ENVIRONMENTAL SUSTAINABILITY PRACTICES AND OPERATIONAL EFFICIENCY AT NILE BREWERIES UGANDA LTD

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A DISSERTATION SUBMITTED TO THE SCHOOL OF BUSINESS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A DEGREE OF MASTER OF BUSINESS ADMINISTRATION OF UGANDA CHRISTIAN UNIVERSITY

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UGANDA CHRISTIAN UNIVERSITY

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DECLARATION

I, **Kato Paul,** declare that this Dissertation entitled ***"Environmental Sustainability Practices and Operational Efficiency at Nile Breweries Uganda LTD"*** is my own original work and has never been presented at any academic Institution in fulfilment of the requirements for any academic award. All sources of information used in this report have been well cited and corresponding authors acknowledged. I therefore submit it to Uganda Christian University for the award of a Master's Degree in Business Administration.

Signed: ……. Date 20/05/2025

APPROVAL

I certify that this research by Kato Paul, entitled ***"Environmental Sustainability Practices and Operational Efficiency at Nile Breweries Uganda LTD"*** was conducted under my supervision and is now ready for submission.

Sign……. Date…20/05/2025……

Mukisa Simon Peter
SUPERVISOR

DEDICATION

I dedicate this work to my beloved Parents; Mr & Mrs Peter Turiyo, My wife; Atungye Caroline, My Sons; Mugarura Paul and Abaho Lyon, and My daughter; Ahabwe Liana

ACKNOWLEDGEMENT

I thank God Almighty, for it is by His sufficient grace that I have come this far. Without His guidance, strength, and provision, this achievement would not have been possible.

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God bless you all

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LIST OF ABBREVIATIONS

CVR	Content Validity Index
CSR	Corporate Social Responsibility
ESP	Environmental Sustainability Practices
EPR	Extended Producer Responsibility
NRBV	Natural Resource-Based View
NBL	Nile Breweries Limited
OE	Operational efficiency
PP	Pollution Prevention
PPP	Pollution prevention practices
RE	Resource Efficiency
REP	Resource efficiency practices
RBV	Resource-Based View
RCP	Responsible Consumption and Production
SMEs	Small and Medium-Sized Enterprises
SDG	Sustainable Development Goal
SPS	Sustainable Product Stewardship
TQM	Total Quality Management

ABSTRACT

This study investigated the effect of environmental sustainability practices on operational efficiency at Nile Breweries Uganda Ltd. The specific objectives were to examine the effect of pollution prevention practices, resource efficiency practices, and sustainable product stewardship on operational efficiency. A cross-sectional study design was used, enabling data collection at a single point in time. A mixed-methods approach was used which involved collecting quantitative data from 214 members of operational staff and qualitative data from 10 middle level managers and 3 members of Top. The respondents were sampled using purposive sampling and simple random sampling techniques. Data were collected using questionnaires and interview guide. Quantitative data was analysed using percentages, mean, standard deviation, correlation, and multiple regression analysis, whereas qualitative data was analyzed using thematic analysis as per the objectives of the study.

The findings indicated that resource efficiency practices had a significant positive effect on operational efficiency ($\beta = 0.476$, $t = 5.491$, $p = .000$), demonstrating that enhanced resource management significantly boosts operational performance. Similarly, sustainable product stewardship had a significant positive effect on operational efficiency ($\beta = 0.328$, $t = 3.950$, $p = .000$), implying that proactive stewardship practices effectively can improve operational efficiency. On the other hand, Pollution prevention practices had a positive but not-significant effect on operational efficiency ($\beta = 0.005$, $t = 0.062$, $p = .951$), indicating that while pollution prevention practices may be beneficial environmentally, these practices alone do not significantly and sustainably influence operational efficiency.

Basing on the findings, it was concluded that adopting and enhancing resource efficiency and sustainable product stewardship practices positively affect operational efficiency at Nile Breweries. However, implementation of pollution prevention initiatives require additional support to maximize their operational benefits.

Therefore, it was recommended that management of Nile Breweries strengthen investment in resource-efficient technologies, advance sustainable product designs and packaging, and enhance employee training and awareness programs. Further it was recommended that management support regulatory frameworks, enact clear industry-specific standards, and incentives for adopting sustainability practices which are expected to further improve operational efficiency and sustainability outcomes within the brewing industry in Uganda.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Globally manufacturing industries are under increasing pressure to adopt environmental sustainability practices to enhance efficiency and reduce ecological harm (Tumwine et al., 2022). The brewing sector which is known for high water and energy consumption faces growing demands for sustainable production (Scheller et al., 2021).

This study investigated the effect of environmental sustainability practices on operational efficiency at Nile Breweries Uganda Ltd. The dependent variable was environmental sustainability practices whereas the dependent variable was operational efficiency. The chapter presents background, problem statement, purpose, objectives, research questions, hypothesis, conceptual framework, scope, justification, significance and definitions of key terms and concepts of the study.

1.1 Background of the study

Historically, the concept of operational efficiency evolved significantly from Frederick Taylor's scientific management principles in the early 20^{th} century, which emphasized process standardization and labor productivity to contemporary approaches such as lean manufacturing and total quality management (TQM) (Smith & Jones, 2023). These modern methodologies integrate technological advancements and systematic management practices to optimize resource use, eliminate waste, and enhance productivity across industries (Lee, Chung, & Cho, 2023). Currently, operational efficiency is not only perceived in terms of productivity and cost reduction but is also intricately linked with sustainability and environmental performance.

Environmental sustainability practices emerged as critical operational considerations primarily during the late 20th century, gaining prominence from the 1980s due to increased global awareness about environmental degradation, resource depletion, and climate change (Li et al., 2024). The seminal Brundtland Commission Report (1987) marked a significant milestone, introducing sustainable development as a strategic objective balancing economic growth, environmental stewardship, and social responsibility. Consequently, global organizations began to acknowledge sustainability practices as essential strategies for long-term viability, regulatory compliance, and competitive advantage (Wang, Li, & Chen, 2023). Globally, companies are currently adopting practices such as; preventing pollution, ensuring efficient use of resources, minimizing waste, and sustainable product stewardship to enhance operational efficiency, reduce costs, mitigate risks, as well as strengthen brand reputation (Smith & Jones, 2023). This integration of sustainability into strategies of operation has gradually transformed organizational processes, pushing global competitiveness, productivity, and environmental protection.

For over 20 years, industries have operated with minimal regard for environmental impact, focusing primarily on production efficiency and profitability (Porter & Linde, 1995). Nevertheless, the rise of global environmental concerns in the late 20th Century, together with regulatory frameworks such as the Kyoto Protocol (1997) and the Paris Agreement (2015), compelled industries to integrate sustainability into their operations (OECD, 2018). This shift marked the emergence of green production practices to create a balance between industrial growth and environmental sustainability.

In the African continent, the inclusion of sustainability into daily enterprise functions has gradually gained attention, and this is primarily influenced by the demands form International standards and regulations, and changing market expectations. In Africa's manufacturing

industry, companies have continued to shift to implementing sustainable operational approaches as a strategic response to environmental issues and limitations in resource availability (Adegbite, Ojo, & Oluwole, 2023). Africa has seen manufacturers in Nigeria, Kenya, and South Africa implementing practices like energy conservation, pollution control, and resource efficiency, which have created significant improvements in their operational efficiency (Ojo, Adegbite, & Olaleye, 2022). Despite these improvements, businesses in Africa still experience challenges such as financial limitations, use of outdated technology, poor infrastructure, and limited institutional support, which have led to difficulty in the promotion of environmental sustainability strategies (Mwesigye, Okello, & Mbowa, 2024).

Manufacturing industries including the Brewing sector have elevated environmental sustainability as a priority because of strict regulations and public expectations and ecological concerns. The current manufacturing sector implements waste minimization strategies and renewable energy adoption and environmentally friendly packaging materials to enhance resource usage efficiency for operational performance improvement (Mugerwa, 2023; Nabukeera, 2022). The implementation of environmentally sustainable practices in manufacturing industries leads to reduced operational expenses and elevated productivity levels and regulatory compliance and better brand perception (Kiggundu & Nalunga, 2023). The implementation of these strategies shows differences among firms because of their unique internal capacities and technological systems and regulatory frameworks (Tumwine & Atuhairwe, 2021).The sustainability of the brewing industry has also developed as a reaction to the mostly resource-hungry production methods in the field with energy extensively used, water consumed, and waste generated during production (Scheller et al., 2021). Manufacturing industries in Uganda are implementing environmental friendly interventions which include renewable energy use, water recycling, and circular waste strategies (Hupp et al, 2020). Despite these efforts, Uganda still suffer challenges of capacity to invest weakness in regulation, and

relying on non-modern production technologies that have slowed down the change process to environmentally sustainable practices (Tumwine et al., 2022).

The brewing industry in Uganda has progressed towards adopting sustainability, with Nile Breweries Uganda Ltd leading efforts like the use of biomass energy, treating wastewater, and sustainable sourcing of raw materials (Mugisha et al., 2021). Even though these initiatives are in line with global trends in sustainability, their actual contribution to operational performance remains unknown. A lot of existing research emphasizes compliance and corporate social responsibility, rather than directly exploring how sustainability measures influence production efficiency (Nabukenya et al., 2020).

From this background, this study was designed to examine how environmental sustainability practices (pollution prevention, efficient use of resources, and responsible product stewardship) affect operational efficiency at Nile Breweries Uganda Ltd.

1.2 Statement of the problem

The Annual Operations Report (2023/2024) reveals that Nile Breweries Uganda Ltd has not achieved its targeted environmental protection goals after publicly committing to sustainability. Despite its mission to reduce its environmental footprint Nile Breweries remains challenged by excessive resource usage and ineffective waste management which together with rising carbon emissions forms significant obstacles to its environmental goals (Nile Breweries, 2023). The ongoing sustainability problems bring up critical doubts regarding the actual impact of current environmental practices.

Numerous breweries globally have achieved significant advancements by implementing sustainability measures which simultaneously diminish environmental damage and enhance operational performance. Nile Breweries demonstrates a significant delay in implementing sustainability practices which have proven beneficial to other breweries according to

Amankwah-Amoah (2023). The main barriers to progress at Nile Breweries included outdated technology systems and insufficient financial resources combined with weak environmental law enforcement (Hajmohammad & Vachon, 2016).

Nile Breweries Uganda Ltd has invested in solar panels and biomass boilers while ensuring its purchased electricity comes from renewable sources but the effects on its everyday operations stay unclear (Nile Breweries, 2023). The company initiated waste reduction and eco-friendly logistics projects but insufficient evidence exists to confirm any improvements in productivity or operational cost reduction or overall resource efficiency.

This study examined the effect of pollution prevention, resource efficiency, and sustainable product stewardship on operational efficiency at Nile Breweries Uganda Ltd using the provided context. The study intended to fill current knowledge deficiencies while providing actionable recommendations for merging sustainable practices with business performance in Uganda's brewing sector.

1.3 Purpose of the study

The purpose of the study was to examine the effect of environmental sustainability practices on the operational efficiency of Nile Breweries Uganda Ltd.

1.4 Specific objectives

The study sought to achieve the following objectives;

a) To examine the effect of pollution prevention practices on operational efficiency at Nile Breweries Uganda Limited.
b) To examine the effect of resource efficiency practices on operational efficiency at Nile Breweries Uganda Limited.
c) To examine the effect of sustainable product stewardship on operational efficiency at Nile Breweries Uganda Limited.

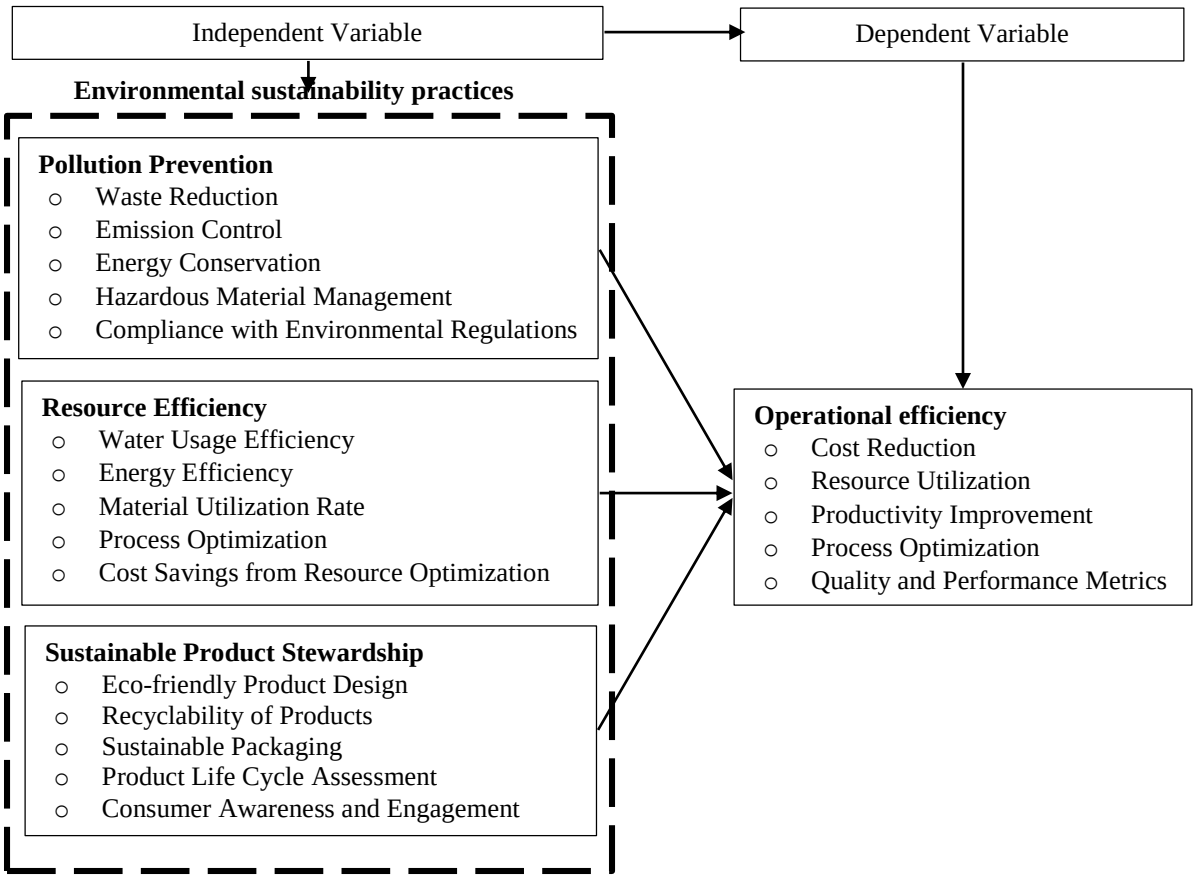
1.5 Research questions

a) What is the effect of pollution prevention practices on operational efficiency at Nile Breweries Uganda Limited?

b) What is the effect of resource efficiency practices on operational efficiency at Nile Breweries Uganda Limited?

c) What is the effect of sustainable product stewardship on operational efficiency at Nile Breweries Uganda Limited?

