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LEVEL OF GREEN INNOVATION IN THE FOOD AND BEVERAGE FIRMS IN LAGOS STATE

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ABSTRACT

The impact of green innovation on the continued development of firms is increasingly being recognized globally in recent years. However, not many scientific studies have examined the degree to which the adoption of Green Innovation (GIN) influences both the financial and non-financial performance of firms in the food and beverage industry. This study applies Partial Least Square Structural Equation Modeling (PLS-SEM) and Mean Item Rating (MIR) to examine the extent of the adoption of green innovation in food and beverage firms in Lagos State, Nigeria. This research categorised green innovation, also known as eco-friendly innovation into green product innovation (GPRD), green process innovation (GPRO), and green managerial innovation (GMIN). Responses were obtained from a selection of 282 firms, representing about 77 % of the administered questionnaire. The results show that food and beverage firms are practicing green innovation. However, green managerial innovation practice is relatively high when compared to the adoption of green process innovation and green product innovation. The results of this paper underscore the understanding that green innovation practices are vital to boosting a firm's environmental functionality.

Keywords: Green innovation; Green product innovation; Green process innovation; Green managerial innovation; Food and beverage firms; Lagos State.

1. Introduction

Greening the economy is an approach that contributes to general well-being and a decrease in environmental footprint (Barbier and Markandga, 2013). There is a continuous rise in competition amongst players in the food and beverage sector, thereby necessitating the deployment of sustainable and innovative practices. To this end, green innovation could denote a significant tool in aiding firms to gain and sustain competitive advantage. Green innovation has led to a drastic reduction in the adverse impact of process and product development on the environment. As concerns on the environmental impact of manufacturing activities grow, green innovation is an important initiative contributing to reducing the impact on the natural environment (Hashim, 2018). Governments, firms and scholars are paying closer attention to green innovation in order to attain sustainable development goals (Tamayo-Orbegozo *et al*., 2016) and minimize environmental costs and impacts (Cai and Zhou, 2014). Calza *et al*. (2017) reiterates that technological or non-technological green innovations may be driven by economic or environmental influences according to the pursuits of stakeholders and requirements of shareholders. Executing green innovation poses great difficulty for non-green businesses since it usually requires investment in new technologies and competencies that differ a lot from their current competencies, thereby greatly increasing costs.

The Food and Beverages (F&B) manufacturing firms are the bedrock of the development of nations (Akpan *et al*., 2016). They are the primary producers of consumer goods as well as beverages in Nigeria and probably the largest sub-sector of the Nigerian manufacturing sector on the Nigerian Stock Exchange (Okere, 2012). The industry is a growing and powerful sub-sector of the Nigerian manufacturing industry (Osundina, 2014) within which there is fierce competition (KPMG, 2014; 2015). Food and beverage firms are characterised by several features that shape the innovation process: long production cycles, slow growth, food safety, high regulation and technological convergence (Boehlje *et al*., 2009). The popularity of green innovation has led to a growth in the variety of research studies related to the area in different industries (Dutz and Sharma, 2012; Hashim, 2018). F & B firms advance economic and industrial development through the use of local raw materials and the production of goods by traditional means and technologies. They provide employment opportunities and add to the economies of many countries all over the world. The sector also contributes largely to the GDP of the Nigeria. Hence, the economic significance of food and beverage firms cannot be overemphasised. Unfortunately, they produce an array of end products which include liquid and gaseous by-products that adversely affect the environment. Moreover, this has resulted in eutrophication of water bodies, contamination of groundwater, and soils and impacted the quality of life in cities (Achi *et al.*, 2018).

Green process innovation has been underestimated in prior research especially within the Nigerian context. The F&B industry is experiencing a continuous increase in industrial activities and growth, resulting in an increased generation of hazardous waste. Understanding a waste stream is a vital tool in equipping one to plan means to address the challenges, following the best acceptable practices (Masen, 2015). In line with these conflicting issues, this study aims to bridge this gap by offering empirical proof to motivate businesses to implement green innovation and ascertain the required level of the practice.

