

GREEN LOGISTICS AND ENVIRONMENTAL SUSTAINABILITY OF BOTTLED WATER COMPANIES IN RIVERS STATE

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Abstract

This study examined the relationship between green logistics and environmental sustainability of bottled water companies in Rivers State. Specifically, the study examined the relationship between green logistics and waste recycling, waste reduction and decreased carbon footprint of Bottled Water Companies in Rivers State. The study was premised on Ecological Modernization Theory. A correlational research design was adopted. The population of the study consisted 10 registered and functional bottled water companies in Rivers State. The entire population was studied. Primary data were collected using questionnaire. The Hypotheses were tested using Spearman's Rank Order Correlation. The findings revealed a moderate positive relationship between green logistics and waste recycling and waste reduction; and a strong positive relationship between green logistics and decreased carbon footprint of bottled water companies in Rivers State. The study concludes that green logistics promotes environmental sustainability of bottled water companies in Rivers State, and recommends that management of bottled water companies in Rivers State that seek improved environmental sustainability in Rivers State should invest in vehicles that meet emission standards, apply technology to optimize journeys, and use effective transport management software as practical green logistics solutions that can deliver decreased carbon footprint.

Keywords: Decreased carbon footprint, environmental sustainability, green logistics, waste recycling, waste reduction

Introduction

The 21st century has witnessed a growing concern about environmental sustainability (Jawaad & Zafar, 2020); and firms organizations across the globe have been challenged to operate in ways that show concern for the environment. This increase in concern for environment sustainability around the globe is partly due to consumer awareness of environmental protection and social imbalance.

Shah and Rahim (2019) states that sustainability is the ability to maintain an ecological balance in the planet's natural environment and conserve natural resources to support the wellbeing of current and future generations. Ikegwuru and Akani (2020) informs that, sustainability induces companies not only to consider generating short term attainments in business, but also, consider the long-term effect their businesses have on the natural environment.

Governments and society's growing concern about a sustainable environment has put enterprises under pressure to reduce the negative impact of their operations on the environment. Likewise, climate change in line with organizations' increasingly stringent environmental regulations have called for the adoption of a sustainable environmental strategy in manufacturing, transportation and logistics sectors. According to Centobelli et al. (2017), one of the strategies for environmental improvement and sustainability is the practice of green logistics.

Green logistics contributes directly to effectiveness and efficiency of supply chains. It help firms secure a strong bottom line without sacrificing customer satisfaction, or the well-being of the planet. Intelligent businesses are rushing to understand and embrace sustainable logistics management, supported by powerful technologies such as artificial intelligence, machine learning, and advanced analytics. As enterprises make the shift toward greener logistics, they realize benefits, including improved profitability and good corporate citizenship (Sbihi & Eglese, 2009). As customers see the real-world results of climate change on newsfeeds and streaming

channels daily, they are quickly shifting their loyalty to companies that demonstrate significant, permanent steps toward a sustainable future.

Recent studies examine the relationship between green logistics and environmental sustainability (Centobelli et al., 2017; Hussein et al., 2022; Gholizadeh et al., 2022; Evangelista et al., 2017; de Souza et al., 2022; Ezaki et al., 2022). For instance, Centobelli et al. (2017) used a web-based document approach to investigate the degree of dispersion of green logistic initiatives among 464 logistics service providers. Sustainable environment creativities used by logistics service providers was explored in Brazil by (Froio & Bezerra, 2021). Equally, Wang et al., (2022) investigated if efficiency in logistics is important from a green economic perspective.

However, these studies have been conducted outside Nigeria, hence, do not thoroughly address developing country contexts (Ikegwuru & Akani, 2020). Also, these studies failed to consider the impact of green logistics on sustainability in bottled water companies. Therefore, the current study sought to contribute to knowledge by investigating green logistics and environmental sustainability of bottled water companies in Rivers State.