1.6 Conceptual framework



Researcher's own conceptualization based on NRBV theorization by Hart (1995)

Figure 1.1: Conceptual framework

The conceptual framework illustrates the relationship between environmental sustainability practices and operational efficiency within the context of the brewing industry. The independent variable (environmental sustainability practices) is was measured using three key dimensions: pollution prevention, resource efficiency, and sustainable product stewardship.

Pollution prevention includes measures such as waste reduction, emission control, energy conservation, hazardous material management, and compliance with environmental regulations, all aimed at minimizing environmental harm during production processes.

Resource efficiency focuses on optimizing the use of inputs like water, energy, and materials through strategies such as water usage efficiency, energy efficiency, material utilization, process optimization, and achieving cost savings through better resource use. Sustainable product stewardship requires companies to maintain environmental accountability for a product during all stages of its life cycle. The approach requires environmentally-conscious product designs combined with recyclable materials and sustainable packaging while performing life cycle assessments and engaging consumers in green practices.

The study used cost savings, optimal resource use, productivity improvements, streamlined processes, and quality performance measures to assess operational efficiency as the dependent variable. The conceptual framework suggests that maintaining strong environmental sustainability practices produces improved operational results through cost reduction alongside efficiency gains and enhanced performance. Researchers can examine the effects of sustainability initiatives on operational effectiveness at firms like Nile Breweries Uganda Ltd. based on this established connection.

1.7 Scope of the study

This section describes the content, time, and geographical scope of the study.

1.7.1 Content scope

The study examined the effect of environmental sustainable practices on operational efficiency at Nile breweries Ltd. Specifically, the study focused on three key constructs: pollution prevention, resource efficiency, and sustainable product stewardship. Operational efficiency was conceptualized as assessed through measures such as cost reduction, resource utilization, productivity improvement, process optimization, and quality and performance metrics.

1.7.2 Time scope

The study focused on the period 2021 to 2024, since this is the period when the company implemented environmental sustainability initiatives. Besides, this is the time when the company was faced with challenges of environmental protection as per the international standards (Nile Broweries, 2023/24).

1.7.3 Geographical scope

The study was conducted at Nile Breweries Uganda Ltd headquarters, located in Jinja City, Eastern Uganda, at geographic coordinates Latitude 0.4471° N and Longitude 33.2032° E. The Jinja facility serves as the central hub for the company's production and sustainability operations, making it an ideal site for assessing the integration and effectiveness of environmental sustainability practices.

1.8 Justification of the study

Despite global emphasis on sustainable industrial operations, there was limited empirical evidence within the Ugandan context linking sustainability initiatives, such as pollution prevention, resource efficiency, and sustainable product stewardship—to measurable improvements in operational performance. The study was particularly relevant to the

achievement of the United Nations Sustainable Development Goals (SDGs), specifically SDG 12: Responsible Consumption and Production and SDG 13: Climate Action, as it explores how Nile Breweries' environmental practices contribute to global sustainability efforts while enhancing operational efficiency (UNDP,2023). The study offers practical insights into how such initiatives can lead to cost savings, increased productivity, and long-term business sustainability by examining the effectiveness of renewable energy adoption, improved waste management, and resource optimization, (Dangelico & Pontrandolfo, 2015; Hajmohammad & Vachon, 2016). Additionally, it addresses challenges common in the Sub-Saharan manufacturing sector, including technological limitations, weak enforcement of environmental regulations, and poor sustainability integration (Amankwah-Amoah, 2020). Therefore, the findings of this research would not only benefit Nile Breweries but also serve as a benchmark for other industries and policymakers seeking to align environmental responsibility with operational excellence in similar contexts.

1.9 Significance of the study

It is hoped that the findings of this study might assist the Ministry of Water and Environment and UNBS in developing policies that promote sustainable practices in Uganda's brewing industry, contributing to SDG 12 Responsible Consumption and Production and SDG 13: Climate Action.

The findings of this study might provide practical insights for managers and sustainability officers within the brewing industry to adopt strategies that reduce costs, improve productivity, and enhance environmental sustainability.

The findings of this study might serve as a foundation for further research on sustainable business practices, particularly in developing economies, offering valuable data in terms of

literature and suggested areas for further study for scholars studying environmental sustainability and operational efficiency.

1.10 Definition of key terms and concepts

Pollution Prevention Practices: These are proactive strategies and initiatives implemented by an organization aimed at minimizing waste generation, controlling emissions, conserving energy, and managing hazardous materials effectively, thereby reducing environmental harm at the source.

Resource Efficiency Practices: These are strategic management and optimization of critical resources such as water, energy, raw materials, and waste materials, aimed at minimizing resource consumption, reducing waste, and lowering production costs within organizational processes.

Sustainable Product Stewardship: These are practices and processes through which a company takes proactive responsibility for the environmental impacts of its products throughout their entire lifecycle—from design and manufacturing to consumption and disposal, focusing on eco-friendly design, recyclable materials, sustainable packaging, and responsible waste management.

Operational Efficiency: This is the capacity of an organization to deliver products or services using the least possible amount of resources, time, and cost, while maintaining high standards of quality, productivity, and effectiveness in meeting organizational objectives.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter analyses the related literature on environmental sustainable practices and operational efficiency based on what others have observed world over. The literature is reviewed according to study objectives. The various sources of literature include past research dissertations, texts books, journals, conference papers and magazines. The section is organized in four sections: introduction, theoretical review, empirical review and summary of literature.

2.1 Theoretical Review

2.1.1 Natural Resource-Based View (NRBV) Theory

The Natural Resource-Based View (NRBV) of the firm, originally developed by Hart (1995), expands the traditional Resource-Based View by positioning environmental sustainability as a potential source of competitive advantage. Unlike the Resource-Based View (RBV), which focuses on the internal capabilities of a firm that are valuable, rare, inimitable, and non-substitutable (VRIN), the NRBV emphasizes that firms can gain sustained advantage by developing capabilities that address environmental challenges. Hart (1995) proposed three strategic pathways through which firms can achieve this: pollution prevention, product stewardship, and sustainable development through clean technology. Companies are encouraged to adopt proactive environmental strategies that extend beyond compliance to integrate environmental considerations throughout their operations and supply chains while driving innovation.

According to the Natural Resource-Based View (NRBV) firms which integrate environmental sustainability into their core operations will reduce expenses and improve resource efficiency while building consumer confidence and adapting to new environmental regulations. New research findings support these claims, showing organizations which invest in renewable energy sources and improved waste management systems along with sustainable product development achieve long-term savings and operational improvements (Xie et al., 2022; Omulinga & Lwanga, 2023). The NRBV framework connects with worldwide initiatives including the United Nations Sustainable Development Goals (SDGs) especially SDG 12 which focuses on Responsible Consumption and Production and SDG 13 that targets Climate Action by establishing environmental responsibility as an essential strategic and ethical requirement for contemporary organizations (UNDP, 2023).

The primary criticism of the framework is its absence of tangible and usable guidelines which creates significant challenges for firms specifically those with limited resources to implement its ideas (Zhao et al., 2021). This theory operates under the assumption that businesses can obtain essential resources together with institutional support and advanced technologies which developing countries like Uganda frequently lack. The concept of green innovation appears beneficial but many African businesses face obstacles including inadequate funding and outdated technology alongside weak implementation of environmental regulations (Tumusiime & Nambatya, 2022). According to critics the NRBV fails to account for immediate costs like expensive clean technology investments and the organizational pushback against changes in established manufacturing processes (Mwangi & Oloko, 2023).

The NRBV serves as a useful framework for evaluating the integration of environmental sustainability into operational models by companies such as Nile Breweries Uganda Ltd. The research analyzed the impact of Nile Breweries' environmental strategies in achieving better

operational efficiency and long-term market competitiveness while generating cost savings. The NRBV framework effectively linked sustainability initiatives to concrete performance outcomes within Uganda's brewing sector.

2.1.2 Lean Management Theory

The Lean Management Theory created by the Toyota Production System gained prominence when Womack and Jones introduced it in 1996 because it provides a practical framework for operational improvement. The approach aims to remove waste while optimizing processes and enhancing value delivery. At its core are five guiding principles: Lean management involves these five core principles: understanding value from customers' perspectives, mapping the value stream, maintaining smooth process flows, implementing pull-based production systems, and pursuing continuous perfection. The principles provide a path for companies to streamline their operations by reducing waste and unnecessary expenses while improving productivity resulting in improved operational efficiency.

The theory demonstrates that improved performance results from intelligent methods which focus on eliminating non-value adding activities instead of simply increasing effort. Organizations place substantial focus on eliminating all types of waste including time, materials, labor, and energy while upholding top quality standards. The integration of Lean principles with environmental goals in modern times has led to the development of "Green Lean" or sustainable lean practices. According to Xie, Zhang, and Du (2022), operational efficiency in manufacturing firms from developing economies improves significantly when lean methods integrate environmental capabilities. Omulinga and Lwanga (2023) identify efficient resource utilization and waste minimization as crucial elements that enhance both environmental and financial performance for manufacturers in Uganda. Lean Management offers practical benefits but also presents distinct disadvantages. The emphasis on efficiency in Lean Management can obscure the importance of innovation and strategic adaptation during

rapid market changes (Zhao et al., 2021). In resource-limited environments such as Uganda achieving Lean implementation requires large-scale organizational cultural transformation, comprehensive employee training programs and effective leadership which proves challenging.

Tumusiime and Nambatya (2022) identified that structural difficulties including limited technical capabilities together with organizational change resistance and insufficient regulation can prevent or significantly delay Lean implementation in the local manufacturing sector. Lean methods show maximum efficiency in stable conditions with predictable process variations which developing countries often lack due to infrastructure deficiencies and inconsistent supply chains.

Lean Management Theory continues to provide essential insights into how environmental practices result in improved operational performance despite existing challenges. The focus of Lean Management on resource efficiency along with process improvement and waste reduction aligns with sustainability objectives and advances worldwide development initiatives especially SDG 12 for responsible consumption and production (UNDP, 2023). This research applied the Lean framework to evaluate how Nile Breweries Uganda Ltd's specific practices of energy conservation and water recycling along with waste minimization lead to better outcomes such as cost savings and higher productivity accompanied by smoother operations. The research offered valuable information for Ugandan brewing companies about integrating sustainable practices with operational excellence.

2.2 Empirical review

This section presents the empirical review of literature in line with the objectives of the study.

2.2.1 Pollution Prevention Practices and Operational Efficiency

A growing body of recent research examines the connections between pollution prevention practices (PPP) and operational efficiency across different regions with particular attention to Africa. For example, Wu et al. Wu et al. (2023) analyzed how green innovation technologies helped reduce carbon and particulate emissions in multiple developing nations across Africa. The study showed that the implementation of green technologies led to a substantial decrease in emissions thus establishing a beneficial connection between environmental tech advances and ecological benefits. The research was explicit about the environmental advantages but provided little information regarding the effects of these innovations on daily operational performance.

Wang et al. conducted research in China on collaborative strategies to manage pollution and carbon emissions. Wang et al. (2023) studied joint methods for controlling pollution and carbon emissions. The research demonstrated that collective approaches enhanced environmental performance and produced operational benefits for enterprises. Similarly, Zhang et al. Zhang et al. (2023) demonstrated through their research that heavy smog degraded business efficiency with the impact being more pronounced in labor-dependent companies and those using cost-reduction methods. The research reveals how environmental factors and operational performance are intricately linked.

The brewing sector now recognizes PPP as an innovative approach to enhance operational effectiveness. PPP differs from traditional "end-of-pipe" waste treatment methods by focusing on waste prevention at its origin while simultaneously reducing resource consumption and enhancing cost-effectiveness (Gabler et al., 2020). The expansion of these practices in breweries continues to generate discussion about their widespread adoption and true effects on operational performance. Some studies show environmental and financial benefits from these

practices but Bocken et al. (2022) warn that the high initial costs and technical difficulties frequently obstruct successful implementation.

Research shows breweries that implement sustainable practices demonstrate better operational efficiency. The implementation of water savings and energy reduction initiatives alongside recycling promotion and eco-friendly packaging enables companies in developed regions to lower their production expenses and achieve better regulatory compliance (Wesolowski et al., 2021; Garza-Reyes et al., 2018). The lessons from these sustainability practices do not translate well to developing economies due to their limited infrastructure capabilities and inconsistent regulatory enforcement along with financial limitations (Ojo et al., 2022).

Adegbite et al. (2023) observed that the implementation of PPP in Africa depends primarily on regulatory requirements and financial rewards rather than self-imposed sustainability efforts. For instance, research by Ojo et al. Ojo et al. (2022) revealed that Nigerian breweries experienced better operational performance through waste reduction and water recycling but their success depended heavily on government financial support. Without external assistance many breweries would struggle to make a business case for expensive environmental improvements. Some experts believe environmental practices improve brand reputation and customer loyalty gradually (Gonzalez-Rodriguez et al., 2021), but others find that immediate financial challenges tend to outweigh these long-term advantages particularly for smaller breweries (Mwesigye et al., 2024).

