

Green Manufacturing Effect on Green Marketing and Environmental Sustainability of South-South and South-East States of Nigeria

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Abstract

This study was on green manufacturing effect on green marketing and environmental sustainability of states in South-South and South-East geo-political zones of Nigeria. The main objective of the study was to examine the effect of green manufacturing on green marketing and environmental sustainability of states in South-South and South East geo political zones of Nigeria. Cross sectional survey research design was used for the study. The population of the study was 5001 registered companies in these states. The sample size was 370. Simple random technique was used to avoid bias in the selection of the companies while judgemental sampling technique was used based on experience to avoid non-functional companies. Primary data were obtained from the respondents. Multiple regression statistical tool was used to test the stated research hypotheses. The findings of the study were that green design or design for the environment with t-value of 12.900 and life cycle analysis with t-value of 2.88 have significant effect on green marketing and environmental sustainability of the states South-South and South East geo political zones of Nigeria. The study recommended that companies should adhere to declared environmental protection plan or policy as to ensure environmental sustainability and relevant government regulatory should sanction defaulting companies that do not keep to their environmental sustainability promises, companies can invest in modern sources of energy supply such as wind power and other renewable energy means as to reduce conventional energy consumption that results in toxic emission of hazardous substances to the environment. Also, companies should cultivate or imbibe the culture of recycling and reuse materials as inputs for manufacturing as to effectively manage life cycles of products to reduce waste.

Keywords: Green Manufacturing, Green Marketing, Environmental Sustainability, Green Design, Life Cycle Analysis.

Introduction

Global environmental crisis is one of the undeniable challenges the world is experiencing. Environmental crisis has reached the magnitude that the consequences constitute, dangerous threats to both human and ecological survival. Anijah- Obi (2006) asserts that environmental problems have attained crisis level and have caused negative effects on the survival and existence of man, animals and the vegetation which is a serious trade off to sustainability of the environment. The sustainability of the environment is a sine quo non

to the survival of mankind and other living things. It is a researched truth that the environment can exist without man but mankind cannot survive without the environment. Understanding the prospects of development couple with prudent control and utilization of environmental resources could serve as a check to the disturbing environmental trends that presently constitute danger not only to the world's survival but its sustainability. Bisong (2024) and Pellow (2018) are of the view that environmental justice which is the examination of who profits from the environment against who pays for the losses cannot be overemphasized. It focuses on the promotion of fairness and equity on environmental advantages and costs. Richards (2023), Tutu and Anfu (2019) remark that manufacturing methods are worsening global energy, wastewater, gas and residue crisis. Therefore, the reconsideration of manufacturing practices such as green manufacturing which is less harmful to the environment as it contributes critically to reduction of carbon footprint in the atmosphere. This approach equally contributes positively to the wellbeing of mankind and the society at large. According to Ballatos and Basaly (2005) green manufacturing is environmental conscious manufacturing approach that is environmental friendly, which is a deliberate and efficient manufacturing attempt that is focus on the production of goods and services with the aim to achieve a cleaner and safer environment to achieve green engineering objectives. Haleem et al. (2023) posit that green manufacturing practices efficiently utilize resources to guarantee environmental friendliness throughout the life cycle of products. Collaboratively, Gyamifi et al. (2022); Tufu and Anfu (2019) state that green manufacturing approach takes into consideration the usage and consumption of material resources in the production process and their consequences in the environment. Green manufacturing reduces electricity consumption or usage to curb greenhouse gases emission to the atmosphere as one of the hazardous contributors to global warming resulting to climate change and environmental degradation (Dantas et al, 2023). Climate change exposes people, societies, economic sectors and ecosystems to risk of survival and extinction (Osinowo, 2021). Green manufacturing approaches demand that companies should demonstrate commitment to improving manufacturing operational methods while also following the various environmental, social and governance standards. Green manufacturing promotes sustainable development of human society and circular economy mode in modern manufacturing industries, of course an approach that leads to the sustainability of the environment.

Jan et al. (2021) and Juma et al. (2021) highlight that environmental sustainability practices of manufacturing companies are very necessary for the continuous survival of the environment in which companies operate. Sustainability involves the frugal generation and management of environmental wealth and making provision for generations ahead. This will enhance checks and balances in the environment to promote the wellbeing or standard of living of the people. Of course, the outcome will be favourable preservation of the environment. Kariuki and Jemaiyo (2025) submit that sustainability of the environment is very important that it has to be listed in vision 2030 agenda for the promotion of sustainable production and assumption of Sustainable Development Goals.

On the other hand, green marketing is the creation and promotion of products (goods and services) that are perceived to be valuable for actual environmental sustainability. Green marketing involves highlighting the reduction of emission linked to the manufacturing processes of product(s). Green marketing is product oriented focusing on the usage of green products orientation that deals with natural materials which are recyclable, reusable and biodegradable for product packaging, product campaign or green communication and many others (Darekar et al., 2023). Green manufacturing in this study focuses on the design for the environment and product lifecycle design as the affect green marketing.

The choice of selected states in South- South and South East Zones is based on the high level of manufacturing activities for the production of goods and services for commercial and tourism activities in these states. Environmental scientists have warned that manufacturing companies during the process of production of products, discharge both organic and inorganic chemical substances to the environment. Ismanto et al, (2023) and Jan et al. (2023) remark that these chemical substances are hazardous waste that are released into the water, air and land in the forms of acids, toxic and poisonous minerals resulting to negative consequences in the environment. The effect of these pollutants are; rendering water unfit for domestic consumption, irrigation purposes and contamination of foods with outcome of health complications for animals and human beings. Hence, manufacturing companies play an essential role for the continuous survival of people, animals and plants in the environment which they operate.

