GREEN INTELLECTUAL CAPITAL AND ENVIRONMENTAL SUSTAINABILITY OF LISTED MANUFACTURING COMPANIES IN NIGERIA

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ABSTRACT

Business sustainability by adopting green approaches ensures the going concern of businesses. The objective of this study is to determine the effects of green intellectual capital on environmental sustainability of listed manufacturing firms in Nigeria. The independent variable is the green intellectual capital (GIC) proxied by green human capital (GHC), green organisational capital (GOC), green relational capital (GRC), stakeholders' integration (STI), environmental management competence (EMC) and green marketing (GRM). The dependent variable is the environmental sustainability. The study adopted survey research design. The study's population was 53,404 and 665 staff were chosen with the adjusted taro Yamane formula. Data were obtained from the selected staff through questionnaire administered physically and electronically and 83% response rate was obtained. The study adopted both descriptive and inferential statistical analysis (multiple regression). The study discovered that the green intellectual capital had significant effect on the environmental sustainability with the adj. $R^2 = 42.3\%$, $F (6,421) = 53,176$, p-value < 0.05. The study recommended organisations should consider adequate investment in environmental systems and processes and that sustainability performance goals should be inculcated as part of the reward system.

Keywords: Green Intellectual Capital, Environmental Sustainability, Business Sustainability, Sustainable Practices, Sustainability Development Goals.

INTRODUCTION

Business sustainability by adopting green approaches ensures the going concern of business and economic growth. According to the Nigerian exchange, sustainable business and reporting of such to stakeholders would promote transformational initiatives for the Nigerian economy (Iheanachor, 2020; Oji, 2022). Therefore, capital market collaboration with companies, regulators and investors would enhance better understanding of the relationships and move best practices for sustainable development (Alqubaisi, 2021). The emergence of industrial revolution has led to mass efficiency but also global adverse effect in the form of resources depletion, industrial pollution, and extensive energy utilization. The rise in technology actually revealed breakthrough of processing efficiencies and production with lucrative growth, but the enormous utilization of natural resources and high dependency on energy has resulted in great environmental burden (Roeshartono et al., 2019; Yadiati et al., 2019). The goal of firms in maximizing the economic profits has improved the prosperity of many businesses even though with adverse effects on social and environment inequality (Sullivan et al., 2018).

Gong et al. (2018) revealed that the ecosystem has been degraded to the tune of 60% worldwide, which if no attention and redress are put in place to control the situation, it will continue to get worse (Sabir et al., 2020; Yusoff et al., 2019). However, many organisations

claim that their operations do not impose negative consequences on environmental protection and thereby ignore or pay little attention to the issues relating to business sustainability. In fact, there are differences in business landscape when compared to the period before now with limitation of resources, high rate of technological development and disruptions in the new way of business model from the conventional method (Sullivan et al., 2018).

This current situation has increased environmental awareness resulting to increase in the ecological regulations world-wide with the tendency of impacting on industries globally. In compliance with the rapid reduction in the prevailing state of ecology, a shift of trend exists in the modern business for the notion of sustainability. Therefore, with the current environmental era, businesses are prone towards eco-friendly means of achieving organisational goals to ensure the sustainability prospect (Mushtaq et al., 2019; Yusoff et al., 2019). Whereas, the SDGs developed by the united nations (UN) focus on devising and ensuring that organisations are responsible in terms of production to overcome the adverse effects of operational activities of firms on the environment (UNSD, 2016). The increase in environmental awareness has encouraged enterprises in attaining the objective of becoming 'green' in order to fulfil the organisational goals aligning with the prospect of sustainability development (SD) (Roeshartono et al., 2019). The notion of becoming green has spread across industries globally, which is gradually altering and replacing the orthodox organisational practices and resources' utilisation.

