SUSTAINABLE SUPPLY CHAIN PRACTICES AND OPERATING EFFICIENCY OF CONSUMER GOODS MANUFACTURING COMPANIES

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Abstract

The achievement of sustainable supply chain remains a major problem for the manufacturing companies that are into consumer goods in Nigeria. They experience challenge in achieving an equilibrium state in regenerative sourcing and sustainability. They lack proper closed loop system that handles product returns. Their slow involvement in energy-saving technologies can also deter them from operating at efficient level. This study examined the effect of sustainable supply chain practices on operating efficiency of the consumer goods manufacturers. Specifically, it determined the relationship among regenerative sourcing, green product design, energy-saving, closed loop supply chain, and operating efficiency of consumer goods manufacturers. Using a survey research design, the study's population was 10,800 employees from consumer goods manufacturing companies in Lagos State. The sample size was 386. The responses generated were analysed using inferential statistics through the SPSS version 25. The findings were that operational efficiency was significant affected by sustainable supply chain practices, namely regenerative sourcing (B = 1.131, t = 16.835, p = 0.000), energy saving (B = .250, 1, t = 4.909, p = 0.000), and closed loop supply chain (B = .110, t = 3.051, p = 0.000) of the consumer goods sector in Lagos state. The study thus highlights the critical importance of tailored sustainable supply chain practices in optimising operating efficiency within the dynamic context of the consumer goods sector in Lagos State. It is recommended that manufacturers can enhance their operating efficiency by investing in regenerative sourcing practices, strategically balancing energy saving practices, and enhancing closed loop supply chain capabilities.

Keywords: Closed loop supply chain, Energy saving, Regenerative sourcing, Operating efficiency, Sustainable Supply Chain

Introduction

In recent years, there has been a rise in global recognition for sustainability in supply chains (Hmouda, Orzes, & Sauer, 2024; Khan, Tao, Ahmad, Shafique, & Nawaz, 2020). This is due to the increased rate of production of consumer goods across the world. In the United States of America for instance, consumer goods manufacturing is projected to reach 11.4 trillion dollars in 2025 (Alda, 2024). Similarly, consumer goods market accounts as the highest contribution in United Kingdom (Nwaulune, Ajike, & Bamidele, 2023). In Nigeria, consumer

goods manufacturing increases yearly. A study by Aja (2023) revealed that the distribution of products from manufacturers of consumer goods in Nigeria increased by 38.6% in 2022. There is however a unique set of challenges accompanying this trend, particularly lack of infrastructural facilities, renewable energy shortage, and poor regulatory background, which affect the extent to which sustainability in supply chain is adopted within Lagos State. Considering the high influx of goods into the consumer market in Lagos state, there are mounting environmental concerns for their impact on the economy. Consequently, manufacturers are compelled to adopt sustainable environmental practices. Sustainable supply chain (SSC) has thus emerged as a pivotal strategy to address environmental challenges (Hmouda, et al., 2024; Mahmood, Misra, Sun, Luqman, & Papa, 2024).

SSC goes beyond just pursing profit to encompass balancing environmental impact, social responsibility, and economic viability (Kiforodu, 2022; Ozigbo, 2021). This translates to practices like regenerative sourcing (sourcing with concern for eco-system equilibrium), green product design (environmentally friendly production), energy saving through renewables and efficient processes, and closed-loop systems for managing product end-of-life (Kiforodu 2022; Salehi-Amiri, Zahedi, Gholian-Jouybari, Calvo, Hajiaghaei-Keshteli, 2022). These approaches hold potential benefits in Lagos State especially in the area of improving the environment and enhancing the operating efficiency of organisations in Lagos State.