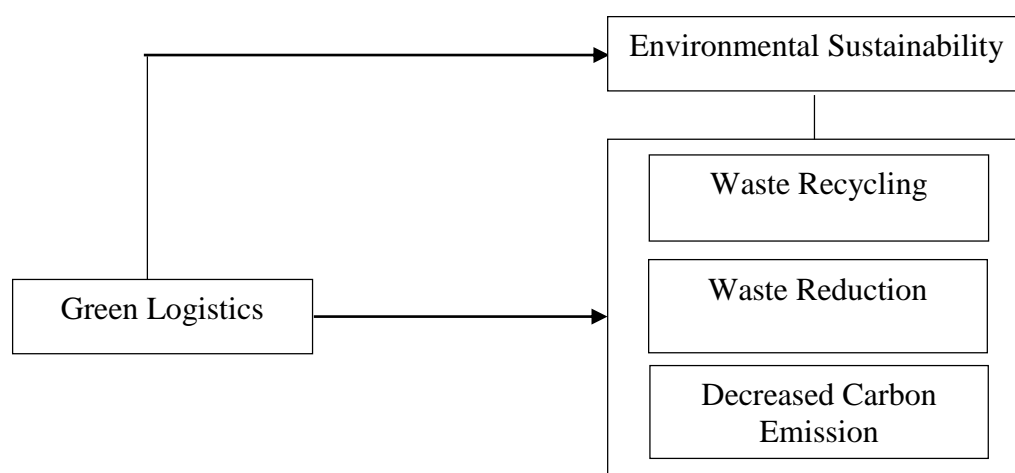


Fig. 1: Conceptual framework of relationship between green logistics and sustainability

Theoretical Framework

The study is anchored on ecological modernization theory (EMT). EMT was developed by Spaargaren and Mol, (1992). EMT posits that ecological regulations and policies can induce green supply chain management (GSCM) practices among manufacturers (Janicke, 2008). As a systematic eco-innovation theory, EMT is channeled towards shared accomplishment of industrial development and environmental protection through innovation and technological development, or novelty (Janicke, 2008; Murphy & Gouldson, 2000).

EMT is the foundation of environmental policies required for GSCM development (Berger et al., 2001) which are integration by manufacturing firms (Gibbs, 2000). To promote GSCM practices, appropriate institutional preparations and legal frameworks by governments are desirable (Kassolis, 2007).

Jennings and Zandbergen (2005) suggests that environmental issues can be solved through green procurement activities. EMT has been extensively engaged to give details of environmental planning by companies and their configuration of production in an approach that minimizes environmental impact by major manufacturers (Murphy, 2000). Firms that resolve to ecologically

renovate their industry practices profit from enhanced performance both economically and environmentally (Janicke, 2008).

As noted by Huber (2000), industrial ecology, of which GSCM is a central phase, facilitate the realization of sustainable development. Some scholarly inquiries on GSCM practices anchored on EMT make clear how environmental policy can uphold the espousal of GSCM practices and revealed that GSCM can convey both economic and environmental performance (Hall, 2001). It is based on this argument that this theory is relevant to the present study.

Concept of Green Logistics

Rodrigue (2012) defines green logistics as supply chain management practices and strategies that reduce environmental and energy footprint of freight distribution, which focuses on material handling, waste management, packaging and transport. Lee and Klassen (2008), describe green logistics as organizations activities that consider environmental issues, while according to (Sbihi & Eglese, 2009), green logistics activities include measuring the environmental impact of different distribution strategies, reducing the energy usage in logistics activities, reducing waste and managing its treatment.

From sustainable development point of view, green logistics means producing and distributing goods in a sustainable way, taking account of environmental and social factors (Sbihi & Eglese, 2009). Green Logistics practices include a set of green activities that help minimize the overall environmental impact of Logistics activities and ensure the protection and sustainable development of the natural, social and corporate environment (Agyabeng, 2020).

