b>Energy consumption (kw)</b>	<b>Water consumption (kl)</b>	<b>Carbon emission (tonnes)</b>	<b>Waste generated (kg)</b>	<b>Sales revenue "000"</b>
13	2018	31200000	460000	989900	499870	2583341000
13	2019	34300000	508000	106 719	508980	3966452000
13	2020	489361702	492000	89 170	513980	4375339000
13	2021	51700000	392000	121 464	611564	4615463000
14	2012	21365789	1120000	2111342	1887656	342514000
14	2013	20098765	1200000	2009876	1987700	362348000
14	2014	20065478	1154600	1988876	18765666	439019000
14	2015	20078767	1176500	1876547	19987680	526087000
14	2016	19876567	1010900	1765478	21090000	542087000
14	2017	16545679	1009000	1654678	19786780	542712000
14	2018	13454345	1003000	1546578	20987000	526721000
14	2019	12678760	900900	1453456	21398760	665693000
14	2020	11232456	809009	1356749	21329800	703677000
14	2021	10023456	765000	1234980	22232456	635583000

## APPENDIX E: VAR RESIDUAL HETEROSCEDASTIDITY TESTS

### ROA model

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 12/23/23 Time: 07:56

Sample: 2012 2021

Included observations: 100

Joint test:

Chi-sq	df	Prob.
437.3344	300	0.0000

Individual components:

Dependent	R-squared	F(20,79)	Prob.	Chi-sq(20)	Prob.
res1*res1	0.088986	0.385828	0.9906	8.898592	0.9841
res2*res2	0.268442	1.449439	0.1250	26.84425	0.1397
res3*res3	0.152067	0.708388	0.8062	15.20672	0.7645
res4*res4	0.428156	2.957473	0.0003	42.81556	0.0022
res5*res5	0.207920	1.036869	0.4315	20.79199	0.4095
res2*res1	0.281414	1.546906	0.0890	28.14139	0.1061
res3*res1	0.427894	2.954316	0.0003	42.78941	0.0022
res3*res2	0.267638	1.443509	0.1276	26.76382	0.1420
res4*res1	0.354796	2.172096	0.0081	35.47961	0.0177
res4*res2	0.424441	2.912899	0.0004	42.44414	0.0024
res4*res3	0.523682	4.342776	0.0000	52.36818	0.0001
res5*res1	0.453359	3.275945	0.0001	45.33587	0.0010
res5*res2	0.152302	0.709680	0.8049	15.23022	0.7631
res5*res3	0.241023	1.254377	0.2355	24.10234	0.2380
res5*res4	0.254120	1.345761	0.1766	25.41204	0.1861

## SP Model

VAR Residual Heteroskedasticity Tests: Includes Cross Terms

Date: 12/23/23 Time: 08:05

Sample: 2012 2021

Included observations: 101

Joint test:

Chi-sq	df	Prob.
1955.882	1806	0.0074

Individual components:

Dependent	R-squared	F(86,14)	Prob.	Chi-sq(86)	Prob.
res1*res1	0.922633	1.941348	0.0817	93.18594	0.2796
res2*res2	0.932439	2.246729	0.0454	94.17629	0.2562
res3*res3	0.946146	2.860007	0.0154	95.56071	0.2254
res4*res4	0.843500	0.877407	0.6634	85.19353	0.5043
res5*res5	0.999874	1290.419	0.0000	100.9873	0.1287
res6*res6	0.980173	8.047906	0.0000	98.99751	0.1598
res2*res1	0.899304	1.453860	0.2197	90.82968	0.3401
res3*res1	0.928591	2.116891	0.0581	93.78765	0.2652
res3*res2	0.934151	2.309392	0.0405	94.34925	0.2522
res4*res1	0.946397	2.874186	0.0151	95.58611	0.2249
res4*res2	0.952642	3.274667	0.0080	96.21686	0.2117
res4*res3	0.949880	3.085257	0.0107	95.93793	0.2175
res5*res1	0.984582	10.39549	0.0000	99.44275	0.1524
res5*res2	0.982305	9.036850	0.0000	99.21277	0.1562
res5*res3	0.935587	2.364524	0.0366	94.49434	0.2489
res5*res4	0.998969	157.7004	0.0000	100.8958	0.1300
res6*res1	0.891788	1.341577	0.2767	90.07058	0.3608
res6*res2	0.883690	1.236837	0.3422	89.25269	0.3837
res6*res3	0.856920	0.974970	0.5636	86.54893	0.4631
res6*res4	0.969571	5.187081	0.0007	97.92668	0.1786
res6*res5	0.996102	41.59544	0.0000	100.6063	0.1343