Operating efficiency, which is a manufacturer’s ability to achieve strategic goals through cost or waste minimisation can be impacted by SSC (Handoyo, Suharman, Ghani, & Soedarsono, 2023; Saruchera & Asante-Darko, 2021). These practices can lower costs through resource optimisation, improve product quality and responsiveness, and boost customer loyalty (Ogunlela, 2018; Omoregbe & Adjaino, 2019). Consequently, the consumer goods industry's long-term success depends on the integration of SSC. Thus, the purpose of this study was to investigate the connection between SSC practices and the operating effectiveness of the consumer goods industry in Nigeria.

Statement of the Research Problem

Achieving SSC presents several challenges for manufacturers in the consumer goods market in Nigeria (Nwaulune, et al 2023; Soyege, Makinde, & Akinlabi, 2023). Unreliable sourcing of raw materials disrupts operations (Omoregbe et al., 2019; Ozigbo, 2021). Balancing product design with both sustainability practices and regulations adds further complexity (Nwaulune et al., 2023).

Additionally, inefficient closed loop SSC for handling product returns and waste require specialised infrastructure and staff, increasing costs and management burdens. Also, limited investment in energy-saving technologies can hinder long-term cost reduction due to upfront costs. Though there are several studies that studies SSC practices (Kifordu, 2023; Ogunlela, 2018; Nwaulune, et al., 2023), Studies that have examined how SSC affects operating efficiency within the context of the consumer goods sector in Nigeria are scarce. Kiforodu (2022) only focused their studies recycling on industrial goods, while Nwaulune et al (2023) streamlined their study to green logistics and did not look at other aspects of SSC. These study suggest conceptual gaps. Hence the need to conduct a study that examined the impact of SSC practices on operating efficiency in the consumer goods in Nigeria. This study closes this gap by examining key aspects of SSC such as regenerative sourcing, green product design, energy saving, and closed loop supply chain in relation to their impact on operating efficiency of the Nigerian consumer goods sector.

Objectives of the Study

The broad objective of this study was to determine the relationship between SSC practices and the operating efficiency of consumer goods manufacturers in Lagos State. The specific objectives were to:

i. determine the relationship between regenerative sourcing and the operating efficiency of consumer goods manufacturers in Lagos State;
ii. assess the effect of energy saving on the operating efficiency of consumer goods manufacturers in Lagos State; and
iii. evaluate the influence of closed loop supply chain on the operating efficiency of consumer goods manufacturers in Lagos State.

Literature Review

Conceptual Review

Sustainable Supply Chain Practices

Sustainable Supply Chain (SCC) is a set of organisational activities that incorporate environmental considerations such as eco-friendly design, resource conservation, minimisation of harmful materials, and product reuse throughout the product's life cycle (Omoregbe & Adjaino, 2019; Mugoni, Nyagadza, & Hove, 2023). Ultimately, SSC aims to minimises harmful environmental impact in the supply chain by ensuring that there is a

responsible resource use for future generations (Hmouda et al., 2024; Omoregbe & Adjaino, 2019). The SSC practices include regenerative sourcing, green product design, close loop supply chain and energy saving. They are discussed below.

Regenerative sourcing: Regenerative sourcing has its focus on the replenishment and revitalisation of resources that are utilised in production. Reed and Glover (2020) define regenerative sourcing as the process of procuring materials, in such a way that it reduces negative effect on the environment and assists in restoring balance in the ecosystem from which the resources were taken. Hence the practice of regenerative sourcing allows the manufacturer to restore and improve the natural environment where inputs were initially taken.

Closed loop supply chain: Close-loop supply chain is the practice of minimising waste and consumption of resources through the creation of a circular flow of materials such that those products that have reached the last stage in their life cycle engaged in reintegration to the manufacturing process (Abbey, Guide, & Sun, 2024; Anne, Nicholas, Gicuru & Bula, 2015). The emphasis is on reusing, recycling, reproduction of the product within the SC. A closed loop supply chain thus as described by Anne, et al (2015), enables a return of used goods with the intention of regaining and maybe creating value from them.

