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MANAGING ENVIRONMENTAL CHALLENGES USING ENVIRONMENTAL MANAGEMENT ACCOUNTING: A CASE OF FOOD MANUFACTURING COMPANIES IN GAUTENG PROVINCE OF SOUTH AFRICA

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Emmanuel Obinali OBIOHA[1], Jacob Karabo ZULU[2]
[1,2]Department of Finance and Investment, Faculty of Economics and Finance, Tshwane University of Technology Pretoria, Ga-Rankuwa Gauteng, South Africa
Corresponding author: Emmanuel Obinali Obioha
E-mail: emmanuelobioha910@gmail.com

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Abstract:
Substantial resources have been lost and human and societal wellbeing endangered due to the environmental challenges/impacts in the food and beverage manufacturing companies in Gauteng. The focus of this paper therefore, is to establish the potential environmental problems/impacts prevalent in food and beverage companies and to determine how environmental management accounting physical and monetary systems can address these problems. Quantitative techniques were utilized to collect numerical, non-numerical and unstructured data through analytical contacts and qualitative data was collected via annual reports, processes and policies in place in food and beverage companies of Gauteng listed in Johannesburg Stock Exchange and subscribing to Socially Responsibility Investment index and ISO 14000. Documents analysis, was used to validate the literature as well as the data from questionnaire. Data was analysed statistically by employing a computer package called Stata V15 software and summarised in the form of absolute and relative frequencies. Cronbach's alpha tested for internal validity/consistency and reliability. The findings revealed environmental challenges/impacts like input-output balance, pollution, waste and emission generations, recycling of material and environmental costs at Gauteng food manufacturing companies of South Africa. Managerial implication is that these challenges/impacts could be prevented/reduced via full/proper application of environmental management accounting's monetary and physical systems at source. The study thus, presents environmental management accounting to literature as a system/model for achieving strategic advantages, environmental and financial sustainability via capacity to monitor and manage the consumption and flow of energy, water, material and waste more accurately in food manufacturing companies or other industrial sectors in South Africa or the world.

Keywords: Environmental Challenges/Impacts, Environmental Management Accounting, Environmental and Financial Sustainability, Food and Beverage Manufacturing Companies

INTRODUCTION

Over the years there are increasing international concerns about the growing environmental challenges/impacts and its implication on the world economy and people's health and livelihoods (Adedoyin & Zakari, 2020; Ali, Dogan, Chen & Khan, 2021; Onifade, Bekun, Phillips & Altuntaş, 2022). This is evidenced by many United Nations' international summit, protocols and conventions. The United Nations Commission on Sustainable Development (UNCSD), under the umbrella of United Nations Conference on Environment and Development (UNCED), was created to monitor

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and report on the implementation of the Earth Summit agreements at local, national and international levels (Koseoglu, Yucel & Ulucak, 2022; Yi, Tanveer, Bin & Xue, 2024). Similarly, in September 2002, the World Summit on Sustainable Development (WSSD) was held in Johannesburg, South Africa to remind South Africans and the World of their responsibility towards the environment (South African Country Report, 2005; Department of Environmental Affairs and Tourism, 2007; Adedoyin & Zakari, 2020). In South Africa, significant economic treasure has been generated at the cost of its natural assets (Aziz, Sharif, Raza & Jermsittiparsert, 2021; KPMG, 2020; Kate Griffin, 2022). For sustainable distribution and development, these assets need to be protected in order to ensure that they continue to generate positive returns for taking care of the needs of the present generation as well as the aspirations of the future generations. Environmental challenges in South Africa currently, include global warming, air pollution, biodiversity loss, deforestation, desertification and waste (Adedoyin & Zakari, 2020; Ali, Dogan, Chen & Khan, 2021; Dauda, Long, Mensah, Salman, Boamah, Ampon-Wireko & Dogbe, 2021; Kate Griffin, 2022). These environmental issues not only lead to economic loss but they represent a threat to people's health and livelihoods. Interestingly, environmental issues of South Africa are not commonly single: they are mostly connected. For example, deforestation is an environmental issue in its own but it also contributes to soil erosion and global warming, while also destroying protection against air pollution (Alola & Adebayo, 2022; Onifade, Bekun, Phillips & Altuntaş, 2022). More recently, the United Nations under the umbrella of Sustainable Development Goals (UNSDG) is advocating that companies especially manufacturing conduct their business operation in a manner that is socially, economically and environmentally acceptable to the international as well as national policies and regulations (UNSD, 2015; WBCSD, 2018; Dara et al., 2020; Erin, Bamigboye & Oyewo, 2022).

Despite South Africa's indebt environment, pollution and waste management legislation, the management of environment-related impacts is becoming increasingly important in many industrial sectors due to the magnitude of these impacts as a percentage of overall operating costs (IFAC, 2005; Jamila, Muhammad & Ali, 2015; Zenghelis & Paul, 2021; Wachira & Mathuva, 2022). Although, manufacturing companies in Gauteng province of South Africa have environmental mission and value statements, environmental policies (waste, energy and water policies), environmental management systems, quantified environmental targets as well as ISO 14001 certification (Breuer, Janetschek & Malerba, 2019; Kazemikhasragh et al., 2021), yet significant environmental problems/impacts consistently plague their performance. Hence, the research problem is the non-existence of a tool or model to deal with the huge environmental challenges/impacts. The implication of this problem is that Gauteng food manufacturing companies will be unable to determine their value added or destroyed across environmental, social and economic actions resulting to less corporate environmental and financial sustainability.

Hence, food manufacturing companies are challenged to develop a system for managing, reducing and monitoring environmental impacts/problems thereby significantly increasing environmental and financial sustainability. Conversely, a growing consensus exists that conventional accounting practices simply do not provide adequate information for environmental management purposes (IFAC, 2015; Drury, 2019; Burritt et al., 2021) and to fill this gap, the evolving field of environmental management accounting (EMA) has been receiving increasing attention (IFAC, 2015; Jamila et al., 2015; Gunarathne & Lee, 2015; Schaltegger et al., 2020; Nasser, 2020). From literature, Gibassier and Alcouffe (2018) posit that EMA is the missing link to sustainability because various stakeholders do not understand the role of EMA systems in addressing environmental impacts/challenges for sustainable development. Gunarathne and Lee (2015), Jamila, Mohammad and Ali (2015) and Doorasamy and Garbharran (2015) advocate that EMA is invaluable for

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environmental management and organizational change. These authors in their prioritized work agreed that EMA systems are excellent in cost-saving and strategic advantage for daily business tasks. EMA measures environmental impacts/costs and the benefits associated with environmental impacts as traditional financial management accounting systems are limited to recording environmental activities. Hence, implementation of EMA in developing countries like South Africa should be prioritized. Additionally, Solovida and Latan (2017) and Olalekau and Jumoke (2017), link EMA to environmental strategy and environmental and financial performance. EMA serves as a mediating role to sustainability accounting. To these environmental and sustainability authors, implementing EMA in South African businesses has its own set of challenges. Since, traditional accounting has failed to provide accurate data on environmental expenses/impacts and companies have ethical responsibilities to protect the environment. While on the one hand, EMA can assist companies in managing and accessing environmental risks, sustainability accounting on the other hand, focuses on the ability of EMA implementation to report on environmental consequences and to assist in internal decision-making and external reporting. According to Schaltegger (2018) and Schaltegger, Hörisch and Loorbach (2020), EMA is a new approach to management accounting. Its tools, systems and procedures can assist stakeholders in making useful environmental decisions. On the one hand, EMA measures environmental costs of business operations and on the other hand, it has to bridge the limitations of conventional management accounting systems and identify hidden environmental impacts/problems that affects business performance.

Thus, the focus of this study is to determine the environmental challenges/impacts associated with the Gauteng food manufacturing companies that are listed in Johannesburg Stock Exchange (JSE) and subscribing to socially responsibility investment (SRI) index and ISO 14001. It will also explore and communicate how EMA's physical and monetary systems and procedures can be utilized to address these challenges resulting to environmental and financial sustainability. Hence, the research questions or hypothesis for achieving these objectives are as follows:

To which degree do Gauteng food and beverage manufacturing companies care about the environment in terms of utilizing environmental strategies and tools? E.g. environmental management systems, environmental vision and mission statements, environmental policies (i.e. waste, water and energy), ISO 14000 certification.

To what extent do Gauteng food and beverage manufacturing companies accept the nature and volume of environmental issues/problems faced in terms of their products or services?

To determine on the one hand how the food manufacturing organisation's environmental impacts/costs can be controlled, reduced and managed/accounted for with the help of EMA's physical and monetary systems and procedures and on the other hand the extent at which it translates to environmental and financial sustainability?

Thus, food manufacturing companies in Gauteng, South Africa or the world that have incorporated environmental, social and economic values in their production processes and service portfolios by implementing EMA's physical and monetary systems and procedures may attract and retain customers, build strong brands in the market and achieve profit leading to environmental and financial sustainability (Burritt et al., 2021; Obioha & Klingelhoefer, 2023; Obioha, 2024).

Theoretical Framework, Environmental Management Accounting, Environmental Management Systems and Regulations. Theoretical framework focuses on the basic ideas and systems of how one comprehends the association between various factors and elements recognized as significant to the problem (Leedy & Ormrod, 2021). Hence, it illustrates the ideas and perceptions relevant to the subject matter, which relates to the larger areas of the theme in focus (Leedy & Ormrod, 2021; Lehrmann, Skovbjerg & Arnfred, 2022). According to Jarvis (2013), having a theory

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will assists in identifying the limits to the generalization. Hence, to achieve the study's purpose i.e. to determine the environmental challenges/impacts of the food and beverage manufacturing companies in Gauteng, South Africa and using EMA to manage these challenges for environmental and financial sustainability, this research considers contingency theory.

