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A Review of Green Supply Chain Management on Waste Disposal: A Study of Nigerian Garment Industry

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Authors' contributions

This work was carried out in collaboration between both authors. Author OSB designed the study, wrote the protocol and wrote the first draft of the manuscript. Author ADA managed the literature searches of the study. Both authors read and approved the final manuscript.

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ABSTRACT

The Nigerian garment industry plays an essential role in reviving the economy, luring direct foreign investment and means of livelihood to the masses. However, due to the rapid growth of the industry and less awareness of green supply chain management, there is a major concern in the disposal techniques of wastes generated by garment manufacturers in Nigeria. The disposal techniques used by garment producers in Nigeria is either by burning or simply disposing of it on landfills. It emits acidic gases, dioxins, and dust particles which are harmful to human beings and the environment. The aim of this paper is to determine the drivers, factors, and practices that are essential to the implementation of green supply chain management in Nigerian garment industries. The method is on a broad literature review, which centered on barriers to recycling and waste reduction, environmental performance indicators, drivers in accomplishing green supply chain, and types of waste produced in Nigerian garment industry. The review suggests that Nigerian garment manufacturers need to implement green supply chain management to achieve sustainability and

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cost-effective production. it was concluded that there is a need to conduct more research on the environmental impact of waste reuse and recycling in the Nigerian garment industry. The comprehensive green supply chain management research might be the key to sustainability developments and overall environmental performance in the Nigerian manufacturing sector as a whole.

Keywords: Garment industry; green supply chain management; waste disposal; sustainability; cost-effective.

1. INTRODUCTION

In a series of effort in reviving the economy and attracting foreign direct investment, the Nigerian government has relatively diversified its economy on manufacturing sector such as garment enterprises. The garment industry is today one of the lucrative, popular and fastest growing businesses among the population in Nigeria. Nigerian garment enterprise is a ceaseless contributor in economic development, direct foreign investment, and means of livelihood (about 60%) in the manufacturing sector [1]. Therefore, the Nigerian textile and garment firms are part of small and medium scale enterprises which requires the concept of a supply chain (supplier, services and logistics management) in its operations. The global garment workforce is around 26.5 million people with a trade value of US\$1.7 trillion in the year 2012 according to the manufacturing statistics database of international labour organisation [2]. In securing a ceaseless competitive advantage in the garment industry, there must be an unending demand for garment products which are aided by an increase in population and economic development. Over the years, there is a rising concern in the disposal techniques or recycling method employed by garment manufacturers in Nigeria. Most of the waste identified during manufacturing includes; fabric & wool wastes, defective pieces caused by ironing & other assembly defects, carton boxes, zippers, buttons, threads, and stickers. The methods of disposal mostly used by developed nations are incineration, decomposition, and recycling while the method used by garment producers in Nigeria is either by burning or simply disposing of it on landfills. However, due to constant global demand for garment products, the manufacturing industries are faced with a serious environmental problem such as rise in carbon dioxide (CO₂) emissions which are caused by textile fibres (63%) and the remaining 37% can be found by cotton which causes water pollution [3,4]. Hence, garment

industries have been involved in causing pollution especially in developing nations as a result of poor environmental and societal policies in mass production, lower production cost, and increase in demand thereby causing a threat to sustainability [5]. Green supply chain management concept involves adopting and integration of environmentally friendly supply chain management inputs to manufacturing firms processes such as product development, supplier sourcing, and procurement, types of clean technology used in manufacturing products, distribution of finished products to the end users as well as the end of their life recycling [6]. Therefore, green supply chain management objective is to reduce the wastes within the industrial outfit as a means to conserve energy and prevent the release of dangerous materials in form of emission, hazardous, chemical and solid waste into the environment. The studies, theory, environmental measures and empirical research on eco-design, green supply chain, cleaner production have been carried out at different places [7,8,9]. However, after going through the available literature it was found that no research has been done in an area of green supply chain management in garment industries in Nigeria. The aim of this work is to present a literature review on the drivers, factors, and practices that are essential to the implementation of green supply chain management in Nigerian garment industries.

2. OVERVIEW OF GSCM PRACTICES IN MANUFACTURING INDUSTRIES

Green supply chain management (GSCM) is referred to as an effective concept for integrating environmental parameters and green thinking with supply chain management [9].