There are several motives behind industries' inspiration of becoming green which include the internal consciousness of reducing ecological pressures and improving the environmental conditions. Secondly, organisations' green label can be adopted as a result of consumers' increase demand for eco-friendly product with the intention of providing a positive image to the consumers. Thirdly, it can be an accepted notion by firms due to obligatory requirements from both the national and international regulatory to drive businesses towards sustainable corporate procedures (Jahanshahi et al., 2019; Roeshartono et al., 2019). Manufacturing companies are imperative to the growth and development of nations as dearth of manufacturing companies can affect the survival of nations' economy (Mbang et al., 2020). In Nigeria, many of these companies face challenges in achieving growth as an effect to offset the environmental challenges obtainable from their operational activities which might swallow up the environment and the economy on the long run. Actions of Nigerian Government through several strategies with the aim of supporting the manufacturing industries have all proved abortive and Nigerian manufacturing companies are lagging behind and missing out opportunities that will enhance win-win competitiveness (Mbang et al., 2020).

Although, the environmental management practices in Nigeria are growing gradually as the government of Nigeria took some proactive measures ensuring the preservation and protection of environment. For instance, the state environmental protection agency (SEPA) was established in each of the 36 states with the aid of the federal environmental protection agency (FEPA). The FEPA and SEPA were both charged with the responsibilities of managing the environment, biodiversity, protection and preservation of environmental assets (Obamen et al., 2021). Some other programmes of government in Nigeria aimed to achieve sustainability development include National Poverty Eradication Programme (NAPEP) established in 2002, the NEEDS was introduced in 2004 and the millennium development goals (MDGs).

Several studies have revealed how GIC components which include the green human capital (GHC), green organisational capital (GOC) and green relational capital (GRC) relate with environmental sustainability in countries globally (Bombiak, 2022; Muhamad, 2017; Nawangsari et al., 2022; Secundo et al., 2020; Yusmazida, 2019). According Hussain et al., (2021), the GHC with green innovation as a mediating variable has a relationship with the

sustainability. There is a need for organisations to institute green initiatives in their employees which is a core strategy in green human capital management (GHCM) as it necessitates the behaviour of employees to attain the organisations' green goals of boosting the triple bottom lines especially the environmental performance (Chaudry, 2020; Dumont et al., 2017; Roscoe et al., 2019). The study evaluated the effect of green intellectual capital on the environmental sustainability of the listed manufacturing companies in Nigeria. The study provided an answer to this research question "*What is the effect of green intellectual capital on the environmental sustainability performance of listed manufacturing companies in Nigeria?*" This hypothesis was tested in the study:

H_{01}: *Green intellectual capital has no significant effect on the environmental sustainability performance of the listed manufacturing companies in Nigeria.*

LITERATURE REVIEW

Conceptual Review

Environmental sustainability (ENS)

A crucial foundation for sustainable development and alleviation of poverty is environmental preservation and when there is a failure in achieving stability of biodiversity as an example can destruct efforts towards both the social and economic development. In the same vein, when resources like forests are properly controlled it sustain the environmental health by ensuring the climate change mitigation, biological diversity conservation, maintenance of reliable and clean water resources, control of the erosion, protection of agricultural soils, provision of renewable and low-costs energy and finally enhancing the development of urban environment (Kanayo et al., 2013). Regrettably, the uncontrolled natural resources exploitation which include land, water, forests and fisheries by powerful few globally has caused serious change in the natural world of nowadays and most vulnerable people have been seriously affected who depend only on the natural resources as a means of livelihood.

ENS ensures that the processes of interaction with the present environment is with ideal behaviour of ensuring keeping the natural resources and environment from disaster. It entails maintaining integrity towards the environmental systems for proper functioning and beneficial consumption of both the current and upcoming generations. According to Mehra & Sharma (2021), environmental sustainability in the healthcare context entails practices which include the adoption of circular practices such as re-use, recycling, repair, refurbishment of products, utilization of resources efficiently, natural resources conservation such as water conservation. These practices have resulted in products' life improvement, products sharing, treatment of products in terms of services and waste prevention (Elabed et al., 2019; Ertz & Patrick, 2019; Giusti et al., 2020; Singh, 2019).

Green intellectual capital

Jermsittiparset (2017) posited that GIC is the only way out and viable solutions to sustainable issues globally and therefore described GIC as the unquantifiable relationships, reserves, expertise, information relating to green protection and ecological uprising measured through the combination of management of IC and social responsibilities of firms (Dewi et al., 2021). GIC also entails steps taken by organisations in improving their green awareness and CA. Therefore, firms should improve on their green modernisation and thereby increase their green picture (Jermsittiparset, 2017).