## NP model

VAR Residual Heteroskedasticity Tests: Includes Cross Terms

Date: 12/23/23 Time: 08:06

Sample: 2012 2021

Included observations: 101

Joint test:

Chi-sq	df	Prob.
1973.396	1785	0.0011

Individual components:

Dependent	R-squared	F(85,15)	Prob.	Chi-sq(85)	Prob.
res1*res1	0.867608	1.156466	0.3953	87.62837	0.4011
res2*res2	0.881927	1.318124	0.2818	89.07467	0.3599
res3*res3	0.946456	3.119359	0.0081	95.59210	0.2028
res4*res4	0.971921	6.108219	0.0002	98.16398	0.1557
res5*res5	0.999753	712.9432	0.0000	100.9750	0.1138
res6*res6	0.990128	17.69855	0.0000	100.0029	0.1272
res2*res1	0.759035	0.555878	0.9521	76.66250	0.7291
res3*res1	0.966012	5.015649	0.0006	97.56720	0.1659
res3*res2	0.942904	2.914322	0.0115	95.23335	0.2101
res4*res1	0.934888	2.533794	0.0229	94.42369	0.2271
res4*res2	0.918894	1.999333	0.0657	92.80830	0.2636
res4*res3	0.955541	3.792809	0.0028	96.50963	0.1850
res5*res1	0.988059	14.60182	0.0000	99.79394	0.1302
res5*res2	0.977055	7.514557	0.0000	98.68256	0.1472
res5*res3	0.939685	2.749346	0.0154	94.90819	0.2168
res5*res4	0.999535	379.6151	0.0000	100.9531	0.1141
res6*res1	0.993173	25.67112	0.0000	100.3104	0.1229
res6*res2	0.921529	2.072393	0.0566	93.07443	0.2574
res6*res3	0.917736	1.968703	0.0700	92.69134	0.2664
res6*res4	0.975001	6.882728	0.0001	98.47513	0.1506
res6*res5	0.998424	111.8119	0.0000	100.8408	0.1156

ROC model

VAR Residual Heteroskedasticity Tests: Includes Cross Terms

Date: 12/23/23 Time: 08:09

Sample: 2012 2021

Included observations: 98

Joint test:

Chi-sq	df	Prob.
1951.826	1806	0.0088

Individual components:

Dependent	R-squared	F(86,11)	Prob.	Chi-sq(86)	Prob.
res1*res1	0.947668	2.316248	0.0623	92.87149	0.2874
res2*res2	0.948819	2.371190	0.0574	92.98423	0.2846
res3*res3	0.935054	1.841534	0.1315	91.63531	0.3187
res4*res4	0.915618	1.387894	0.2841	89.73052	0.3703
res5*res5	0.999918	1552.673	0.0000	97.99193	0.1774
res6*res6	0.974276	4.844324	0.0032	95.47902	0.2272
res2*res1	0.930493	1.712295	0.1630	91.18831	0.3305
res3*res1	0.966464	3.686062	0.0104	94.71343	0.2440
res3*res2	0.966913	3.737855	0.0099	94.75746	0.2430
res4*res1	0.965752	3.606861	0.0114	94.64373	0.2455
res4*res2	0.956448	2.808995	0.0309	93.73194	0.2666
res4*res3	0.984993	8.395036	0.0002	96.52928	0.2054
res5*res1	0.992499	16.92342	0.0000	97.26487	0.1910
res5*res2	0.985152	8.486802	0.0002	96.54494	0.2051
res5*res3	0.963633	3.389249	0.0148	94.43607	0.2502
res5*res4	0.992362	16.61754	0.0000	97.25145	0.1912
res6*res1	0.963881	3.413342	0.0143	94.46032	0.2497
res6*res2	0.960605	3.118874	0.0206	94.13929	0.2570
res6*res3	0.904210	1.207373	0.3877	88.61254	0.4021
res6*res4	0.994668	23.86171	0.0000	97.47749	0.1869
res6*res5	0.997284	46.97180	0.0000	97.73386	0.1821