Energy saving: Energy saving refers to the optimisation of energy consumption throughout the entire supply chain process, from raw material extraction to end-product delivery (Malliaroudaki, Watson, Ferrari, Nchari, & Gomes, 2022). This approach aims to reduce greenhouse gas emissions, minimise environmental impact, and conserve natural resources. (Perotti & Colicchia, 2023). This suggests that in the process of optimising energy usage across the SC processes, manufacturers have the potential of reducing their carbon footprint thereby mitigating climate change risk for enhanced operating efficiency.

Operating Efficiency

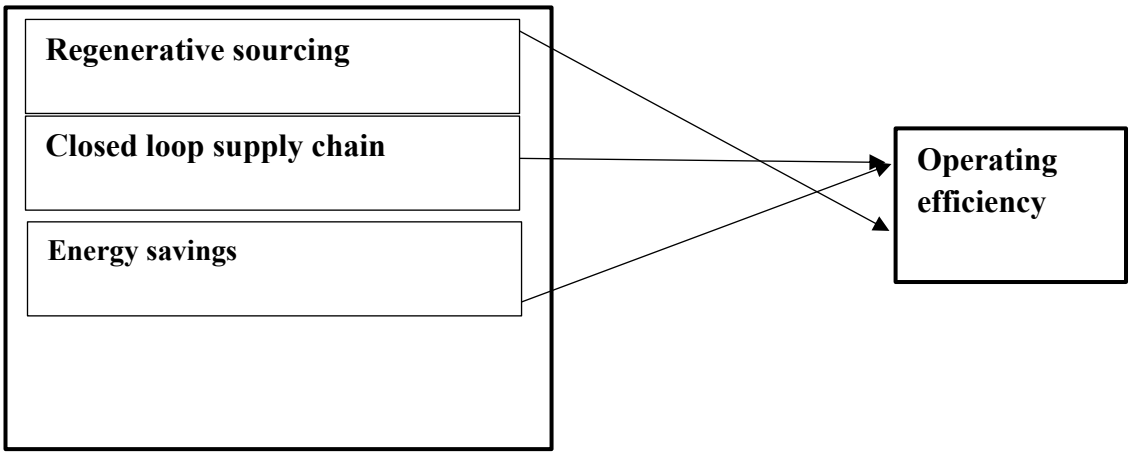
Operating efficiency is the manufacturing plant's capabilities to use resources in the most economical way (Handoyo, et al., 2023; Mugoni, et al., 2023). Ross, Westerfield, and Jaffe (2013) explain that operating efficiency as the ratio of output to input. The emphasis in the definitions is how well the manufacturers translate their resources to revenue. This suggests that operating efficiency deals with a manufacturer's ability to minimise the use of input while

maximising output, with emphasis on controlling cost for enhanced productivity.

The above descriptions suggest that operating efficiency is concerned with the ability of the manufacturers to make use of their resources (such as labour, capital and materials) optimally in their production at the least possible cost with quality not compromised. Moreover, sustainability is enhanced as efficient use of resources is promoted (Nwaulune, et al., 2023).

Research Model

Figure 1: Sustainable supply chain practices and operating efficiency



Source: Researchers' Conceptualisation (2025)

Theoretical Background

This study has its underpinning on Hart's (1995) Natural Resource-Based View (NRBV), which maintains that a manufacturer's competitive edge is derived from its distinct combination of resources and competencies. These resources must be valuable (contribute to a competitive edge), rare (few competitors possess them), inimitable (difficult to copy), and non-substitutable (no easy alternatives exist) (Barney, 1991; Conner, 1991). SSC practices perfectly exemplify this concept. Regenerative sourcing, which focuses on replenishing natural resources used in production, directly address environmental concerns. Similarly, closed-loop supply chains, where used products are reintegrated into the production cycle, minimise reliance on virgin resources, a valuable but potentially scarce resource. Therefore, NRBV provides a valuable lens for understanding how sustainable supply chain practices contribute to operating efficiency.