The aim of the study is to establish the environmental challenges/impacts of food manufacturing companies in Gauteng and to determine the linkages or relationships between these impacts and EMA which is the central idea of Contingency theory. The contingency approach is based on the assumption that there is no one size fits all in management accounting. This implies that different environmental management systems apply to different organizations relative to their circumstances (Otley, 2014; Omonona, et al., 2021). As stated earlier by IFAC (2015) and Drury (2019), traditional accounting systems are no longer giving adequate data for environmental purposes and to occupy this position EMA is receiving an increasing attention from management and governmental boardrooms (IFAC, 2015; Jamila et al., 2015; Gunarathne & Lee, 2015; Schaltegger, 2018; Schaltegger, Hörisch & Loorbach, 2020). This theory suggests that food manufacturing companies in Gauteng, South Africa should align their internal strategic operations (i.e. systems and processes) with their external environmental factors for their continuous existence and performance. The external environmental factors include the rules and regulations governing the environment in which food manufacturing companies are located. The question is why must organisations take care of the environment? Globally, environmental concerns have risen significantly during the past two decades, triggered in part by climate change, global warming, pollution, waste and emission as well as rising environmental expenses and societal awareness of products. Thus, as environmental pressure and impacts increase environmental management accounting (EMA) become prominent. Hence, organisations particularly, Gauteng food and beverage companies should consciously and effectively respond to this environmental call in order to be good citizens and enjoy financial fortune.

In the following sections, this research examines the South African environmental regulation/protection policies in place, the linkage between EMA and management accounting systems/frameworks, EMA and food and beverage manufacturing companies, environmental management systems (EMS) and ISO 14001 as well as EMA uses and benefits.

Regulatory Framework and Environmental Protection in South Africa. Globally there is a call to protect the environment as global warming continues to escalate (compare to this and the following statements, South African Country Report, 2005; Adedoyin & Zakari, 2020; Kate, 2022). In South Africa the regulation or legal framework for environmental protection is covered in the environmental clause 24 of the South African Bill of Rights of the Constitution Act, no. 108 of 1996. This is a positive development from an environmental legal framework point of view. According to the Bill, governments have an important role to protect the environment. Furthermore, Section 24 of the Constitution clarifies environmental concerns such as:

- communal welfare
- reducing pollution and ecological harm;
- encouraging conservation; and
- promoting environmentally sustainable development and utilisation of natural resources.

The National Environmental Management Act (NEMA), no.107 was promulgated in January 1999 (NEMA Act, 1998), primarily for cooperative environmental governance and public participation in environmental management.

Regulatory entities for food manufacturing companies:

- Consumer Goods Council of South Africa (CGCSA).
- South African Bureau of Standards (SABS).

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- South African Veterinary Council (SAVC).
- Institution of Packaging South Africa (IPSA).
- Packing Council of South Africa (PACSA).
- Plastics Federation of South Africa (PFSA).
- Muslim Judicial Council (MJC).
- Food Safety Services International (FSSI).

Hence, for food manufacturing companies in Gauteng to be sustainable in their operations and achieve environmental and financial sustainability, environmental provisions enshrined in these Acts/regulations need to be adequately implemented in their value and goal systems.

Environmental Management Accounting (EMA) and Management Accounting Systems (MAS). Companies have various management accounting systems in place, such as operational procedures, health and safety protection, traditional accounting methods and EMA (IFAC, 2015; Schaltegger et al., 2020). EMA and traditional accounting should complement one another. EMA is designed to manage the cost of environmental protection associated with business operations. The idea is to be transparent in reporting the costs and benefits of environmental management. The more transparent, the higher the reputational image of the business. The reporting of environmental aspects of business operations should include:

- assessment, disclosure and reporting of environment-related financial information as a separate accounting method
- estimation of external environmental impacts and costs as part of traditional cost accounting
- flows of natural resources as reported in natural resource accounting (NRF)

Thus, the main scope of environmental accounting is to achieve economic, environmental and social benefits by generating environmental accounting information. Hence, by identifying, managing and measuring economic gain or loss regarding environmental issues and providing sufficient environmental information these benefits can be achieved (IFAC, 2015; Jamila et al., 2015; Christ, Burrit, Robert & Varsei, 2016; Dlamini & Shuttle, 2021). EMA systems can provide information relating to expenditures on pollution control; income from recycled material; as well as costs and benefits of energy-efficient production methods. Environmental financial information should be available to all stakeholders (i.e. internal and external) (IFAC, 2015; Schaltegger et al., 2020; Zenghelis & Ekins, 2021).

The initial risk assessment of an EMA is broad based and should consider the environmental impact from the following:

- suppliers of raw materials
- energy/water consumption and types
- by-products produced
- waste generation and disposal
- pollution (emissions) of air and water systems
- risk of hazardous on-site issues (i.e. fire)
- land erosion and
- disposal (i.e. packaging) of final product to consumer.

Design of EMA. The following steps are to be followed in order to design and efficient and effective EMA: (compare this and the following statements, Burritt et al., 2021; Schaltegger et al., 2020)

- planning/designing
- implementation of processes according to ISO standards

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- monitor performance (i.e. audit reports whether processes are followed) and
- continuous review (improvement of systems).

Definition of EMA. EMA is defined differently by different organizations (IFAC, 2015; Burritt et al., 2021; Schaltegger et al., 2020). According to United Nations Expert Working Group EMA is the "collection of two types of data: physical and monetary. Physical data covers the usages, fluxes, and destinations of energy, water, and materials, as well as waste and monetary data deals with environmental costs, revenues, and savings, used to make management choices. Zenghelis and Ekins (2021), defined "EMA as an integrated concept that generates financial and cost accounting information that increases organisational material efficiency reduces environmental impact, risk and protection costs".

EMA is a sub-set of environmental accounting (EA) that assists in controlling, reducing and managing environmental impacts/problems related to production processes (Jamila, Muhammad & Ali, 2015; Schaltegger & Burritt, 2018; Burritt et al., 2021). Christ, Burrit, Robert and Varsei (2016) and Nkundabanyanga et al. (2021), EMA is contrary to conventional management accounting. It generates information to managers for making improved social and environmental decisions". The authors are of the opinion that EMA systems/data complements each other. In an organisation while EMA physical information can assist in reducing the environmental impacts, the monetary information can utilize in cost savings for the same company. While EMA is suitable for management internal decision-marking relating to environmental management, such as supply chain management, conventional management accounting on the other hand might not adequately address environmental costs (IFAC 2015; Dlamini & Shuttle, 2021).

EMA tools and systems have been widely used in many industrialised countries for internal management purposes. However, in under-developed and developing nations like South Africa, the study on EMA and its implementation is still at a foundation stage (Ambe, 2007; Nyirenda, 2010; Klingelhoefer & Obioha, 2012; Obioha & Klingelhoefer, 2017). Previous studies on environmental management in developing countries indicated that 21 organisations lack the experience in acquiring environment-related information, making measuring and recognising of future liabilities difficult (Jamila et al., 2015; Sari, et al., 2020). The following categories of information are reviewed by the organisation under the EMA to ensure effective management and cost savings associated with the environment: (IFAC, 2015; Burritt et al., 2021). Physical information of EMA involves the accounting costs on the different production stages of a product including aspects such as data on materials used in production (i.e. energy and water usage) and the spill-over of wastes and emissions. All physical input and output information must be collected to ensure an all-inclusive EMA. The table 1, below illustrates EMA's different types of raw materials inputs that are converted into products outputs.

Table 1. Physical environmental management accounting input and output types

Material inputs	Product outputs
Raw and Auxiliary Materials (are input material that become part of an organization's final product or by-product)	*Products* (are any tangible products created by the organization)
Packaging Materials (are input material intended for use in shipping the organization's final product)	*By-products* (are minor products incidentally produced during the manufacturing of the main product)
Merchandise (items that are then directly sold again as products with little or no additional processing)	**Non-product outputs (wastes and emissions):**

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Operation Materials (are input material that are purchased and used by the organization but do not become part of any tangible product delivered to a customer)	*Solid Wastes* (are relatively non-hazardous waste in solid form, such as waste paper, plastic containers, food waste, non-hazardous solid scrap products)
Water (includes all water used by an organization, from all sources)	*Hazardous Wastes* (are more hazardous waste materials, in solid form, liquid form or mixed form)
Energy (includes all energy used by an organization, of all types, e.g. electricity, gas, coal, fuel, oil, district heating and cooling, biomass, solar, wind, water)	*Wastes-water* (are streams whose primary components is water, but which also contain contaminants of some kind)
	Air Emissions (are air streams that are contaminated with problematic levels of pollutants)

The table 1, above summarises the physical information required by EMA for the application of material balances, material flow accounting, and environmental performance indicators. Environmental costs are those incurred because of an organisation's energy usage, materials, and water in the creation of its products and services. These costs include waste and emission treatment, prevention and environmental management (IFAC, 2005; Burritt et al., 2021; Dlamini & Shuttle, 2021). In other words, in the process of using energy and water to convert material into final products, waste such as solids, recycled, hazardous and wastewater is generated and are identified as relevant physical non-production output for the study.