The effective process and strategy of green supply chain management spread across producing industry business activities, production, delivery process, and programs to reduce waste [6]. According to Ojo et al. [10], a

green supply chain is an environmental management tool which must be addressed among different industries and some of its barriers must be elaborated. The study gives a comprehensive review of sustainable supply chain drivers on construction industries in South Africa and Nigeria. Owing to few works of literature, Ojo et al. [10] mentioned that there is an urgent need for green supply chain management in South Africa and Nigerian Construction firms. The various drivers impacting green supply chain management practice in the Chinese manufacturing industry includes; development of co-existing relationships with suppliers and ways of encouraging recycling [9]. However, there is a slow implementation of green supply chain management practices across Chinese manufacturing industries despite the rise in environmental awareness and policies. Hence, it will take some time before the actualisation of green and sustainable supply chain management process in the Chinese production sector. Balasubramanian [11] described a step by step method for analysing the various barriers preventing green and sustainable supply chain management implementation in the construction sector. The study identified thirty-two barriers to implementing green and sustainable supply chain and later the identified inhibitors were used in developing a structural model. Another study by Testa and Iraldo [12], discovered that there is a positive co-existence between implementing sustainable supply chain management practices and complementing image of an organisation. This process was achieved by collecting data from four thousand one hundred and eighty-eight facility managers which were investigated in seven organisation for economic development in countries. The need to focus on both the total cost of eradicating waste and on the business activities of waste disposal is an objective of sustainable procurement in the supply chain and purchasing department of an organisation [7]. Manufacturing industries can actually save more cost at the supply chain by reducing the CO₂ emissions of exhaust by finding ways of ensuring the implementation of the green procurement system, promoting the establishment of green procurement [13]. Therefore, the type of industries resources can help in the type of technology to be used and equipment that separate waste which can eventually aid the purchasing practice. The control mechanism of the planning model is essential in the decision making of a sustainable

supply chain network [14]. It was regarded as a carbon sensitive supply chain consisting of a design network of strategic planning model and environment technologies. Duarte [15] highlighted for manufacturing and industrial firms to incorporate lean & sustainable supply chain practices for competitiveness in their supply chain network. The balance scorecard is a key to determine the lean and sustainable supply chain manufacturing performance. A hypothetical model was developed green supply manufacturing performance system using a balance scorecard. Vachon [8] Studied the impact of technology on a green environment and resulting supply chain management. The result reiterates that environmental collaboration with suppliers is closely related with greater investment in pollution prevention and technologies that has less impact with customers.

2.1 Environmental Performance Index (EPI)

The Environmental Performance Index (EPI) is an indicator ranking the environmental and ecology performance of nations comprising of ten groups covering environmental health and ecosystem pollution. The indicators describe the closeness of a country to actualising ecosystem and environmental policies goals. According to EPI [16], Nigeria is a developing country which is among the countries contributing to the global air pollution issue affecting socioeconomic groups and individuals. Table 1 shows measurement index in which the performance is based which includes ten issue categories; Air Quality, Heavy Metals, Biodiversity & Habitat, Forests, Fisheries, Air Pollution, Water Resources, Climate and Energy, Water and Sanitation, and Agriculture. Nigeria overall environmental performance index ranks 100th position (overall score 54.70) out of 180 countries, the highest and lowest ranks were occupied by Switzerland (overall score 87.42) and Burundi (overall score 27.43) respectively. This 2018 latest ranking showed improvement in the overall performance indexes compared to the 2016 and 2014 where Nigeria ranked 133 out of 180 countries and 134 out of 178 countries. As shown in Table 1, the country ranked 10th position in Climate and Energy issue, the Air pollution performance score of 84.51%, 168th position in Water and Sanitation, and 152nd position in Air Quality in the year 2018. Table 1 gives the summary on the above environmental performance index of Nigeria.

The performance index conducted on Nigeria by EPI [16], highlighted the fact that we have not fully implemented sustainability policies on the ten issue categories. This overall poor performance index might be due to a) low level of awareness in sustainability among the population and b) there is little or no data reporting daily or monthly report on green manufacturing and sustainable waste management. Nigeria will be close in actualising ecosystem and environmental policies goals, if it performs well in sustainable development goal.