2. Literature Review

2.1.Green Innovation

Innovation is essential for competitiveness as well as workplace performance (Szirmai *et al*., 2011; Radas and Božíc, 2009). Green innovation provides strategic demand for firms that provide a good chance of meeting requirements without damaging the environment. Green innovation (GIN) means the creation of new products, designs, procedures, providers, or perhaps management systems that will tackle environmental problems (Saunila *et al*., 2018). Based on Halila and Rundquist (2011), the term, eco-innovation (environmentally friendly innovation, green innovation or sustainable innovation), is often used to locate those innovations that bring about sustainable environment through ecological improvements. Also, GIN consists of completely new or perhaps modified procedures, methods, and items that benefit the environment and additionally play a role in environmental sustainability (Li *et al.*, 2018).

Furthermore, the customer's expectation is the most essential variable influencing a firm's environmental methods. They choose to buy environmentally friendly products. As a result, this has further increased competition in the market. When the opposition adopts new environmental methods, firms in the exact same business reevaluate their current status and determine whether to enhance or even adopt green innovation habits. This has but driven many companies toward better environmental practices.

Several governments see green innovation as part of their growth strategy. Considering global challenges like scarcity, environmental deterioration, and economic downturns of resources.

Green innovation is an essential tool for reconciling environmental and economic goals and opening new renewable paths for business (OECD, 2012). Regulatory changes and enforcement of environmental policies are necessary, thereby enforcing firms to reduce pollution which will increase profits and standard of the products as well as resource productivity.

Dyck and Silvestre (2018) identified an expanding consciousness of society to discover solution to socio-ecological emergencies through adoption of sustainability. A key factor is to adopt innovation that advances improvements in sustainability. Seman *et al*., (2018) investigated the adoption of green innovation practices, and they reported that bringing together green innovation practices is a key to survival and maintenance of manufacturing companies in improving and sustaining their capabilities and performance.

2.2.Categories of Green Innovation

Chen *et al*., (2006); Burki and Dahlstrom (2017), take into consideration green product innovation, green process innovation and green managerial innovations.

Green product innovation (GPRD)

Green product innovation refers to the advent of new or perhaps enhanced products, such as enhancements in complex materials or even supplies (Cheng *et al*., 2014; Xie *et al*., 2019), to lessen environmental impacts throughout a product's life cycle, thereby fulfilling market needs (Cheng *et al*., 2014). GPRD has been recognized as one of the crucial variables in obtaining environmental sustainability and growth (Dangelico and Pujari, 2010). Furthermore, investing in GPRD can help protect firms from encountering environmental protests and legitimate penalties. It will additionally foster the development of brand-new market opportunities and the attainment of new green item success (Xie *et al*., 2019). Furthermore, GPRD is vital for building environmentally friendly competencies, reinforcing a firm’s eco-friendly brand, and improving its environmental, financial and overall performance (Cheng *et al*., 2014; Xie *et al.,* 2019).

Green process innovation (GPRO)

Green process innovation advances present production procedures or even adds new tasks to minimize undesirable environmental impacts, therefore boosting a firm’s environmental compliance as well as engendering differentiation benefits (Cheng *et al*., 2014). GPRO is often more internal to the firms and and costly to apply but has considerably more operational advantages than some other green methods (Xie *et al*., 2019). GPRO could be an additive fix or incorporated into the production activity through replacing inputs, optimizing generation, or reclaiming outputs (Rennings, 2000). These have a beneficial effect on firms' cut-throat edge as well as sustainability (Chen *et al*., 2006; Sezen and Çankaya, 2013; Cheng *et al*., 2014).

Green managerial innovation (GMIN)

Regarding GIN, managerial innovation consists of environmental management methods or perhaps any other distinct environmental management tools like process control equipment, environmental audits, as well as chain management (Reid and Miedzinski, 2008). GMIN can be perceived as possible use of environmental business techniques in the entire firm’s system to diminish environmental influence (Seman *et al*., 2018). According to Bernauer *et al*. (2006), GMIN does not reduce environmental impacts immediately but helps in the commercial execution of green innovation in terms of product and process in companies.