**SCHOOL OF ACCOUNTANCY**  
Private Bag X1106, SOVENGA, 0727, South Africa  
Telephone: (015) 268 3147; Email: [gibson.nyirenda@ul.ac.za](mailto:gibson.nyirenda@ul.ac.za)

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**To:** Ms DH Malapa ( [REDACTED] )  
Degree Registered: DCoM (Accounting)

**From:** Mr G. Nyirenda  
Chairperson: School Research & Higher Degrees Committee  
School of Accountancy (SOA)

**Date:** 12 May 2022

**Subject:** Oral Defence OF DCoM Proposal & Defence Acceptance  
Student: DH Malapa ( [REDACTED] ) DCoM Accounting

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Dear Ms DH Malapa ( [REDACTED] )

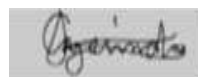
This confirms that you presented an oral defence of your DCoM proposal during the School of Accountancy Research and Higher Degrees Committee meeting held for this purpose on **Wednesday 04 May 2022 at 08:30-10:00am**.

The committee was convinced that you demonstrated research ownership and the possession of skill to conduct doctoral research in accounting. In addition, the committee noted you demonstrated that your research has the potential to make a new contribution to knowledge.

Therefore, the committee was satisfied and accepted your oral defence.

The committee's comments for your proposal document have been sent to you in a separate email.

Kind regards,



---

**Mr Gibson. Nyirenda**  
Chairperson: School Research & Higher Degrees Committee  
School of Accountancy

Cc:  
: Director SOA  
: PAO Accountancy  
: Supervisor  
: Faculty Research Professor

## APPENDIX G: SRHDC APPROVAL



### SCHOOL OF ACCOUNTANCY

Private Bag X1106, SOVENGA, 0727, South Africa

TELEPHONE: (015) 268 3147, EMAIL: [gibson.nyirenda@ul.ac.za](mailto:gibson.nyirenda@ul.ac.za)

---

To: Ms DH Malapa [REDACTED]  
Degree Registered: DCoM (Accounting)

From: Mr G. Nyirenda  
Chairperson: School Research & Higher Degrees Committee  
School of Accountancy (SOA)

Date: 10 May 2022

Subject: DCOM Proposal Defence & Approval by Soa School Research & Higher  
Degrees Committee:

Student: DH MALAPA [REDACTED] DCOM Accounting

Dear Ms DH Malapa [REDACTED]

Your DCoM research proposal titled “**A Framework for Eco-efficiency and Financial Performance in Food and Beverage Companies Listed in the Johannesburg Stock Exchange**” served at the School of Accountancy (SOA) Research and Higher Degrees Committee meeting, which sat on 04 May 2022 for the purposes of your oral defence and committee assessment of your proposal.

**Committee Decision:**

**Oral Defence:**

The committee accepted your oral defence of your DCoM proposal

## Proposal Approval:

Proposal is approved for submission to the faculty after the suggested corrections are made to the satisfaction of the chairperson of SRHDC and the supervisor

## Committee Comments:

### Title

- The word “industry” in the title (remove industry from the title as the study will not study the entire industry)
- The framing “JSE companies” (it is preferred to say in listed JSE – so it does not appear JSE has companies) i.e.: “food and beverage companies listed in JSE”
- Include framework in the title to make it sound like a doctorate study

### The Model Section

- Reduce the number of control variables to avoid the danger of over fitting the model – that is the model may have very high R Squared with too many control variables.
- The four independent variables could be enough (with one or two control variables)
- Include the running of the unit root test
- Include beta1, beta2, beta3, beta4 – correct all the numbers (t & i) for the coefficients, the error term must also have a t – to represent the panel – check also capital letters
- In the model section, indicate how you chose the variables of eco-efficiency included in the model
- Indicate how your theories link to your hypothesis and your model