Statement of the problem

Modern technological advancement has heightened rapid production processes of goods and services that have resulted in increased propensity for consumption of goods especially fast moving consumer goods with high usage of energy emitting greenhouse gases to the atmosphere. Dantus et al. (2023) report that manufacturing processes results in high energy requirement which lead to increased green gas emission causing damage not only to the environment but also institute obstacles to ecological sustainability and enormous health risk to humanity. Inter-governmental panel of climate change (IPCC), (2021) emphasises that manufacturing processes have increased anthropogenic greenhouse emissions, which has resulted in atmospheric concentration of carbon dioxide, methane among others with dangerous consequences that has led to atmospheric warming, pollution of air, water and land.

The present dominance of many manufacturing companies' usage of non- renewable energy resources in the production of goods and services has created tremendous problems of polluting the air, land and water. Again, modern technological methods of energy supply of power through electricity, combustion engines and others, in the practice of agriculture, production of goods and services construction sites, military operations and information technology have escalated and exerted far –reaching consequences on the environment that are obvious. Uka, (2005) comments that the increased consumption of non-renewable

resources results in energy crisis This development is far from the modern designed framework that could serve as a strategic guide for green economy transformation in Nigeria (Bisong, & Okon, 2018). Thus, the non-consideration of renewable materials for production lacks compatibility with the sustainability of the environment. In addition, there exist few studies on green manufacturing such as Manish and Soren (2013), Oyeboode (2021) and Otegbulu (2011) which implies that there is scarcity of literature on green manufacturing practices in Nigeria. Hence, there exit a gap in literature that this study seeks to address. Thus, the study on green manufacturing effect on green marketing practices and environmental sustainability in Nigeria.

Objectives of the study

The main objective of this study is to examine green manufacturing effect on green marketing and environmental sustainability of South- South and South East states of Nigeria. The specific objectives are; to,

- i. determine the effect of design for the environment on green marketing practices and environmental sustainability of South- South and South East states of Nigeria,
- ii. examine the effect of life cycle design on green marketing and environmental sustainability of South- South and South East states of Nigeria.

Literature Review

Theoretical framework

Value-belief-norm theory is used to anchor the study. This theory was the work of P. C. Stern and his associates in 1999. This theory is a combination of value concept of psychology, the activation theory of models and the new environmental conceptual theory. The theory states that the establishment of ecological practices describes the relationship between values, beliefs and norms. The theory explains how human values can influence and affect human behaviour in the environment. Environmentalists content that connection among values, behavioural acts, beliefs and social norms act as agents by which effects are produced. These guiding principles or values portray the path for any behaviour based on desired transitional goal which may be of relative importance (Dantus, et al, 2023). This theory can be used to provide adequate understanding of consumers' markets and manufacturers' pro-environmental behaviour and concern particularly in relations to environmental protection, safety and preservation.

Green manufacturing

Globally, manufacturing industries have been identified among the major drivers of any country's path to industrialization and development. Jan et al. (2023); Akuoko and Bour (2013) mention that manufacturing is one of the primary agents of industrialization and contributes to a nation' developmental strives. Kenton (2020) mentions that although companies are required by law to adhere to their Environmental Protection Plan to ensure

that their operational activities are environmentally sustainable, however, many of these companies violate the law by not acceding to the declared policies.

This development has resulted to high demand in different parts of the world by various international bodies on the need for companies to operate within the globally accepted and approved guidelines on the adoption of best environmental sustainability practices (Fahad et al., 2022). Hence the emergence of 'Green manufacturing' which refers to an orderly procedural definition of manufacturing process for various measures of efficient material conversion and the extent to which these materials may be effectively reused (Billatos & Basally, 2005). Green manufacturing is a demonstration of modern manufacturing methods of companies that consider the nature and usage of materials, the manufacturing process and their consequences on the environment in the production process (Gyamifi et al.; Tutu & Aufu, 2022). Green manufacturing process deals with the conversion of renewable materials to finished goods for beneficial reasons that are of great advantage to the environment.

Green manufacturing methods are processes that seek to prevent or reduce pollution in the environment through reduction of energy utilization, raw or natural materials, solid waste, reusing products and recycling water. Goyal et al. (2022) remark that the concern of green manufacturing method is applicable not only to tangible products but a generic term that comprised all manufacturing processes and the complete system which include practices that rely on the cultures that seek to reduce, reuse, recycle, recover, redesign and remanufacture. D'Angelo et al. (2022) posit that companies that are engaged in the production of goods are directing their efforts toward green manufacturing practice adoption for the purpose of been environmental friendly which will result in benefiting the society generally. Again, contributes to improving the brand image and reputation of the company in the market as well as attracting green consumers to appreciate, prefer or patronize products of company for being environmentally responsible. This will eventually enhanced the company's environmental, operational, social, economic and marketing performance.

Manish and Soren (2013) posit that green manufacturing is an economised manufacturing process that tend to exploit all available resources leaving behind reusable waste and thus relieving the concept of environmental sustainability through green marketing products and consumers. Green manufacturing reduce the pressure on the environment caused by the growth of industrial production by conventional manufacturing methods. Spence (2021) remarks that the whole process of green manufacturing from materials sourcing, production delivery and recycling emphasises renewable power sources for environmental friendly manufacturing techniques as best practices and ensuring maximum efficiency in the usage of materials and energy.