Green logistics contributes directly to supply chain effectiveness by securing a strong bottom line without sacrificing customer satisfaction and the well-being of the planet. Intelligent businesses are rushing to understand and embrace sustainable logistics management, supported by powerful technologies such as artificial intelligence, machine learning, and advanced analytics. As enterprises make the shift toward greener logistics, they realize benefits across the business, including improved profitability and good corporate citizenship (Sbihi & Eglese, 2009).

Green logistics practices help minimize the overall environmental impact of logistics activities and ensure the protection and sustainable development of the natural, social and corporate environment (Agyabeng, 2020). Mogeni and Kiarie (2016) operationalized green logistics to include; eco-design, green purchasing, reverse logistics, responsive packaging.

Concept of Environmental Sustainability

The term environment in its simplest form represents what surrounds us. Hagget (1975, as cited in Anijah-Obi, 2001) aver that environment refers to the summation of all settings that surround man at any point on the earth's surface. According to the Federal Environmental Protection Agency (FEPA) Act of 1990, section 38, environment includes water, air, land and all plants and human beings and/or, any of them. From the above definitions, environment encompasses land, air, water and the sum of the physical configuration that surrounds us. Sustainability is the upholding of equilibrium amid the environment, economy and man (Nwanne, 2013).

Gbenda (2012) define environmental sustainability as conservation, management and rational exploitation of natural resources in a way that upholds the integrity of each ecosystem, support all life, guarantee preservation of biodiversity and put off environmental degradation. Ikegwuru and Akani (2020) informs that, environmental sustainability challenge companies not only to consider generating short term attainments in business, but also, consider the long-term effect their activities have on the natural environment.

Environmental sustainability challenges companies to seek economic benefits while supporting environmental protection and preservation. Therefore, this study decomposes environmental sustainability into waste recycling, waste reduction and decreased carbon emission.

Waste recycling

Waste Recycling is the process of converting waste materials into new products to prevent waste of potentially useful materials, partly supplement the consumption of fresh raw materials, reduce energy usage (almost 70% less energy is required in recycling), reduce air pollution from incineration and water pollution from land filling by reducing the need for “conventional” waste disposal, and lower greenhouse gas emissions (Basel Convention, 2019).

The philosophy of waste recycling is to bring into the fore the idea of re-using resources or materials. We may not guarantee the neutrality of these resources again as they were in their originality, however; we can re-engage the use of it again for continuity. A great percentage of materials are being recycled and are being used as household products and their number is increasing by the day.

The most common recyclable material is plastic. Many plastic products and bags are in use nowadays. Plastic recycling serves as a solution to the earthly pollution. Plastics are polymers and are resinous and they are melted down to make other products. Most importantly plastic containers like water bottles, beverage containers, milk bottles, soap boxes, etc., are recycled (Basel Convention, 2019)

Waste reduction

Business activities generate waste as by-products or resources that have been used improperly, partially or sub-optimally (Van Engeland et al., 2020, as cited in Ateke et al, 2025). Wastes are materials that no longer find usefulness, are residues of industrial activities, have become obsolete or lost their integrity or have been damaged in transit or due to improper handling (Ateke et al, 2025).

Waste reduction entails handling resources or materials in ways that keep their integrity intact, and preventing them from damage. It means using less material and energy to minimize waste generation, and preserve natural resources. Waste reduction includes reusing products such as plastic and glass containers, purchasing more durable products, and using reusable products, such as dishrags instead of paper towels.

Donating products, from office equipment to eyeglasses and clothing, reduces the amount of material manufactured overall (Alireza & Mahdi, 2012). Purchasing products that replace hazardous materials with biodegradable ingredients reduces pollution as well as waste. In general, waste reduction offers several environmental benefits. Greater efficiency in the production and use of products means less energy consumption, resulting in less pollution. More natural resources are preserved. Products using less hazardous materials are used. Finally, less solid waste ends up in landfills.