In Uganda, the picture is mixed. Leading breweries such as Nile Breweries have implemented waste-to-energy systems and carbon reduction strategies which Mugerwa (2023) reports as resulting in better compliance and efficiency. According to Kiggundu and Nalunga (2023) these practices have been adopted mainly by large multinational breweries because they possess the necessary financial resources and technical expertise to implement them. Small

local breweries do not have enough funding or expertise and lack regulatory pressure to implement equivalent measures. Environmental initiatives show inconsistency as they are applied unevenly across different sectors.

The broader effectiveness of PPP continues to generate debate among experts and stakeholders. Ainebyona and Nduhura (2023) acknowledge the financial benefits of circular economy practices such as wastewater reuse and spent grain repurposing but point out that these approaches depend on both policy and market support which cannot always be assured. Nabukeera (2022) agrees with this perspective but emphasizes that successful implementation requires very supportive external conditions. Tumwine and Atuhairwe (2021) state that inadequate governmental supervision and weak motivation result in poor compliance which prevents PPP from achieving significant operational efficiency improvements. Concerns emerge because Uganda's breweries appear to focus more on meeting regulatory requirements than on delivering actual efficiency improvements.

A critical consideration involves understanding how immediate costs conflict with potential long-term gains. According to Kiggundu and Nalunga (2023), solar power and energy-efficient systems offer operational benefits through technology use. Mwesigye et al. (2024) indicate that breweries remain reluctant to fully adopt new technologies because of the high initial costs and unpredictable financial returns. It highlights why a detailed cost-benefit analysis is essential to confirm that these investments achieve genuine returns. Some researchers suggest implementing stronger governmental regulations and incentives, but others express concern that excessive regulation may drive up operational costs and obstruct business expansion (Adegbite et al., 2023).

Several research studies recognize the benefits of PPP for operational efficiency but often overlook the specific challenges breweries in developing areas encounter. Research does not

currently provide long-term assessments of these practices since most studies target major breweries while neglecting the smaller and medium-sized ones. The absence of data creates uncertainty about the effectiveness of pollution prevention strategies in the entire brewing industry.

2.2.2 Resource Efficiency Practices and Operational efficiency

Breweries now treat resource efficiency practices (REP) as fundamental methods to enhance operational performance while minimizing waste and achieving effective cost management. Breweries across the globe which adopted REP reported improvements in their productivity and environmental performance alongside better financial results (Gabler et al., 2020). The Resource-Based View (RBV) theory forms the foundation of resource efficiency as it shows that organizations which utilize internal resources such as energy, water and raw materials effectively can gain a competitive advantage (Barney, 1991). Studies demonstrate that breweries using REP systems for energy and water management achieve reduced operational expenses and improved process efficiency (Bocken et al., 2022).

Wang et al. Wang et al. (2023) conducted a study to examine the effects of merging green innovation practices with corporate social responsibility (CSR) initiatives on manufacturing sector resource efficiency. The study demonstrated that combining both strategies resulted in quantifiable enhancements in resource utilization and operational efficiency. Smith and Jones (2023) established that firm performance depends heavily on internal aspects such as business strategy and operational practices. Businesses that implement strategies focusing on resource efficiency benefit from enhanced daily operations alongside organizational growth.

In Japan, Zhang et al. Zhang and his research team explored how resource efficiency and energy productivity levels relate to environmental degradation in Japan in 2023. The team discovered that improved resource management resulted in both reduced environmental

damage and higher operational efficiency demonstrating that these objectives can achieve simultaneous success.

Current studies show potential results yet there remains insufficient research examining the direct effects of REP on operational efficiency particularly in SMEs and developing countries. Research primarily focuses on big companies within developed countries but fails to explore how similar practices function under more limited financial and structural conditions. Research needs to focus on local contexts to understand the implications of REP on both operational performance and environmental outcomes across different organizational structures and national environments.

African breweries operate in distinctive environments where energy supply constraints and water scarcity combine with intricate regulatory frameworks to present ongoing operational challenges. Resource efficiency becomes an essential strategy for enhancing performance because of these conditions (Ojo et al., 2022). Research demonstrates that breweries which dedicate resources to energy-efficient systems and methods for water reuse and waste reduction experience better productivity and cost-efficiency (Adegbite et al., 2023). The success of these initiatives relies on multiple factors such as the size of the company, technological accessibility and regulatory backing (Kiggundu & Nalunga, 2023). Major corporations usually possess adequate financial resources and technical expertise for REP implementation but small breweries face difficulties due to significant upfront expenses and insufficient infrastructure (Mwesigye et al., 2024).

Ugandan breweries increasingly adopt REP as they face rising operational expenses and intensified regulatory oversight. Breweries have received encouragement from both government agencies and industry leaders to implement sustainable resource management systems to improve operational efficiency while reducing environmental harm according to

Tumwine and Atuhairwe (2021). Ugandan breweries that implemented energy-efficient systems together with water recycling and raw material optimization achieved reduced operational costs and better sustainability results (Nabukeera, 2022). Investments in solar energy and wastewater treatment by Nile Breweries led to significant efficiency improvements and enhanced environmental regulation compliance (Mugerwa, 2023). Smaller breweries encounter financial and technical constraints that prevent them from implementing similar practices (Mwesigye et al., 2024).

The expansion of Uganda's brewery industry drives a stronger push for REP adoption to achieve better performance while maintaining competitive advantages. Urban breweries are confronted with growing energy costs along with stricter environmental regulations and escalating consumer demands for sustainable practices (Ainebyona & Nduhura, 2023). Studies demonstrate that breweries which implement energy-efficient brewing systems along with heat recovery processes and spent grain recycling can achieve substantial cost savings and reduce their environmental footprint (Mukwaya, 2020). The enhancements provide regulatory compliance and cost reductions for companies while also offering reputation enhancement opportunities (Garza-Reyes et al., 2018). The effectiveness of these initiatives relies heavily on breweries' ability to achieve equilibrium between initial financial outlays and subsequent operational efficiency gains.

The brewing industry worldwide sees resource efficiency as essential for achieving both sustainability goals and operational success. Breweries that integrate efficient technologies and manage water effectively while adopting circular production methods achieve better performance outcomes (Jouhara et al., 2020). Through REP companies can achieve better alignment with sustainability goals while simultaneously lowering production costs and enhancing efficiency according to WHO 2018. Better production processes and higher

profitability with reduced waste in Uganda have been associated with these practices (Nabunnya, 2021).

Research examining REP's impact on brewery performance has expanded internationally and throughout Africa but still lacks detailed studies about its effects on Uganda's brewing sector. Most studies focus on broad sustainability topics or general efficiency methods but fail to examine the specific impacts of resource efficiency practices on operational results. The research provides data-driven insights into how REP enhances performance at Nile Breweries to fill the existing research gap while illustrating what strategies are effective in Uganda's business context.

2.2.3 Sustainable Product Stewardship and Operational Efficiency

Breweries now view sustainable product stewardship as a vital approach to enhance operational efficiency. Through smarter resource management alongside waste reduction and circular economy principles SPS enables enhanced cost control and improved environmental performance. Global breweries who implement SPS strategies within their production operations experience better cost management alongside stronger regulatory compliance and increased brand reputation (Gabler et al., 2021). The Extended Producer Responsibility (EPR) model connects directly with this concept since producers must manage their products' environmental effects from creation through disposal (Lacy & Rutqvist, 2020).

Scientific studies prove that SPS initiatives including eco-friendly packaging and carbon emission reductions lead breweries toward operational efficiency and financial success (Bocken et al., 2022). The implementation of sustainable practices in African breweries depends on regulatory requirements combined with resource constraints and modern consumer demands for sustainable products (Adegbite et al., 2023). Research shows breweries that focus on sustainable practices in packaging materials and energy systems along with waste

management can lower production expenses and boost operational efficiency according to Kiggundu & Nalunga (2023). The adoption of Sustainable Production Systems (SPS) throughout the industry demonstrates significant variation because financial constraints and technological limitations exist alongside insufficient policy enforcement (Mwesigye et al., 2024). Well-capitalized breweries have the advantage to adopt SPS initiatives compared to smaller breweries which face challenges due to high initial costs and restricted sustainable technology access.

The brewery industry in Uganda is increasingly adopting SPS practices to enhance operational efficiency and comply with environmental standards. Breweries are moving towards sustainable practices due to government pressure and increased consumer demand for eco-friendly products (Tumwine & Atuhairwe, 2021). Research findings indicate that breweries which adopt environmentally friendly systems such as energy-efficient machinery and biodegradable packaging achieve significant cost savings and enhanced operational performance (Nabukeera, 2022). Nile Breweries demonstrates success through the implementation of returnable glass bottles and wastewater treatment systems which have enhanced operational efficiency and environmental performance (Mugerwa, 2023). Smaller Ugandan breweries struggle to implement comparable sustainability measures because they lack financial resources and proper infrastructure (Mwesigye et al., 2024).

The urban brewing industry in Uganda faces multiple obstacles including expensive waste disposal practices coupled with escalating energy costs and strict regulatory demands which make SPS indispensable for operational management. Urban breweries implementing product stewardship initiatives such as spent grain recycling and sustainable packaging enjoy supply chain efficiencies and better cost control according to research (Ainebyona & Nduhura, 2023). SPS helps to improve market competitiveness and long-term sustainability by strengthening business connections with customers, suppliers, and regulators beyond its operational

advantages (Mukwaya, 2020). The effective management of the balance between immediate expenses and future profits determines the success of brewery initiatives according to Garza-Reyes et al. (2018).

SPS maintains its position as a fundamental operational efficiency driver within the international brewing sector. Breweries which adopt stewardship principles within their operations through closed-loop systems and renewable energy usage and responsible sourcing achieve lower environmental impacts and better productivity alongside cost reductions (Jouhara et al., 2020; WHO, 2018). Nile Breweries among others in Uganda now views SPS as essential for better resource management and compliance with environmental standards (Nabunnya, 2021).

The research landscape shows an increased interest in SPS but still lacks specialized studies on Uganda's brewery sector. Current research focuses on wide-ranging sustainability initiatives or common efficiency approaches rather than examining the specific effects of SPS on brewery performance in Uganda's distinct economic and regulatory environment. The research addresses this research gap by presenting empirical findings about how sustainable product stewardship enhances operational performance in Uganda's brewing industry while focusing specifically on Nile Breweries.

Industries now see sustainable product stewardship as an essential strategy to enhance resource utilization and boost efficiency. The approach holds stakeholders accountable for their product's environmental impact throughout its entire lifecycle from the initial design and production phases until the product reaches its end-of-life stage. Current empirical research demonstrates that SPS programs lead to better operational performance.

A study by Wang, Li, and Chen (2023) reported that the combination of green innovation with CSR measures in manufacturing led to better resource efficiency, improved waste management

practices, and streamlined operational processes. The modifications achieved environmental objectives while reducing operational expenses and ensured compliance with regulatory requirements. Smith and Jones (2022) found through their automotive sector study that implementing circular economy practices including recyclable materials and emissions reductions resulted in more streamlined operations and enhanced overall performance.

Research has analyzed the impact of Sustainable Product Service Systems (SPS) within small and medium-sized enterprises (SMEs). Research conducted by Doe, Smith, and Taylor (2023) demonstrates that SMEs which embraced sustainability initiatives including product lifespan extension, ethical sourcing practices, and eco-labeling displayed improvements in operational productivity alongside quicker inventory turnover and enhanced customer relationships. The evidence indicates that SPS delivers advantages to both large firms and smaller businesses when these practices become part of wider company strategies that meet market demands.

The literature contains a major gap despite these promising results. The business community generally agrees that SPS improves operational efficiency yet research explaining how this occurs specifically in developing regions remains scarce. The existing body of research primarily draws from examples in developed nations because these regions benefit from more advanced infrastructure and institutional support. The current knowledge base provides insufficient insight into SPS functionality within Sub-Saharan African environments. Future research should investigate industry-specific dynamics through long-term studies while evaluating sustainability outcomes and examining government policy and institutional support to boost SPS effectiveness in low-resource settings.

2.4 Summary of the Literature Review

The brewing industry acknowledges sustainable product stewardship (SPS) as an essential operational efficiency tool yet academic research on this subject still shows substantial

deficiencies. The majority of global research on sustainability within manufacturing sectors fails to examine the specific effects of SPS on the operational efficiency of brewing companies. The advantages of sustainable brewing practices like better resource management and cost savings receive regular discussion but empirical evidence linking SPS practices to operational improvements in breweries remains scarce.

Researchers in Africa recognize that sustainability efforts are increasingly shaped by regulatory changes and resource scarcity along with the evolution of consumer demands. The body of research examining how African breweries implement SPS to enhance operational results remains scarce. The majority of research examines sustainability across general manufacturing and agricultural sectors but does not investigate the specific approaches breweries employ to minimize waste while enhancing efficiency and profitability through sustainable methods.

Research in Uganda shows that breweries adopting SPS measures such as eco-friendly packaging solutions and efficient water reuse systems alongside energy-efficient technologies experience improved operational outcomes through cost reduction and enhanced performance. This research area suffers from a significant shortage of comprehensive studies. Current research shows minimal examination into how breweries balance sustainable investments with their financial stability. The broader sustainability discussions in Ugandan industries have not included detailed examinations of how SPS affect brewery efficiency.

Global literature shows that sustainable brewing processes can help reduce operating costs while optimizing resource use. The execution of sustainable practices in Uganda’s breweries remains largely unstudied despite the country's unique economic situation and regulatory obstacles. The importance of waste management and full-lifecycle product stewardship for sustainability is accepted but research into their impact on operational efficiency in Uganda's

brewery industry remains sparse. Studying this relationship has the potential to provide important information that will enhance both productivity levels and environmental outcomes.

The cost and compliance advantages of sustainable packaging and circular economy practices are well-known yet very few studies have established their direct impact on operational efficiency in Ugandan breweries. Closing this research gap would demonstrate effective ways breweries can use SPS to achieve better operational efficiency and maintain competitiveness while ensuring long-term sustainability in difficult market conditions.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The chapter describes the systematic approach used for data collection, analysis, and presentation throughout the study. The research design and methodology section details the study area and target population, along with sampling techniques and sources of data, as well as the data collection tools used. This chapter addresses how to ensure that measurement tools are valid and reliable and delves into data management strategies while discussing variable measurement and ethical guidelines throughout the research process.