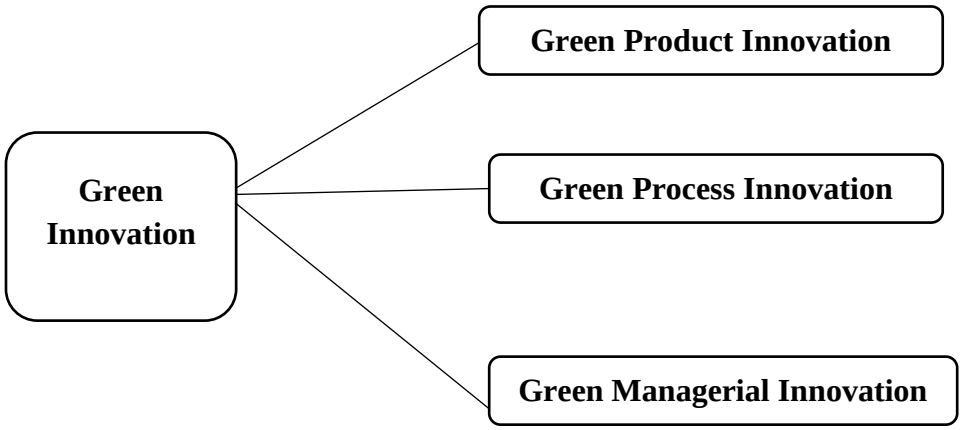

Figure 1: Research Framework

3. Methodology

3.1 Sample of the study

This study adopted a quantitative approach employing a set of structured questionnaire as the research instrument. The population for the study comprised the 341 food manufacturing firms in Lagos State listed in the Nigerian Directory (2019). Table 1 presents the distribution of these firms by main product. The choice of Lagos State was based on the fact that it is the fastest developing city with the highest number of F&B firms in Nigeria. Using Yamane's (1973) formula to compute the sample size, an approximated size of 184 was reached with at least two representatives from each firm, resulting in a total of 368 respondents. Consequently, a total of 368 copies of questionnaire were sent out to respondents in the study area. The respondents of the study include managers of various processes such as; production, environmental protection, operations, and human resource within the registered F&B firms. The effective response rate was 76.6%.

Table 1: Categories of Food and Beverage Firms in Lagos State, Nigeria

Industry	Number
Bakeries & Confectionaries	28
Distilleries	62
Food Processing Companies	89
Milk and Dairy Products	6
Sugar Manufacturing	3
Tobacco	1
Breweries	9
Flour Mills	10
Fruits Drinks	83
Soft drinks, Beer and Alcoholic Beverages	9
Sweets and Beverages	7
Water, Spring and Bottled	34
Total	**341**

Source: Nigerian Directory, 2019

3.2 Questionnaire development

To achieve the goal of this research, assessment of the level of GIN practice was measured by 17 items based on a well-structured questionnaire used by numerous past studies (e.g. El-Kassar and Singh, 2019; Cai and Li, 2018; Seman *et al.*, 2019; Xie *et al.*, 2019). Green innovation practices comprise of three major constructs namely GPRD, GPRO and GMIN with a total of 17 measurement items. Regarding the evaluation of the three green innovation constructs, respondents were required to assess each question in terms of the level of implementation of each practice in their organisation. Questions in the structured questionnaire were graded using an 11-point scale selected for uniformity and ease of reaction (0 is extremely dissatisfied, 1 is very dissatisfied, 2 is moderately dissatisfied, 3 is slightly dissatisfied, 4 is dissatisfied, 5 is neither satisfied/dissatisfied, 6 is satisfied, 7 is highly satisfied 8 is moderately satisfied, 9 is very satisfied, while 10 is extremely satisfied).

4. Data Analysis, Results and Discussion

In this study, both descriptive (mean, frequency and standard deviation) and inferential analytic tools (Partial Least Square – Structural Equation Methods (SEM)) were used to calculate the mean score value of the constructs, and test the reliability and validity of each construct respectively.