Empirical Review

Regenerative sourcing and operating effectiveness

Azevedo et al. (2011) examined how manufacturing performance was affected by SSC procedures in Portugal. The survey results show that SSCM procedures improve customer happiness, quality, and the effectiveness of the manufacturers under investigation. Also. Kiforodu (2022) investigated the impact of recycling on publishing manufacturers' performance in Nigeria using a survey-based approach. The findings revealed a positive correlation between recycling practices (both resource and waste) and organisational performance, suggesting that recycling can contribute to a publishing manufacturer's success.

Closed loop supplier chain and operating efficiency

Vachon and Klassen (2008) explored the relationship between remanufacturing capabilities and operating performance within a multi-industry context. Through a survey methodology, they found that a favourable relationship between high remanufacturing capacities and operating metrics of performance including shorter wait times and higher-quality products. Also, Saruchera and Asante-Darko (2021) in their study on reverse logistics, organisational culture, and their effect on factory operating performance in Ghana's, revealed that manufacturer's operational performance was positively impacted by the implementation of reverse logistics techniques. Moreover, Salehi-Amiri et al (2022) focused their study on closed-loop supply chain network Mexico. They found that that operations are significantly impacted by closed-loop supply chain networks.

Energy savings and operating efficiency

Amal and Umarali (2017) carried a research on how lean manufacturing affected operating effectiveness in the Indian automobile manufacturing sector. In this study, a survey research design was used. Using Analysis of Moment Structure (AMOS) software, the results showed a strong and favorable correlation between operating success and lean approach. In another study, Panwar, Jain, Rathore, Nepal, and Lyons (2018) examined the effect of lean methods on performance in operations. In this study, a survey research design was used among Indian processing companies. The findings revealed that lean practices had positive and significant relationship with operating efficiency. Furthermore, Ozigbo (2021) explored mechanisms that

influence Nigeria tourism industry for adopting sustainable SSCM practices. They revealed that the industries that pursue low-cost strategy enjoy positive association with the dimensions of performance.

Methodology

Research design: The study employed a correlational survey research approach. It involved assessing the magnitude and direction of the relevant variables and gathering data from the respondents via a questionnaire. The study's target demographic consisted of workers from Nigerian enterprises that produce consumer goods. Purposively, six manufacturers of consumer goods were chosen based on the researchers' capacity to collect data from them. Table 1 shows the population of the selected manufacturers. Based on the data provided by the companies' websites as at April, 2024, the total number of employees in the companies was 10,800.

Table 1: Population of employees in selected consumer goods manufacturing Companies in Lagos State

S/N	Companies	Location	Population
1.	BUA foods	Lagos State	718
2.	Dangote Sugar refinery	Lagos State	2,981
3.	Flourmill	Lagos State	5,404
4.	Unilever PLC	Lagos State	610
5.	PZ Cusson	Lagos State	996
6.	Enamelware	Lagos State	91
Total			**10,800**

Source: Companies' website (2024)

Sample size: The sample size was arrived at by use Yamane (1967) formula, as calculated below.

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = sample size; N = population size (finite population); e = desired level of significance, (in this case is 5%):

$n = \frac{10800}{1+10800(0.05)^2}$ = 386

Sampling technique: The sampling technique employed was stratified random sampling. This entailed a division of the population into strata. Each stratum represented a company. The sample size was allocated to each stratum by computing the sample size estimate as a proportion of the population of employees in the companies. This was presented in Table 2

Table 2: Sample size allocation

S/N	Strata	N	Sample Size Estimate
1.	BUA foods	718	26
2.	Dangote Sugar refinery	2,981	107
3.	Flourmill	5,404	192
4.	Unilever Nig. PLC	610	22
5.	PZ Cusson Nig.	996	36
6.	Enamelware	91	3
Total		10,800	386

Source: Researchers' Computation (January, 2025)

Next, purposive sampling technique was used to reach the employees in the companies. In doing this, the management of each companies was approached, who in turn directed the researcher to those employees who were chanced to participate in the study as at the time the researcher visited the company. The researchers approached such employees based on their convenience. Once the quota that was allotted to a particular company was reached, the researcher stopped the administration of the research instrument.