Mutiskiwa and Marumbwa (2013) state that green manufacturing considers the after use stage of a product in the environmental context and adoption of appropriate production strategy. Also, gives significant information or eco-labelling that can influence consumer

shopping and consumption habit as green manufacturing involves the use of appropriate technology and organic materials for the production of goods (Liu & Pang, 2017). Green manufacturing leads to eco-packaging with multiple objectives that are advantageous to the consumer's safety and health as well as the society throughout the product life cycle. Economic viability and market efficiency are also of important concern (Kariuki & Jemaiyo, 2025). Green manufacturing approach demands that companies should demonstrate their commitment to improving their operations while also giving consideration to environmental, social and governance (ESG) (Darekar et al., 2023).

Green manufacturing is the bedrock of green marketing and the sustainability of the environment as it fosters new ideas of production by reusing, recycling, waste reduction and less energy consumption. This approach promotes the consumption of green goods, through green communication or eco-friendly labelling and safeguarding the earth's resources (Sangwan & Vyes, 2020).

Green marketing concept

Green marketing is a philosophy of developing, practicing and communicating business operations that focus on environmental mission which leads to improved corporate reputation and market performance of organizations. Of course, it has become a pivotal force in moderating and restructuring of marketing strategies (Lu et al. 2013). However, the philosophy of green marketing started by W. Lazer in 1969 as a social dimension of marketing that deals with the limited availability of environmental resources, the environmental impact of conventional marketing and greening the various aspects of traditional marketing (Kotler & Armstrong, 2013).

Darekar et al (2023) report that green marketing is the practice of promoting products that are sustainable and environmental friendly. Tripathi (2014) records that green marketing is environmental marketing that comprised activities designed to generate and provide changes in order to satisfy human needs and expectations with minimal negative impact on the natural environment. Kotler and Armstrong (2013) view green marketing as marketing that meets the current needs of consumers and businesses while maintaining and improving the ability of future generation to meet their needs. Al-hamed et al. (2021) state that green marketing is a consistent marketing process that is characterised by the company's push to configure, advance, decide the value, appropriate and advance the product as far as ecological security measures. It is currently views a part of a wider trend towards socially and environmentally friendly business practices and depicts activities that are intended to create and empower any trade that is planned to satisfy human needs or wants with friendly consequences.

Darekar et al (2023) content that companies that practice green marketing benefit from increased customer loyalty and positive brand reputation while helping to protect the plants and contribute to a more sustainable future. The authors mentions that green marketing is important in the following ways: namely,

- Green marketing raises the awareness of environmental issues and motivate consumers to make sustainable choices
- Green marketing assists to distinguish companies that carry out environmental friendly practices from competitors that are not environmental friendly.
- It can also enable companies to promote products and practices with lower carbon footprint or recycled materials.
- Green marketing practices assist companies that are viewed as environmentally responsible to have increased customer loyalty and positive brand reputation.
- Green marketing communication campaign (green communication) enables companies that are environmental friendly contribute to positive change and a more sustainable future.

Environmental sustainability

Gilaspy (2010) in Anucha et al (2018) defines environmental sustainability as the deliberate and responsible interaction with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality and safety. Environmental sustainability is strictly against greed by satisfying today needs and wasting or destroying resources of the environment against future generations. Goncalves (2013) mentions that environmental sustainability requires the present generation to embark on activities to meet their daily needs and at the same time preserving the environment for future generation to meet their needs adequately.

Barber (2010) reports that the protection of the environment from depletion and pollution is the core product of environmental sustainability that lands, atmosphere and waters must be protected and preserve by the current generation so that forth coming generations will have earth's resources to use and meet their daily needs adequately. Leal-Filho (2011) mentions that environmental sustainability is a holistic approach for human development which establish a state of balance between environmental protection and socio-economic progression for better quality of life to satisfy environmental, social and economic needs for both current and future generations. This brings the environment to an equilibrium position by integrating the concept into practice.

Wersing et al (2020) posit that environmental sustainability is the perception that the future should be improved and healthier than the present. This implies that companies should not only focus on economic factors but should include and as well give attention to environmental, social and governance concern in the present decade (Camiller, 2020).

Design for environment (DFE)

Design for the environment is generating immense interest in recent times among manufacturing methods. This is also known as eco-design or green product design. This is the theory and practice of reversing decades of neglect, regarding environmental responsibility of designers and manufacturers. Green design for the environment requires

useful tools for the conversion and the reuse of scarce natural resources in a way that the earth planet can be preserved for the future generations (Billatos & Basally, 2005). Buzuku and Kassi (2019) in Onyeka-Iheme et al. (2024) justify that eco-design is a relevant element in sustainable development because it integrates aspects of the environment into the design of the product to cut down the hazardous impact on the environment through the product process design and product life cycle as to reduce waste, mitigate air, land and water pollution as well as to reduce health risks to man, animals and plants.

Design for the environment is important because the success or downfall of a product is most cases linked to the design and imagery (Petit et al, 2018). The design for the product and manufacturing approach is necessary right from the inception of the product. Nagarajan (2011) posits that the choice of a suitable technology for manufacturing calls for proper identification of appropriate technology. This is appropriate because the life cycle and the nature of packaging of the product can be determined from the inception of the production process. Onyeka-Iheme et al. (2024) content that green design or design for the environment seeks for material properties that are desirable to reduce waste in the environment. Green manufacturing starts with the design followed by the procurement, manufacturing, packaging and distribution, consumption and reverse logistics. Again, green design involves the reuse and recycling of materials instead of virgin raw materials. Another factor is the cost of materials and energy to be incurred in the production process. Billatus and Basally (2005) state that acquisition of product with high quality but at minimal cost is an objective concern and focus in product design and design for maintainability. Eneizan et al. (2020) mention that the cost of energy is another important factor in green design. The cost of energy is increasing regularly due to global energy crises Hence, the success of any business lies on the supply of energy as products are priced based on the amount of energy invested during manufacturing or production. Green design advocates for alternative clean sources of energy such as coal, sun and wind.