Cahyono & Hakim (2019) indicated that firms that invest judiciously in GIC will not only comply and meet up with the strict environmental regulations requirements but will also win corporate competitive advantages. Yusoff (2018) described the GIC as all the knowledge and tangible assets that are related to green innovation and green protection which include the GHC, GSC and the GRC and that all these elements of GIC contribute positively and greatly into the level of firms' CA. The study of Bombiak (2022) defined the GIC as the total knowledge required in the process of managing the environment for the attainment of CA. The Knowledge is revealed in different ways which include database information, employees, external and internal relations, systems or processes (Allameh, 2018).

Theoretical Review

The study was underpinned by stakeholder theory

The stakeholder theory or stakeholder thinking emerged as a narrative of understanding and providing solution to three interconnected problems in business which include the problem of having understanding as to how value can be created within an organisation, the problem relating to capitalism and ethics and finally the problem concerning how managers could be assisted in providing solutions to the first two enumerated problems (Parmar et al., 2010). These problems are very important and their effect cannot be confined alone in the management theory but cut across several disciplines and a need to revisit how the capitalism need to be perceived. Therefore, Freeman (1984) and other scholars suggested that managers need to adopt a concept refer to as stakeholder to address the aforementioned three problem facing businesses.

The study of Baranova & Meadows (2017) emphasised that some stakeholders have roles in organisational environmental capabilities and therefore such could be referred to as environmental stakeholders categorised into four which include the local and national green pressure group, regulators and governments, the green interest stakeholders such as the customers, economic or financial stakeholder, media and the suppliers (Fineman & Clarke, 1996; Muntari et al., 2021) Figure 1.
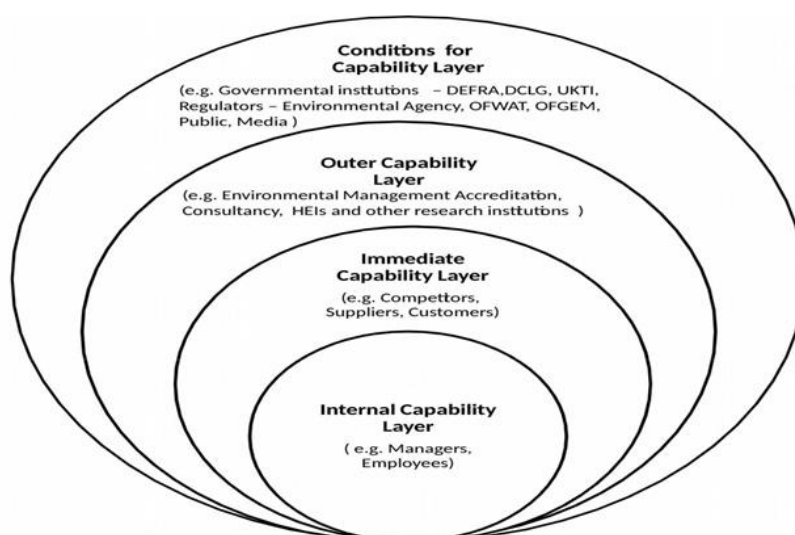

Figure 1
LAYERS OF ENVIRONMENTAL STAKEHOLDERS (ADAPTED: BARANOVA & MEADOWS, 2017)

The engagement of stakeholders in organisational operations is a mechanism to ensure environmental capacity building and enhancement of sustainability (Freeman et al., 2021). The categories of stakeholders can be on how firms engage them most especially in the green economy where green technological development, green innovation, environmental management, green skills and green financing become more prominent for successful and sustainable business strategies. The Figure 1 above indicated how environmental stakeholders could be grouped by organisations due to closeness to enhance sustainability or build environmental capabilities.

Empirical Review

Green Intellectual Capital (GIC) and Environmental Sustainability (ENS)

Studies have established that three components of the GIC positively affect environmental sustainability of firms (Asieai et al., 2022b; Asiaei et al., 2021; Asiaei & Jusoh, 2017; Chen, 2008; Eugenio et al., 2021; Nikolaos et al., 2021; Tang et al., 2017; Yadiati et al., 2019; Yusliza, 2020). Studies revealed the GHC's effect on the social and environmental performance of firms (Asiaei et al., 2021; Asiaei et al., 2022; Hussain et al., 2021; Paille et al., 2020; Shah et al., 2021; Shoaib et al., 2021; Yadiati et al., 2019). Studies also indicated how green organisational capital impacted firms' environmental sustainability (Asieai et al., 2021; Asieai et al., 2022a; Yadiati et al., 2019).

