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SUSTAINABLE MARITIME TRANSPORT INFRASTRUCTURE AND ITS ROLE IN ADVANCING NIGERIA'S GREEN AND BLUE ECONOMIES.

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Abstract
This paper examines the role of sustainable maritime transport infrastructure in advancing Nigeria's green and blue economies. Quantitative data was analyzed using multivariate regression to assess the impacts of economic growth and other factors on sustainability outcomes. The results showed economic growth did not have a significant effect. Most independent variables like policies and innovation also lacked significant relationships. However, environmental performance and blue economy growth impacted environmental sustainability. Technological readiness influenced sustainable transport. The findings indicate targeted efforts beyond just economic growth are needed to improve sustainability in Nigeria's maritime sector. Further research should investigate the complex dynamics involved to inform policies.

Keywords: Maritime transport infrastructure, Sustainability, Green economy, Blue economy, Nigeria

Introduction

Sustainable maritime transport infrastructure is essential for supporting economic growth and sustainable development in maritime nations like Nigeria. As Ahmad and Fasola (2020) state, "Maritime transport infrastructure plays a vital role in determining a country's level of economic growth." However, the specific factors driving sustainability outcomes in the Nigerian context remain unclear. This paper aims to evaluate the impacts of economic growth and other key variables on goals related to the green economy, blue economy, and sustainable transport in Nigeria's maritime sector.

The development of environmentally and economically sustainable maritime infrastructure is a priority for Nigeria as it seeks to expand its emerging blue economy (Ekeada et al., 2019). However, research on the dynamics between transport infrastructure, economic growth, and sustainability has shown mixed results. For instance, while some scholars like Chukwu and Igbokwe (2015) found a positive association between maritime transport infrastructure and economic growth, others like Ogunsinan and Apanisile (2022) found no significant relationship. This highlights the need for further evidence-based study.

Through an empirical analysis of quantitative data, this paper will assess the statistical relationships between multiple independent variables and key sustainability outcomes. The

independent variables considered include economic growth, environmental impact, investment in green infrastructure, government policies, and technological innovation among others. The outcomes examined are green economy performance, blue economy growth, and advancement of sustainable transport.

Understanding the significance and magnitude of these relationships can help guide policy and decision-making to promote sustainable development in Nigeria's maritime sector. As Nwokedi et al. (2020) note, lessons from emerging economies like Nigeria are crucial for leveraging maritime infrastructure to enable sustainable blue economic growth. This study aims to contribute robust evidence to this body of knowledge and support the achievement of national strategic objectives, guided by the UN's Sustainable Development Goals.

The results and discussion will present the findings from multivariate MANOVA, highlighting which independent variables have statistically significant effects on the sustainability outcomes. Key results are that economic growth does not have a significant impact, while environmental performance and technological readiness do appear to influence green economy and sustainable transport goals. The implications of these findings will be analyzed to provide actionable insights for research and policy in this critical area for Nigeria's sustainable development.

Literature Review

The role of maritime transport infrastructure in supporting economic growth and sustainability has been extensively studied, especially in the context of developing maritime nations like Nigeria. However, the findings from previous research present mixed results.

Some studies have found a positive link between maritime infrastructure development and economic growth. Chukwu and Igbokwe (2015) analyzed data from Nigeria and concluded that maritime transport infrastructure contributes significantly to economic growth. Similarly, Ahmad and Fasola (2020) state that "maritime transport infrastructure plays a vital role in determining a country's level of economic growth".

On the other hand, other scholars like Ogunsinan and Apanisile (2022) found no significant relationship between maritime infrastructure and economic growth in Nigeria. This indicates that the connections are complex and dependent on context.

Looking beyond just economic growth, several authors have examined how transport infrastructure and the maritime sector relate to sustainability outcomes. Benson et al. (2018) proposed that a sustainable maritime transport system is key for Nigeria to meet the UN's Sustainable Development Goals. Ekeada et al. (2019) specifically analyzed how maritime infrastructure enables sustainable blue economy development.

Some researchers have looked at particular dynamics such as the link between transport infrastructure and environmental impact. Chukwudi et al. (2019) found that transport infrastructure expansion has varying effects on environmental sustainability in Nigeria. Nwokedi et al. (2020) discussed how to leverage maritime infrastructure for environmentally sustainable blue economic growth.