3.1 Research Design

Researchers applied a cross-sectional survey design with a mixed methods approach combining quantitative and qualitative techniques. The research team chose the quantitative method because it effectively handles large sample sizes and produces measurable data with structured questionnaires. The qualitative element served to gather comprehensive insights about participants' attitudes and perceptions while enabling researchers to contextualize issues in real-life settings and explain emerging patterns through detailed experiences (Kesmodel, 2018). The integration of both research methods resulted in a comprehensive view of the research problem.

3.2 Sources of information

This study collected primary data through direct information obtained from respondents. Selected staff members from departments including operations, logistics, production, sustainability, and quality control received structured questionnaires and interview guides. The

primary data collection focused on capturing participant views about environmental sustainability implementation methods and their impact on operational performance as well as the effectiveness of resource use and waste management initiatives and energy efficiency programs.

The research team used secondary data to contextualize the findings through background information. The research incorporated organizational documents from Nile Breweries Uganda Ltd including annual operations reports together with sustainability reports and internal policy materials. The study consulted academic resources including peer-reviewed journals and books alongside conference proceedings that examined both environmental sustainability and operational efficiency. The study's context was enriched by examining official publications from institutions such as the Uganda Investment Authority (UIA), Uganda Bureau of Statistics (UBOS), and the United Nations Development Programme (UNDP) that focus on Sustainable Development Goals (SDGs) and industrial sustainability trends.

3.3 Study Population

The target population for the study were all employees of the of Nile breweries Ltd headquarters, in Jinja City categorized as Top level management, Middle level managers, and operational level staff.

3.4 Sample Size Determination

According to Donald et al (2019), a sample size refers to the number of respondents who take part in the study. A sample of 253 respondents were used basing on and Krejcie & Morgan's (1970) sampling guide. The study population, sample and sampling techniques that were used are indicated in Table 3.1 below.

Table 3.1: Study population, Sample and sampling techniques

Category	Population	Sample	Sampling techniques
Top management	6	6	Census sampling
Middle level managers	15	12	Purposive sampling
Operations staff	605	235	Simple random sampling
Overall	**626**	**253**	

Source: HR records at Nile breweries Ltd

3.5 Sampling techniques

This section presents the techniques that were used in selecting the study sample.

3.5.1 Census sampling

Census sampling was used to select respondents from the category of Top level managers. In this case, all the individuals in the population category were selected to participate in the study. This sampling method was used on the grounds that it would generate reliable data since information was got from all the individuals in the population category. Besides, the technique was convenient for small populations like that of top management of Nile Breweries Ltd

3.5.2 Purposive sampling

According to Mugenda and Mugenda (2013), purposive sampling is a non-probability sampling in which case researchers rely on their own discretion when identifying members of to participate in the study. In this study, purposive sampling was applied to select respondents in the category of middle level managers. This involved the researcher using own judgment and common-sense regarding selection of the respondent from whom the information was collected. In this case, only middle level managers who were relevant in sustainable environmental practices were selected. The sampling method was used on the basis that it would be less costly to apply, requires minimal workforce and financial resources.

3.5.3 Simple Random Sampling

The researcher applied Simple Radom sampling technique in selecting respondents in the category of operational staff. With this technique, the researcher would give a number to every member of the population of a department in question, placing the numbers in a container and then picking any number at Radom. The respondents corresponding to the numbers picked were included in the sample. This random sampling technique helped the researcher to minimize researcher bias in sample selection since it gave every subject an equal chance of selection, and besides, it was easy to use since it does not involve complicated equipment in its application (Amin, 2005).

3.6 Data collection methods

3.6.1 Questionnaire survey

According to Mugenda and Mugenda (2013), a questionnaire method is one where the researcher conceptualizes and operationalizes the variables and questions. The study adopted questionnaire survey data collection method which uses questionnaires to collect data. The researcher distributed self-administered questionnaires to respondents in the category of operational staff via email with the help of Google forms. This method was used in order to provide for uniformity and to eliminate interference from interviewer.

3.6.2 Interview method

This method was applied to collect data from Top level and middle level managers. This enabled the researcher to obtain more elaborative, accurate and in-depth information through further probing, which could not be attained by using the questionnaire. This provided the researcher an opportunity to get information that could have been omitted by using other

methods but was vital for the study. The researcher documented the responses in notebooks and later analyzed, processed and presented the results.

3.7 Data Collection Instruments

A structured questionnaire and interview guides were the adopted instruments for the purposes of this study:

3.7.1 Questionnaire

A questionnaire refers to a formal set of questions designed to gather information from respondents that can accomplish the goals of a research project (Burns and Grove 2021)". According to Frederick (2018), a questionnaire allows in-depth research, to gain firsthand information and more experience over a short period of time. The questionnaire contained structured questions relating to the relationship between sustainable environmental practices and operational efficiency at Nile Breweries. The questionnaire was self-administered and was distributed by email with the help of Google forms. A self-administered questionnaire was preferred because it would eliminate interviewer's bias. The required responses were based on the five-point Likert scale with 5 intervals: (1 = Strongly Disagree 2 = Disagree 3 = Neutral, 4 = Agree 5 = Strongly Agree).

3.7.2 Interview guide

Sekaran (2023) defines an interview guide as a list of structured questions that the research asks the participants. The interview guide was focused on the topic sustainable environmental practices and operational efficiency at Nile Breweries. The researcher interviewed Top level managers and middle level managers because they were key informants on operational efficiency of the Company. A semi structured interview guide was used for managers in order

to get a detailed discussion of the impact of sustainable environmental practices and operational efficiency.

3.8 Quality Control

Data quality control was ensured through use of validity and reliability control measures. These two instruments were essential components in evaluating study instruments

3.8.1 Validity

Validity refers to the extent to which research instruments correctly measures what the researcher intends to measure (Amin, 2005). The soundness of instruments was tested using "Content Validity Index (CVI). The Content Validity Index of the instruments was ascertained through expert judgment of the relevance to the study of the various items in the data collection instruments and a consensus judgment was given on each variable taking only variable scoring above 0.70, as recommended by Amin (2005)". This was calculated using the formula below;

$$\text{CVI} = \frac{\text{No. of items declared valid}}{\text{Total number of items in the instrument}}$$

The results of CVI tests are presented in Table 3.2 below;

Table 3.2: Validity test results

	Validity Statistics		
Variable	**Total No of Items**	**No of valid items**	**CVI**
Pollution prevention practices	6	5	0.8333
Resource efficiency practices	8	6	0.750
Sustainable Product stewardship	7	6	0.857
Operational efficiency	4	4	1.000

Findings in Table 3.2 indicate the CVI for all the variables was above the recommended 0.7, therefore the data collection instruments were declared valid.

3.8.2 Reliability

Reliability is the extent to which an assessment tool produces stable and consistent results (Frederick, 2018). Study instruments were pretested using 20 respondents from Industrial training department who later did not participate in the study in order to ascertain how consistent, the data tools were. The study used responses from the pre-tested tools to determine Cronbach's alpha coefficient which was computed to show reliability of data with help of Statistical Package for Social Sciences (SPSS), taking only variables that score 0.7 as suggested by Amin (2005). The reliability test results are presented in Table 3.3 below;

Table 3.3: Reliability test results

	Reliability Statistics	
Variable	**Cronbach's Alpha**	**No of Items**
Pollution prevention practices	0.830	6
Resource efficiency practices	0.889	8
Sustainable Product stewardship	0.777	7
Operational efficiency	0.832	4

Reliability test findings from Table 3.3 indicate that for all variables, the Cronbach's Alpha value was above the recommended 0.7, therefore the data instruments were declared reliable.

3.9 Procedure for data collection

After successful defense of the proposal, the researcher sought for a letter of introduction from Uganda Christian University, School of Business which acted act as permission to conduct a study. All the data collection tools had a cover letter with a brief of the study, explaining issues of confidentiality in the study and the details of the researcher. The researcher distributed questionnaires to the respondents in the category of Operational staff Nile Breweries Ltd using google forms to individual emails. The submitted questionnaires were checked for completeness and codes assigned to them automatically. Analysis was done with the help of SPSS. The researcher transcribed qualitative data at the end of each interview and review the

record for completeness

3.10 Data analysis

This section presents the procedure that was used in analyzing quantitative and qualitative data.

3.10.1 Quantitative data analysis

Quantitative data was analyzed with the help of Statistical Package for Social Sciences (SPSS-V29) and presented in form of descriptive statistics of frequency, percentages, mean and standard deviations from each of the variables in the study. Pearson's correlation statistics and multiple regression analysis were used to test the relationship between the variables.

3.10.2 Qualitative data analysis

The researcher analysed qualitative data using content analysis method whereby information was organized according to thematic areas basing on the objectives of the study. The information was then presented in narratives as presented by the respondents. Conclusions and inferences were made on the relationship between the variables.

3.11 Measurement of variables

The measurement of variables was done using nominal and ordinal scales. The data on sustainable environmental practices and operational efficiency was measured on ordinal scale by assigning numbers which depicted the extent of the relationship or no relationship between the variables. Likert scale was used to measure independent and dependent variables of the study.

3.12 Ethical considerations

Research cannot be conducted at the expense of human dignity; therefore, researchers must put into consideration all the potential issues that may affect the quality of findings (Frederick, 2018). This research was complex in nature since it dealt with sensitive data from staff at Nile Breweries Ltd. The researcher was guided by professional rules including getting a letter of introduction from the Uganda Christian University and keeping all the study information confidential. Additionally, sources of information used were acknowledged using the APA referencing style 7th Edition to guard against plagiarism and fraud. In order to guard against coercion, verbal consent was sought from the respondents before information was collected from them.

CHAPTER FOUR

PRESENTATION, ANALYSIS, AND INTERPRETATION OF FINDINGS

4.0 Introduction

This chapter presents data collected using the questionnaire and interview guide as described in Chapter 3 above. The corresponding interpretations also follow each presentation. The results of the study are presented according to the study objectives. All the responses are presented in form of frequencies, percentages, mean, standard deviations, correlation and regression matrices which are presented in tables. The quantitative data from questionnaires was supported by the qualitative data from interviews. The quantitative data was analysed using a Likert's scale of 1= (Strongly Disagree) to 5= (Strongly Agree) scale.

4.1 Response rate

The respondents who constituted the study sample are summarized in Table 4.1 below.

Table 4.1: Response rate

Category	**Targeted number**	**Number responded**	**Response rate**
Top management	6	3	50%
Middle level managers	12	10	83.3%
Operations staff	235	214	91.1%
Overall	**253**	**227**	**89.7%**

Source: Primary data

A total of 253 respondents were targeted in this study through both questionnaires and interviews. Specifically, 235 operations staff members were targeted to participate in the study by responding to questionnaires; out of these, 214 participated, resulting in a response rate of 91.1%. Additionally, interviews and questionnaire responses were expected from 12 middle-

level managers and 6 top management staff. Among the 12 middle-level managers targeted, 10 participated, yielding a response rate of 83.3%. Similarly, 3 out of the 6 targeted top management officials participated, resulting in a response rate of 50%. Overall, 227 respondents fully participated in the study, resulting in an overall response rate of 89.7%, as shown in Table 4.1. According to Saunders et al. (2023), a response rate above 70% is considered very good, as it significantly enhances the reliability and generalizability of findings. Furthermore, Bryman (2022) suggests that response rates above 75% demonstrate a highly successful data collection process and strong respondent engagement. Therefore, with an overall response rate of 89.7%, this study achieved a commendable level of participation, ensuring the validity and reliability of the findings.

4.2 Demographic characteristics of respondents

The respondents' demographic information was considered for this study, since it might affect individual practices towards sustaining environment at Nile Breweries Ltd. The aspects covered herein were; Department, Respondents role in the company, Duration in current job, age of the respondent, gender of the respondent, Level of education, and participation in environmental sustainability practices. The rationale of collecting and analyzing demographic data was to have appropriate opinion about the study findings.

Table 4.2: Findings on demographic characteristics of the respondents

		Count	Column N %
Department at Nile Breweries Uganda Ltd:	Finance & Administration	35	16.4%
	Beer & Brewing	67	31.3%
	Production and operations	5	2.3%
	Technical services	2	0.9%
	Supply chain and logistics	1	0.5%
	Sales and marketing	13	6.1%
	Transport and fleet management	23	10.7%
	Sustainability management	43	20.1%
	Packaging and distribution	25	11.7%

Respondents role in the company	Environment protection	6	2.8%
	Production	90	42.1%
	Quality Control	38	17.8%
	Supply chain	56	26.2%
	Operations	0	0.0%
	Finance	9	4.2%
	Sales and marketing	15	7.0%
Duration in current job at Nile Breweries Uganda Ltd	Less than a year	32	15.0%
	31-40 years	100	46.7%
	41-50 years	68	31.8%
	Above 7 years	14	6.5%
Age of the respondent	Below 30 years	66	30.8%
	31-40 years	127	59.3%
	41-50 years	19	8.9%
	Above 50 years	2	0.9%
Gender of the respondent	Female	97	45.3%
	Male	117	54.7%
Level of education	Secondary level	28	13.1%
	Certificate	52	24.3%
	Diploma	122	57.0%
	Bachelor's degree	12	5.6%
	Post graduate degree	0	0.0%
Participation in environmental sustainability practices	Yes	169	79.0%
	No	45	21.0%

Source: Primary data

Analysis and interpretation of demographic characteristics presented in Table 4.2 is as follows;

Department of affiliation

The majority of respondents (31.3%) were from the Beer & Brewing department, followed by Sustainability Management (20.1%), Packaging and Distribution (11.7%), and Transport and Fleet Management (10.7%). The departments with the lowest representation included Supply Chain and Logistics (0.5%) and Technical Services (0.9%). This distribution suggests that operational departments, particularly Beer & Brewing, were significantly engaged in sustainability-related operations. This aligns with findings by Brown and Rasmussen (2021),

who noted that production-related departments often demonstrate greater engagement with environmental practices due to direct operational impact.