4.1. Measurement model for green innovation

In this study, the formative measurement model was used to assess the construct measured (Green innovation). PLS-SEM is the preferred approach when there is a small correlation between the indicators and also when there is a small sample size (Hair *et al*., 2019). According to Hair *et al.*, (2017), the measurement model helps the researcher to evaluate how latent variables fit in collectively and also regardless of whether they are linked appropriately to their indicators. This means the measurement model helps to assess areas of the latent variables' validity as well as their dependability (Hair *et al*., 2017).

We also evaluated the dimensions of formative constructs by checking out multicollinearity issues and evaluating the significance as well as the relevance of the indicators. Formative Measurement Model was used to assess collinearity among indicators (VIF< 5) and also the significance and relevance of outer weights (t > 1.645). The estimated values of the external weights in formative measurement models are often less than that of the reflective. In this study, the researcher examined the weight, significance (i.e. whether p-values were less than 0.05), the formative indicators' validity and the formative latent variables' validity. Table 2 shows that all the formative indicators' p-values for the weights connected with the variables are important (p-values of all indicators are less than 0.05). This shows that the formative construct variables' measurement indicators were adequately constructed. Standard errors were additionally provided with regards to all formative indicators' weights. Based on Hair *et al*. (2017), each and every predictor construct's tolerance needs to be greater than 0.2 and less than five, otherwise they must be removed or perhaps merged with other constructs. All indicators' tolerance (VIF) values are less than two which suggests collinearity is not a problem in this particular study since they are all less than the cap of five recommended by Hair *et al*. (2017). What this means is that adequate VIFs were attained for the study.

In addition, in term of the significance as well as the relevance of the formative signs, the analysis examined every indicator's outer weight (relative importance), outer loadings (absolute importance) as well as used bootstrapping to evaluate the significance. The majority of the indicators' outer loadings and outer weights were significant while PRD2 (Our firm chooses

materials that are easy to reuse, recycle, and decompose for conducting product development or design) and PRO2 (The manufacturing process of our firm recycles waste and emission that allow them to be treated and re-used) were removed based on the criteria found in Hair et al. (2014). The results are presented in Figure 2, which shows the loading weight of indicators on its respective latent constructs. Also, Figure 3 presents the bootstrapping analysis results showing the t-values of each indicator well above the threshold value of 1.96. Hence, the PLS-algorithm and bootstrapping were used to ascertain the relevance and significance of the indicators, respectively.

Table 2 summarises the results for the formatively measured constructs MIN, PRD, PRO by displaying the initial outer weights estimates, t values, p values, as well as the confidence intervals produced from the percentile technique. We find that all formative indicators are significant at 5%. The results give their outer loadings, t-values, and p-values (Table 2). Also, prior theory and research provide support for the relevance of these indicators for capturing green innovation (Davila *et al*., 2018). The analysis of external weights concludes the evaluation of formative measurement models.

Table 2: Formative Indicator Constructs for Green Innovation

Formative Construct	Outer Weight	Outer Weight (Outer Loading)	T Value	P Values	95% Confidence intervals	Significance(p<0.05)	VIF
MIN	cGMIN1	0.682(0.790)	7.418	0.000	0.519(0.818)	Yes	1.031
	cGMIN2	0.622(0.741)	6.461	0.000	0.455(0.764)	Yes	1.031
PRD	cGPRD1	0.633(0.799)	7.552	0.000	0.489(0.764)	Yes	1.079
	cGPRD3	0.425(0.710)	4.034	0.000	0.245(0.593)	Yes	1.233
	cGPRD4	0.319(0.604)	3.184	0.001	0.13690.464)	Yes	1.195
PRO	cGPRO1	0.472(0.645)	4.373	0.000	0.282(0.642)	Yes	1.069
	cGPRO3	0.630(0.828)	6.323	0.000	0.456(0.785)	Yes	1.125
	cGPRO4	0.345(0.504)	2.821	0.005	0.127(0.527)	Yes	1.054

Note: ACQ=Acqusition, ASS=Assimilation, EXP=Exploitation, TRA=Transformation, MIN=Green Managerial Innovation, PRD= Green Product Innovation, PRO =Green Product Innovation.