However, physical accounting information does not provide all the data needed to effectively manage and reduce the potential environmental impacts, hence, monetary information is also needed.

Monetary information under EMA. Is a subset of environmental management accounting system that calculates all costs incurred in an organisation (i.e. material, energy and water) that affects the environment (IFAC, 2005; Burritt et al., 2021; Dlamini & Shuttle, 2021). It assesses the costs of all inputs, material, energy and water, products and non-products like waste and emissions for internal decision-making as in Table 2 below

Table 2. EMA's environment-related costs

S.no	Types of Costs
1.	Materials Costs of Product Outputs: Include the purchase costs of natural resources such as water and other materials that are converted into products, by-products and packaging.
2.	Materials Costs of Non-Product Outputs: Include the purchase (and sometimes processing) costs of energy, water and other materials that become Non-Product Output (Waste and Emissions).
3.	Waste and Emission Control Costs: Include costs for handling, treatment and disposal of Waste and Emissions; remediation and compensation costs related to environmental damage; and any control-related regulatory compliance costs.
4.	Prevention and Other Environmental Management Costs: Include the costs of preventive environmental management activities such as cleaner production projects. Also, it includes costs for other environmental management activities such as environmental planning and systems, environmental measurement, environmental communication and any other relevant activities.
5.	Research and Development Costs: Include the costs for Research and Development projects related to environmental issues.

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6.	Less Tangible Costs: Include both internal and external costs related to less tangible issues. Examples include liability, future regulations, productivity, company image, stakeholder relations and externalities.

Source: (IFAC, 2005)

The above Table 2, relates to the cost categories in the monetary EMA (MEMA), that managers at food manufacturing companies need to manage and control in order to achieve environmental and financial sustainability (IFAC, 2005; Muza, 2018; Schaltegger et al., 2020). The process of assessing environmental costs in food manufacturing companies can be steered at unique levels (Muza, 2018; Kelsall, C., 2020). For examples, monetary data of EMA can be collected at particular sites for data that are detailed or for profit and loss account, waste stream of interest, customer service, product lines, material and cost centres (IFAC, 2005; Kelsall, C., 2020). Proper and correct allocation of an environmental cost to the right cost centre allows management to determine the proper cost associated to each product or service (IFAC, 2005; Kotzee, 2014; Burritt et al., 2021).

Types of management accounting systems (MAS). Activity-based costing (ABC) – As the world economies and GDP escalate, their effect on the environment as well as the cost of management increases (Drury, 2019). For example, if a food and beverage manufacturing company uses a raw material input of say 200 kg and the final product is 190 kg. This indicates that 10 kg make up waste and scrap which affects the price of their product (food). The objective of EMA is to improve the end product's weight while decreasing waste. The traditional accounting method will include all production costs such as machine hours, labour, materials and other factory costs (Drury, 2019; Garrison & Noreen, 2020; Schaltegger et al., 2020).

Hence, EMA aims to eliminate waste, scrap, environmental cost and protects the environment as well as increase financial performance (IFAC, 2015; Burritt et al., 2021). According to Drury (2019) and Garrison and Noreen (2020), activity based costing (ABC) "assigns overheads to product using volume and non-volume-based cost drivers". Thus, ABC as a concept involves the use of many activities that make up cost and different cost centres for the allocation of overheads. Garrison and Noreen (2020) and Burritt et al. (2021), defined ABC as "a costing concept designed for providing quantitative overheads cost-based information to managers for making strategic decisions". Seal (2020) and Zenghelis & Ekins (2021), identifies the following steps for the implementation of ABC:

- "Identify and define activity-based production costs.
- identify different production process costs,
- Calculating production-activity cost rate based on the cost pool drivers of the production-activity to determine production-activity costs of the production process.

Thus, by applying these steps, organisations can identify and measure the costs of each operation in the production process using pre-determined absorption rate.

Materials flow accounting. IFAC (2005, 2015), states that "the total amount of materials used in an organisation can be determined by accounting for all the materials that passed through different organisational material management steps right from the time it enters the organisation till the products are produced and sold and waste collected, recycled and disposed."

Flow cost accounting. This accounting system focuses on material flow processes within organisational structures (IFAC, 2015; Schaltegger et al., 2020). The aim is to ensure a transparent exposition of the costs during different production stages until the sale of products. This accounting measure considers physical quantities and costs of material used as inputs Material flows are categorised into production, delivery and disposal.

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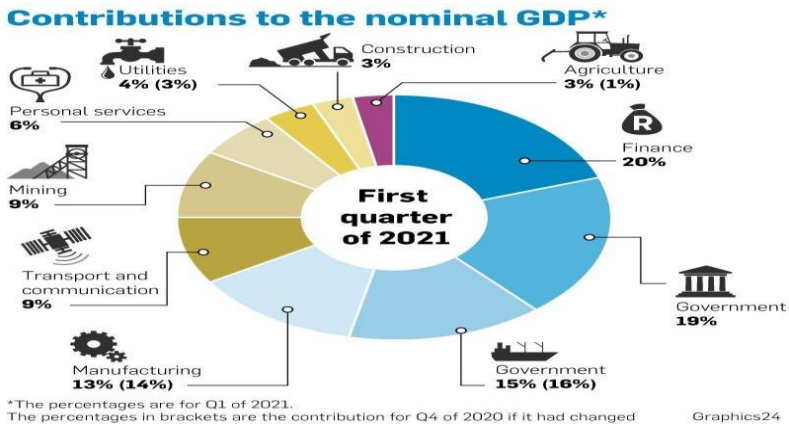
Life cycle costing. In environmental accounting, the life cycle costing approach determines the environmental expenses associated with a product's complete lifespan.

Full cost accounting. Is a system that calculates the environmental impacts and cost within and outside the organisation. Decision-makers to ensure that the organisational decisions take full account of environmental impacts may use full cost accounting.

EMA in food manufacturing companies in South Africa. South Africa is regarded to be the most industrialised country in Africa (compare this and the following statements, Govender, 2016; South Africa. Info, 2021; Dlamini & Shuttle, 2021). This is because the end of the white dominated rule (apartheid) and the lifting of the international restrictions/sanctions ushered in a positive and steady economic growth. South Africa has a well-developed manufacturing sector that is globally competitive. Figure 1, demonstrates the composition of the South African nominal gross domestic product for the first quarter of 2021.

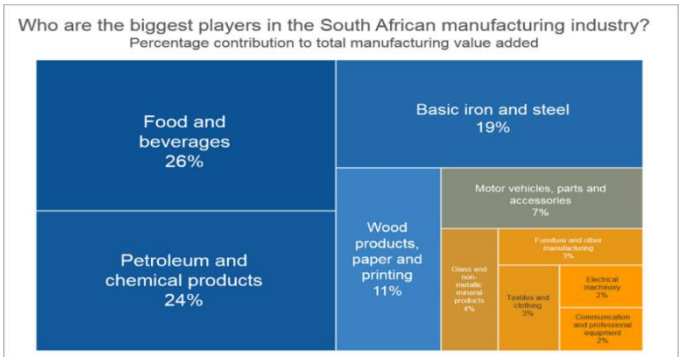


Source: (Statistics South Africa, 2020)

Figure 1. Contribution to the nominal GDP first quarter 2021.

The manufacturing sector assists in the acceleration of the country's growth and development plans. The sector contributed 14% to the country's gross domestic product (GDP) in last quarter of 2020 and 13% in first quarter of 2021 (Govender, 2016; Statistics South Africa, 2020; Dlamini & Shuttle, 2021).

Figure 2, demonstrates the total South African manufacturing industry as well as the biggest contributors of the Sector in percentages.



Source: (Statistics South Africa, 2020)

Figure 2. Contribution to total manufacturing sector

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The manufacturing sector is dominated by food and beverages division in South Africa. The food and beverages contributed 26% to the total manufacturing activities and followed by petroleum and chemical products; basic iron and steel and wood products (Statistics South Africa, 2020; Dlamini & Shuttle, 2021).

All manufacturing operations have different environmental impacts and thus require diverging EMS (compare for this and the following statements, Doorasamy & Garbharran, 2015; Dlamini & Shuttle, 2021). Various environmental management initiatives are predominant in the manufacturing industry. However, the level of application of EMA in practice is limited because of the gap in identifying inefficiencies in a production processes in the manufacturing sector. This is also the case In South Africa. Financial constraints are seen as a major factor in South Africa for not have yet introduced global standard in implementing EMA and EMS practices (Olalekau & Jumoke, 2017; Wendling, Emerson, Esty, Levy, de Sherbinin, et al., 2018; Dlamini & Shuttle, 2021).

The majority of manufacturing companies who are using EMA information in their operations and environmental reporting achieve environmental sustainability (compare this and the following statements, Norsyahida, Norhayah & Ruzita, 2014; Schaltegger et al., 2020). EMA has the capability to change companies's environmental impacts and costs with the help of its physical and monetary information thereby enhancing both internal dicisicion-making and external reporting. It is however, believed that traditional costing systems can no longer provide efficient and effective information on environmental costs. Some of these costs are hidden in overhead cost (Doorasamy and Garbharran . 2015; Jamila, Mohamed, Muhammad & Ali, 2015; Solovida & Latan, 2017; Gibassier & Alcouffe, 2018; Dlamini & Shuttle, 2021). Production costs have an impact on the price of a product. Environmental costs also influence pricing. The objective is to limit overhead and production costs. This will have a positive impact on profit margins and profitability (Schaltegger, 2018; Zenghelis & Ekins, 2021).