Methodologically, studies have utilized different techniques to examine these relationships. Igbokwe (2017) used cointegration analysis to assess the impact of transport infrastructure on Nigeria's economic growth. Amadi and Abdullah (2020) applied a combined DEMATEL-ANP approach to evaluate maritime sustainability dimensions.

Several gaps remain in understanding these complex dynamics in the Nigerian context. As noted by Chukwu (2018), more empirical research is required to analyze the impact of transport

infrastructure on not just economic growth but also broader sustainability goals. This study aims to contribute robust evidence to this body of knowledge to guide policymaking in this critical area.

Methodology

This study utilizes a quantitative research design to examine the statistical relationships between key independent variables and sustainability outcomes related to maritime transport infrastructure in Nigeria.

Quantitative data on the independent and dependent variables were collected from secondary sources including published studies, government reports, and databases from reputable international organizations. The sources provide recent data covering the past 5-10 years relevant to the Nigerian maritime sector.

The model specification is implicitly expressed as follows:

The independent variables included in the analysis are:

X1 Economic growth
X2 Environmental impact
X3 Investment in green infrastructure
X4 Government policies and regulations
X5 Technological innovation
X6 International partnerships
X7 Economic factors
X8 Political stability
X9 Market demand
X10 Technological readiness
X11 Public awareness and acceptance

The dependent variables representing the sustainability outcomes are:

Y1 Green economy performance
Y2 Blue economy growth
Y3 Sustainable transport

Additional control variables may be incorporated in the analysis to account for other factors that can influence the outcomes.

Analysis Technique

The data will be analyzed using multivariate regression modeling to assess the statistical relationships between the independent and dependent variables. Specifically, the analysis utilized the analysis of variance (MANOVA) and F-tests to determine the significance and strength of the relationships.

The regression coefficients indicated the magnitude and direction of each independent variable's effect on the sustainability outcomes. Key assumptions of the MANOVA were tested. If needed, data transformations or alternative models will be pursued.

Presentation of Results

The results of the MANOVA will be presented in tables showing the F-values, p-values, and other key statistics for each independent variable's relationship with the sustainability outcome

variables. The findings highlighted the significant factors influencing green economy, blue economy, and sustainable transport goals.

Result and Discussion

Dependent variable: Economic_Growth

Variable	Df	Sum_Sq	Mean_Sq	F_value	Pr_gt_F
Environmental_Impact	1	3.99	3.987	2.06	0.1532
Sustainable_Transport	1	1.08	1.079	0.558	0.4563
Investment_Green_Infrastructure	1	3.69	3.691	1.906	0.1693
Govt_Policies_Regulations	1	1.52	1.523	0.787	0.3764
Technological_Innovation	1	0.13	0.128	0.066	0.7976
International_Partnerships	1	1.06	1.065	0.55	0.4594
Economic_Factors	1	1.17	1.169	0.604	0.4382
Political_Stability	1	1.37	1.367	0.706	0.402
Market_Demand	1	2.04	2.045	1.056	0.3056
Technological_Readiness	1	2.41	2.41	1.245	0.2661
Public_Awareness_Acceptance	1	0.09	0.089	0.046	0.8306
Environmental_Performance	1	0.12	0.123	0.064	0.8013
Economic_Productivity	1	0.06	0.056	0.029	0.8653
Green_Economy_Performance	1	6.45	6.453	3.333	0.0697
Blue_Economy_Growth	1	0.12	0.119	0.062	0.8043
Residuals	162	313.6	1.936	NA	NA

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

1. **Economic Growth (Independent Variable)**: The F-value for Economic Growth is not statistically significant (F = 2.06, p = 0.1532), indicating that it may not have a significant impact on Green Economy Performance and Blue Economy Growth in the context of sustainable maritime transport infrastructure in Nigeria.
2. **Other Independent Variables**: Similarly, most other independent variables like Sustainable Transport, Investment in Green Infrastructure, Government Policies and Regulations, Technological Innovation, International Partnerships, Economic Factors, Political Stability, Market Demand, Technological Readiness, Public Awareness and Acceptance, Environmental Performance, Economic Productivity, and Blue Economy Growth do not show statistically significant effects on Green Economy Performance and Blue Economy Growth, as their p-values are above the common significance level of 0.05.
3. **Green Economy Performance**: Green Economy Performance does have a relatively lower p-value (p = 0.0697), which suggests that it might be influenced by some of the independent variables to some extent, although the relationship is not very strong.
4. **Residuals**: The residuals represent unexplained variability in the dependent variables. The sum of squares for residuals is 313.6, indicating that there is still a substantial amount of variability in Green Economy Performance and Blue Economy Growth that is not accounted for by the independent variables included in the analysis.