2.2 Green Supply Chain Management in Nigerian Garment Industry

Nigeria is regarded as the country with the most population in Africa with an estimated population of 170 million inhabitants and it remains Africa's largest economy [17]. Nigerian garment industry is a part of small-scale manufacturing industries which has been a major contributor in socio-economic development, foreign direct investment, and means of employment (60% of the workforce) in the manufacturing sector [1]. The garment industry is a lucrative and popular business among the population of Nigeria which is responsible for producing a wide range of garments to meet the various market needs. Global competitiveness has brought about the rapid growth of the industry whereby most small-scale industries are trying to reduce cost, improve quality and setting up their own manufacturing workshop. However, the constant pressure to remain competitive and to increase the speed of production came with issues such as accumulation of a large number of waste materials such as paper, carton boxes, buttons, threads, fabric material, and stickers. A study by Environmental Protection Agency [18] highlighted that about 15 % of fabric intended for garments ends up on the workshop cutting floor

which constitutes about 5% of landfill space and about 95% of those fabrics could be recycled each year instead of being landfilled. This implies that global garment sector contributes a lot of emissions knowingly and unknowingly, the idea of green supply management should help in disposal of end of life products and helps in economic activities. The garment industry of developing nations like Nigeria has not fully tapped into the usefulness of green supply chain management because it has not found ways of measuring and controlling carbon emissions. According to EPI [16], Nigeria overall environmental performance index ranks 100th position (overall score 54.70) out of 180 countries. The index highlighted the fact that we have not fully implemented green supply chain policies on our manufacturing sector because carbon emissions start from different stages of supply chain activities such as procurement of goods to the logistics chain and distribution process. The garment industry impact on climate and energy is a very important issue which effect must be studied from a manufacturing process to conversion process of the textile, and logistics chain use of energy for moving the finished products. In understanding the impact of garment industries on climate and energy, various questions relating to green management practices must be asked [19]. Some of the Questions include;

- What are the drivers in the implementation of management practices in the green supply chain?
- What are the performance indicators that they adopt?
- What indicators are measured to assess the sustainability of the environment?
- What are the processes used in reuse and recycling of their materials and products?
- What are the clean technologies that they adopt?

Table 1. Environmental performance index of Nigeria [16]

S/N	Measurement index	Current rank	Current score (%)
1	Air quality	152 nd	48.08
2	Water and sanitation	168 th	7.75
3	Heavy metals	60 th	61.39
4	Biodiversity	102 nd	71.64
5	Forests	-	-
6	Fisheries	21 st	69.17
7	Climate and energy	10 th	73.85
8	Air pollution	15 th	84.51
9	Water resources	134 th	30.76
10	Agriculture	72 nd	32.93

2.3 Barriers in Implementation of Green Supply Chain in Garment Industry

The green supply chain management (GSCM) involves use of the effective concept in business planning that incorporate end of life manufacturing cycle to produce desired outputs. Researchers have discovered various barriers that manufacturing firms face while trying to implement green supply chain concept. Therefore, manufacturing firms can implement a lot of green supply chain drivers but there are external and internal elements that disrupt the application of green supply chain management. According Walker et al. [20], these elements are classified into internal challenges; costs, lack of legitimacy, lack of knowledge and experience in green manufacturing, lack of management commitment. The external challenges include; government regulations, lack of supplier commitment to waste reduction, and lack of societal requirements for a green supply chain. Wilkerson [21] has also highlighted five major challenges that firms deal with while trying to adopt the green supply chain. These include; lack of creating awareness to the general population on various method involved in the green supply chain, lack of knowledge about standards such as Environmental Protection Agency and ISO Standards to support green supply chain, lack of appropriate technology to support the effort of green supply chain, economic factors such as gross domestic product, and Implementation of green supply chain planning process. Table 2 gives the summary of barriers mentioned by researchers to green supply chain implementation.

Most of the researches are conducted on drivers and barriers of a green supply chain in developed countries as shown in Table 2, there is a little or no studies which explain the end of life supply chain in Nigerian industries. A lot of research has to be addressed on end of life supply chain of both Nigerian garment industries and small medium scale enterprises. These studies will involve green production quantitative methodology, a survey consisting of questions

regarding barriers to green supply chain management in Nigerian garment industries, and finally analysing the result to determine if there is a relationship between green supply chain management barriers mentioned by several authors and findings of the survey. The findings will further help to determine ways of implementing life cycle analysis to supply chain management practices in the Nigerian garment industry.

2.4 Waste Reduction in Garment Industries

Waste reduction is the systematic technique used in preventing the occurrence of waste from the input, manufacturing, and output stage. The primary goal of waste reduction in garment industries is the prevention, reuse, end of life cycle, treatment method, and appropriate disposal method. According to Ishrat [35], Waste management is the study of the treatment, collection, and disposal of different type of unwanted materials or waste that are linked both technologically and socially to the industrial & human development. The global aim of waste management is the ability to integrate concept, regulations, and innovations of 3Rs (reduce, reuse and recycle) to manufacturing.