Dantas et al. (2023) answer that one of the means to sustain the environment is for green design or for manufacturers to use components and manufacturing processes that will lessen the energy requirements for production as to have less harmful effect on the environment such as emission of greenhouse gases or carbon foot print to the air. Green design typically advocates materials for manufacturing that can be reused and recycled. Hence, sustainable manufacturing focuses on minimizing energy consumption and reduction of greenhouse gas emission to the atmosphere.

Green design has assisted energy intensive companies to implement lean process to minimize waste and enhance energy efficiency as to reduce industrial carbon emission to the atmosphere. Green design is intended to develop more environmental green products. Thus, design for environment or green design is aimed at reducing energy consumption, operation and maintenance cost, reduced factory related hazards, increase productivity and comfort for employees, reduce waste and pollution (Olegbulu, 2011).

Life cycle design analysis

Lifecycle analysis is the study of the total cost of acquiring operating and maintaining a product over its entire life. The lifecycle of a product is directly related to the quality of materials and the design processing method that is utilised (Billatus & Basally, 2005) Zeng et al. (2020) submit that green manufacturing considers the lifecycle of a product by determining the nature of materials to be used in the manufacturing of the product. Thus, life cycle design of products with recyclable and biodegradable materials assist to minimize the effect of waste in the environment.

Escursel (2021) opines that the determination of the lifecycle of the product design starts with the nature, quantity and quality of materials to be used in the production process right from the design stage of the manufacturing process. Thus, it is imperative to adopt manufacturing process that will enhance environmental sustainability and pointedly with materials that can be easily reused or decomposed. It is important to note that consumers' purchasing and consumption pattern can determine the level that manufacturing companies will produce goods and services in the market (Escursel, 2021)..

Kariuki and Jemaiyo (2025) argue that producing products that can easily be disposed require usage of biodegradable materials. Recyclable materials used in the production and packaging of products would assist in the reduction of waste in the environment due to shorter life cycle of the product. The usage of biodegradable and recycled materials to manufacture goods such as the packages of Fast Moving Consumer Goods (FMCG) would invariably assist to reduce the large quantity of one time or single use non- biodegradable packages such as metals, plastics and other forms of waste that have long life cycles and take many decades to decay in the environment. The use of plant-base alternative for manufacturing product will shorten the duration of the packages as these packages would decompose with ease and faster (Chioatte & Sospioo, 2023; Jian et al., 2022). This is very important because it aids to reduce emission of greenhouse gases, toxic and hazardous wastes into the air, water and land since these substances are detrimental or harmful to the environment.

Research hypotheses

The following null hypotheses were used for the study.

1. Design for the environment has no significant effect on green marketing and environmental sustainability of South- South and South East states Nigeria.
2. Life cycle design analysis has no significant effect on green marketing and environmental sustainability South- South and South East states Nigeria.

Method

The research design used for this study is the cross sectional survey research design. This design involves the collection of data from the respondents once. The study area was the states in South- South and South East geo-political of Nigeria. The population of the study

comprised 5,001 registered companies in these states (Corporate Affairs Commission, Calabar Office, 2023). The sample frame was made up of General managers, Operations managers and Supervisors of the companies. The sample size was determined with the use of Taro Yamane formula at error margin of 5 percent which is given as: $n = N / 1 + N(e^2)$, where n is the sample,

N = Population of the study

e = error margin at 5% = 0.005

1 = constant.

$n = 5001 / 1 + 5001(0.05^2)$

$n = 5001 / 1 + 5001(.0025)$

$n = 5001 / 13.5025 = 370.38$

$n = 370$.

Therefore, sample size for the study was 370. Simple random sampling technique was adopted for the study. The method uses a table of random numbers to select five states for the study. The eleven states that make up the south- south and south east zones were code numbered from 1 to 11 and using a die, the column and row approach to enter the numbers provided by Dillow et al. (1993). Following the row-wise movement and taking one number at a time to match with the pre-coded states number, five states were randomly selected from column 1 row1. The five states were Abia, Anambra, Akwa Ibom, Cross River and Rivers. This sampling method was conducted to avoid bias in the selection of the states. Purposive sampling method was used in the selection of the manufacturing companies. The choice of this technique was informed by the prior knowledge and experience about the companies. The sample size was distributed based on the number of manufacturing companies located in each state. Anambra had the highest number of 101 manufacturing companies, next by Abia with 87, Rivers had 70, Akwa Ibom, 77, and 35 for Cross River. The purposive method of selection reduces the probability of selecting non-operational companies that might have wound-up. Face validity was used to justify the instrument. Primary data were obtained from respondents through questionnaire administration that was assisted by 3 research assistants. The instrument was administered for reliability on 30 respondents with Cronbach alpha reliability coefficient and the results obtained were 0.73, design for the environment and 0.95 for life cycle analysis. Regression analysis was used to determine the effect of design for the environment and life cycle analysis (Green manufacturing) on green marketing and environmental sustainability. A compendium of the registered companies cannot be listed because the list will be too long and it is ethically wrong in research to pass on information entrusted to someone to a third party.

Results

The result section shows the significant effect of green manufacturing (design for the environment and lifecycle design analysis) on green marketing (green packaging, green product and green consumers) and environmental sustainability (safe environment) in South- South and South East states Nigeria.