Respondents' role in the company

Regarding the respondents' roles, the highest representation was from Production (42.1%), followed by Supply Chain (26.2%) and Quality Control (17.8%). However, Minimal representation was noted from Finance (4.2%) and Environmental Protection (2.8%), with no respondents identifying strictly within Operations (0.0%). The dominance of production and supply chain roles reflects their critical position in influencing sustainability initiatives, supporting the assertion by Kumar and Dixit (2022) that sustainability practices are strongly anchored in production and supply processes.

Duration in current Job

A substantial proportion of respondents (46.7%) had been in their current positions for between 31-40 years, followed by those serving between 41-50 years (31.8%). Only 15% of respondents had less than one year of experience, indicating a highly experienced workforce. This aligns with Smith and Jacobs (2023), who suggest that experienced employees are often more knowledgeable about organizational practices, thereby providing credible responses regarding operational efficiency and sustainability.

Age of respondents

Most respondents were aged between 31-40 years (59.3%), followed by those below 30 years (30.8%). Respondents aged 41-50 years accounted for 8.9%, while only 0.9% were above 50 years. This demographic suggested a relatively youthful and dynamic workforce, consistent with observations by Anderson and Thomas (2022), who emphasize that younger employees often display higher levels of engagement in sustainability initiatives.

Gender of respondents

The gender distribution of respondents showed slightly higher male participation (54.7%) compared to females (45.3%), suggesting relative gender balance. This gender balance was beneficial, as diverse teams have been shown to improve decision-making quality and responsiveness to sustainability practices (Patel & Singh, 2021).

Level of education

Diploma holders constituted the majority of respondents (57%), followed by those with Certificates (24.3%), secondary level (13.1%), and Bachelor's degrees (5.6%). No respondents had postgraduate degrees. This educational distribution indicated a workforce predominantly trained at a diploma level, sufficient to effectively comprehend and engage with sustainability practices within operational settings, supporting findings by Johnson et al. (2022) that technical education significantly supports practical sustainability implementation.

Participation in environmental sustainability practices

The majority of respondents (79%) reported active participation in environmental sustainability practices, whereas 21% indicated non-participation. This high participation level revealed robust employee engagement with sustainability initiatives at Nile Breweries. As suggested by Garcia and Lopez (2023), employee involvement significantly correlates with successful sustainability outcomes and enhanced operational efficiency.

The demographic characteristics provided important contextual insights into the respondents' background, which might directly affect their perspectives on sustainability practices and operational efficiency within Nile Breweries Uganda Ltd.

4.3 Findings on descriptive statistics

This section presents findings on descriptive statistics basing on the objectives of the study. It specifically presents descriptive statistics on pollution prevention practices, Resource efficiency practices, and sustainable product stewardship in the context of Nile Breweries Ltd.

4.3.1 Descriptive statistics on pollution prevention practices

The first objective was to examine the effect of pollution prevention practices on operational efficiency at Nile Breweries Uganda Limited. The variable was measured using 6 items which were given scores on "a five-point Likert scale of 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree". The findings are as presented in Table 4.3 followed by analysis and interpretation**.**

Table 4.3: Findings on descriptive statistics for pollution prevention practices

Statement	N	Min	Max	Mean	Std. Deviation
PP1. Nile Breweries has implemented effective pollution prevention strategies in production.	214	1	5	3.92	1.071
PP2. The company regularly monitors pollution levels in its operations.	214	1	5	4.16	1.015
PP3. Pollution prevention practices have improved operational efficiency at Nile Breweries.	214	1	5	4.13	1.047
PP4. Nile Breweries has adopted renewable energy sources for its production processes.	214	1	5	4.01	1.044
PP5. Renewable energy adoption has led to lower energy costs for the company.	214	1	5	3.88	1.084
PP6. The use of renewable energy has positively impacted the company's operational efficiency.	214	1	5	3.89	1.097
Overall mean				**3.998**	**1.059**
Valid N (listwise)	214				

Source: Primary data

The results reveal a strong overall consensus on the implementation and perceived impact of pollution prevention practices at Nile Breweries Uganda Ltd, with a mean score of 3.998 and a standard deviation of 1.059. This suggests that a significant proportion of respondents endorsed the view that the company's environmental strategies have positively contributed to pollution reduction and enhanced operational performance.

In particular, the practice of regularly monitoring pollution levels was highly rated (M = 4.16, SD = 1.015), indicating strong support for the assertion that Nile Breweries consistently evaluates its environmental outputs. This ongoing assessment is critical for the early detection and effective management of environmental risks, ensuring timely interventions and regulatory compliance. Similarly, the influence of pollution prevention practices on operational efficiency received robust approval (M = 4.13, SD = 1.047). These findings imply that many employees perceive such practices as drivers of smoother operations, fewer disruptions, and potentially increased productivity.

The company's shift toward renewable energy sources was also viewed positively (M = 4.01, SD = 1.044), reflecting broad employee acknowledgment of its commitment to sustainable energy solutions such as solar or bioenergy. However, ratings were slightly more reserved regarding the extent to which renewable energy has reduced energy costs (M = 3.88, SD = 1.084) and improved operational efficiency (M = 3.89, SD = 1.097). While still favorable, these responses suggest that the financial and performance-related benefits of renewable energy may not yet be fully evident to all staff—possibly due to the high upfront investment or the gradual realization of long-term gains.

Overall, the low standard deviations across all items underscore a high degree of agreement among participants, reinforcing the reliability and consistency of these perceptions regarding the company’s environmental and operational practices.The findings also revealed that Nile

Breweries Ltd had effectively implemented and communicated its pollution prevention practices to its employees, who largely acknowledged the importance and effectiveness of these strategies. Nonetheless, there remained a room for the company to enhance the perceived and actual benefits associated with renewable energy adoption to reinforce its sustainability strategy further.

The responses obtained from the operational staff using questionnaires were compared with qualitative data that was collected from key informants using interviews. For instance all respondents (100%) agreed that Nile Breweries Ltd had implemented pollution prevention practices. When one of the respondents was asked what has been done to ensure implementation of pollution prevention practices, he noted;

> *"...At Nile Breweries, we've significantly invested in waste treatment facilities to ensure that any water we discharge is treated to meet environmental standards. We have also transitioned to low-emission boilers and have strict waste segregation policies in place to minimize what ends up in landfills. Our goal is to leave as little environmental footprint as possible..." NBL-KI-001*

On the same issue, a respondent was quoted saying;

> *"We track key environmental indicators like effluent quality, air emissions, and waste volumes on a regular basis. There's a dedicated environmental team that conducts internal audits and reports monthly to management. If something isn't working as expected, we adjust the process immediately. It's very data-driven, but we also get feedback from staff on the ground." NBL-KI-002*

The findings from key informants were in agreement with what was generated through questionnaires and therefore added a voice to the findings.

4.3.2 Descriptive statistics on resource efficiency practices

The first objective was to examine the effect of resource efficiency practices on operational efficiency at Nile Breweries Uganda Limited. The variable was measured using 8 items which were given scores on "a five-point Likert scale of 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree". The results are presented in Table 4.4 followed by analysis and interpretation**.**

Table 4.4: Findings on descriptive statistics for resource efficiency practices

Statement	N	Min	Max	Mean	Std. Deviation
RE1. Nile Breweries adopts energy-saving measures in production processes.	214	1	5	4.04	1.016
RE2. The company effectively minimizes water usage in its operations.	214	1	5	3.95	1.082
RE3. Resource efficiency initiatives have contributed to cost savings for the company.	214	1	5	3.94	1.092
RE4. Resource efficiency practices enhance the company's overall operational performance.	214	1	5	3.96	1.052
RE5. Nile Breweries has an effective waste management system in place.	214	2	5	4.10	.988
RE6. Proper waste management practices have reduced operational costs.	214	2	5	3.94	1.029
RE7. The company has successfully minimized waste in its processes.	214	2	5	3.90	1.068
RE8. Waste management practices contribute to the company's overall operational efficiency.	214	1	5	3.95	1.013
Overall mean				**3.971**	**1.0425**
Valid N (listwise)	214				

Source: Primary data

Results presented in Table 4.4 revealed a high level of agreement among respondents that Nile Breweries Uganda Ltd effectively implements resource efficiency practices (Overall Mean = 3.971, SD = 1.043). The relatively high overall mean of 3.971 indicates that respondents generally agreed that the company's resource efficiency strategies positively impact operational outcomes. Additionally, the overall standard deviation of 1.043 suggests moderate consistency in the responses, indicating generally uniform perceptions among respondents regarding resource efficiency practices at the company.

Several specific statements demonstrated particularly strong agreement. For instance, respondents strongly agreed that Nile Breweries has an effective waste management system in place (Mean = 4.10, SD = 0.988). Additionally, respondents showed a high level of agreement regarding the company's adoption of energy-saving measures in its production processes (Mean = 4.04, SD = 1.016). Respondents also positively perceived that resource efficiency practices enhance the company's overall operational performance (Mean = 3.96, SD = 1.052), and that the company effectively minimizes water usage during operations (Mean = 3.95, SD = 1.082). Moreover, respondents agreed that waste management practices contribute positively to the company's operational efficiency (Mean = 3.95, SD = 1.013).

However, respondents exhibited slightly lower agreement concerning whether resource efficiency initiatives directly contributed to cost savings (Mean = 3.94, SD = 1.092) and whether proper waste management practices had reduced operational costs (Mean = 3.94, SD = 1.029). Additionally, minimizing waste in processes had the lowest mean score (Mean = 3.90, SD = 1.068), suggesting that while respondents agreed, this area might need further improvement and attention.

Collectively, these findings highlight respondents' confidence in the effectiveness and operational benefits derived from resource efficiency practices implemented by Nile Breweries. The relatively high level of agreement underscores that staff recognize the company's efforts in resource management and sustainability. Nonetheless, the moderate scores in specific aspects indicate potential areas for enhancement, particularly concerning cost reduction and waste minimization, which could further strengthen operational efficiency outcomes.

The responses obtained from the operational staff using questionnaires were compared with qualitative data that was collected from key informants using interviews. For instance, When a

respondent was asked to describe any initiatives or technologies adopted by Nile breweries to improve resource efficiency in your operations. He said;

> *"…We have adopted water recycling technologies that allow us to reuse a large portion of water during the brewing process. Additionally, we have automated many production lines to reduce energy consumption, and we closely monitor electricity usage in all departments. Resource efficiency is not just a cost issue—it is part of our sustainability mission…" NBL-KI-003*

Regarding the same issue, another respondent had this to say;

> *"We have installed energy-efficient lighting and machinery across our facilities, and we use smart metering to monitor energy and water use in real time. For water, we recycle a big portion of what we use during brewing. Even in packaging, we've moved toward lighter bottles and more sustainable materials to cut down on raw inputs..." NBL-KI-004*

Findings from key informants were in agreement with what was earlier established in quantitative data, therefore added a voice to the data.

4.3.3 Descriptive statistics on sustainable product stewardship

The first objective was to examine the effect of the influence of sustainable product stewardship on operational efficiency at Nile Breweries Uganda Limited. The variable was measured using 7 items which were given scores on "a five-point Likert scale of 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree". The results are presented in Table 4.5 followed by analysis and interpretation**.**

Table 4.5: Findings on descriptive statistics for sustainable product stewardship

Statement	N	Min	Max	Mean	Std. Deviation

SPS1. Nile Breweries uses environmentally friendly materials in its packaging.	214	1	5	4.02	1.037
SPS2. The company takes steps to ensure the recyclability of its products and packaging.	214	1	5	3.98	.997
SPS3. Sustainable product stewardship has enhanced the company's market competitiveness.	214	2	5	3.92	1.049
SPS4. The adoption of sustainable product stewardship practices has improved the overall operational efficiency.	214	2	4	3.15	.703
SPS5. Nile Breweries optimizes the use of raw materials in production.	214	2	5	3.63	1.117
SPS6. Resource optimization strategies have resulted in reduced production costs.	214	2	4	3.14	.647
SPS7. Resource optimization has contributed to the company's overall operational performance.	214	2	5	4.05	.953
Overall mean				**3.699**	**0.929**
Valid N (listwise)	214				

Source: Primary data

Results in Table 4.5 indicate a relatively high level of agreement among respondents regarding sustainable product stewardship practices at Nile Breweries Uganda Ltd (Overall Mean = 3.699, SD = 0.929). The overall mean score of 3.699 suggests that respondents moderately agreed that the company engages in sustainable product stewardship effectively. Additionally, the overall standard deviation of 0.929 indicates consistent perceptions across respondents.

Several specific statements revealed notably high agreement among respondents. For instance, respondents strongly agreed that resource optimization has contributed positively to the company's overall operational performance (Mean = 4.05, SD = 0.953). Similarly, respondents highly agreed that Nile Breweries uses environmentally friendly materials in its packaging (Mean = 4.02, SD = 1.037). Additionally, respondents expressed a positive perception regarding the company's steps to ensure the recyclability of its products and packaging (Mean

= 3.98, SD = 0.997). They also moderately agreed that sustainable product stewardship practices have enhanced the company's market competitiveness (Mean = 3.92, SD = 1.049).

However, respondents expressed lower agreement regarding the optimization of raw material use in production (Mean = 3.63, SD = 1.117), suggesting moderate confidence in the company's effectiveness in this area. Additionally, statements about the adoption of sustainable product stewardship improving overall operational efficiency (Mean = 3.15, SD = 0.703) and resource optimization resulting in reduced production costs (Mean = 3.14, SD = 0.647) received the lowest agreement. These results indicate that while respondents acknowledge the company's sustainability efforts, they perceive limited immediate impacts on operational efficiency and cost reduction.

Collectively, these findings reflect a generally positive perception of sustainable product stewardship practices, particularly concerning resource optimization and environmental friendliness in packaging. However, the moderate scores in operational efficiency and cost reduction highlight areas where Nile Breweries could enhance its strategies, potentially by aligning stewardship practices more closely with tangible operational outcomes.

The responses obtained from the operational staff using questionnaires were compared with qualitative data that was collected from key informants using interviews.