Hypotheses of the study: The hypotheses of the study stated in the null form are:

1. Ho_1: There is no significant relationship between regenerative sourcing and operating effectiveness consumer goods manufacturers in Lagos State
2. Ho_2: There is no significant relationship between closed loop supplier chain and operating effectiveness consumer goods manufacturers in Lagos State.
3. Ho_3: There is no significant relationship between energy savings and operating effectiveness in the consumer goods sector in Lagos State.

Model specification: The model of the study in its econometric form was specified as follows:

$$OPE = \beta_0 + \beta_1 RGS + \beta_2 ENS + \beta_3 CLS + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where: OPE = Operating efficiency; RGS = Regenerative sourcing;
Energy saving = Energy saving; CLS = Closed loop supply chain; e_t = error term; β_0 = Constant and intercept β_1, β_2, *and* β_3, = Coefficients of the various independent variables. Also the *a priori* expectations were stated as β_i (i = 1 to 3) > 0, indicating that positive relationship was expected as the outcome.

Research instrument: The questionnaire was divided into two sections: a demographic profile of the respondents and details on SSC procedures and operating effectiveness. The respondents' general profile or demographic data is presented in the first portion, and specific remarks about SSC and operating efficiency are included in the second section. A five-point Likert scale will be used to measure or rate each item related to SSC practices and operating efficiency: 5 corresponds to highly agree, 4 to agree, 3 to undecided, 2 to disagree, and 1 to strongly disagree.

Validity and reliability of the research instrument: An early version of the questionnaire was provided to senior colleagues in the study's field to critically assess the statements' relevance and make any necessary revisions relevant to the research project in order to verify the validity of the questionnaire design. The study questionnaire reliability was then examined to determine whether its measurements would produce the same outcomes in different situations. Pilot testing was used to determine the instrument's reliability by surveying 20 randomly chosen respondents. The Cronbach alpha test was used to examine the collected data. The outcome is presented in Table 3.

Table 3. Reliability test

Variables	No of items	Cronbach Alpha Values
Regenerative sourcing	4	0.719
Closed loop supply chain	4	0.775
Energy saving	4	0.756
Operating efficiency	8	0.838

Table 3 shows that the values were higher than 0.7, indicating that the research instrument was reliable for the study. The questionnaire was administered online to the employees of the respective companies based on the sample size estimate for each of the companies. The collected data were analysed through Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics and regression analysis were used to analyse the data.

Results and Discussions

From the 386 respondents who were administered questionnaire online, 318 (83%) were responses were received, which were used for further analysis.

Table 4: Relationship between sustainable supply chain practices and operating efficiency

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	4.357	1.043		4.178	.000
Regenerative sourcing	1.131	.067	.696	16.835	.000
Energy saving	.250	.051	.194	4.909	.000
Closed loop supply chain	.110	.036	.105	3.051	.002
$R = .845^a$ $R^2=.714$; Adj $R^2=.709$; F-Statistic = 145.468; F-Statistic (Prob) = 0.000. N = 318; Dependent Variable: Operating efficiency					

Table 4 indicates that there is 84.5% association between SSC practices and operating efficiency, as indicated by the multiple correlation (R) value of 0.845. Furthermore, the regression model's strength is indicated by its R^2 value of 0.714, which clarifies its capacity to explain the SSC practices influencing operating efficiency. Specifically, the model demonstrated that the combination of regenerative sourcing, green product design, energy saving, closed loop supply chain, network knowledge accounted for 71.4% of the changes observed in operations efficiency. Furthermore, the F-value of 145.468, with p= 0.000 indicated the overall significance of the regression model. The higher F-value suggested a stronger relationship between the independent variables and the dependent variable.