Data for hypothesis one

Frequencies on items of design for the environment or green design on green marketing and environmental sustainability.

Table 1: Distribution of respondents by their responses on design for the environment

S/N	Statement		SA 4	A 3	D 2	SD 1	T	$\bar{X}$
1	Design for the environment made use of recycled raw materials	f % Fx	117 32.1 468	149 40.8 447	52 14.2 104	47 12.9 47	365 100 1,066	2.92
2	Design for the environment determines the functional properties that raw materials and finished product should posses	f % fx	104 28.5 416	141 38.6 423	82 22.5 164	38 10.4 38	365 100 1041	2.85
3	Design for the environment determines the use of non-hazardous and toxic substances for production process	f % fx	116 31.8 464	144 39.5 432	67 18.3 134	38 10.4 38	365 100 1068	2.93
4	Design for the environment examines manufacturing process that aid reduction of cost incurred	f % fx	110 30.1 440	183 50.2 549	42 11.5 84	30 8.2 30	365 100 1103	3.02
	Overall mean ($\bar{x}$)		2.93					

Source: Field survey, 2025.

Data obtained in Table 1 reveal that design for the environment otherwise known as green design affects green manufacturing with overall mean score ($\bar{x} = 2.93$). The item of design for the environment that examines manufacturing processes to aid reduce incurred cost has the highest mean score ($\bar{x} = 3.02$), followed by design for the use of non-hazardous and toxic substances with mean score ($\bar{x} = 2.93$), design for environment to make use of recycled materials with mean score ($\bar{x} = 2.92$) and design to determine functional properties that raw materials and finished product should posses with a mean score ($\bar{x} = 2.86$). All the statements and their mean scores are greater than 2 and shows that design for the environment affects green marketing and environmental sustainability.

H02: Frequencies on statements of lifecycle design analysis and green marketing and environmental sustainability.

Table 2: Distribution of respondents by responses on life cycle design analysis on green marketing and environmental sustainability.

S/N	Statement		SA 4	A 3	D 2	SD 1	T	$\bar{X}$
1	Nature of materials affects the life span of a product.	f	130	176	35	24	365	3.13
		%	35.6	48.2	9.6	6.6	100	
		fx	520	528	70	24	1142	
2	The life cycle design affects the duration of a product.	f	124	181	12	48	365	3.04
		%	34.0	49.6	3.3	13.1	100	
		fx	496	543	24	48	1111	
3	Manufacturing process can determine the life cycle of the product	f	124	110	105	26	365	2.91
		%	34.0	30.1	28.8	7.1	100	
		fx	496	330	210	26	1062	
4	Consumption pattern of consumers determines the frequency of product production.	f	113	168	33	51	365	2.94
		%	31.0	46.0	9.0	14.0	100	
		fx	452	504	66	51	1073	
	Overall mean ($\bar{X}$)		3.01					

Source: Field survey, 2025.

Data obtained in Table 2 revealed that life cycle design analysis affect green manufacturing an overall mean ($\bar{X} = 3.01$). The statement of nature of materials has the highest mean score ($\bar{X} = 3.13$) followed by the statement life cycle analysis determines the disposal of the product with a mean score ($\bar{X} = 3.04$). The manufacturing process can determine the life span a product with mean score ($\bar{X} = 2.91$) and the statement of consumption pattern of consumers affect the frequency of product production with mean score ($\bar{X} = 2.94$). All the statements and their means are greater than 2 and show that the life cycle design affect green marketing and sustainability.

Table 3: Responses on green manufacturing effect on green marketing and environmental sustainability.

S/N	Statement		SA 4	A 3	D 2	SD 1	T	$\bar{X}$
1	Design for the environment affects green marketing and sustainability of the environment	f	102	134	17	112	365	2.62
		%	27.9	36.7	4.7	30.7	100	
		fx	408	402	34	112	956	
2	Life cycle design analysis affects green marketing and sustainability of the environment	f	89	140	36	100	365	2.60
		%	24.4	38.3	9.9	27.4	100	
		fx	356	420	72	100	948	
	Overall mean ($\bar{X}$)		2.61					

Source: Field survey, 2025

Data on Table 3 show effect of the independent variables (Design for the environment and life cycle design analysis) effect on the dependent variable (green marketing and environmental sustainability) with an overall mean ($\bar{x} = 2.61$), design for the environment has the highest mean score ($\bar{x} = 2.62$) followed by life cycle design analysis with mean score ($\bar{x} = 2.60$). All the independent variables are greater than 2 and show that the independent variables have effect on the dependent variable.

Test of hypotheses

Hypothesis one

H₀₁: Design for the environment has no significant effect on green marketing and environmental sustainability of South –South and South East states of Nigeria.

H₁₁: Design for the environment has significant effect on green marketing and environmental sustainability of South –South and South East states of Nigeria.

Hypothesis two

H₀₂: Life cycle design analysis has no significant effect on green marketing and environmental sustainability of South –South and South East states of Nigeria.

H₁₂: Life cycle design analysis has significant effect on green marketing and environmental sustainability of South –South and South East states of Nigeria.

Table 4: Multiple regression analysis showing the effect of design for the environment and life cycle design analysis on green marketing and environmental sustainability.