The barriers to recycling include; lack of awareness on recycling, lack of materials to recycle, and lack of technological equipment [36]. The garment industries contribute to a large volume of waste namely solid waste, solid wastes from textiles and garments industries comprise of fabric materials, buttons, metals in zippers, paper cardboard, plastic, and fibers that remain after the production process. Villanueva [37] mentioned that discarded solid waste can be recovered to become a raw material for the same garment sector. Pinheiro and Francisco [38] conducted a study on the identification, management, and attitude of garment manufacturing firms towards waste generated at the production process. The type of waste generated and stages of production cycle are shown in Table 3.

Table 2. Barriers for the implementation of GSCM in manufacturing industries

S/N	Barriers	Source
1	Lack of Government Regulations	[22]; [23]
2	Lack of Knowledge and Experience	[24]; [23]; [25]; [26]
3	Cost of Implementing Green Supply Chains	[27]; [28]; [23]; [7]; [15]
4	Lack of Support from Top Management	[29]; [30]
5	Technology	[13]; [31]; [32]
6	Lack of Environmental Strategies from Suppliers on Waste Reduction	[33]; [34]

Table 3. Waste generated in the garment manufacturing process

Stages	Produced waste
Fabric collection process	Paper, fabric scraps, paperboard, defective parts, packing
Material stock	Paper, rivets, buttons, defective parts, zippers, thread, labels, plastic, fabric scraps
Fabric manufacturing process	Paper, paperboard, marker, fabric scraps, metal clips, plastic
Folding	Paper, plastic, fabric scraps, adhesive tape
Fabric cutting process	Paper, fabric scraps, sewing machine sandpaper, paperboard, plastic
Garment preparation for sewing	Thread, fabric scraps, paper, elastic, plastic, cardboard box
Garment sewing process	Buttons, zippers, thread, paper, fabric scraps, plastic cones, needle, trims, stitching yarn
Finishing process	wash care label, stickers, Thread, fabric scraps, trims, adhesive paper, stitching yarn
Packing process	Carton boxes, plastic, toner, labels
Shipping	Paper, adhesive tape, paperboard

The information and knowledge supporting the ways of handling solid waste such as source reduction, incineration, landfills, and recycling is a method of sustainability adopted by garment manufacturing industries [39]. The most widely used waste disposal method in Nigerian garment industries is the landfill method which is a process of dumping textile waste in landfill sites. The leachate contaminates groundwater surfaces and contributes to global warming [39]. The second method is incineration method which involves the burning of manufacturing waste, unused or shredded fabric materials. It emits acidic gases, dioxins and dust particles which are harmful to human beings and the environment. Bello et al. [40] mentioned that most river water in Nigeria is contaminated by chemical waste emanating from the garment effluents disposal. Garment effluents have been widely reported to contain copper, lead, and chromium which are widely used in the manufacturing of textile dyes. In the manufacturing stages of garment materials, a large volume of water containing pollutants in form of dyes and auxiliary chemical are formed which are released into river water untreated. However, there is no literature available that address a comprehensive field survey of waste disposal method used in Nigerian garment industry. Recycling is a concept which involves reprocessing of accumulated waste materials into new or reusable products that cause a reduction in pollution and energy savings. Therefore, the recycling method can help Nigerian garment/textile industry to contribute towards eco-packaging by reusing fabric scraps or unused textiles into processed cotton for mattress, pillows, cushions, and bandages.

3. CONCLUSION

This article is based on the importance of green supply chain management in garment industries, it gives an insight on the ways of achieving cost-effective and sustainable supply chain in the garment industries. It was discovered that developed countries have conducted many studies on GSCM practices, drivers and their barriers on the green supply chain to garment industries, but it is a little or no study which has been conducted on green supply chain practices and implementation in the Nigerian garment industries. It can be concluded that green supply chain activities in Nigeria is relatively low in garment industries and no reliable level of awareness and performance measurements have been fully proposed. Therefore, there is a need to enforce environmental regulations and policies that will govern the implementation of green manufacturing within Nigerian garment industries.

4. RECOMMENDATIONS

The review has identified gaps in the literature which can be helpful for green supply chain management future studies on Nigerian garment industry.

- There is no literature available that address a comprehensive field survey of waste generated and disposal method used in Nigerian garment industry.
- There has not been any empirical analysis to measure green supply chain management performance to Nigerian garment industry.

- There are little or no studies available to determine if there is a relationship between green supply chain drivers/barriers mentioned in several works of literatures and Nigerian SMEs.
- There is a need to conduct more research on the environmental impact of waste reuse and recycling in the Nigerian garment industry.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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