Environmental challenges/impacts in food manufacturing companies. Despite, the fact that food manufacturing companies in Gauteng recognize the need to conduct business in a responsible and ethical manner, yet they are confronted with the following environmental and community impacts (Jamila, Muhammad and Ali, 2015; Christ et al., 2016; Christine et al., 2019; Dlamini & Shuttle, 2021).

- Management of pollution
- Compliance with environmental ISO standards.
- Managing health and safety, community relationship and CSR.
- Management of waste and emissions.
- Management of recycling.
- Management in the use of energy and water.
- Determination of environmental costs

Thus, the management of environmental impacts/costs or challenges becomes inevitable. These costs could be hidden, but it must be accounted for and measured and that is where EMA comes into play. Hence, the aim of this research is to determine the environmental challenges/problems or impacts through quantitative surveys as well as qualitative systems in place and to establish and communicate how EMA can be utilized to address them. Thus, according to IFAC (2015) and Drury (2019) and Erauskin et al. (2021), EMA's principles/characteristics include the following:

- providing information that encompasses environmental impact costs/benefits

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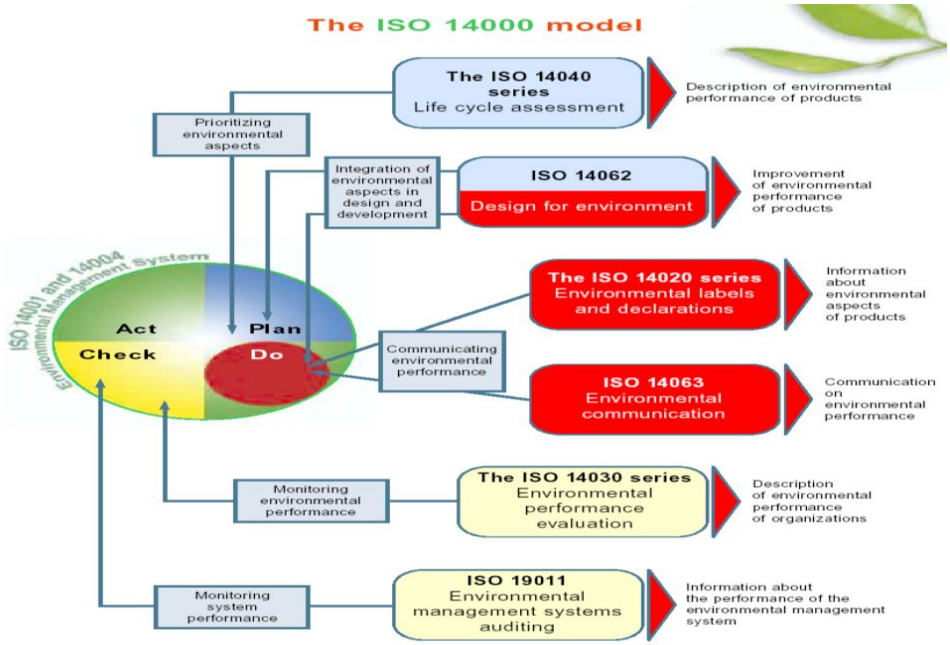
- not focusing on purely financial costs
- identifying, analyzing, managing and reducing environmental impacts and costs, expenditures, investments and liabilities
- separate accounting systems/practices outside traditional accounting
- assisting in setting prices (not only manufacturing costs) and budgeting
- identifying performance targets and
- categorising environment-related costs into protection, detection and internal failure/external costs.

Environmental Management Systems (EMS) – ISO 14 000. Globalization as well as increased international pressure on companies to operate in an environment friendly manner led to a need for international EMS standards. This resulted in the development of the ISO 14000 family of standards which aims at achieving standardization in the field of environmental management and thereby guides the implementation and maintenance of an EMS (Ambe, 2007; Erauskin-Tolosa et al., 2021).

The International Organization for Standardization (ISO) has a family of standards, namely ISO 14000, related to environmental management that are globally recognized. The International Organization for Standardization was established in 1947 with delegates from 25 countries. ISO is an independent, non-governmental international organization with a membership of 163 national standards and 3 368 technical bodies. Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant international standards that support innovation and provide solutions to global challenges. The ISO 14000 family of standards are listed in Figure 3 according to the Plan-Do-Check-Act model.



Source: (ISO 2016)

Figure 3. The International Organization for Standardization 14000 Model

ISO Management Systems within Foods Consumer Division.

- ISO 14000: The ISO 14000 family of standards provides practical tools for manufacturing companies and organizations of all kinds looking to manage their environmental

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responsibilities. Other standards in the family focus on specific approaches such as audits, communications, labelling and life cycle analysis, as well as environmental challenges such as climate change.

- ISO 14001: The ISO 14001 sets out the criteria for an environmental management system. It maps out a framework that a company or organization can follow to set up an effective environmental management system. It can provide assurance to company management and employees as well as external stakeholders that environmental impact is being measured and improved.
- ISO 22000: The ISO 22000 addresses food safety management, food safety standards to help organizations identify and control food safety hazards. It sets out the requirements for a food safety management system. It maps out what an organization needs to do to demonstrate its ability to control food safety hazards in order to ensure that food is safe.
- ISO 17025: ISO 17025 is the main standard used by testing and calibration laboratories. There are many commonalities with the ISO 9000 (9001, 9002) standard, but ISO 17025 adds the concept of competence to the equation and it applies directly to those organizations that produce testing and calibration results.

Conventional accounting systems within Foods Consumer division. MAX ERP system: is a manufacturing Software designed for manufacturers that must maintain compliance with government or industry regulations, manage recalls, and control and document product revisions and engineering changes. It provides the control and visibility that is needed to drive sustainable and scalable growth and empowers employees with the tools that they need to:

- Track cost variances for material costs, labour costs and purchase costs by part, order number, or by work centre, and compare actual costs with planned costs
- Control the purchase, delivery and tracking of materials in the most efficient manner possible
- Track and maintain inventory balances for each part of your stock, including finished goods, assemblies, component parts and raw materials with complete audit trails
- Plan production of finished goods, generate forecast orders and maintain customer demand for consistent and realistic production plans
- Document Control and quality management analysis for ISO and regulation certification processes.
- Provide more detailed warranty tracking and recall management
- Track actual work performed by employees for specific work order operations

The services business models provide by MAX ERP system is demonstrated in Figure 4 below.

Figure 4. MAX ERP services business models

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The food consumer division implemented MAX ERP as their accounting system for finance, materials, production and scheduling purposes. All the product costing are done using the system and the information is late-on integrated Systems Application and Products (SAP), a system for financial reporting. The following are the costing methods integrated in the system and are applied by the company during product costing: Job costing, process costing, activity-based costing, standard costing, target costing, materials flow accounting, flow accounting, life cycle budgeting, life cycle costing, full costing and relevant environmental costing.

Thus, the above ISO management systems and conventional accounting systems are systems in place at RCL Foods Consumer Division, used to manage and account for their environmental related costs. Most of these environmental costs are invisible and cannot be identified due to these costs being allocated as overheads costs under current conventional accounting system. As mentioned earlier in this section that the challenges of using conventional management accounting systems can be that environmental costs are not correctly allocated from overhead accounts back to processes, products and process lines, the communication between accounting and other departments is poor and the inaccurate information for raw materials waste and costs. Similarly, at RCL Foods the above environmental management systems in place for managing, reducing and monitoring the above volumes and components of environmental costs simply do not provide adequate information for environmental costs management purposes.

EMA uses and benefits at Food manufacturing companies. Given the prevalence of volumes of environmental challenges/impacts as envisaged above is an indication that the environmental management systems in place at food manufacturing companies in Gauteng, South Africa, simply do not provide adequate information for reducing, managing and controlling of environmental impact/costs.

Hence, EMA is particularly valuable for internal management initiative with a specific environmental focus. Organization can have strategic advantages in better decision making, based on reliable and accurate information to identify opportunities for cost savings and efficiency improvements. According to Ambe (2007), Solovida and Hengky (2017) and Schaltegger and Burritt (2018), some of the benefits of EMA include:

Table 3. Uses and Benefits of EMA

S.N0	USES/Benefits
1.	More complete and precise information to support the establishment of cost-effective programmes to improve environmental performance.
2.	The capability to monitor and manage the consumption and flow of energy and materials more accurately.
3.	More complete and precise information for the measuring and reporting of environmental performance, thus improving the company image with stakeholders.
4.	The capabilities to identify, estimate, allocate and manage/reduce environmental types of costs more accurately.
5.	The more industry can justify environmental programmes on the basis of financial self-interest, the lower the financial, political, and other burdens of environmental protection on government.
6.	Implementation of EMA by industry should strengthen the effectiveness of existing government policies/regulations by revealing to companies the true environmental costs and benefits resulting from those policies/regulations.