Model summary

Model	R	R-square	Adjusted R square	Std error of the estimate.
1	.759	.576	.570	2.04894

a) Predicators: (constant) design for the environment and life cycle

Table 5: ANOVA table showing the effect of green manufacturing on green marketing and environmental sustainability of South –South and South East states of Nigeria

Model	Sum of squares	Df	Mean square	f	Sig
Regression	2044.025	5	408.805	97.377	.000 ^b
1 Residual	1507.142	359	4.198		
Total	3551.167	364			

(a) Dependent variable: Green marketing

(b) Predicators (constant) design for the environment and life cycle design analysis

Table 6: Regression coefficient showing the effect of green manufacturing on green marketing and environmental sustainability of South –South and South East states of Nigeria

Model	Unstandardized coefficients		Standardized coefficients	t	Sig
	B	Std error	Beta		
1 (Constant)	3.277	.635		5.160	.000
Design for the environment	.566	.044	.566	12.900	.000
Life cycle design analysis	.105	.036	.102	2.881	.004

(a) Dependent variable: Green marketing and environmental sustainability

Table 6 shows the value of individual variable's contribution to the corresponding t-value are as follows: Design for the environment (green design) has a t-value of 12.900 with a significant level of .000 less than 0.005 p-value. This implies that the variable was significant and predicted the effect of the result on the design for the environment which significantly affect green marketing and environmental sustainability. Life cycle design analysis has a t-value of 2.88 and p-value of 0.005 < table p-value of 0.005. This implies that the variable contribution was significant in determining the relationship and the effect on green marketing and environmental sustainability.

Discussion of Findings

Hypothesis one

From the test of hypothesis carried out, it was revealed that design for the environment has significant effect on green marketing and environmental sustainability of South –South and South East states of Nigeria. This finding is in agreement with the study of Onyeka-Iheme et al. (2024), Raisiene et al. (2021) and Petit et al (2018) that design for environment is important because the success or failure of a product is linked to the design. This because the design uses innovative approach to address environmental problems. The design for the product and manufacturing approach is necessary right from the inception of the product. Green manufacturing is the bedrock of green marketing as the nature of the product starts from its manufacturing stage.

Thus, green design significantly determines the green product, waste disposal and eco-label which significantly promote the preservation of earth resources for future generation. Green design make use of non-toxic and hazardous liquids and sustenance as well as recycle or renewable materials or permitted chemicals for production of consumer goods that do not damage the environment or cause pollution (Zhang et al. 2022; Billatos & Basally, 2005). In support for this finding, Dantus et al. (2023) state that green design or design for environment results in adoption of manufacturing processes that require the use of less energy requirements for production as to have less harmful effect on the environment with

less emission of greenhouse gases or carbon footprint to the air and introduction of eco-label on each product by manufacturers. Otegbulu (2011) and Ezenizen et al. (2021) mention that energy cost is another factor of green manufacturing as it has assisted energy intensive companies to implement lean processes that minimize waste and enhance energy efficiency as well as reduce individual company carbon emission to the atmosphere. Green design is intended to develop more environmental green products with selection of appropriate technology for efficient manufacturing processes. Determination of appropriate technology and efficient manufacturing methods, companies can produce goods without much harm to the environment.

Again, design for the environment brings about development of sustainable manufacturing system, a system that is circular and based on the practice of recycling in which the wastes from the processes can become or serve as raw materials inputs for the production of other goods. Such a sustainable system could potentially allow for huge production and consumption of green products.

Test of hypothesis two

From the analysis of the data collected, hypothesis two reveals that life cycle design analysis has a significant effect on green marketing and the sustainability of the states east of River Niger. This finding is in line with the view of Zeng (2020) that life cycle design analysis of products depends on the quality or nature of the materials used. Dantas et al (2023) support that since the life cycle used in the manufacturing of the product, the use of biodegradable and recyclable materials are very useful in the life cycle of green marketing products (green products) as they would not take long period to decompose or reused unlike plastic materials that take 100 to 500 years to decompose.

Esaurd (2021) states that reusable and decomposable materials are useful in the life cycle of the product to prevent generation of waste, reduction of hazardous liquids and toxic materials in the environment as well as reduces the health risk to humans during manufacturing process. Kariuki and Jemaiyo (2025) support that the biodegradable materials are important in the production of packages and products to assist in the reduction of waste due to shorter life cycle. Again, Chioatto and Sospioo (2023) report that the promotion of recycling and the use of biodegradable materials are recommended for use in the life cycle of packages especially for fast moving consumer goods (FMCG). Thus, the use of plant-based alternatives for manufacturing products will shorten the duration of such packages because the packages will decompose fast and the non-production of hazardous gases and toxic waste to the environment. These are very useful to green marketing because there is less or non-generation of greenhouse gases into the air nor release of toxic substances and hazardous waste that contaminate the environment, harmful to the man and animals in the eco-system (Murtas et al; 2022).

Conclusion

The campaign for green marketing as one of the pillars of environmental sustainability that can be successfully achieved through consent to green manufacturing practices by companies and government. This is obvious because green manufacturing practice reduces waste in the environment through the use of biodegradable and recyclable materials as well as less energy consumption methods in the production of goods and services. However, many manufacturing companies do not adhere to practical measures of managing production processes as to ensure compliance to improving their environmental sustainability promises. It is obvious that understanding and acceptance of the fact that humans depend on the environment and the sustenance of the environment is squarely the responsibility of man will ensure efforts to free the environment from toxic and harmful substances as well as to jealously preserve the natural resources. Hence, green manufacturing practices will enhance green marketing by reducing littering of waste and causing different environmental hazards in the society. .