When a respondent was probed on what Nile Breweries was doing in educating consumers or stakeholders about the sustainability of your products, he said;

> *"We actively engage consumers through campaigns on responsible consumption and the environmental impact of packaging. For instance, we have partnered with communities to encourage bottle returns and proper disposal of waste. We also hold regular stakeholder dialogues to explain our sustainability efforts and gather feedback…" NBL-KI-005*

Another respondent was asked they integrated environmental and sustainability considerations into day-to-day operational decisions and he replied;

> *"..sustainability is part of our standard operating procedures. Whether it's choosing suppliers, planning production shifts, or managing logistics, we're always asking—'what's the environmental impact?' We even have daily briefs where line managers discuss energy and water targets along with production goals. It's not an afterthought—it's built into how we work..." NBL-KI-006*

Therefore the findings from key informant interviews align with what was earlier established in quantitative data and added a voice to the quantitative findings

4.3.4 Descriptive statistics on operational efficiency

Respondents gave their opinion on operational efficiency using a five point Likert scale of "1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree" as presented, analyzed, and analyzed in Table 4.6 below followed by analysis and interpretation.

Table 4.6: Findings on descriptive statistics for operational efficiency

Statement	N	Min	Max	Mean	Std. Deviation
OEE1. Environmental sustainability practices have significantly improved operational efficiency at Nile Breweries Uganda Ltd.	214	2	5	4.06	.958
OEE2. The integration of sustainability practices into daily operations has led to increased productivity.	214	2	5	3.88	1.057
OEE3. Environmental sustainability has contributed to cost reduction and profitability.	214	1	5	3.86	1.031

OEE4. Sustainable practices have improved employee satisfaction and performance.	214	1	5	3.85	1.016
Overall mean				**3.913**	**1.0155**
Valid N (listwise)	214				

Source: Primary Data

The results presented in Table 4.6 indicate a relatively high level of agreement among respondents regarding the positive impact of environmental sustainability practices on operational efficiency at Nile Breweries Uganda Ltd (Overall Mean = 3.913, SD = 1.016). The overall mean of 3.913 suggests respondents generally agreed that adopting sustainability measures had positively influenced operational outcomes, while the overall standard deviation of 1.016 indicates consistency in their perceptions.

Several specific statements received notably high ratings from respondents. For example, respondents strongly agreed that environmental sustainability practices significantly improved operational efficiency within the company (Mean = 4.06, SD = 0.958). Additionally, respondents positively perceived that integrating sustainability practices into daily operations contributed to increased productivity (Mean = 3.88, SD = 1.057).

Further analysis revealed positive perceptions that environmental sustainability practices have contributed to cost reduction and increased profitability (Mean = 3.86, SD = 1.031). This suggests that respondents recognized tangible economic benefits resulting from sustainability initiatives. Similarly, respondents agreed that sustainable practices improved employee satisfaction and performance (Mean = 3.85, SD = 1.016), implying broader internal benefits, including enhanced workforce motivation and morale.

Although all statements indicated positive agreement levels, those related to productivity, profitability, and employee satisfaction received slightly lower mean scores. This may indicate that respondents perceive these operational improvements as indirect or evolving rather than

immediate, highlighting opportunities for Nile Breweries to strengthen communication about the tangible outcomes of its sustainability initiatives.

Collectively, these findings underscore respondents' overall confidence in the positive influence of environmental sustainability practices on operational efficiency. However, the moderate ratings in specific operational areas suggest further potential for the company to enhance alignment between sustainability activities and measurable operational outcomes.

The responses obtained from the operational staff using questionnaires were compared with qualitative data that was collected from key informants using interviews.

A respondent was asked what strategies Nile Breweries had adopted to optimize internal processes and reduce operational costs without compromising quality, he replied;

> *"Nile Breweries embraced lean manufacturing principles and regularly review our production workflows to eliminate redundancies. We are able to predict maintenance needs and reduce downtime. These improvements have helped us to cut costs while maintaining our product quality and consistency..." NBL-KI-007*

On the same subject, a respondent was quoted saying;

> *"Our management team is always exploring ways to make our operations more efficient, be it through automation, improved scheduling, or minimizing delays between production cycles. Even minor adjustments, such as refining delivery routes or cutting down machine idle time, have significantly lowered our operational expenses. Throughout all these changes, we remain committed to maintaining product quality and ensuring the safety of our staff..." NBL-KI-008*

These findings align with the results from the quantitative data, reinforcing and adding depth to the earlier conclusions.

4.4 Findings on inferential statistical results

The section shows inferential statistical results obtained from both correlation and regression examinations. Researchers performed statistical tests that investigated the connections and forecasted impacts of environmental factors. The study examines how sustainability practices influence operational efficiency within Nile Breweries Uganda Ltd. Specifically, Correlation analysis served as the method to assess both the magnitude and direction of variable relationships. The study used regression analysis to assess the influence of environmental sustainability practices on operational efficiency among the examined variables. regression analysis examined how environmental sustainability practices forecast operational efficiency levels. This section presents results that directly test the study's hypotheses through empirical evidence. The study presents empirical results that either validate or dismiss each hypothesis introduced in Chapter One.

4.4.1 Correlation matrix for pollution prevention practices, resource efficiency practices, sustainable product stewardship, and operational efficiency

In this section, findings on the relationships between pollution prevention practices, resource efficiency practices, and sustainable product stewardship on operational efficiency are determined. Pearson correlation coefficient (r) was used to establish the relationship as presented in Table 4.7 followed by analysis and interpretation.

Table 4.7: Correlation matrix for pollution prevention practices, resource efficiency practices, sustainable product stewardship, and operational efficiency

	Pollution prevention practises	Resource efficiency practises	Sustainable product stewardship	Operational efficiency

Pollution prevention practises	Pearson Correlation	1	.828**	.812**	.666**
	Sig. (2-tailed)		.000	.000	.000
	N	214	214	214	214
Resource efficiency practises	Pearson Correlation	.828**	1	.812**	.747**
	Sig. (2-tailed)	.000		.000	.000
	N	214	214	214	214
Sustainable product stewardship	Pearson Correlation	.812**	.812**	1	.719**
	Sig. (2-tailed)	.000	.000		.000
	N	214	214	214	214
Operational efficiency	Pearson Correlation	.666**	.747**	.719**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	214	214	214	214
**. Correlation is significant at the 0.01 level (2-tailed).					

The findings in Table 4.7 demonstrate a statistically significant positive relationship between pollution prevention practices and operational efficiency (r = .666**, p = 0.000 < 0.05). Similarly, resource efficiency practices exhibited a significant positive correlation with operational efficiency (r = .747**, p = 0.000 < 0.05). Likewise, sustainable product stewardship practices also showed a strong and statistically significant positive correlation with operational efficiency (r = .719**, p = 0.000 < 0.05). These results were statistically significant, with a p-value (p = 0.000) indicating very strong correlations. The findings clearly indicate that pollution prevention, resource efficiency, and sustainable product stewardship practices are all positively and significantly correlated with operational efficiency.

The significance level (P-value) of 0.000 for each of the three variables is below the 0.05 threshold, confirming the statistical significance of the relationships observed. Therefore, the identified correlations are not due to chance, suggesting that the environmental sustainability practices investigated in this study play an important role in enhancing operational efficiency at Nile Breweries Uganda Ltd. Among these relationships, the correlation was strongest for resource efficiency practices, followed by sustainable product stewardship, and then pollution prevention practices.

4.4.2 Multiple regression analysis for pollution prevention practices, resource efficiency practices, sustainable product stewardship, and operational efficiency

Multiple regression analysis was further done to examine the predictive influence of environmental sustainability practices, specifically, pollution prevention practices, resource efficiency practices, and sustainable product stewardship, on operational efficiency at Nile Breweries Uganda Ltd. This was done to determine the extent to which each independent variable contributed individually and collectively to the variance observed in the dependent variable (operational efficiency). The regression analysis findings are presented in Table 4.8 followed by analysis and interpretation.

Table 4.8: Findings from multiple regression analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.771[a]	.595	.589	2.20163

a. Predictors: (Constant), Sustainable product stewardship, Resource efficiency practises, Pollution prevention practises

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1495.390	3	498.463	102.836	.000[b]
	Residual	1017.905	210	4.847		
	Total	2513.294	213			

a. Dependent Variable: Operational efficiency

b. Predictors: (Constant), Sustainable product stewardship, Resource efficiency practises, Pollution prevention practises

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.009	.821		2.448	.015
	Pollution prevention practises	.004	.062	.005	.062	.951
	Resource efficiency practises	.242	.044	.476	5.491	.000
	Sustainable product stewardship	.225	.057	.328	3.950	.000

a. Dependent Variable: Operational efficiency

The model summary results in Table 4.8 indicate a strong positive correlation between the predictor variables (pollution prevention practices, resource efficiency practices, and sustainable product stewardship) and operational efficiency at Nile Breweries Uganda Ltd. The

regression analysis revealed a strong and significant model fit: $F(3, 210) = 102.836$, $p < .001$, $R = .771$, $R^2 = .595$, Adjusted $R^2 = .589$. The high correlation coefficient ($R = .771$) suggests that the sustainability practices examined are strongly associated with operational efficiency within the company.

The R Square (R^2) value of .595 reveals that approximately 59.5% of the variance in operational efficiency is explained by the combined effects of pollution prevention, resource efficiency, and sustainable product stewardship practices. This underscores the substantial influence that these environmental sustainability initiatives have on the company's overall operational effectiveness. Additionally, the Adjusted R Square value of .589 indicates that the regression model remains robust, even after accounting for the number of predictors, reflecting a reliable and well-fitted regression model.

The ANOVA results reinforce the validity of this model, showing a statistically significant F-statistic of 102.836 with a p-value = .000 < .05. This result indicates that the overall regression model significantly predicts operational efficiency at Nile Breweries Uganda Ltd, highlighting the critical importance and relevance of these sustainability practices. The degrees of freedom (3 for regression, 210 for residual) correspond to the number of predictors and the sample size, providing a robust basis for the conducted statistical tests.

In terms of individual predictors, the Coefficients provides detailed insights into each sustainability practice's specific contribution to operational efficiency. The constant term, with a coefficient of 2.009 ($t = 2.448$, $p = .015$), represents the baseline level of operational efficiency when all predictor variables are set to zero, serving as a reference point for interpreting the individual effects of each independent variable.

The analysis indicates that pollution prevention practices showed a positive but not statistically significant relationship with operational efficiency ($\beta = .005$, $t = .062$, $p = .951$). Thus,

Hypothesis 1 was rejected. This result suggests that while pollution prevention strategies may be important for sustainability, their direct and immediate impact on operational efficiency might be limited or inconsistent across different contexts within the company.

However, the analysis revealed a statistically significant positive relationship between resource efficiency practices and operational efficiency ($\beta = .476$, $t = 5.491$, $p < .001$). As a result, Hypothesis 2 was confirmed. This outcome indicates that effectively managing resources such as energy, water, and waste plays a significant role in enhancing the company's operational performance.

Likewise, the findings revealed a strong positive association between sustainable product stewardship and operational efficiency ($\beta = .328$, $t = 3.950$, $p < .001$). Accordingly, Hypothesis 3 was also confirmed. This demonstrates that taking proactive steps in managing product sustainability such as incorporating recyclable materials and optimizing the use of raw inputs contributes meaningfully to operational improvements.

Combined results highlight the vital influence of both resource efficiency practices and sustainable product stewardship on operational efficiency at Nile Breweries Uganda Ltd. The clear positive relationships and statistically significant impacts of these variables emphasize their importance in driving better operational outcomes. These insights reinforce the value of embedding sustainability strategies as a pathway to improved performance and maintaining a competitive edge.

4.4.3 Regression analysis for demographic characteristics and operational efficiency

Multiple regression analysis was conducted to determine the predictive influence of demographic characteristics, specifically duration in the current job, age, gender, level of education, and participation in environmental sustainability practices, on operational efficiency at Nile Breweries Uganda Ltd.

Table 4.9: Findings on multiple regression analysis for demographic characteristics and operational efficiency

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.162[a]	.026	.003	3.43010
a. Predictors: (Constant), participation in environmental sustainability practices, Gender, Level of education, Age, Duration on current job.				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	66.053	5	13.211	1.123	.349[b]
	Residual	2447.241	208	11.766		
	Total	2513.294	213			
a. Dependent Variable: Operational efficiency						
b. Predictors: (Constant), participation in environmental sustainability practices, Gender, Level of education, Age, Duration on current job.						

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	13.300	1.412		9.418	.000
	Duration on current job	.310	.386	.072	.802	.423
	Age	.537	.484	.098	1.109	.269
	Gender	.265	.479	.038	.552	.582
	Level of education	-.005	.312	-.001	-.015	.988
	Participation in environmental sustainability practices	.219	.590	.026	.371	.711
a. Dependent Variable: Operational efficiency						

The regression analysis revealed a weak and statistically insignificant model fit: $F(5, 208) = 1.123$, $p = .349 > .05$, $R = .162$, $R^2 = .026$, Adjusted $R^2 = .003$. The low correlation coefficient ($R = .162$) indicates a weak relationship between the demographic characteristics and operational efficiency. The R-square (R^2) value of .026 indicates that only approximately 2.6% of the variance in operational efficiency can be explained by these demographic factors. The Adjusted R-square value of .003 further confirms a negligible explanatory power, implying that demographic characteristics have a minimal impact on operational efficiency within the context of this study.

The ANOVA results also supported these findings, with an insignificant F-statistic ($F = 1.123$, $p = .349 > .05$). This indicates that the overall regression model does not significantly predict operational efficiency based on demographic characteristics. With degrees of freedom (5 for regression and 208 for residual), the statistical tests conducted are reliable but reflect that demographic variables collectively do not substantially influence operational efficiency.

Examining individual demographic predictors from the coefficients table, none of the characteristics showed statistically significant relationships with operational efficiency. Specifically, duration on the current job ($\beta = .072$, $t = .802$, $p = .423$), age ($\beta = .098$, $t = 1.109$, $P = .269$), gender ($\beta = .038$, $t = .552$, $p = .582$), level of education ($\beta = -.001$, $t = -.015$, $p = .988$), and participation in environmental sustainability practices ($\beta = .026$, $t = .371$, $p = .711$) all demonstrated non-significant influences on operational efficiency.