The significant relationship between SSC practices and the operating efficiency is displayed in Table 5 as follows*:* regenerative sourcing ($\beta = 1.131$, $p = 0.000 < 0.05$), energy saving ($\beta = .250$, $p = 0.000 < 0.05$), and close loop supply chain ($\beta = .110$, $p = 0.002 < 0.05$). Consequently, the formulated null hypotheses 1, 2 and 3 were rejected. It was thus concluded that regenerative sourcing, closed

loop supply chain, and energy saving have significant relationship with operating efficiency of manufacturing-based companies in Lagos state

Discussions

The objective of the study was to ascertain how SSC practices affected the operating effectiveness of consumer goods firms in the Nigerian state of Lagos. It was discovered that operating efficiency and regenerative sourcing have a strong positive connection. This suggests that the prioritisation of regenerative practices can promote increased operating efficiency. This result underscores how essential it is to engage in sustainable sourcing above managing reputation. The finding is consistent with that of Kiforodu (2022), who revealed that recycling techniques improve manufacturers' performance. It also supports the findings of Azevedo et al. (2011), who found that regenerative sourcing enhances customer happiness and product quality.

Also, energy saving had a significant and positive relationship with operating efficiency. This suggests that efforts at reducing energy usage would enhance operating efficiency. This can be in the area of maintaining equipment or employees' performance. The findings are consistent with Amal and Umarali (2017) and Panwar et al (2018). They both found that lean practices can positively and significantly affect operating efficiency.

Furthermore, a significant positive relationship was found to exist between closed-loop supply chains and operating efficiency. The result indicates the economic gains of engaging in closed-loop practices. In the process of having returned products, and reducing waste, the manufacturers recovers the value of their products at lowered cost which enhances their operating process. The outcome is consistent with the findings of Salehi-Amiri et al. (2022), who discovered a favourable and substantial association between operating performance and closed-loop supply chains. The outcomes corroborate the findings of Saruchera and Asante-Darko (2021), who demonstrated that reverse logistics significantly and favourably impacts a manufacturer's operations.

Conclusion

The relationship between SSC practices and the operating effectiveness of consumer products producers in Lagos State, Nigeria, was investigated in this study. The outcome provide key insights that the manufacturers who pursue optimisation in their operations while practicing sustainability precepts. The

results show that regenerative sourcing positively and significantly affect operating efficiency. It is thus suggestive that prioritising a concern for the environment can provide benefits that go beyond reputation especially strategic advantage, cost reduction and efficiency. This study has also found that there is positive and significant relationship between energy saving and operating efficiency thus reiterating the need for more energy efficiency. The outcome of this study suggest that the cost-reduction decisions of the manufacturers have to spread across other areas of their production. Finally, it was discovered that a closed-loop supply chain has a favourable and considerable impact on operating efficiency, highlighting the improvements in waste and product return management. All of these can put firms in a better position to use resources more effectively and spend less on operating expenses.

Recommendations

On the basis of the results of the study on sustainable SSC practices and operating efficiency in the Nigerian consumer goods sector, the following are proposed:

1. ***Prioritising regenerative sourcing:*** This will enable the manufacturers to have access to more raw materials for their production thereby reducing the cost of sourcing for suppliers and enhanced operating efficiency.
2. ***Bridging the innovation gaps:*** Manufactures should ensure that there is efficiency in their production procedure. To do this to should pursue production processes that can accommodate the kind of green product design they desire.
3. ***Embracing closed-loop supply chains:*** They should adopt product return and waste management practices that are effective as this will enable the recovery of value from those products that were returned, enhance waste minimisation and generally lead to an improvement in their use of resources.
4. ***Holistically approaching SSC:*** They ought to see SSC methods from a wider angle, taking into account both the potential advantages and disadvantages of various approaches in terms of operating efficiency.

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