Recommendations

The following are recommendations for the study and include:

1. Companies should adhere strictly to proclaimed Environmental Protection Plan or Policy (EPP) to ensure sustainability of the environment. Government regulatory agencies must ensure that companies comply with regulatory laws and placing sanctions on defaulting companies. Companies should invest in wind power and other renewable energy sources to reduce carbon emission to the atmosphere. This will promote environmental friendly production practice.
2. Companies should imbibe the culture of using biodegradable, recycling and reusable materials for production of goods. This will be a better approach to manage life cycle of products to avoid waste of materials and to preserve the scarce natural raw materials. Particularly, the use of plant based materials should be encouraged as inputs for the production of goods.

References

- Al-hamed, A. M., Junoh, M.Z.B. & Alabboodi, A. S. (2021). Environmental concern, health consciousness and purchase intention of green products: An application of extended theory of planned behaviour. *Journal of Social Sciences Research*, 5(4), 1203-1215.
- Anijah-Obi, F. (2006) *Environmental overview* in Alozie, P. I. edited *Technology, science and environment*, El-Sapphire Limited.
- Anucha, V.C., Grant, S. & Okechukwu, A. A. (2018). Green packaging and environmental Sustainability, (A case study of selected green companies in Port Harcourt). *International Journal of Research and Development Studies*, 9(1), 16-26.
- Akuoko, K, O, & B our, K.B.(2013) Effect of mining pollution on the people of Wassa West district of Ghana. *Zenith International Journal of Multidisciplinary Research* 3 (2)330-344
- Barber, N. (2010). Green wine packaging: Targeting environmental consumers. *International Journal of Wine Business Research*, 22(4), 423-444

- Billatos, S. & Basally, N. A. (2005). *Green engineering and environmentally conscious manufacturing in* Dwight, et al (2005) edited New Page: New portal to approaching our global environment, Old Dominion University Press.
- Bisong, F.E.& Okon, A. (2018). *Green jobs /green economy framework*, Cuso International & Cross River State Planning Commission
- Camilleri, M.A (2020). Strategic corporate social responsibility. *Tourism and Hospitality and Sustainable Development*. 28(3), 504-506. <https://doi.org/10.1002/sd.2059>.
- Chioatto, E. & Sospiro, P. (2023). Transition from waste management to circular economy. *The European Union Roadmap. Environment Development and Sustainability*, 25(1), 249-276 <https://doi.org/10.1007/s10668-021-02050-3>
- D' Angelo, V., Cappa, F., & Peruffo, E. (2023). Green manufacturing for sustainable development: The positive effects of green activities, green investments, and non green products on economic performance. *Business Strategy and the Environment* 32 (4)1900-1913. <https://doi.org/10.1002/bse.3226>
- Dantas, R., Sabir, I., Martins, J.M., Majid, M.B., Rafiq, M., Martins, J.N. & Rana, K. (2023). Role of green and multisensory packaging in environmental sustainability: Evidence from FMCG sector of Pakistan. *Cogent Business and Management*, 10:3, 228563, Doi: 1080/2331975. 2023. 2285263.
- Darekar, S., Misal, S., Bagal, S. Banerjee, S. & Thakre, P. (2023). Exploring green marketing practices: Insights from marketing managers on environmental sustainability. *Shodhkosha Journal of Visual and Performing Arts*, 4(2), 1402-1406. doi: 1029121/shodhoshiv4.122023.2455.
- Dillon, W.R., Madden, T. J., & Firtle, N. H. (1993) *Essentials of research*, McGraw-Hill
- Eneizan, B. Alshare, F. Selaymeh, M., Enaizan, O. & Abdul-Latif, M. (2020). Marketing and sustainability: Review Paper. *In International Journal of Academic Management Science Research (IJAMSR)*, 4(4), 26-30.
- Escursell, S. Llorach-Massana, P. & Roncero, M.B. (2021). Sustainability in e-commerce packaging: A review. *Journal of Cleaner Production* 280, 124314. <https://doi.org/10.1016/j.jclepro.2020.124314>.
- Etuk, J. E. (2010) *Business Research Methods: Concepts, process and applications*, University of Calabar, Press.
- Fahad S., Alnori, F., Su, F. & Deng, J. (2022). Adoption of green innovation practices in SMES sectors: Evidence from emerging economies. *Economic Research - Ekonomska Istrazivanja* 35(1) 5486-5501 <https://doi.org/10.1080/1331677X.22022.2029713>
- Goyal, A., Agrawal, R., Chokhani, R. K., & Saha, C. (2018) Waste reduction through kaizen approach: A case study of a company in India. *Waste Management Research*, 37(1) 102-107. <https://doi.org/10.1177/0734242X1879620>
- Gyyamfi, BB. A., Bein, M. A., Udemba, E. N., & Beku, F.V. (2022). Renewable energy, economic globalization and foreign direct investment linkage for sustainable development in the E7 economies. Revisiting the pollution haven hypothesis. *International Social Science Journal*. 72 (243) 90- 110. <https://doi.org/10.1111/issj.12301>
- Haleem, A., Javaid, M., Singh, R. P., Suman, R. & Qadri, M.A. (2023). A pervasive study on green manufacturing towards attaining sustainability. *Green Technologies and Sustainability*, 1,100018. <https://doi.org/10.1016/j.grets.2023.100018>
- Intergovernmental Panel for Climate Change (IPCC) (2021). Summary for policy makers in climate change 2021, the physical science basis. Contribution of working group to the sixth Assessment Report of IPCC (Masson-Delmotte V.P. Zhai, A. Pirani, S.L. Connors, C. Pean, S. Berger, N. Caud, Y.
- Ismanto, A., Hadibarata, T. Widada, S., Indrayanti, E., Ismunarti, D. H., Sofinatunnajah, N., Kusumastuti, W., Dwiningsh, Y. & Alkahtgini, J. (2023). Ground water contamination statusin Malaysia: Level of