Green Organisational Capital impacted positively on the green service innovation (GSI), green process innovation performance (GPIP) as well as business innovation of firms (Mushtaq et al., 2019; Nadeem et al., 2021). A bi-directional effect of GOC on BS by stating that when firms are environmentally conscious and socially responsible, it enhances the green organizational capital of such firms was indicated (Sudibyoa & Sutanto, 2020).

Studies revealed that green transformational leaders involve the leadership trait of supporting the development needs that ensure the achievement of organizational environmental goals and innovations (Le & Lei, 2018; Dranev et al., 2018; Martinez-Conesa et al., 2017). Studies showed that environmental management abilities include effective education and training for employees and the involvement of suppliers in the environmental practices and enhancement of employees' adaptive performance (Alabri et al., 2022; De Oliveira et al., 2018).

Studies indicated that firms' collaboration and communication with different stakeholders especially the external partners are critical in determining the standard and eco-innovation of firms which ensures mutual benefits, cost reduction as well as enhancement of environmental capabilities of firms (Acebo et al., 2022; Baranova & Meadows, 2017; Hofman et al., 2020). Albertini (2021) stated clearly that managerial competencies in ensuring corporate sustainability include the management's ability to develop environmentally friendly products and are capable of linking wider and more complex adaptive systems to organizational sustainability.

Mutuku et al. (2019), affirmed that compliance with environmental policies affected firms' performance. Some studies have limitations by testing only the relationship between the variable of interest. However, a need to determine the causal effect of variables is required. The scope of coverage was only limited to SMEs which needs to be extended to other manufacturing companies. Some studies need to be empirically tested while some were limited in the measurement of GIC.

METHODOLOGY

Survey research design was adopted by this study through the instrument of a questionnaire administered to the employees of some selected manufacturing companies listed on the Nigeria Exchange Group. The population size of this study includes 77 manufacturing companies listed in Nigeria Exchange Group as at January 27th, 2023 which include conglomerates, consumer goods, healthcare, industrial goods and oil and gas companies. Therefore, the population of 53,404 obtained from their annual report and companies' websites will be considered for this study based on certain criteria. In order to determine a sample size suitable, stratified random sampling technique will be adopted. The selected companies considered were chosen on the basis of those that have been incorporated and continuously listed for a period of not less than 10 years, having the staff strength of more than 50 and above as well as having easy access to the location. Adjusted Taro Yamane sample size determination formula was adopted (Yamane, 1967; 1973) and 665 staff were selected. However, Adam (2020) proposed an adjustment to the error margin in Taro Yamane formula of 1967 for optimum sample size determination at all levels of confidence with the development of an adjusted minimum sample size table. Hence adjusted Taro Yamane' formula for sample size determination was employed at 1% margin of error Figure 2.