Decreased carbon emission

Carbon emission is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions. It is the total greenhouse gas (GHG) emissions caused directly and indirectly by individuals, organizations, events or products (Wright et al., 2011). It is calculated by summing the emissions resulting from every stage of a product or service's lifetime (material production, manufacturing, use, and end-of-life). Carbon emission (or greenhouse gas

emission) is a calculated value or index that makes it possible to compare the total amount of greenhouse gases that an activity, product, company or country adds to the atmosphere.

Carbon emissions are usually reported in tonnes of emissions (CO₂-equivalent) per unit of comparison. Such units can be for example tonnes CO₂-eq per year, per kilogram of protein for consumption, per kilometer travelled, per piece of clothing and so forth. A product's carbon emission includes the emissions for the entire life cycle. These run from the production along the supply chain to its final consumption and disposal (Wright, Kemp, & Williams, 2011).

Green Logistics and Environmental Sustainability

Pratiwa and Widodob, (2019) investigated the effect of green logistics practices on corporate sustainability performance; and revealed that green logistics have a significant relationship with sustainability performance. Relatedly, Maji et al. (2023) examined the impact of green logistics initiatives on environmental sustainability, and found that that 2/3 logistics managers are aware of how logistics activities negatively affect the environment, but only about 1/5 of them have taken steps toward green logistics initiatives.

Mogeni and Kiarie (2016) explored the effect of green logistics practices on performance of supply chains of multinational organizations. The result showed that reverse logistics positively affected performance of supply chains of multinational organizations. Similarly, Baah (2019) examined how an organization's decision to go green influences its performance in the logistics sector. The study reported significant positive relationships between green logistics, organizational performance and time-based competition as well as between time-based competition and organizational performance.

Also, Eshikumo and Odock (2017) assessed the relationship between green logistics practices and operational performance of a cement manufacturing company in Kenya. The results indicate a significant relationship between green logistics practices and operational performance.

Consequent on the foregoing, the study formulated the following hypotheses:

- Ho₁: There is no significant correlation between green logistics and waste recycling of bottled water companies in Rivers State.
- Ho₂: There is no significant correlation between green logistics and waste reduction of bottled water companies in Rivers State.
- Ho₃: There is no significant correlation between green logistics and decreased carbon emission of bottled water companies in Rivers State.

Methodology

The study adopted a correlation research design. The population of the study consisted 10 registered and functional bottled water companies in Rivers State. The entire population was studied. For proper coverage, 4 top managers (procurement manager, operational manager, sales manager and logistics manager) were drawn from each bottled water company, making a total of 40 respondents. The data for the study was collected using questionnaire. The Cronbach alpha was adopted to assess the reliability of the instrument. The Spearman's Rank Order Correlation was used to test the hypotheses formulated for the study. All analyses was done through the application of Statistical Package for Social Science (SPSS 27.0).

Data Analysis and Results**Table 1: Descriptive statistics for study variables**

	N	Minimum	Maximum	Mean	Std. Deviation
Green Logistics	40	2.00	5.00	3.7083	.68848
Waste Recycling	40	2.00	5.00	3.6500	.82673
Waste Reduction	40	1.33	5.00	3.4833	1.00978
Decreased Carbon Emission	40	2.00	5.00	3.6833	.71988
Valid N (listwise)	40				

Source: SPSS Output, 2025

Table 1 illustrates the descriptive statistics for green logistics, waste recycling, waste reduction and carbon emission with mean scores of 3.70, 3.65, 3.48 and 3.68 respectively. This shows high level of manifestation of the various variables in the organizations under study.