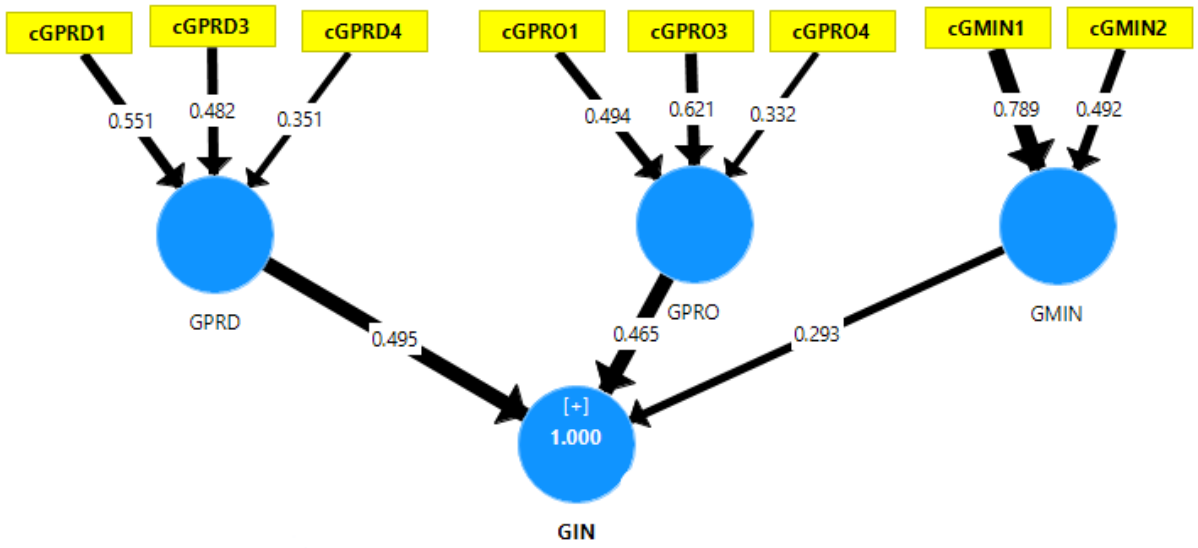

Figure 2: PLS Algorithm Result For Green Innovation

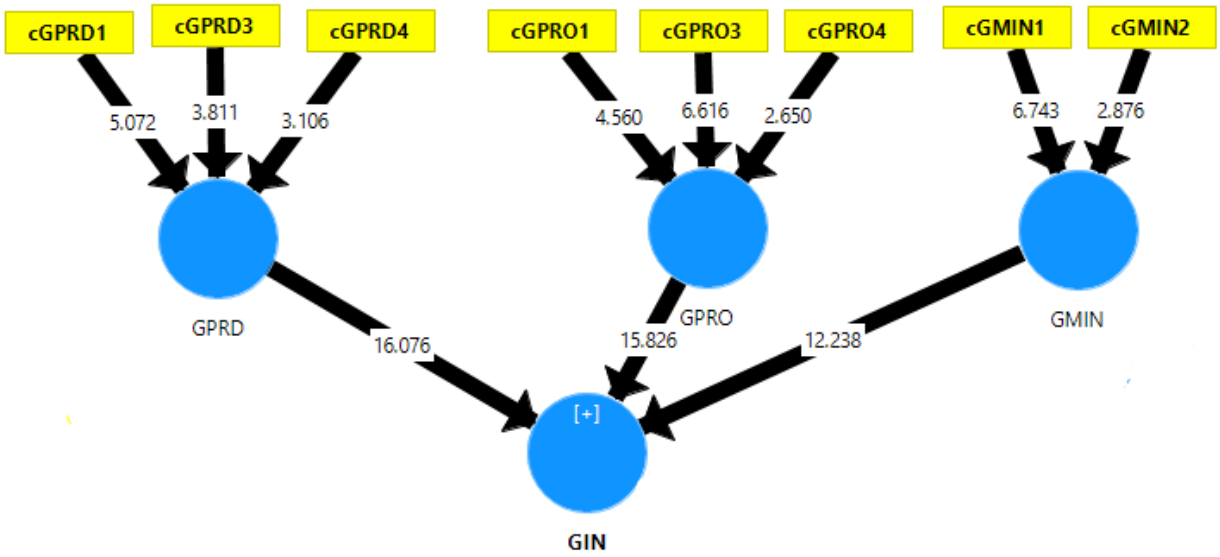

Figure 3: Complete Bootstrapping For Green Innovation

4.2.Description of level of firms' green innovation implementation

Table 3 contains the results of assessing the level of green innovation in the firms. The mean response rating values for the 8 green innovation indicators offered to respondents ranges from a maximum of 6.432 (cGMIN2 - The firm has redesigned and improved service or product to get new environmental criteria or directives) to a minimum of 6.067 (cGPRD1 - Firm chooses items which consume probably the least amount of power for conducting product development or design). No indicator mean value score was categorized into the "extremely satisfied" (>9) and "dissatisfied" (<4) categories, indicating that all of these 8 green innovation constructs are considered important and can be used to determine the level of environmentally friendly innovation in the F&B firms. This affirms the opinion of Oltra and Saint Jean (2009) that environmentally-friendly innovation consists of new or maybe modified processes, methods, and

items that benefit the environment and therefore add to environmental sustainability. Ardyan *et al*. (2017) also revealed that eco-innovation is the driving element of lasting competitive advantage. Furthermore, they confirmed green innovation capability can sustain competitive advantage, which in turn can improve marketing performance considerably.

Based on the survey result (Table 3), the mean values of all the indicators were more than 6 across all the three packages. This shows that firms in the food and beverage industry were adopting green innovation in their product, process as well as their managerial ability. Leal-Rodríguez *et al*. (2018) confirm eco-innovation as a cornerstone in connecting customers' requests as well as business efficiency. Items related to green managerial innovation ranked as the first (cGMIN2 the firm has redesigned and improved service or product to get new environmental criteria or directives) and second (cGMIN1 production procedures