Researcher's Conceptual Model
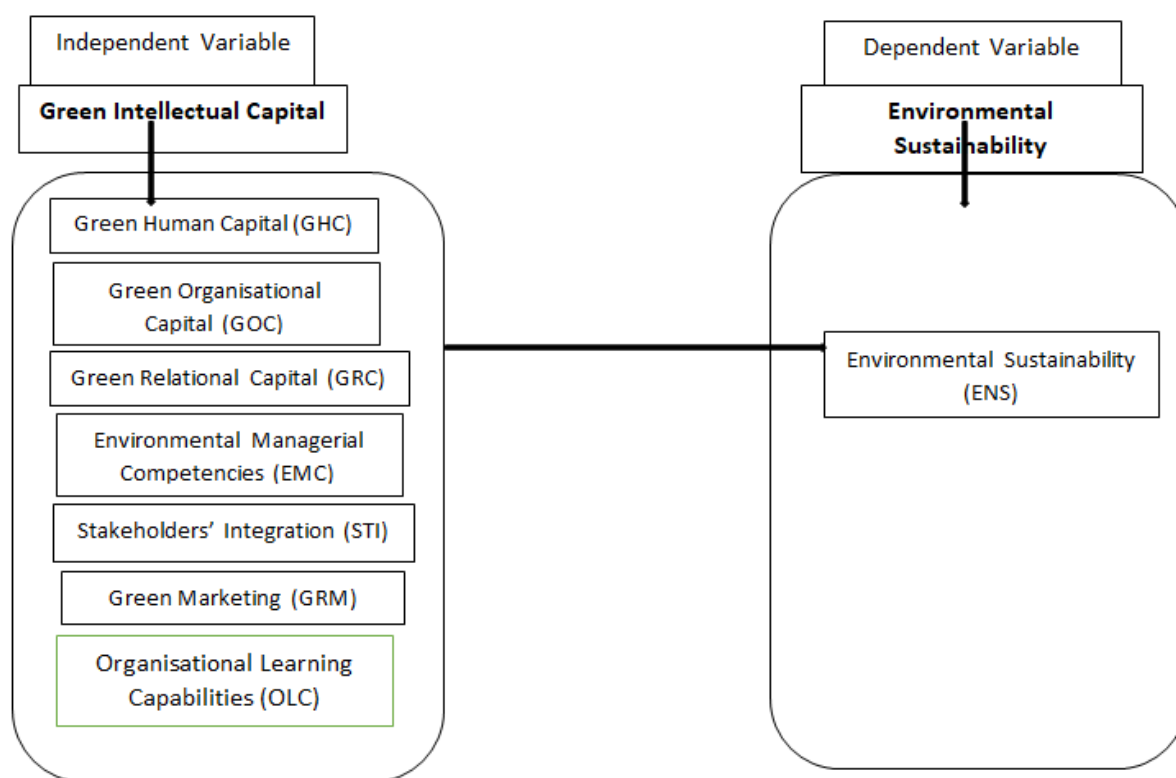
Figure 2
CONCEPTUAL MODEL: GIC AND ENS

Model Specification

In order to test and determine the hypotheses stated for the study, the regression model stated below examined the effect of the independent variables on the dependent variable Table 1.

$$ENS_i = \beta_{0i} + \beta_1 GHC_i + \beta_2 GOC_i + \beta_3 GRC_t + \beta_4 EMC_i + \beta_5 STI_i + \beta_6 GRM_i + \mu_i$$

Where:
ENS_i = Environmental Sustainability
GHC_i = Green Human Capital
GOC_i = Green Organisational Capital
GRC_i = Green Relational Capital
EMC_i = Environmental Managerial Competencies
STI_i = Stakeholders Integration
GRM_i = Green Marketing

Data Analysis, Results and Discussion of findings

Test of Hypothesis (H_{01})

1. **Research Objective:** To examine the effect of the green intellectual capital on the environmental sustainability of the listed manufacturing companies in Nigeria.
2. **Research Question:** What is the effect of the green intellectual capital on environmental sustainability of the listed manufacturing companies in Nigeria
3. **Research Hypothesis (H_{01}):** Green intellectual capital has no significant effect on environmental sustainability of the listed manufacturing companies in Nigeria.

Table 1 Regression Result				
MODEL 1				
Variable	Coeff	Std. Err	T-Stat	Prob
Constant	0.730	0.205	3.559	0.000
GHC	0.197	0.052	3.786	0.000
GOC	0.103	0.047	2.186	0.029
GRC	0.178	0.056	3.203	0.001
EMC	0.088	0.049	1.797	0.073
STI	0.117	0.048	2.459	0.014
GRM	0.150	0.048	3.115	0.002
Adj R^2	0.423			
F-Stat (Prob) (D.F)	53.176 (0.000) (6, 421)			

Dependent Variable: ENS
Source: Author's Work (2023)
Note: all the analysis was tested at 5% significance level

Model

$$ENS_i = \beta_{0i} + \beta_1 GHC_i + \beta_2 GOC_i + \beta_3 GRC_i + \beta_4 EMC_i + \beta_5 STI_i + \beta_6 GRM_i + \mu_i$$

$$ENS_i = 0.730 + 0.197 GHC_i + 0.103 GOC_i + 0.178 GRC_i + 0.088 EMC_i + 0.117 STI_i + 0.150 GRM_i + \mu_i$$

t-test = 3.559 + 3.786 + 2.186 + 3.203 + 1.797 + 2.459 + 3.115

***A Priori* Expectation:** $\beta_1 - \beta_6 > 0$

This means that a positive association is expected to exist between the green intellectual capital proxies and environmental sustainability. From the Table 1 the regression estimates result showed that the proxies of green intellectual capital have positive effect on environmental sustainability as all the components of GIC have coefficients that are above 0.