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7.	Government can use industry's EMA data to estimate and report on financial and environmental performance matrices for government stakeholders, such as regulated industries or the industry partners in voluntary programmes.
8.	Industry's EMA data can be used to inform government programme/policy design.
9.	Government can use industry's EMA data to develop matrices for reporting the financial and environmental benefits of voluntary partnership programmes with industry, innovative approaches to environmental protection, and other government programmes and policies.
10.	Industry's EMA data can be used for accounting purposes at regional or national level.
11.	Government's EMA data can be used for environmental and other decisions in government operations, e.g. purchasing, capital budgeting, and federal/provincial facility environmental management systems.
14.	Government's EMA data can be used to estimate and report financial and environmental performance matrices for government operations.
15.	To enable the more efficient and cost-effective use of natural resources, including energy and water.
16.	To enable the cost-effective reduction of pollutant emissions.
17.	To reduce the external societal costs related to industry pollution, such as the costs of environmental monitoring, control and remediation, as well as public health costs.
18.	To provide improved information for improved public policy decision making.
19.	To provide industrial environmental performance information that can be used in the broader context of the evaluation of environmental performance and conditions in economies and geographic regions

Source: (IFAC, 2005; Ambe, 2007)

METHODS

The study employed a mixed approach consisting of both quantitative and qualitative data collection techniques. As mentioned earlier, the study targeted the environmentally sensitive sector, the food and beverage manufacturing companies in the Gauteng province, that are listed in Johannesburg Security Exchange (JSE) and subscribing to Socially Responsibility Investment (SRI) index in South Africa and ISO 14001. The population comprises of 8 food manufacturing companies in Gauteng with 24 factories. Since random sampling is not feasible considering the nature and number of the companies and factories, the study applied a purposive sampling involving all 8 companies consisting of 24 factories.

Quantitative data was collected by means of a structured questionnaire with an approximation of three key senior personnels from each factory, who are involved and conversant with the company's environmental impacts/costs and issues. A follow-up face-to-face and telephone interviews was conducted with personnels on management level such as environmental managers, production managers or financial managers and other personnels who understand the activities that generate environmental impacts/costs. In addition to interview and questionnaire items, the study also collected non-numerical and unstructured data by examining the processes, procedures, systems and policies in place.

Qualitative data was collected from intellectual archives that was used to establish an understanding of the relevant literature on environmental issues within the consumer goods/foods manufacturing industry. Due to the wide scope of consumer goods manufacturing industry in South Africa, it was impractical to apply the study to the whole manufacturing industry. Therefore, as mentioned earlier, the study was restricted to food manufacturing companies in Gauteng province, that boast of significant amounts of internal environmental impacts and environmental costs.

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The study in the first instance explored and communicated the current environmental performance of Gauteng food and beverage manufacturing companies, i.e. the extent to which they care about the environment by implementing environmental management systems, policies and procedures through qualitative and quantitative data and through document analysis of the current systems, policy documents and financial statements in place. Thus, the documents analysis together with the literature review informed the questionnaire generated by the author. The study furthermore used a survey method employing a Likert-scaled questionnaire to obtain the views of various senior managers or chief executives on the nature and volumes of environmental impacts/challenges or problems faced by Gauteng food and beverage manufacturing companies and how EMA concepts and systems i.e. physical and monetary data can be useful in reducing significantly, levels of environmental costs and impacts that are generated during production, in order to bring them into internal decision-making regarding processes, products, and services for environmental and financial sustainability.

Data was collected through face-to-face and telephonic interviews using a structured Likert scale-type questionnaire based on the two document analyses and themes that were developed, with three main sections, namely 1) organizational characteristics (5 questions) and 2) the current environmental issues including the environmental challenges/impacts or problems faced by food and beverage manufacturing companies (36 questions). Section 3 is the relationship between EMA, environmental and financial sustainability (13).

The data consists of 5 categories, ranging from 1) being clearly expressed as "extremely low importance" (ELI), “extremely low priority” (ELP) and “not implemented” (NI). 2) As “low important” (LI), “low priority” (LP) and “partly implemented” (PI). 3) As “neutral” (N). 4) As “high importance” (HI), “high priority” (HP) and “fully implemented” (FI) and 5) as "extremely high importance” (EHI), extremely high priority” (EHP) and strongly agree" (SA). The surveyed data was analysed statistically using computer package called Stata V15 software to determine the relationships/associations between the categorical variables and their factors/elements affecting the environmental management accounting, environmental challenges/issues and its impacts on financial performance/sustainability. Internal and external validity and reliability of instrument was ensured using Cronbach Alpha.

The following section displayed the results/findings of the paper, followed by discussions leading to the reduction and management of environmental impacts/problems faced using EMA and its subsequent effect on environmental and financial sustainability. Thereafter, the paper is concluded by highlighting the managerial implication, contribution to literature, limitation as well as recommendations for further research.

RESULT AND DISCUSSION

Respondent information. The response rate is 91.67% which is 22 factories of the entire 8 Gauteng food and beverage manufacturing companies as against 24 factories earlier targeted. The legal status of all the 22 factories of the 8 companies that participated is public limited i.e. (n=22, 100%) and their geographical location is Gauteng, South Africa. The organisation’s industrial sector is food and beverages, (n=22, 100%). The number of employees ranges as follows: 1 001 – 5 000 is (n=11, 50%); 5 001 – 10 000, (n=2, 9%) and >10 000 is (n=9, 41%). The function of the staff is, operational (n=7, 32%); financial (n=4, 18%); environmental (n=7, 32%) and others (n=4, 18%). The role category includes, leadership (n=7, 32%); specialisation (n=4, 18%); optimisation (n=4, 18%); executives (n=2, 9%); process optimisation (n=4, 18%) and process implementation (n=1, 5%). Thus, the following results/findings are presented in accordance with the survey questionnaire.

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Current environmental issues at food and beverage manufacturing companies in Gauteng. This section seeks to determine whether food and beverage manufacturing companies are environment-conscious in their operations in terms of implementation of policy, compliance to ISO 14001 standards, regulation to industry standards, sustainable development requirements and the responsible environmental initiatives. The following results were obtained:

(54.55%, n=12), of the factories accept the implementation of environmental action plans or quantified environmental targets.

Limitation to this claim is while (n=4, 18.18%) rate implementation of action plans as low importance, (n=6, 27.27%) were neutral. These results concur with that of Jamila, Muhammad and Ali (2015) and Burritt et al., (2021).

Similarly, (95.45%, n=21) of the respondents agree to the implementation of ISO 14001 certification and the limitation is that (n=1, 4.55%) is neutral, which correspond to the findings of Solovida and Latan (2017) and Ilyas et al. (2020) who posit that to be environment-friendly, companies need to implement ISO 14001.

As the majority of the participants (90.91%, n=20) are of the opinion that their companies are implementing environmental mission statement, (95.45%, n=21) are implementing environmental value statement. These results conform to the results of environmental authors like Govender (2016) and Hagarty (2020). Limitations are (n=2, 9.09%) and n=1, 4.55% respectively.

(63.64%, n=14), of the interviewees strongly agree implementing environmental policy i.e. waste, water and energy, (68.18%, n=15), are implementing environmental management systems (EMS) while (54.55%, n=12) are implementing action plan or quantified environmental target. Again the findings concur with those of Solovida and Latan (2017) and Ilyas et al. (2020) who found that companies that implement environmental policy, environmental management systems and are engaging in quantified environmental targets are sustainable in their operations.

Limitations: while (n=1, 4.55%) say that their company implementing environmental policy is of low importance, (n=7, 31.82%) is neutral. Again, as (n=2, 9.09%) agree that engagement in environmental management system is of low importance, (n=5, 22.73%) are neutral of the results while (n=4, 18.18%) believe that implementing environmental target is of low importance and (n=6, 27.27%), are neutral of environmental target.

For transparency and accountability food manufacturing companies in Gauteng should implement an environmental section in their annual reports as well as stand-alone sustainability report.

As the majority of the factories (81.82%, n=18) believe that they have an environmental section in their annual report, (n=4, 18.18%) are neutral to this claim.

(72.73%, n=16), of the factories have a stand-alone environmental sustainability report. This result is a sign that companies are environment focus according to authors like Baruah (2020) and Asit (2019). Limitation: 27.27%, n=6) was neutral

Likewise, (59.09%, n=13) of the respondents strongly believe that they developed systems for managing, reducing and monitoring environmental costs while the same number (i.e. 59.09%, n=13), accept planning and implementing pollution control investment. Again, these results are supported by the findings of environmental authors like Schaltegger, Hörisch and Loorbach (2020) and Ong, Soh, Tan, Teh & Ong (2022) who says implementing environmental control investment is a sign of environmental conscious.

Limitation: while (4.55%, n=1), say these results are low importance, (n=8, 36.36%) are neutral of the respective opinions.

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Table 4. Cronbach' alpha result on how the organisations care about the environment

Item	Observation	Sign	Item-test correlation	Item-rest correlation	Average interitem covariance	Alpha
Sec2q7.1	22	+	0.4738	0.3786	.2525734	0.8618
Sec2q7.2	22	+	0.6640	0.5990	.2398749	0.8498
Sec2q7.3	22	+	0.8252	0.7671	.2091871	0.8336
Sec2q7.4	22	+	0.6631	0.5633	.2259259	0.8503
Sec2q7.5	22	+	0.7686	0.6837	.2089947	0.8402
Sec2Q7.6	22	+	0.4955	0.4103	.2525734	0.8600
Sec2q7.7	22	+	0.3603	0.2676	.2631554	0.8672
Sec2q7.8	22	+	0.6465	0.5433	.2277537	0.8519
Sec2q7.9	22	+	0.6219	0.5104	.2294853	0.8547
Sec2q7.10	22	+	0.7755	0.7065	.2161135	0.8390
Sec2q7.11	22	+	0.7500	0.6623	.2124579	0.8421
Test scale					2307359	0.8624

The scale above shows an adequate internal consistency, α=0.86.

The above Cronbach's alpha test results confirm that the items in section (sec2Q7.1- sec2Q7.11) are reliable in terms of how the food and beverage manufacturing companies are environment-conscious.