These findings suggest that demographic characteristics, such as employee age, gender, educational level, tenure, and participation in sustainability practices, have a limited and non-significant effect on operational efficiency at Nile Breweries Uganda Ltd. The overall results indicate that other organizational factors or specific sustainability practices may play a more substantial role in influencing operational efficiency than demographic variables.

CHAPTER FIVE

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the findings of the study, discusses the empirical results in view of the research objectives, stated hypotheses and similar findings from other research elsewhere. The researcher's conclusions are as well presented and finally recommendations made. The chapter also gives the areas suggested for future studies on the subject of environmental sustainability practices and operational efficiency.

5.2 Summary of findings

This section presents the summary of the findings of the study.

5.2.1 Pollution prevention practices and operational efficiency

The findings demonstrated a positive but not statistically significant effect of pollution prevention practices on operational efficiency at Nile Breweries Uganda Ltd. The regression analysis indicated a weak positive relationship between pollution prevention practices and operational efficiency ($\beta = 0.005$, $t = 0.062$, $p = .951$). With a p-value greater than 0.05, this result suggests that while pollution prevention practices may be beneficial for environmental sustainability, their direct contribution to improved operational efficiency at Nile Breweries is minimal, thereby not supporting the hypothesis that pollution prevention significantly enhances operational efficiency

5.2.2 Resource efficiency practices and operational efficiency

The study results showed that resource efficiency practices have a significant positive impact on operational efficiency at Nile Breweries Uganda Ltd. Regression analysis indicated a strong

positive relationship between the two variables (β = 0.476, t = 5.491, p = .000). Since the p-value is well below the 0.05 threshold, the findings suggest that when resource efficiency measures are effectively applied, they lead to notable improvements in operational performance. This outcome provides strong support for the hypothesis that resource efficiency practices are instrumental in boosting operational efficiency.

5.2.3 Sustainable Product Stewardship and operational efficiency

The results revealed a significant positive impact of sustainable product stewardship on operational efficiency at Nile Breweries Uganda Ltd. The regression analysis showed a strong positive association between sustainable product stewardship practices and operational efficiency (β = 0.328, t = 3.950, p = .000). Given that the p-value is below the 0.05 threshold, these findings indicate that adopting sustainable product stewardship practices meaningfully contributes to improved operational performance. This outcome supports the hypothesis that sustainable product stewardship plays a vital role in enhancing operational efficiency.

5.3 Discussion of findings

This section presents the discussion of the study findings as per the study objectives.

5.3.1 Pollution prevention practices

Although pollution prevention practices (PPP) showed a positive effect on operational efficiency at Nile Breweries Uganda Ltd, statistical analysis determined that this impact was insignificant. Despite the company's implementation of waste reduction and emissions control measures along with energy-saving initiatives the business has not shown measurable operational efficiency improvements. The findings provide a detailed analysis which stands in opposition to the general patterns identified in worldwide and regional research literature.

Global research literature has consistently highlighted pollution prevention as an essential factor for achieving improved operational performance. For example, Wang et al. According to research published in 2023 Wang et al. observed that firms achieved better operational outcomes through joint efforts to control environmental pollution. Similarly, Gabler et al. (2020) and Wesolowski et al. Research by Wesolowski et al. (2021) indicated breweries which adopted waste and emission reduction measures achieved significant improvements in operational efficiency alongside better regulatory adherence.

The present study's results do not align with the majority of findings from research conducted in developed countries. Scholars such as Garza-Reyes et al. The study by Garza-Reyes et al. (2018) demonstrated that pollution prevention measures led to important cost savings and productivity enhancements. The research findings indicate that the observed benefits from waste and emission reduction strategies may not transfer effectively to developing nations like Uganda. Studies conducted in African environments have identified structural problems including inadequate infrastructure and weak regulatory enforcement along with financial constraints as primary obstacles that reduce PPP effectiveness in achieving operational advantages (Ojo et al., 2022; Aegbite et al., 2023).

The results of this study show a stronger connection with the latest empirical evidence obtained from African research. Kiggundu and Nalunga's 2023 study found that pollution prevention methods showed potential in Ugandan breweries but substantial operational advancements were mostly achieved by well-funded multinational corporations. Smaller breweries and local businesses faced challenges in implementing the same practices because they suffered from financial constraints and technical expertise shortages. In the same vein, Mwesigye et al. Mwesigye and colleagues (2024) warned that the high upfront costs and uncertain returns make SMEs hesitant to adopt complete pollution prevention practices which restricts their short-term efficiency gains.

According to the Natural Resource-Based View (NRBV) framework proactive environmental strategies such as pollution prevention can drive competitive and operational advantages as indicated by Hart (1995). Although existing literature suggests performance benefits from sustainability practices, this study reveals that external factors including regulatory support and market conditions together with internal resource capabilities substantially affect that relationship. According to Mugerwa (2023) and Nabukeera (2022), PPP demonstrates long-term benefits but faces limitations in initial effectiveness unless there is sufficient policy support and financial resources.

The study identified a weak and statistically insignificant relationship which brings to light research gaps previously noted by scholars. The research landscape reveals an absence of longitudinal studies examining pollution prevention efforts' long-term effects whereas prevailing studies provide cross-sectional perspectives (Ainebyona & Nduhura, 2023). Existing studies predominantly examine large businesses located in developed nations and do not include SMEs or companies operating in resource-poor areas. Through this study we advance toward bridging this research gap while emphasizing the necessity of integrating internal capabilities with external assistance during sustainability planning processes.

The results reveal that Nile Breweries has not achieved immediate operational benefits from pollution prevention practices yet highlight the crucial role of financial resources alongside regulatory strength and institutional capacity in determining success. The study contributes valuable empirical data to the sustainability discussion in developing countries and demonstrates the necessity of specific policies and technical assistance to maximize pollution prevention operations in the brewery sector.

5.3.2 Resource efficiency practices and operational efficiency

Research analysis showed resource efficiency practices (REP) significantly enhanced operational efficiency at Nile Breweries Uganda Ltd with $\beta = 0.476$, $t = 5.491$, $p = .000$. The study shows that properly executed resource management strategies including energy conservation, water efficiency and waste reduction significantly enhance company operational performance. The results confirm existing research from both worldwide and African sources which highlights how resource efficiency is essential for sustainability and operational performance in breweries.

The research findings confirm global empirical studies that establish resource efficiency as a primary driver of operational enhancements. For example, Wang et al. The research by Wang et al. (2023) demonstrates that companies which implement resource-efficient and environmentally innovative strategies achieve superior operational performance through improved resource utilization. Smith and Jones (2023) discovered that organizations which adopted resource-efficient business strategies experienced substantial improvements in productivity along with financial performance. The findings from multiple studies demonstrate that REP leads to improved operational performance consistently.

The study conducted in Africa shows agreement with results from Adegbite et al. (2023) and Ojo et al. Ojo et al. (2022) found that breweries improved their productivity and cost efficiency when they adopted energy-efficient technologies along with water-saving systems and waste reduction measures. These researchers stressed that the success of REP implementation depends on organizational size along with technological preparedness and existing regulatory conditions. The substantial results Nile Breweries achieved demonstrate their efficient use of capital and technological infrastructure to achieve operational benefits through REP.

The Natural Resource-Based View (NRBV) framework advocated by Hart (1995) receives solid backing from these findings because it shows that sustainable resource management practices generate competitive advantages along with improved operational efficiency. The study's data confirms the theoretical concept that strategic integration of resource efficiency leads to major improvements in performance and cost management.

According to the research by Nabukeera (2022) and Mugerwa (2023), Ugandan breweries that used energy-efficient technologies and followed responsible water practices with optimized materials management achieved significant operational advancements. REP shows significant value within the Ugandan environment where operational expenses continue to rise alongside stricter environmental laws and limited resources. Both Kiggundu and Nalunga (2023) and Mwesigye et al. (2024) demonstrated that large breweries such as Nile Breweries are better positioned to adopt these practices because they have adequate financial and technological resources. Large breweries such as Nile Breweries demonstrate greater feasibility in adopting these practices because they have the necessary financial and technological resources. Smaller breweries encounter difficulties obtaining necessary resources to pursue these initiatives which indicates the importance of providing specific support.

This study successfully tackles multiple research gaps identified in previous scholarly work. Although numerous studies recognize REP's value many fail to study its direct causal impact on operational efficiency in developing countries. This research provides empirical evidence from Uganda that helps explain how REP leads to operational improvements within specific economic and infrastructural settings. The research contributes to the wider debate about the adaptability of proven practices from developed regions to the African brewery sector.

The research findings demonstrate that Nile Breweries Uganda Ltd. experiences significant operational efficiency improvements through the implementation of resource efficiency

practices. The results align with worldwide and regional studies while demonstrating REP's effectiveness in achieving operational sustainability and efficiency. The study emphasizes that financial and technological support is essential for smaller breweries to reach comparable outcomes. The research delivers substantial theoretical and practical insights by highlighting REP's impact on advancing sustainable performance in the Ugandan brewery industry..

5.3.3 Sustainable Product Stewardship and operational efficiency

Research revealed that sustainable product stewardship (SPS) at Nile Breweries Uganda Ltd shows a strong positive connection with operational efficiency ($\beta = 0.328$, $t = 3.950$, $p = .000$). Eco-conscious packaging together with sustainable product design alongside product recyclability and responsible lifecycle management practices significantly impact operational performance at Nile Breweries Uganda Ltd. Current research findings match prior global and regional studies which confirm that SPS functions as a critical strategic element for enhancing efficiency in the brewery sector.

Research conducted internationally demonstrates that SPS has a positive effect on operational performance. The study by Wang, Li, and Chen (2023) demonstrated that companies utilizing sustainability-focused product strategies achieved significant advancements in resource use efficiency and waste reduction while enhancing their processing capabilities. Smith and Jones (2022) found that the adoption of circular economy models and sustainable practices in sourcing materials and packaging led to operational efficiency and cost reductions for companies. The findings of these studies support current results by demonstrating how SPS leads to increased productivity and better global market positioning.

Within Africa this study demonstrates that prior research accurately identified SPS as an effective method to advance brewery operations. Researchers such as Adegbite et al. Both Adegbite et al. (2023) and Kiggundu and Nalunga (2023) found that breweries which focused

on sustainable practices related to packaging, energy consumption and recycling achieved enhanced operational efficiency while also saving costs and meeting regulatory requirements. The financial and technological capabilities of individual companies determined the extent to which they experienced these advantages. The study demonstrates that Nile Breweries achieved substantial performance upgrades from their sustainability-related infrastructure and innovative investments.

Uganda's findings support Mugerwa's (2023) and Nabukeera's (2022) conclusions that breweries which implement wastewater recycling and returnable bottle systems and eco-friendly packaging achieve operational advantages such as reduced costs and better compliance. That said, as Mwesigye et al. Mwesigye et al. (2024) stated that larger companies which possess adequate resources can more realistically achieve these benefits. This research confirms that although SPS demonstrates significant effectiveness it requires enough financial resources and technical capacity to succeed which smaller breweries might not have available.

The results provide empirical evidence for Hart's (1995) Natural Resource-Based View (NRBV) which demonstrates that managing products sustainably throughout their lifecycle yields competitive and operational benefits. NRBV indicates that businesses focusing on sustainable product design and sourcing along with recyclability and customer engagement will achieve better performance while minimizing inefficiencies. Research evidence supports this view by demonstrating that Nile Breweries' sustainability initiatives have led to observable improvements in operational performance.

The research highlights critical deficiencies within existing studies. Prior research has generally neglected the examination of how context-specific elements including regulatory environments and market conditions influence the success of SPS initiatives in developing economies. The investigation resolves existing research gaps by delivering empirical evidence

from local contexts and highlighting the necessity for sustainability strategies in markets similar to Uganda which reflect their unique conditions.

The research reveals that sustainable product stewardship practices lead to notable operational efficiency improvements at Nile Breweries Uganda Ltd. The findings correspond with worldwide and regional research but show the necessity of understanding the contextual elements that affect the implementation and effectiveness of Sustainable Product Stewardship (SPS). This research provides important data showing that sustainability-based activities lead to operational enhancements especially when they receive sufficient resources and customization for developing economy environments.

5.4 Conclusions

This section presents the conclusions of the study basing on the findings of the study.

5.4.1 Pollution prevention practices and operational efficiency

Research findings demonstrate that Nile Breweries Uganda Ltd experiences a positive correlation between pollution prevention practices and operational efficiency but statistical analysis shows this correlation lacks significance. The company's continued work on waste reduction, emission control and energy conservation has not led to immediate operational performance improvements. Environmental benefits from pollution prevention practices in Uganda’s brewing sector do not translate into operational efficiency gains unless supported by robust regulatory structures together with technical and financial assistance.

5.4.2 Resource efficiency practices and operational efficiency

The research shows that Nile Breweries Uganda Ltd. improves its operational efficiency through effective resource efficiency practices. The implementation of energy conservation measures along with water usage optimization and effective waste management has resulted in

significant operational performance improvements. The brewery has strategically utilized resource efficiency to enhance productivity while minimizing operational expenses. Investment in sustainable resource management stands out as essential for securing long-term success in brewery operations.

5.4.3 Sustainable Product Stewardship and operational efficiency

Sustainable product stewardship practices deliver substantial improvements to operational efficiency at Nile Breweries Uganda Ltd according to the study. The implementation of recyclable product designs along with eco-conscious packaging and responsible lifecycle management strategies resulted in enhanced operational performance. The findings show that sustainable product stewardship delivers environmental progress along with tangible business advantages through improved resource management, regulatory compliance and boosted market standing. Breweries committed to enduring operational efficiency and competitive positioning must adopt SPS practices.

5.5 Recommendations

This section presents the recommendations of the study basing on the conclusions of the study.

5.5.1 Pollution prevention practices and operational efficiency

The discoveries from this research resulted in multiple strategic recommendations aimed at improving pollution prevention methods at Nile Breweries Uganda Ltd.

The company needs to establish a continuous program of technical training and capacity development for employees. Through continuous training programs about modern pollution control methods and efficient waste management along with emission reduction techniques employees will gain essential skills that enable them to put these practices into action more effectively thus enhancing their operational performance.

Nile Breweries should build strategic partnerships with essential stakeholders which include government bodies, industry associations, academic institutions and international sustainability organizations. These partnerships enable knowledge sharing and bring specialized skills while supplying important resources which help address implementation obstacles in pollution prevention strategies.