Table 2: Correlation between green logistics and metrics of environmental sustainability

			Green Logistics	Waste Recycling	Waste Reduction	Decreased Carbon Emission
Spearman's rho	Green Logistics	Correlation Coefficient	1.000		.446**	.754**
		Sig. (2-tailed)	.	.466**	.004	.000
		N	40	.002	40	40
	Waste Recycling	Correlation Coefficient	.466**	40	.504**	-.237
		Sig. (2-tailed)	.002	1.000	.001	.140
		N	40	.	40	40
	Waste Reduction	Correlation Coefficient	.446**	40	1.000	.448**
		Sig. (2-tailed)	.004	.504**	.	.004
		N	40	.001	40	40
	Decreased Carbon Emission	Correlation Coefficient	.754**	40	.448**	1.000
		Sig. (2-tailed)	.000	-.237	.004	.
		N	40	.140	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Research Data 2025 and SPSS Output version 27.0

Table 2 display the results of test of hypotheses between green logistics and measures of environmental sustainability (waste recycling, waste reduction and decreased carbon emission). The results show a rho coefficient of 0.466** and probability value of 0.002. The rho coefficient of 0.466** suggests a moderate positive relationship between green logistics and waste recycling of bottled water companies in Rivers State; while the probability value of 0.002 means that relationship between green logistics and waste recycling is statistically significant. This result indicates that effective green logistics practices enhance waste recycling of bottled water companies in Rivers State. Hence, the null hypothesis was rejected.

Table 2 also shows a rho value of 0.446** and probability value of 0.004, suggesting that the relationship between green logistics and waste reduction is moderate, positive and statistically significant. This result indicates that effective green logistics practices enhance waste reduction of bottled water companies in Rivers State. Hence, the null hypothesis was rejected.

Furthermore, Table 2 shows that a strong positive relationship exists between green logistics and decreased carbon emission of bottled water companies in Rivers State. This is by virtue of the rho coefficient of 0.754** produced by the test. The result also shows and a probability value of 0.000,

which means that the relationship between green logistics and decreased carbon emission of bottled water companies in Rivers State is statistically significant. Hence, the null hypothesis was rejected.

Discussion of Findings

The outcomes of the analysis on how green logistics relates to measures of sustainability of bottled water companies in Rivers State showed that a moderate positive relationship between green logistics and waste recycling and waste reduction of bottled water companies in Rivers State; and a strong positive relationship between green logistics and decreased carbon emission of bottled water companies in Rivers State.

The findings align with the report of Ikegwuru and Akani (2020) found that green purchasing; green manufacturing, green packaging, green distribution and green marketing have direct positive effect on environmental sustainability in the food industry in Rivers State of Nigeria. The findings also support the findings of Feng et al. (2018) that a positive significant correlation exists between GSCM and environmental and operational performance.

Feng et al. (2018) also reported that both environmental and operational performance significantly relate to financial performance. The mediation effect of each environmental performance and operational performance between GSCM and financial performance was empirically supported by their study as full mediation effects. The researchers attributed the success of the various firm performances to the complementarity of both internal and external GSCM practices and hence management effort to build a more resilient organization in environmental, operational and financial performances should focus on the combined capabilities of both internal and external GSCM practices rather than considering them in segment as it is their complementarity effects that result in improved environmental and operational performance, which intends leads to financial performance.

Conclusion and Recommendations

It is noteworthy that green logistics practices significantly influence environmental sustainability of organizations, most notably through the adoption of green transportation, green reverse logistics, and the up-take of responsive packaging. The study concludes that the implementation of green logistics promotes the environmental sustainability of bottled water companies in Rivers State. Through green logistics activities, firms are able to reduced administrative, transportation and aftermarket support costs, increased velocity, increased service market share, higher achievement of sustainability goals, greater customer service, higher retention levels and recovery of capital investments in assets.

Based on the above findings and conclusion, the following recommendations are made:

1. Management of the Bottled Water Companies should invest in vehicles that meet emission standards, applying technology to optimize journeys, and using effective transport management software as practical solutions to greening transport activities. This will reduce environmental pollution, thereby improves its sustainability in terms of waste reduction and decreased carbon footprint.
2. Management of Bottled Water Companies should build an effective goods reverse system, speed up the processing of return requests, and apply a modern recall information system, in order to improve the overall sustainability through waste reduction and decreased carbon emission.

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