Environmental challenges or problems faced by food manufacturing companies in Gauteng. This section demonstrates the respondents' opinion on the environmental challenges or problems faced by their companies. The results are as follows:

(86.36%, n=19) of the food and beverage factories agree that they are faced with environmental challenges such as waste and emission generation and only (n=3, 13.64%) are neutral to this problem. This shows that input-output are at disproportionate rate. These results conform to the findings of Dlamini and Shuttle (2021) and Sari et al. (2020).

Similarly, (77.27%, n=17) say their food companies struggle to recycle their materials for maximisation of resources and they see it as a major problem and this conforms to the findings of Shahbaz et al. (2018). However, (13.64%, n=3) regard the claim as low importance and only (9.09%, n=2) are neutral.

(81.82%, n=18) of the Gauteng food manufacturing companies are agree facing the problem of input-output balance as a result of deficiency of capacity to track or control all the energy, water, materials and wastes flowing inside and outside of an organization but only (18.18%, n=4) are neutral to this claim. This result is supported by Wang et al. (2019) and Zenghelis and Paul (2021) who found that disproportion in input-output occurs when organisations lack the capacity to control their material and material-driven costs.

(77.28%, n=17) of the participants accept that their companies are facing the problem of high environmental cost and the limitation to this result is that (22.73%, n=5) are neutral to this claim. This result agrees with those of environmental authors like Shahbaz, Wamba and Latan (2018) and Burritt, Schaltegger and Katherine (2021).

(90.91%, n=20) of participants say that reporting environmental data to regulatory authority is a major problem facing food manufacturing companies in Gauteng which requires urgent attention but only (9.10%, n=2) is neutral. These results concur with those of Dlamini and Shuttle (2021) and Norsyahida et al. (2014) and Haggerty (2020) who found that most organisations in developing countries like South Africa struggle to report their environmental information in environmental/sustainability report.

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(68.18%, n=15) of the participants strongly agree that food and beverage companies have the environmental problem of pollution. According to Asit (2019) and Govender (2016) South African food and beverage companies have poor environmental footprints from production to disposal. However, the limitation to this claim is that (9.10%, n=2) believe that this problem is of low importance while (22.73%, n=5) are neutral of these results.

Likewise, (72.74%, n=16) confirm that compliance with environmental regulation or certification to standards (i.e. ISO 14001) is a big problem in food and beverage companies and authors like Gibassier and Alcouffe (2018) found it to be true. However, while (9.10%, n=2) feel that this result is of low importance, (18.18%, n=4) are neutral to this claim.

(63.64%, n=14) of the participants say that the food manufacturing companies have a problem of estimating their performance through sustainability reporting and that concurs with the findings of Obioha (2024). The limitation to this claim is that while (13.64%, n=3) see it as low importance, (22.73%, n=5) are neutral.

Table 5. Cronbach' alpha result on how the organisations care about the environment

Item	Observation	Sign	Item-test correlation	Item-rest correlation	Average interitem covariance	Alpha
Sec2q8.1	22	+	0.4984	0.4556	.8676374	0.9407
Sec2q8.2	22	+	0.5571	0.5032	.8436967	0.9394
Sec2q8.3	22	+	0.8252	0.7671	.2091871	0.8336
Sec2q8.4	22	+	0.8865	0.8596	.7405221	0.9287
Sec2q8.5	22	+	0.8974	0.8755	.7525253	0.9286
Sec2Q8.6	22	+	0.8387	0.7990	.7423587	0.9308
Sec2q8.7	22	+	0.9003	0.8767	.7394726	0.9281
Sec2q8.8	22	+	0.8983	0.8705	.7190739	0.9281
Sec2q8.9	22	+	0.8993	0.8760	.7417027	0.9282
Sec2q8.10	22	+	0.8787	0.8451	.7203201	0.9291
Sec2q8.11	22	+	0.9054	0.8796	.7186147	0.9277
Sec2q8.12	22	+	0.1376	0.0668	.9090253	0.9486
Sec2q8.13	22	+	0.2176	0.1594	.8989899	0.9458
Test scale					7776668	0.9386

The above test results confirm that the items in section (sec2Q8.1- sec2Q8.13) i.e. the internal consistencies are valid and reliable in terms of how food and beverage companies accept broad environmental issues/problems faced by their organisations.

Despite the pro-active steps taken by the food manufacturing companies in Gauteng, to become environment-friendly by implementing environmental strategies and tools such as environmental vision and mission statements and even to the extent of rating the environment as a corporate priority, environmental challenges, impacts and problems are significantly on the increase. Although most manufacturing companies develop a system for managing, reducing and monitoring environmental costs as well as planning and implementing pollution, waste and emission control investment, they keep performing poorly in terms of environmental protection and regulation. One probable reason might be that these environmental management systems, tools and strategies are not utilized at their full potential. Hence, EMA could be the appropriate tool/model that can occupy the gap for effective management and reduction of environmental impacts/costs in the absence of traditional accounting systems.

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How EMA's physical and monetary data can address the environmental challenges/impacts of Gauteng Food and beverage manufacturing companies. This section demonstrates the capabilities of EMA's physical and monetary information in managing and controlling the food and beverage manufacturing companies' environmental challenges or problems as aforementioned. EMA uses some standard accountancy techniques to identify, analyse, manage, reduce and control environmental challenges and impacts/costs thereby providing joint benefit to the company, community/society and economy as a whole as under:

Problem of waste and emission generation: (86.36%, n=19) of the companies regard this as a serious problem. According to IFAC (2015) and Burritt et al. (2021) and Dlamini and Shuttle (2021), waste and emission is referred to as non-product output (NPO). Examples include solid waste, hazardous waste, wastewater and air emissions. These are as a result of poor equipment efficiency and maintenance, inefficient operating practices, production losses, product spoilage and poor product design.

Although Gauteng food and beverage manufacturing companies have management accounting and environmental management systems, policies and procedures in place to reduce, manage, and control environment related costs and impacts for improving environmental and financial sustainability, waste and emission generations continue to be a serious concern. Even for those food and beverage manufacturing companies who pose as environmental leaders in environmental protection by subscribing to JSE under sustainable responsible investment (SRI) index and ISO 14001, there remains a large margin between what they say and what they actually do. Thus, (EMA) is receiving an international recognition as a tool or system that is useful for business in addressing environmental challenges/problem faced resulting to social, environmental and economic performance (Klingelhoefer & Obioha, 2012; Asit Bhattacharyya, 2019; Burritt et al., 2021; Schaltegger et al., 2020). EMA principles and procedures can be used to obtain efficiency in projects by the reduction of waste and emissions generation in the manufacturing companies especially the food and beverage companies in Gauteng, South African. The physical information under EMA can be utilized for the generation of environmental performance indicators (EPIs) in order to assess and report the material and material-driven cost related to levels of consumption of natural resources, generation of wastes and emission, total amounts of fresh water consumed and total amount of wastewater created each year leading to environmental performance and financial sustainability. This is helpful for fixing service consumption prices for Gauteng food and beverage manufacturing companies, government municipalities as well as other parties.

Problem of recycling: Essentially recycling is vital for the environment and any economy. Recycling is converting old and abandoned products or wastes into new ones (Compare for this and the following statements Tsheleza et al., 2019; Rasmeni & Madyira, 2019; Nyika et al., 2020). Recycling saves resources and less garbage to the landfills. Thus, recycling reduces air and water pollution. The quantity of waste produced increases with the population and the more the waste production, the more the landfills. Conversely, there is few space on earth compared to the magnitude of the waste, therefore obviously we must use it judiciously.

Hence, this problem of waste dumping and the valuable space to dump them is solved through recycling. With recycling the atmosphere is rid of millions of tonnes of carbon. Thus, recycling has the ability to reduce carbon emissions of 10.4 – 11.2Gt carbon dioxide equivalent (CO_2e) emission from 2020-2050, which would be equivalent to the one Japan emits in a year. There are gains to be made from what we do with our food too. Globally about 17% of food in shops, restaurants and homes are thrown away rather than eaten each year. This enormous waste contributes to about 8-10% of global greenhouse gas emissions as it gets rotten (UNEP, 2015). However, composting

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reduces the carbon emissions associated with food by 14% compared to dumping them in landfills and keeping leftovers to eat later rather than throwing them to the bins can reduce that further.

The majority of the food manufacturing companies (77.3%, n=17) believe this is a major problem. This implies that Gauteng food and beverage companies are more involved in disposing their solid and non-solid wastes like waste paper, plastic containers and solid scraps rather than increasing their resources through recycling. EMA's material flow accounting can ensure that no substantial amount of energy, water, material and material driven costs are unaccounted for by installing internal or external recycling processes at possible points in the value chain. Thus, for efficient and effective management of the costs of wastes and recycling of materials, EMA physical and monetary data is highly recommended.

Problem of input-output balance: The environmental impacts, costs/challenges of most organisations originate from when they use energy, water and materials for production purposes. When these resources are not adequately and effectively utilized, the result is the generation of waste and emissions in the environment; hence, energy, water and materials purchase costs are the major cost driver in many manufacturing organizations (IFAC, 2015; Schaltegger et al., 2020). Thus, to address these impacts/challenges efficiently and effectively physical and monetary information or financial and non-financial data is essential. EMA has the potential to document physical accounting information which is key to the development, management and reduction of many environment-related impacts. (81.82%, n=18) of the food and beverage companies are facing the challenges of input-output balance. This may be as a result of inadequate control systems for tracking all the inputs (i.e. energy, water, materials) and output (i.e. products, wastes) ensuring a balance. Thus, input-output challenge, implies that the materials, water and energy utilized in production in food manufacturing companies are not equivalent to the product and non-product outputs, resulting to loss of resources in terms of sale of products and cost of disposal of waste and emissions.