This is indicated by the signs of the coefficients, which are $0.197 + 0.103 + 0.178 + 0.088 + 0.117 + 0.150$ (that is $\beta_1 - \beta_6 > 0$). These results $\beta_1 - \beta_6 > 0$ are consistent with the *a priori* expectation for the study.

Interpretation

From the multiple linear regression estimates of the model, the signs of the coefficient of the independent variables shows that the green human capital (GHC) had a positive effect on the environmental sustainability with coefficient of 0.197. The positive effect is statistically significant at t-statistics level of 3.786 and p-value of 0.000 which is less than 0.05 level of significance. The green organisational capital (GOC) has a positive effect on the environmental sustainability with a coefficient of 0.103. The positive effect is statistically significant at the t-statistics of 2.186 and a p-value of 0.029 which is less than 0.05 level of significance. The green relational capital (GRC) has a positive effect on the environmental sustainability with a coefficient of 0.178. The positive effect is statistically significant at the t-statistics of 3.203 and a p-value of 0.001 which is less than 0.05 level of significance. The environmental managerial competence (EMC) has a positive effect on the environmental sustainability with a coefficient of 0.088. The positive effect is statistically insignificant at the t-statistics of 1.797 and a p-value of 0.073 which is greater than 0.05 level of significance. The stakeholders' integration (STI) has a positive effect on the environmental sustainability with a coefficient of 0.117. The positive effect is statistically significant at the t-statistics of 2.459 and a p-value of 0.014 which is less than 0.05 level of significance. The green marketing (GRM) has a positive effect on the environmental sustainability with a coefficient of 0.150. The positive effect is statistically significant at the t-statistics of 3.115 and a p-value of 0.002 which is less than 0.05 level of significance.

Therefore, hypothesis of this study aimed to determine if Green intellectual capital has a significant effect on environmental sustainability performance of listed manufacturing companies in Nigeria. Considering the signs of the estimated parameters, all the measurements of Green intellectual capital have a positive effect on Environmental Sustainability (ENS). This is reflected by the signs of the coefficients $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 i.e. $0.197GHC_i + 0.103GOC_i + 0.178GRC_i + 0.088EMC_i + 0.117STI_i + 0.150GRM_i$ respectively. It is worthy of note that the positive relationships of the sub-variables GHC, GOC, GRC, STI and GRM with Environmental Sustainability (ENS) from model three were all significant as depicted by their p-values (0.000, 0.029, 0.001, 0.014 & 0.002) being less than the 5% level of significance for this study, while EMC was not significant as depicted by its p-values of 0.073 bring greater than the 5% respectively.

The adjusted R^2 values for the models show the change in the dependent variable caused by the collective interactions of the independent variables. Model 3 having adjusted R^2 value 0.423 meant that only 42.3% variations of Environmental Sustainability (ENS) of listed manufacturing companies in Nigeria is attributed to the collective interactions of all the independent variables (i.e. all Green intellectual capital proxies) utilized in this model. The remaining 57.7% variation in Environmental Sustainability (ENS) are caused by other variables not put into consideration in this study.

The F-statistics which measures the combined significance of all the independent variables on Environmental Sustainability (ENS) of listed manufacturing companies in Nigeria showed a value of 53.176. The significance of this F-statistics value depicted by its corresponding p-value was 0.000, which is less than the 5%, showing that the combined proxies of Green intellectual capital has a significant effect on Environmental Sustainability (ENS) in the performance of listed manufacturing companies in Nigeria.

DECISION

At 0.5 level of significance and degree of freedom (6,421), the F-statistics is 53.176 while the p-value = 0.000 which is less than 0.05. This implies that the cumulative effect of the green intellectual capital has a positive significant effect on environmental sustainability of the listed manufacturing companies in Nigeria. Therefore, the study rejected the null hypothesis and conclude that green intellectual capital has significant effect on environmental sustainability of the listed manufacturing companies in Nigeria.