### Problem Statement:

- Reduce the size of the problem statement to focus on the problem and make it clearer – the problem statement in the slide presentation is more straightforward and clearer
- In the problem, when you say, you have reviewed many studies (cite some of these many studies as an example)

### Significance & Contribution of study

- Include a citation in the significance to justify the claim
- Include the contribution of the study – what is new (the new framework to be developed)

### No of Years for Panel data

- Check if the research indicates the number of years to be covered in the panel data analysis

### Mixed Method

- Clarify mixed method in the method section and include some open-ended questions in the questionnaire

### Data Collection

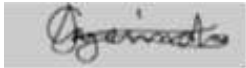
- you have indicated to use 16 food and beverage companies – indicate clearly in your proposal (the number of participants, which will be 32: (which is:  $16 \times 2 = 32$ ))

**Ethics Section:**

- In the ethics section – check the risks and benefits of the study and include how the study will contribute to social benefits

You are required to submit a revised copy of your proposal for submission to the faculty with a table detailing how you have attended to the SRHDC comments; also include language editor certificate and a Turnitin report.

Kind regards,



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**Mr Gibson. Nyirenda**  
**Chairperson: School Research & Higher Degrees Committee**  
**School of Accountancy**

Cc:  
: Director SOA  
: PAO Accountancy  
: Supervisor  
: Faculty Research Professor

## APPENDIX H: ETHICAL CERTIFICATE



**University of Limpopo**  
Department of Research Administration and Development  
Private Bag X1106, Sovenga, 0727, South Africa  
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

### TURFLOOP RESEARCH ETHICS COMMITTEE

### ETHICS CLEARANCE CERTIFICATE

**MEETING:** 22 August 2022

**PROJECT NUMBER:** TREC/348/2022: PG

**PROJECT:**

**Title:** A framework for eco-efficiency and financial performance in food and beverage companies listed in the Johannesburg Stock Exchange.  
**Researcher:** DH Malapa  
**Supervisor:** Prof CC Ngwakwe  
**Co-Supervisor/s:** N/A  
**School:** Accounting and Auditing  
**Degree:** Doctor of Commerce in Accounting

**PROF D MAPOSA**  
**CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE**

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

**Note:**

- i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.
- ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.
- iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

## APPENDIX I: EDITORIAL LETTER

# Anne Kruger Language Practice

† 19 Nooitverwacht, 105 Main Street, Paarl 7646

† tel 072 374 6272

† [annekruger25@gmail.com](mailto:annekruger25@gmail.com)

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To whom it may concern

### DECLARATION OF LANGUAGE EDITING

I, Elsje Anne Kruger, hereby declare that I have personally read through the dissertation of Dimakatso Malapa titled “A framework for eco-efficiency and financial performance in food and beverage companies listed in the Johannesburg stock exchange”. I have highlighted language errors and checked references. The track changes function was used and the author was responsible for accepting the editor’s changes. I did no structural rewriting of the content.

Yours sincerely

Date

30 September 2024



APPENDIX J: NEW EDITORIAL LETTER

**LEBOMA INVESTMENTS (PTY) LTD**

REGISTRATION NUMBER: 2018 / 299676 / 07

**TO WHOM IT MAY CONCERN**

This letter serves to confirm that I, **Prof T.W Molotja**, have proofread and edited the  
thesis for

**DIMAKATSO HELLEN MALAPA**

student number

██████████

entitled

**A FRAMEWORK FOR ECO-EFFICIENCY AND FINANCIAL PERFORMANCE IN  
FOOD AND BEVERAGE COMPANIES LISTED IN THE JOHANNESBURG STOCK  
EXCHANGE**

The report is edited focusing on the following:

- Coherent writing.
- Eliminating spelling errors.
- Fluency in reading.
- Academic writing.

I therefore recommend for its submission.

Yours Sincerely

Date: 17/12/2024