Again, EMA's material flow accounting can provide a correct and complete picture of materials used in production as well as the details of materials flows by tracing through all the different organizational materials management steps, such as materials procurement, delivery, inventory, internal distribution, use and product shipping, as well as waste collection, recycling, treatment and disposal, all with the materials balance numbers attached. With the help of EMA physical data, food manufacturing companies can achieve materials balances at many different levels. The physical information can be collected either for an entire organization, or for particular sites on input materials, waste streams, processes or equipment lines, product or service lines depending on the intended use of the information. By so doing waste and emission can be somehow eliminated or drastically reduced ensuring input-output balance.

Problem of environmental costs: The magnitude of environment-related costs as a percentage of overall operating costs in many industrial sector has been attracting increasing concern and attention (IFAC, 2005; Jamila, Muhammad & Ali, 2015; Schaltegger et al., 2020). This can be due to various reasons such as regulatory requirements involving huge fines for non-compliance to environmental regulation, environmental pressures from internal and external stakeholders, inefficiency of material purchase value of non-product output, processing costs of non-product output as well as the inadvertent hiding of environment-related costs in the overheads account (IFAC, 2005; Jamila, Muhammad & Ali, 2015; Gunarathne & Lee, 2015; Burritt et al., 2021). Additionally, the use of overhead accounts for environmental costs can also be problematic when overhead costs are later re-allocated back to costs centers such as processes and products for costing and other purposes. Thus, as the society as a whole has become more environmentally focus, and

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people becoming increasingly conscious about the 'carbon footprint' the management and reduction of environmental costs has become inevitable.

On the one hand, the United States Environmental Protection Agency (USEPA), defines environmental costs depending on how an organisation intends using the information. They made a distinction between four types of costs:

- conventional costs: raw material and energy costs having environmental relevance
- potentially hidden costs: costs captured by accounting systems but then losing their identity in 'general overheads'
- contingent costs: costs to be incurred at a future date – for example, clean-up costs
- image and relationship costs: costs that, by their nature, are intangible, for example, the costs of preparing environmental reports.

On the other hand, the United Nation Division of Sustainable Development (UNDSD) described environmental costs as the costs incurred to protect the environment – for example, the measures taken to prevent pollution and the costs of wasted material, capital and labour, i.e. inefficiencies in the production process. Neither of these definitions contradict each other; they just look at costs from slightly different angles. It is important to note that environmental costs vary greatly from business to business.

The majority of the food and beverage manufacturing companies (77.28%, n=17), are plagued with high environmental costs. The environmental costs generally comes as a result of the materials, energy, water and wastes that an organisation utilizes in course of production. Hence, the environmental costs associated with food and beverage companies include waste and effluent disposal, water consumption, energy, transport and travel as well as consumables and raw materials. This paper demonstrates how EMA can be utilized to address the above environmental costs as follows:

Waste and effluent disposal: Waste is one of the components of environmental costs. For example, the costs of unused raw materials and its disposal; taxes for landfill; fines for compliance failures such as pollution. EMA's physical and monetary data can be used to identify the quantity of material that become waste by applying the 'mass balance' approach, that enables the weight of materials used in production being compared to the product produced thereby identifying the potential cost savings. Additionally, environmental costs in Gauteng food and beverage manufacturing companies include lost land resources (i.e. waste that is buried) and the generation of greenhouse gases in the form of methane.

Water consumption: Businesses actually pay for water twice – first, to buy it and second, to dispose of it. If savings are to be made in terms of reduced water bills, it is important for organisations to identify where water is used and how consumption can be decreased. Thus, EMA encourages the tracking of physical information on the flow of energy, water, materials and wastes because such information allows an organization to assess and report the important materials-related aspects of its environmental performance, ensuring that all amounts of these materials are accounted properly.

Energy: Little cost is required for the reduction of energy. EMA data has the potential for cost savings in energy via ability to identify energy inefficiencies and wasteful practices. Under EMA, manufacturing organisations can maintain energy balances separately ensuring that all energy inputs will eventually become outputs. Thus, EMA has the capacity and potential for energy cost savings.

Transport and travel: Again, EMA can bring about possible savings in business travel and transportation of goods and materials by investing in more fuel-efficient vehicles.

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Consumables and raw materials: Costs associated with consumables and raw materials are easy to identify. Hence, EMA type data can assist in controlling and reducing the cost of consumable and raw materials with the help of material flow accounting ensuring balance in materials and consumables. For example, toner cartridges for printers could be refilled rather than replaced. Thus, presenting the opportunity of dual cost benefits/savings. Financial benefits/costs for the organisation and waste saving for the environment (dumping of toner cartridges).

Problem of reporting environmental data to regulatory authority: Environmental reporting is a concept that requires sharing of information on an organisation's environmental impacts, policies and performance in sustainability reports, news articles, documentaries and/or scientific research papers (Wachira & Mathuva, 2022; Uyar et al., 2021). The information may include pollution, water and waste management as well as key performance indicators (KPIs). Hence, the significance of environmental reporting is as follows:

- Helps to raise awareness on environmental issues
- Helps companies identify and manage their environmental impacts
- Assist companies demonstrate their commitment to sustainability
- Raises shareholders, warrantors and investors' confidence
- Improves competitiveness
- Raises the motivation and satisfaction of employee
- Improves communication with stakeholders

Environmental reporting can be a tool for improving the relationship of both the business and the society through the provision of detailed and elaborate information on business, environmental goals, procedures and strategies as well as environmental protection. The result is that (90.91%, n=20) of the food manufacturing companies believe that reporting environmental data to regulatory authority is a major problem facing food manufacturing companies in Gauteng. However, this is strange when one considers the fact that the results on whether Gauteng food manufacturing companies cares about the environment. (95.45%, n=21) of the factories believe that their companies are implementing ISO 14001, (81.82%, n=18) have environmental section in annual report and (77.73%, n=16) have stand-alone sustainability report. Hence, the truth of the matter is that they cannot implement the above environmental management systems and still be confronted with the problem of reporting. It is either they are just merely acting but not actually doing it. However, this paper examines how EMA physical and monetary information could be a starting point for addressing this problem. EMA complies with environmental regulation and protection and it reports environmental waste and emission to regulatory authority. Similarly, EMA play a strategic role by implementing cost-effective and environmentally sensitive programmes as well as reporting their environmental issues to stakeholders such as customers, investors and local communities. This implies that implementing EMA systems and procedures fully in Gauteng food manufacturing companies will adequately address the problem of environmental reporting.

Problem of pollution: Over the years, the environment and the natural resources are being threaten due to the increasing urban and industrial development throughout the world leading to high levels of pollution (Obioha & Klingelhoefer, 2012; WBCSD, 2015; Schaltegger et al., 2020; Evans, 2022). Additionally, the sub-optimal use of the natural resources and the unacceptably high levels of air and water pollution has been reported by the South Africa's Reconstruction and Development Programmes as the major problems areas regarding the environment (South African Country Report, 2005; KPMG, 2020; IFAC, 2015; Dauda et al., 2021; Kate Griffin, 2022). While industrial pollution includes waste and emissions generation emanating from product design and quality issues as well as from operating inefficiencies such as input and output imbalances, domestic

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pollution mainly originates from cooking and heating (Aziz, Sharif, Raza, & Jermsittiparsert, 2021; Koseoglu, Yucel & Ulucak, 2022).

(68.18%, n=15) of the factories posit that Gauteng food manufacturing companies are confronted with the problem of pollution. The result shows that Gauteng food and beverage manufacturing companies are unable to account for the amounts and whereabouts of the energy, water and materials used to support their activities. Monetary and non-monetary information on material consumption, personnel hours, pollution, waste and missions generation, monitoring, prevention and control need to be collected in order to address these environmental cost/impacts via EMA on the company level (IFAC, 2005; Drury C, 2019; Burritt et al., 2021). EMA places particular emphasis on the materials and materials-driven costs as well as on the environmental impact resulting from the use of energy, water and materials, as well as of the generation or use of pollution, wastes and emissions (IFAC, 2015; Klingelfoefer & Obioha, 2012; Kate, 2022), so that the company´s objective of environmental, social and economic sustainability can be achieved.

Thus, EMA is a valuable tool for managing the businesses' environmental challenges/impacts resulting to environmental and financial sustainability for the company and the society (Klingelhoefer & Obioha, 2012; WBCSD, 2015; Burritt et al., 2021; Schaltegger et al., 2020; Dlamini & Shuttle, 2021). The results furthermore, show that big portion of the factories do not really know its actual impact on the environment. Hence, the physical and monetary data of EMA may assist in controlling resources, packaging materials, reducing the carbon footprint and improving the efficiency of the company´s sewage systems thereby improving the environment-related costs, earnings and savings.