- heavy metal, source, health impact and remediation technologies,. *Bio Process and Bio systems Engineering* 46(3)467-482 <https://doi.org/10.1007/s00449-022-02826-5>
- Jan, A.A., Lai, F. W., Draz, M. U., Tahir, M., Ali, S. E. A., Zahid, M. & Shad, M. K. (2021) Integrating sustainability practices into Islamic corporate governance for sustainable firms performance. From the lens of agency and stakeholder theories. *Quality and Quantity* 56(3) 1-24, <https://doi.org/10.1007/s11135-021-01261-0>
- Jiao, Ali, S. S. Alsharbaty, M.H.M., Elsamahu, T., Abdelkarim, E., Schagerl, M., Al-tohamy, & Sun, J. (2024). A critical review of plastic waste life cycle assessment and management: Challenges, research gaps and future perspective. *Eco-toxicology and Environmental Safety*, 217(22), 127-140. [Doi.org/10.1016/j.ecoenv.2024.115942](https://doi.org/10.1016/j.ecoenv.2024.115942)
- Jum'a, L., Zimon, D. & Ikram, M. (2021). A relationship between supply chain practices, environmental sustainability and financial performance. Evidence from manufacturing companies in Jordan *Sustainability* 13(4) 2152 <https://doi.org/10.3390/su3042152>
- Kariuki, M.K. & Jemaiyo, B. (2025). Relationship between green product packaging and organisational performance in Kenya: Empirical review. *British Journal of Marketing Studies*, 13(1), 73-87.
- Kotler, P. & Armstrong, G. (2013). *Principles of marketing*. Pearson Englewood Cliffs.
- Lazer, W. (1969). Marketing is changing social relationship. *Journal of Marketing*, 33(1), 3-9
- Leal-Hiho, W. (2010). About the role of universities and their contribution to sustainable development. *Higher Education Policy*, 24, 427-438.
- Liu, B. & Pang, R. (2017). Analysis of green environmental protection concept in packaging design. *Advances in social Science, Education and Humanitarian Research*, 80, 194-197.
- Lu, L., Bock, D. & Joseph, M. (2013). Green marketing: What the millennial buy. *Journal of Business Strategy*, 34(1), 3-10.
- Manish, S. & Soren, D. (2013). Green manufacturing and its impact on environmental sustainability. *Energy and Environmental Sustainability*, 18(9)124-127.
- Murtas, G., Pedeliento, G. & Andreini, D. (2022). To pack sustainably or not to pack sustainably? A review of the relationship between consumer behaviour and sustainable packaging. In *International Series in Advanced Management Studies*. Springer US. <https://link.springer.com/chapter/10.1007/979-3-031-12027-5-9>
- Mutiskiwa, M. & Marumbwa, J. (2013). The impact of aesthetics packaging design elements on consumer purchase decision. A case study of locally produced dairy products in Southern Zimbabwe. *IOSR Journal of Business and Management*, 8(5), 64-71. <https://doi.org/10.9790/487x-0856471>
- Nagarajan, K. (2011). *Project Management*, New Age International Publishers
- Osinowo, O. A. (2021). *Livestock production and global warming: Adaptation of Climate Smart solution*, 4th Public Lecture held on September 14th, 2021, Senate Chambers, University of Calabar.
- Otegbulu, A. C. (2011). Economics of green design and environmental sustainability. *Journal of Sustainable Development*, 4(2), 240-248.
- Oyebode, O. J. (2021). Engineering strategies for environmental sustainability, green society, and way forward out of Covid-19. *Journal of Energy, Environment, Carbon Credits* 4(2) 40-52
- Pillow, D. N.(2018) Environmental justice and the anthropocene meme. *Journal of Environmental Studies and Sciences* 82, 135-142
- Petit, O., Velasca, c. & Spence, C. (2018). *Multisensory consumer packaging interaction: The role of new technologies*. Springer e-books (pp. 349-374) <https://doi.org/10.1007/978-3-319-94977-2-18>
- Spence, C. (2021). The multisensory design of pharmaceuticals and their packaging. *Food Quality and Preference*, 91- 104. <https://doi.org/10.1016/j.foodqual.2021.104200>.
- Stern, P. C., Dietz, T., Abel, T.D., Guagnana, G.A. & Kalof, L. (1999). A value-belief-norm theory of support for social movement. The case of environmentalism. *Human Ecology Review*, 6(2), 81-87. <https://www.humanecologyreview.org/pastissues/her62sternetal.pdf>.

- Tripalhi, N. K. (2014). Improving sustainability through green marketing. *International Research Journal of Management Sciences and Technology*, 5(12), 38-45.
- Tutu, B. O. & Anfu, P. O. (2019) Evaluation of food safety and quality management system of cottage food manufacturing industry in Ghana. *Food Control* 101, 24-28. <https://doi.org/10.1016/j.foodcont.2019.02.028>
- Wersing, J., Caputa, V. Corroresi, L. & Broring, S. (2020). The effect of green nudges on consumer valuation of bio-based plastic packaging. *Ecological Economics*, 178:106783. <https://doi.org/10.1016/j.ecolecon.2020.1067783>
- Zeng, T., Deschenes, I. & Durif, F. (2020). Eco-design packaging: An epistemological analysis and transformative research agenda. *Journal of Cleaner Production*, 276(December) <https://doi.org/10.1016/j.jclepro.2020.123361>.