Discussion of Findings

The statistical results of Table 1 showed that the prediction of hypothesis 3 indicated a significant effect of the green intellectual capital on environmental sustainability of the listed manufacturing companies in Nigeria. Therefore, the study rejected the null hypothesis and concluded that there is a significant effect of green intellectual capital on the environmental sustainability of the listed manufacturing companies in Nigeria.

The outcome of this study was supported by some studies on the subject matter especially at international context. For instance, the study of Avagyan et al. (2021) discovered that firms' actions on environmental innovation and environmental marketing enhanced the overall performance of firms under consideration. Asieai et al. (2022) discovered that the three major elements of the GIC which include the GHC, GOC and GRC had positive but indirect link with environmental performance of firms under consideration. Scarpellini et al. (2019) discovered a positive link between the dynamic capabilities of firms and business sustainability.

Asiaei et al. (2021) discovered that the GIC components are positively related with the environmental accounting and performance of firms. The study of Khan& Sarfraz (2019) established the positive and significant effect of environmental corporate social responsibility on environmental performance of firms in Pakistan. Nawangsari et al established that positive and significant effect of GSC and GRC on business sustainability including the environmental sustainability of SMEs. Asiaei et al. (2021d) conducted the study of 105 listed firms in Iran and established the effect of GHC and GSC on environmental performance of firms. Acebo et al. (2022) conducted the same study on 10918 innovative firms in Spain and concluded that collaboration with different stakeholders which is social capital will better the overall performance of firms including the environmental innovation of firms.

Wang et al. (2021) conducted the same study on 125 manufacturing firms in China. The study confirmed that when organisations' management are environmentally oriented it helps in improving environmental innovation of firms. Garces-Ayerbe et al. (2017) discovered a significant effect of effective communication and collaborations with different stakeholders enhance eco-innovation performance of firms in Spain. Singha et al. (2020) conducted same study on 309 SMEs and discovered a significant effect of green transformational leaders on green innovation of firms through the mediation effect of GHRM. The study of Khan & Sarfraz (2021) indicated that GIC ensures firms compliance with environmental regulations and policies. Nadeem et al. (2021) after conducting an empirical investigation on some selected US-based companies concluded that GOC is highly imperative in the improvement of environmental performance of firms. Mbinya (2017) after conducting a longitudinal research study for the period of 2011 – 2015 affirmed that when environmental management system is established in firms it promotes organisational competitiveness in the dynamic business world.

Shah et al. (2021) established the effect of green human resources practices of firms on environmental and economic performance having conducted a survey on 480 employees

of different status. The study of Baranova & Meadows (2017) when firms engage with wider scope of stakeholders it ensures new capabilities for making strategic decisions and build higher level of organisational environmental capabilities.

CONCLUSION

The relationship between the green intellectual capital (GIC) and environmental sustainability of the listed manufacturing firms in Nigeria was statistically significant and positive, at a significance level of 0.05, the F-statistics is 53.176, the P-value of the F-statistics is 0.000 which is less than 0.05. The study rejected the null hypothesis and concluded that the GIC has significant effect on environmental sustainability of the listed manufacturing firms in Nigeria. Therefore, the statistical findings of this study revealed a positive and significant effect of the green intellectual capital on environmental sustainability of the listed manufacturing companies in Nigeria at p-value of 0.000 which is less than 5% minimum required for this study.

Recommendations

Sustainability performance goals should be created by firms as part of their rewards system which will encourage employees to participate in sustainability thinking and environmental protection. However, environmental performance can be improved on when emphasis is laid recruitment and selection procedures and thereby opportunities for the recruitment of employees that are environmentally-friendly. Organisations should consider adequate investment in environmental systems and processes. However, environmental performance can be improved on when emphasis is laid on recruitment and selection procedures and thereby create opportunities for the recruitment of employees that are environmentally-friendly. Firms should ensure that the level of staff competence is evaluated from time to time in order to ensure effectiveness of organisational task which can be implemented in the organisational procedures and process. A comprehensive zero waste action should be created by firms with the tendencies of recycling, re-use and rebuilt when products are designed.

Contribution to Future Research

Future research should test the relationship between the variable of interest. Other construct for both the green intellectual capital ans business sustainability could be considered while other sector which include banking, IT, healthcare as well as SMEs can be investigated.

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