Problem of compliance with environmental regulation or standard: Environmental regulation is a set of laws and policies that govern how humans and companies relate to the environment (compare to this and the following statements Ilyas, et al., 2020; Erin et al., 2021; Islam & Hossain, 2022). They are created and enforced by local, national and international governments. South African environmental regulation comprises natural resource conservation and utilization as well as land-use planning and development. Furthermore, South African environmental law is influenced by the issues of enforcement as well as the national and international directives. In South Africa the environmental regulation covers land management, water quality, air quality, conservation, contaminant clean-up and protecting species considered important to support species recovery. The aim of the regulation is to avoid over-exploitation and depletion, hence environmental regulation should be able to foster technological innovation within firms. In other words, the effect of environmental regulation on technological innovation is relative to the industrial structures, stages of economic development and types of regulatory instruments prevalent in that company.

(72.74%, n=16) of the factories believe that compliance with environmental regulation, e.g. waste and emission certificates as well as air monitoring is a big problem. Thus, environmental challenges like environmental regulation, self-imposed environmental policies as well as environmental protection via cost-efficient compliance are dimensions of EMA. EMA systems and procedures encourage reporting of waste and emission as well as air pollution to regulatory authorities. In the food and beverage companies as well as the industrial sector, EMA mass balance may result to higher economic efficacy. Thus, by ensuring that all physical inputs eventually become outputs and by establishing systematic controls and effective management systems (e.g. a materials flow accounting process to ensure that no significant amounts of water, energy or other materials and material-driven costs are unaccounted for). Hence, providing a possibility for the identification of sources of unnecessary waste production and pollution; and at the same time ensuring a more efficient use of resources. EMA is that specialised part of the management accounts that focuses on

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the things such as the cost of energy, water and the disposal of waste and effluent. It is important to note at this point that the focus of environmental management accounting is not all on purely financial costs but also on non-financial cost. This includes consideration of matters such as the costs and benefits of buying from suppliers who are more environmentally aware, or the effect on the public image of the company from failure to comply with environmental regulations.

The problem of estimating performance through sustainability report: The field of sustainability was escalated by the World Business Council for Sustainable Development (WBCSD) (2015) and the World Resource Institute (WRI) (2015) along with business strategists such as Porter and Kramer (2011). The positive relationship between corporate sustainability performance and business value is supported by scholarly work and several research articles (Stanković, Novićević & Đukić, 2013; Tilt et al., 2020; Burritt et al., 2021; Schaltegger et al., 2020; Ong et al., 2022; Obioha, 2024). Sustainability is therefore, a process whereby companies increase their bottom lines by integrating their economic, social and environmental purposes into their business strategies by striking a balance between the three (Ramos & Caeiro, 2010; GRI, 2013; Avlonas & Nassos, 2020; Islam & Hossain, 2022; Obioha & Klingelhoefer, 2023). In addition, for continuous performance, companies must comply with a growing number of national regulations and international standards governing the environment, labour, human rights, anti-corruption practices and corporate governance (compare for this and the following statements GRI, 2013; WBCSD, 2015; KPMG, 2020; Tilt et al., 2020; Oware, 2022). However, sustainability is more than legal compliance. Sustainability demands that companies contribute to building a sustainable society by proactively innovating products and services that are not only economically attractive and environmentally sound but also contribute to fulfilling a social need (Obioha, 2024). Although most analysts argue that if implemented, these initiatives and conclusions can contribute to making business more profitable.

The majority of respondents (63.64%, n=14) strongly agree that the food manufacturing companies have a problem of estimating their performance through sustainability reporting. EMA principles and procedure supports environmental and sustainability reporting. The role of accountants has undergone a profound transformation in recent years, driven by shifting paradigms in accounting practices (IFAC, 2017; Erin et al., 2021). Historically, accountants were primarily seen as financial gatekeepers, responsible for ensuring the accuracy of financial statements and compliance with regulatory requirements. However, the contemporary accounting landscape has evolved to encompass a broader set of responsibilities. Accountants are no longer confined to financial reporting alone. They are increasingly involved in sustainability reporting, where they play a pivotal role in measuring and disclosing an organization's environmental, social, and governance (ESG) performance (IFAC, 2017; Obioha, 2024). This shift reflects a growing recognition that organizations must be accountable not only for their financial bottom line but also for their impact on society and the environment. The physical data of EMA could be used to create EPIs which could assist Gauteng food and beverage manufacturing companies in assessing and reporting materials-related aspects of environmental performance in sustainability report, such as the levels of consumption of natural resources, generation of waste and emissions, total amounts of fresh water consumed and the total amount of wastewater generated each year. This information is also required for the suitable tariff setting of service consumption.

EMA and Environmental and Financial Sustainability. This section demonstrates the linkages between EMA type data and environmental and financial sustainability. It additionally reveals how EMA tools and systems can drive or translate to environmental and financial performance in Gauteng food and beverage manufacturing companies. Obtained results are as follows:

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- (86.36%, n=19) of the participants strongly agree that EMA's physical information can bring about efficiency in material flow accounting which is able to translate to environmental and financial sustainability and this result is supported by Schaltegger, Hörisch and Loorbach (2020), Dlamini and Shuttle (2020) and Ong et al. (2022).
- (81.82%, n=18) of the participants are of the opinion that EMA tools that improve eco-efficiency and strategic position on companies' image/reputation can drive environmental and economic sustainability as reputation is a corporate asset that can magnet or attract customers, employees and investors. Again, this result concurs with the findings of Edwards (2010) and Gyver and SeTin (2022) who posit that reputation can help a company to attract and retain customers and it has a strong link to corporate sustainability performance.
- (72.72%, n=16) of the respondents strongly agree that environmental performance indicators (EPIs) that reveal the total amount of waste water treated per year with the assistance of EMA systems and procedures which enables tariffs setting for food manufacturing companies can lead to environmental and financial sustainability and this result conforms with environmental and sustainability authors like Obioha (2024) and Obioha and Klingelhoefer (2023).
- All the respondents (100%, n=22) strongly agree that EMA physical data that allows for tracking and controlling of their resources/operations can result to a more efficient use of energy, water and materials in internal operations for final products or services leading to environmental and financial sustainability. This result agrees with that of IFAC (2005) and Schaltegger et al. (2020) who agree that EMA systems and models have the capacity to eliminate wastes through adequate monitoring and controlling techniques that ensures output equals input hence leading to financial and environmental sustainability.
- The majority of the respondents (95.46%, n=21) strongly agree that EMA physical data ensures efficiency in material and material driven environmental impacts leading to environmental and financial sustainability and this is in line with the findings of IFAC (2005) and Islam and Hossain (2022).
- (95.45%, n=21) of the respondents believe that it is possible that EMA's monetary data can bring about a more efficient costs in the use of energy, water and materials in internal operations and final products hence translating to environmental and financial sustainability. This claim is true as it conforms to the findings of Burritt, Schaltegger and Katherine (2021) and Nkundabanyanga, Muramuzi and Alinda (2021) who posit that EMA type data can translate to environmental and financial sustainability via efficient and effective reduction and control of energy, water and material and material-driven costs in an organisation.
- (100%, n=22) of the participants are of the opinion that EMA monetary data can effectively account for material cost of non-product output via its material cost flow accounting leading to environmental and financial sustainability and this result is supported by the finding of Sari et al. (2020) and Zenghelis and Ekins (2021).
- (77.27%, n=17) of the factories strongly accept that EMA's monetary EPIs that reveal wastewater treatment costs per unit for customer service each year can assist the food manufacturing companies or any other organisation to increase their environmental and financial sustainability. Again, this result is supported by the findings of environmental and sustainability practitioners like Islam and Hossain (2022) who found that EMA monetary data ensures a company's eco-efficiency investments and sustainability performance via more accurately tracking the flow of energy, water, materials and wastes.

CONCLUSION

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Despite corporate strategies in place and the actions taken for improved environmental performance, Gauteng food and beverage manufacturing companies continue to face environmental challenges/impacts. There is a gap in the things which companies who are group leaders in environmental protection (by subscribing to JSE, SRI index) claim they do and what they are actually doing (i.e. confession and measurable action). Most companies maintain being aware of EMA, but most of them lack the capacity, technique and skill necessary to use it to full potential. However, EMA could be a tool for reducing impacts on the environment - throughout the economy. Hence, this paper may have accomplished the research questions and the objectives by determining in percentages how Gauteng food and beverage manufacturing companies care about the environment and the environmental problems/impact faced on the one hand and determining how EMA-type data can be utilized to manage, control and reduce these impacts/challenges at source resulting to environmental and financial sustainability on the other hand.

However, the importance of EMA has been emphasised by concerns from internal and external stakeholders about the negative impact of manufacturing activities on human lives and the environment as demonstrated in the Kyoto Protocol for greenhouse gas emissions. Hence, pollution, emission and waste management is not the exclusive duty of governments. Instead, the private sector and civil society have crucial roles to play too. Industries in South Africa, especially food and beverage manufacturing companies, need to reconsider environmental challenges and environmental management accounting (EMA) and factor them into decision making with respect to their products, services and processes. They also need to consider environmental issues in the context of the consumption of energy, water, raw materials and material-driven costs as well as the prevention of pollution, waste and emission generation from their production processes as enumerated in this study.

Thus, by doing so, growth in terms of economic development may become sustainable, ensuring that the sub-optimal and or inequitable distribution of natural resources is reduced hence translating to environmental and financial sustainability. This paper therefore contributes to literature by projecting EMA as a model for achieving strategic advantages, environmental and financial sustainability via capacity to monitor, manage and control the consumption and flow of energy, water, material and waste more effectively in food manufacturing companies or other industrial sectors in South Africa or the world. For further studies, this paper recommends that the role of EMA be examined in other sectors like industrial, resources and commercial as well as government municipalities.

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