ensure internal efficiency) in Table 3. This signifies that excellent GMIN will positively affect a firm's efficiency. Also, it demonstrates that the F&B firms' GMIN concern moderates the connection between environmentally friendly product innovation as well as the firm's overall performance (Iiker, 2012). Firms' choice of materials that produced less pollution from conducting product development and design (GPRD4), with a score of 6.238, is an important practice. It ranked above items related to decrease in input consumption (GPRO3 and GPRO4). Other important activities, as reflected in Table 3 include; the manufacturing activity of our firm efficiently lowers the emission of dangerous materials or waste (GPRO1) with a score of 6.092; the firm manufactures products that reduce resource consumption, as well as the waste generation in merchandise usage (GPRD3) with a score of 6.090; and the firm chooses items that consume probably the least amount of power for managing product development or design (GPRD1) with a score of 6.067.

Table 3: Ranking of Green Innovation Activities

Codes	Green Innovation Constructs	Mean	SD	Rank
cGPRD1	The firm choose items that consume probably the least amount of power for managing product development or design	6.067	3.080	8
cGPRD3	The firm manufactures products that reduce resource consumption, as well as the waste generation in merchandise usage	6.090	3.064	7
cGPRD4	The firms choose materials that produced less pollution from conducting product development and design	6.238	2.992	5
cGPRO1	The manufacturing activity of our firm efficiently lowers the emission of dangerous materials or waste	6.092	3.044	6
cGPRO3	The manufacturing activity of firms decreases the usage of energy and resources	6.216	2.980	4
cGPRO4	The manufacturing activity of firms decreases the usage of raw content	6.221	3.004	3

cGMIN1	Production procedures ensure internal efficiency	6.388	2.936	2
cGMIN2	The firm has redesigning and improving service or product to get new environmental criteria or directives	6.433	2.935	1

Note: GMIN = Green Managerial Innovation, GPRD= Green Product Innovation, GPRO =Green Product Innovation.