A robust internal monitoring and evaluation (M&E) system remains a fundamental requirement. An effective system needs to track pollution prevention initiative performance and evaluate their results to identify improvement opportunities. When these activities align with the company's wider operational goals they create a pathway for sustainability efforts to achieve genuine efficiency improvements. The brewery needs to invest selectively in cutting-edge technologies like waste-to-energy systems and automated emission monitoring tools alongside energy-efficient production equipment. Advanced solutions can boost operational performance by reducing waste and making resource utilization more efficient.

The study advises government agencies to establish explicit regulatory frameworks that back pollution prevention efforts specifically within the brewing sector. The proposed regulatory framework needs to offer financial benefits including subsidies and tax relief to motivate breweries to implement advanced sustainable practices. Industry representatives and policymakers need to work together to establish practical environmental guidelines tailored to breweries. These standards will direct compliance efforts while promoting improvements throughout the industry and advancing environmental objectives.

Public-private partnerships that target pollution control require government promotion and support according to recommendations. These partnerships provide critical support to small breweries that face difficulties in independently implementing environmental practices by addressing both technical requirements and funding needs.

Adoption of these recommendations promises to enhance pollution prevention measures at Nile Breweries and across Uganda's brewing sector resulting in better operational efficiency and sustainable growth.

5.5.2 Resource efficiency practices and operational efficiency

The study's results lead to strategic suggestions that aim to enhance how sustainable product stewardship connects with operational efficiency at Nile Breweries Uganda Ltd.

The brewery must increase its sustainable product design and packaging initiatives by using more recyclable, returnable, and biodegradable materials in its operations. The adoption of environmentally friendly packaging solutions will minimize the company's ecological footprint and enhance operational efficiency through waste reduction and disposal cost savings.

The brewery should increase consumer and stakeholder awareness about its sustainability efforts. Targeted communication campaigns that highlight product sustainability and environmental benefits can build customer loyalty while enhancing brand perception which leads to stronger competitiveness and increased operational efficiency. Organizations must prioritize employee training and awareness programs that focus on sustainable product practices to establish sustainability values throughout every organizational level.

The company needs to implement regular life-cycle assessments for its products. Evaluations will enable the company to discover potential improvements throughout the entire product journey from raw material sourcing through production distribution usage and ending with disposal. The brewery can improve operational performance and sustainability outcomes by identifying and solving inefficiencies throughout the product life cycle.

Government bodies should develop beneficial regulatory frameworks while providing economic incentives to promote sustainable product stewardship across the brewery industry. The creation of specific sustainability standards and guidelines for product stewardship will

offer breweries precise targets and performance benchmarks to aim for. The sector-wide adoption of sustainable practices will speed up through public-private partnerships established via industry platforms and sustainability programs.

5.5.3 Sustainable Product Stewardship and operational efficiency

The study results lead to recommendations for Nile Breweries Uganda Ltd to enhance sustainable product stewardship and operational efficiency through expanded eco-friendly packaging design that utilizes recyclable materials, returnable systems and biodegradable options. Sustainable product design investments lead to minimized environmental impact while improving operational efficiency by cutting packaging waste and lowering disposal expenses.

The company needs to educate customers and stakeholders about its sustainable product efforts. Marketing efforts that emphasize product sustainability and environmental advantages will strengthen consumer commitment while elevating brand image and indirectly promoting better market positioning and operational effectiveness. Organizations must prioritize employee training programs on sustainable product stewardship to build a work environment centered on sustainability principles.

The company needs to perform thorough product life-cycle assessments regularly to discover ways to improve sustainability throughout all stages of product development including raw material sourcing to production and distribution and recycling. By implementing regular life-cycle assessments Nile Breweries can detect operational inefficiencies while reducing resource waste and boosting both product sustainability and operational efficiency.

Policy recommendations suggest government agencies establish supportive regulatory systems and financial incentives to promote sustainable product stewardship adoption across breweries. Government regulators must develop precise sustainability standards and guidelines dedicated

to product stewardship within the brewery industry which will establish measurable performance benchmarks. The adoption of sustainable product stewardship practices throughout the brewing industry can advance significantly through collaboration between breweries and government entities in industry forums and public-private partnerships and sustainability initiatives. When Nile Breweries Uganda Ltd and Uganda's wider brewing sector enact these recommendations operational efficiency will improve alongside environmental sustainability.

5.6 Limitations of the study

This research study encountered multiple limitations like those found in empirical research which need attention during result interpretation. The research examined only one entity—Nile Breweries Uganda Ltd—in Uganda’s brewing industry. The valuable findings about organizational sustainability practices and operational efficiency from this research have limited applicability across different manufacturing sectors and may not represent the entire industry landscape.

The study's cross-sectional research design with its single-time data collection point limited its ability to measure the long-term impacts of environmental sustainability practices. This approach is effective in assessing present relationships yet fails to evaluate the evolution of practices or their temporal performance impacts. Extended research investigations would gain value from longitudinal studies that monitor transformations and results throughout multiple time frames.

The research faced constraints because its data collection depended mainly on self-administered questionnaires. Response bias presents a risk to this method because participants may have provided answers that reflect social acceptability or may have inaccurately remembered their experiences. The reliability of the findings may be affected by these factors.

Future research can improve data validity by using objective performance metrics or gathering information from various sources.

Moreover, the study focused specifically on three sustainability dimensions: The study examined three key sustainability dimensions including pollution prevention practices, resource efficiency measures, and sustainable product stewardship approaches. The study examined three key sustainability dimensions but did not provide detailed analysis of other important variables including organizational culture, leadership approaches, financial capacity, and external market dynamics. Future research should examine these factors because they could serve as moderating or mediating elements that influence operational efficiency.

Even though regression analysis showed significant relationships, the study's correlational design prevents definitive conclusions about causal relationships. Research through experimental and quasi-experimental designs enables more profound understanding of how sustainability initiatives directly impact operational performance.

5.7 Suggested areas for further research

Future research directions have been identified based on the study's findings and its acknowledged limitations. Future research should expand its study range to examine multiple breweries and perform cross-sectoral comparisons within manufacturing industries. The results would gain better generalizability while offering an encompassing understanding of the relationship between sustainability practices and operational efficiency across multiple industrial sectors.

There should be longitudinal research to investigate how sustainability practices like pollution prevention, resource efficiency, and sustainable product stewardship affect operational efficiency over the long term. A long-term examination of these practices will reveal how they maintain their effectiveness and impact organizational performance.

Subsequent studies could improve by adding variables that encompass leadership styles as well as organizational culture, technological capabilities, regulatory environments and current market circumstances. A thorough analysis of these dimensions will yield a deeper understanding of both internal and external elements that determine how successful sustainability initiatives are in boosting operational efficiency.

Researchers should use mixed-method approaches which integrate quantitative surveys with qualitative methods including interviews, focus groups and case studies. The use of this methodology allows researchers to triangulate data which generates detailed understanding of both practical challenges and organizational dynamics when executing sustainability strategies.

The use of experimental or quasi-experimental research designs produces more definitive causal evidence. These experimental designs enable researchers to accurately measure the effects of distinct sustainability interventions on operational performance in breweries and comparable production settings.

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APPENDICES

Appendix i: Questionnaire

Dear Respondent,

My Name is Kato Paul, I a conducting a study to examine the effect of environmental sustainability practices on operational efficiency at Nile Breweries Uganda Ltd. I conducting this study in partial fulfillment of the requirements for the award of a master of business administration degree. Your input will significantly contribute to understanding how sustainable practices can enhance operational efficiency in the brewing industry. The information gathered will be used solely for academic purposes and will remain confidential.

SECTION A: DEMOGRAPHIC INFORMATION
(Circle the best option)

A.1. Name of Department/Section at Nile Breweries Uganda Ltd:
……

A.2. What is your role within the company?
a) Production
b) Quality Control
c) Environmental Management
d) Supply Chain
e) Others (Please specify): _____

A.3. How long have you worked with Nile Breweries Uganda Ltd?
a) Less than 1 year
b) 1 to 3 years
c) 4 to 7 years
d) More than 7 years

A.4. What is your age group?
a) Below 30
b) 31 to 40
c) 41 to 50
d) Above 50

A.5. Your gender?
a) Male
b) Female

A.6. What is your highest academic qualification?
a) Certificate
b) Diploma
c) Bachelor's degree
d) Postgraduate degree
e) Others (Please specify): _____

A.7. In your role, do you participate in or oversee environmental sustainability practices?
a) Yes
b) No

SECTION B: POLLUTION PREVENTION PRACTICES

Statements regarding pollution prevention practices at Nile Breweries Uganda Ltd. Please indicate your level of agreement with the following statements, where: SA = Strongly Agree, A = Agree, NS = Neither Agree nor Disagree, D = Disagree, SD = Strongly Disagree.

Statement	SD	D	N	A	SA
PP1. Nile Breweries has implemented effective pollution prevention strategies in production.					
PP2. The company regularly monitors pollution levels in its operations.					
PP3. Pollution prevention practices have improved operational efficiency at Nile Breweries.					
PP4. Nile Breweries has adopted renewable energy sources for its production processes.					
PP5. Renewable energy adoption has led to lower energy costs for the company.					
PP.6 The use of renewable energy has positively impacted the company's operational efficiency.					

SECTION C: RESOURCE EFFICIENCY PRACTICES

Statements regarding resource efficiency at Nile Breweries Uganda Ltd. Please indicate your level of agreement with the following statements, where: SA = Strongly Agree, A = Agree, NS = Neither Agree nor Disagree, D = Disagree, SD = Strongly Disagree.

Statement	SD	D	N	A	SA
RE1. Nile Breweries adopts energy-saving measures in production processes.					
RE2. The company effectively minimizes water usage in its operations.					
RE3. Resource efficiency initiatives have contributed to cost savings for the company.					
RE4. Resource efficiency practices enhance the company's overall operational performance.					
RE5. Nile Breweries has an effective waste management system in place.					
RE6. Proper waste management practices have reduced operational costs.					
RE7.The company has successfully minimized waste production in its processes.					
RE8. Waste management practices contribute to the company's overall operational efficiency.					

SECTION D: SUSTAINABLE PRODUCT STEWARDSHIP

Statements on sustainable product stewardship at Nile Breweries Uganda Ltd. Please indicate your level of agreement with the following statements, where: SA = Strongly Agree, A = Agree, NS = Neither Agree nor Disagree, D = Disagree, SD = Strongly Disagree.

Statement	**SD**	**D**	**N**	**A**	**SA**
SPS1. Nile Breweries uses environmentally friendly materials in its packaging.					
SPS2. The company takes steps to ensure the recyclability of its products and packaging.					
SPS3. Sustainable product stewardship has enhanced the company's market competitiveness.					
SPS4. The adoption of sustainable product stewardship practices has improved the overall operational efficiency.					
SPS5. Nile Breweries optimizes the use of raw materials in production.					
SPS6. Resource optimization strategies have resulted in reduced production costs.					
SPS7. Resource optimization has contributed to the company's overall operational performance.					

SECTION E: OPERATIONAL EFFICIENCY

Statements on operational efficiency at Nile Breweries Uganda Ltd. Please indicate your level of agreement with the following statements, where: SA = Strongly Agree, A = Agree, NS = Neither, Agree nor Disagree, D = Disagree, SD = Strongly Disagree.

Statement	**SD**	**D**	**N**	**A**	**SA**
OEE1. Environmental sustainability practices have significantly improved operational efficiency at Nile Breweries Uganda Ltd.					
OEE2. The integration of sustainability practices into daily operations has led to increased productivity.					
OEE3. Environmental sustainability has contributed to cost reduction and profitability.					
OEE4. Sustainable practices have improved employee satisfaction and performance.					

Thank you for participating in the study

Appendix ii: Interview guide

Dear Respondent,

My Name is Kato Paul, I a conducting a study to examine the effect of environmental sustainability practices on operational efficiency at Nile Breweries Uganda Ltd. I conducting this study in partial fulfillment of the requirements for the award of a master of business administration degree. Your input will significantly contribute to understanding how sustainable practices can enhance operational efficiency in the brewing industry. The information gathered will be used solely for academic purposes and will remain confidential.

Questions

A. Pollution Prevention Practices

1. What measures has your organization implemented to minimize emissions or waste discharge into the environment?
2. How do you monitor and evaluate the effectiveness of your pollution prevention strategies?

B. Resource Efficiency Practices

3. What steps has your organization taken to reduce the consumption of energy, water, and raw materials?
4. Can you describe any initiatives or technologies adopted to improve resource efficiency in your operations?

C. Sustainable Product Stewardship

5. How does your organization ensure that products are environmentally responsible throughout their lifecycle?
6. What role does your organization play in educating consumers or stakeholders about the sustainability of your products?

D. Operational Efficiency

7. What strategies have been adopted to optimize internal processes and reduce operational costs without compromising quality?
8. How do you integrate environmental and sustainability considerations into day-to-day operational decisions?

Thank you for participating in the study

Appendix iii: Introductory letter

UGANDA CHRISTIAN UNIVERSITY
A Centre of Excellence in the Heart of Africa

17th March 2025

To Whom It May Concern;

RE: MASTERS IN BUSINESS ADMINISTRATION (MBA)

Mr. Kato Paul , REG NO: S23M15/056 is a student at Uganda Christian University, pursuing a degree of Master's in Business Administration.

In partial fulfillment of the requirements for the award of the Master's degree, he is conducting a research study titled: **Environmental Sustainability Practices and Operational Efficiency at Nile breweries Uganda** Ltd

This communication therefore serves to formally request you to allow him access any information in your custody/organisation, which is relevant to his research .

Thank you for your cooperation on this matter

Yours Sincerely,

Dr. Henry Mugisha
Head of Department, Postgraduate Studies

13 MAR 2025

Appendix iv: Sampling guide

TABLE FOR DETERMINING SAMPLE SIZE FROM A GIVEN POPULATION

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size
"S" is sample size.

Krejcie, Robert V., Morgan, Daryle W., "Determining Sample Size for Research Activities", Educational and Psychological Measurement, 1970.