Table 4 reveals indicators that reflect the level of green product innovation (cGPRD1, cGPRD3, cGPRD4). The result shows that the choice of materials that produce less pollution from conducting product development and design (cGPRD4) is the most effective green product innovation activity. This indicates that people now have strong concerns about the environment and choose to buy green products. Customers might refuse to purchase items that harm their well-being, therefore encouraging businesses to generate green goods (Weng *et al*., 2015). Manufacturing products that reduce resource consumption and waste generation in merchandise usage (cGPRD3) was ranked as the third with a mean value of 6.083. This is consistent with the findings of Dalhammar (2015) and Marcon *et al*. (2017) on the use of recycled materials.

Table 4: Mean Rating of Green Product Innovation

CODES	GREEN PRODUCT INNOVATION CONSTRUCTS	MEAN	SD	RANK
cGPRD1	Firm choose items that consume probably the least amount of power for managing product development or design	6.082	3.090	3
cGPRD3	Firm manufactures products that reduce resource consumption, as well as the waste generation in merchandise usage	6.083	3.060	2
cGPRD4	Firms choose materials that produced less pollution from conducting product development and design	6.194	3.007	1
Average		6.067	3.080	

Note: GPRD= Green Product Innovation

Table 5 shows that the manufacturing activity of the firm which cuts down the use of raw content is the most important in the green process innovation (cGPRO4) with a mean score of 6.22. This is in line with some authors' emphasis on the benefits of reducing or optimizing the usage of raw materials to get items (Eder, 2003; Hellström, 2007; Crabbé *et al*., 2013, García-Granero, Piedra-Muñoz and Galdeano-Gómez, 2018). Furthermore, the finding is in line with the result of Leal-Millian *et al*. (2017) suggesting that green innovation should be targeted at adjusting the look of a current product and facilitate the minimization of bad environmental impacts, adopting a manufacturing process that reduces the consumption of resources and energy (cGPRO3) that lowers the emission of dangerous materials or waste are also ranked as important.

Based on Van Hemel and Cramer (2002) the eco-indicator recycling of supplies is the most profitable among firms to boosts their environmental performance. This reveals that the entire indicators of green process innovation are relevant. None of the mean scores falls below 6,

although Ma *et al*. (2017) asserted that there is a good connection between GPRO and a firm's long-term benefit. However**,** Seyfettinoglu (2016) revealed that innovation at different levels of the generation process for example idea development, commercialization and development may be affected by stakeholders in the firm and substantially impact the output of the firm that is calculated with economic and innovative results.

Table 5: Mean Rating of Green Process Innovation

Codes	Green Process Innovation Constructs	Mean	SD	Rank
cGPRO1	The manufacturing activity of our firm efficiently lowers the emission of dangerous materials or waste	6.085	3.044	3
cGPRO3	The manufacturing activity of firms decreases the usage of energy and resources	6.216	2.980	2
cGPRO4	The manufacturing activity of firms decreases the usage of raw content	6.221	3.004	1
AVERAGE		6.092	3.044	

Note: PRO =Green Process Innovation

Green managerial innovation is the action that concentrates on re-design and the improvement of current products, services, and operations to achieve internal green management effectiveness (Burki and Dahlstrom, 2017). Table 6 shows that there is a high degree of green managerial innovation in the F&B industry. Redefine operation and production processes to ensure internal frequency (cGMIN2) is ranked the most important with a mean score of 6.43, while redefined operation and production to ensure internal efficiency (cGMIN1) is ranked second with a mean score of 6.38.

Table 6: Mean Rating of Green Managerial Innovation

Codes	Green Managerial Innovation Construct	Mean	SD	Rank
cGMIN1	Production procedures ensure internal efficiency	6.388	2.936	2
cGMIN2	The firm has redesigning and improving service or product to get new environmental criteria or directives	6.433	2.935	1
AVERAGE		6.388	2.936	

Note: MIN = Green Managerial Innovation, PRD= Green Product Innovation, PRO =Green Product Innovation.

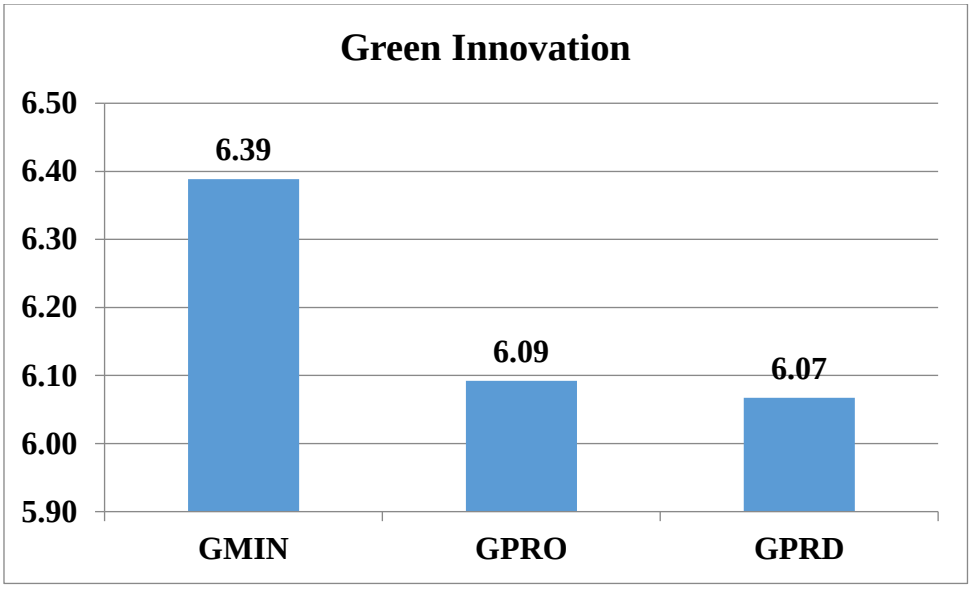

Figure 4: Green Innovation Constructs

This study aims to determine the level of GIN implementation among F&B firms and also to ascertain which practice is mostly embraced by them. The mean score value of green innovation constructs are studied to understand the degree of the level of adoption of green innovation practices in the food and beverage firms. The result of the analysis is evident and discussed extensively in the preceding segment. In light of the outcome, this study found that F&B firms in Lagos State are currently practicing green innovation while most of them have initiated implementation. However, green managerial innovation has been given more attention because Nigeria belongs to the cadre of developing Nations characterized by low knowledge and crude decision-making methods, thereby prompting firms in Nigeria to do more in the area of managerial innovation such as marketing and organisational innovations to improve their profitability.

Regarding the level of green innovation practices implementation (Figure 4), green innovation practices comprise of green product, process and green managerial innovation that are adopted in food and beverage firms. Most of all, green managerial innovation (6.388), green process innovation (6.092), and green product innovation (6.067) are implemented in F&B firms, suggesting a wide diffusion of the basic concept of green innovation among the firms. Therefore, firms should adopt innovation and dynamism not only in their managerial process, but also in their products. Tang *et al*. (2018) reported similar results that firms have managerial concerns for the environment. However, Seman *et al*. (2018) reported a different result which indicated that the practice of green process innovation is prioritized and implemented. Xue *et al*. (2019) examined the penetration of green innovation in firm's performance, and it was reported that adoption of green innovation will provide openings for firm growth as well as foster sustainability and performance. Furthermore, Karabulut (2015) corroborates the assertion that managerial/organisational innovation, process innovation, and product innovation have good impacts on fiscal performance, customer efficiency, internal business, learning and development performance. Therefore, the researcher opined that government should intensify efforts to make green innovation mandatory for all manufacturing firms as this will improve the processes and well-being of individuals. Sustainability should be a vital goal for all food and beverage firms. Government should also sponsor and facilitate training for all manufacturing firms as this will create awareness regarding the relevance of green innovation. Since innovation is the life blood

of firms, firms should be willing to invest enormous amounts of time and effort to build innovative technical competencies.

5. CONCLUSION

This study explores the assessment of the level of GIN in the F&B firms in Lagos State considering the green process innovation, green product innovation, and green managerial innovation. It revealed that F&B firms are already adopting green innovation in their respective business activities at varying levels. The results show that green managerial innovation has been given more priority than other types of green innovation. Therefore, firms are urged to place more value on GPRO and GPRD which will not only have a tremendous impact in terms of competitive edge but also on the sustainability and well-being of individuals.

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