Overall, the results suggest that, in the context of sustainable maritime transport infrastructure in Nigeria, Economic Growth and most of the other examined independent variables do not have a statistically significant impact on Green Economy Performance and Blue Economy Growth. However, Green Economy Performance may be influenced to some extent by other factors not

included in the analysis or by a combination of the examined factors. Further investigation or refinement of the model may be necessary to better understand the relationships involved.

Dependent variable: Environmental Impact

	Variable	Df	Sum_Sq	Mean_Sq	F_value	Pr_gt_F
1	Economic_Growth	1	3.94	3.941	2.144	0.145
2	Sustainable_Transport	1	1.09	1.094	0.595	0.4414
3	Investment_Green_Infrastructure	1	0.05	0.054	0.029	0.8644
4	Govt_Policies_Regulations	1	3.72	3.716	2.022	0.1569
5	Technological_Innovation	1	1.62	1.624	0.884	0.3485
6	International_Partnerships	1	2.78	2.779	1.512	0.2206
7	Economic_Factors	1	3.31	3.307	1.8	0.1816
8	Political_Stability	1	0.74	0.743	0.405	0.5256
9	Market_Demand	1	0.13	0.134	0.073	0.7879
10	Technological_Readiness	1	2.13	2.126	1.157	0.2837
11	Public_Awareness_Acceptance	1	0.86	0.858	0.467	0.4954
12	Environmental_Performance	1	7.56	7.558	4.113	0.0442
13	Economic_Productivity	1	0.46	0.464	0.253	0.6159
14	Green_Economy_Performance	1	1.25	1.25	0.68	0.4107
15	Blue_Economy_Growth	1	7.61	7.607	4.139	0.0435
16	Residuals	162	297.69	1.838	NA	NA

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

1. **Economic Growth**: The independent variable "Economic_Growth" has an F-value of 2.144 and a p-value of 0.1450. This suggests that economic growth is not statistically significant in explaining the variation in the dependent variables being studied. In other words, changes in economic growth do not appear to have a strong influence on the outcomes related to sustainability and economic performance in this context.
2. **Other Independent Variables**: Most of the other independent variables, such as Sustainable Transport, Investment in Green Infrastructure, Government Policies and Regulations, Technological Innovation, International Partnerships, Economic Factors, Political Stability, Market Demand, Technological Readiness, Public Awareness and Acceptance, Economic Productivity, and Green Economy Performance, also do not show statistically significant effects on the dependent variables, as indicated by their high p-values.
3. **Environmental Performance**: The independent variable "Environmental_Performance" has an F-value of 4.113 and a p-value of 0.0442, marked with a single asterisk (*). This suggests that environmental performance is statistically significant in explaining the variation in the dependent variables. Changes in environmental performance are likely to have an impact on the outcomes being studied.
4. **Blue Economy Growth**: Similarly, the independent variable "Blue_Economy_Growth" also has an F-value of 4.139 and a p-value of 0.0435, marked with a single asterisk (*). This indicates that blue economy growth is statistically significant and may have an influence on the dependent variables.
5. **Residuals**: The residuals represent unexplained variability in the dependent variables. The sum of squares for residuals is 297.69, indicating that there is still a substantial amount of variability in the dependent variables that is not accounted for by the independent variables included in the analysis.

In summary, while most of the independent variables do not appear to have a statistically significant impact on the outcomes related to sustainability and economic growth in the context of maritime transport infrastructure, environmental performance and blue economy growth do stand out as statistically significant factors. This suggests that efforts to improve environmental performance and promote blue economy growth may be important for achieving the desired outcomes in this context. Further analysis and exploration of these relationships may be necessary to understand the specific mechanisms at play.

Dependent variable: Sustainable Transport

	Variable	Df	Sum_Sq	Mean_Sq	F_value	Pr_gt_F
1	Economic_Growth	1	0.84	0.838	0.461	0.4981
2	Environmental_Impact	1	1.07	1.072	0.59	0.4436
3	Investment_Green_Infrastructure	1	1.06	1.063	0.585	0.4455
4	Govt_Policies_Regulations	1	3.11	3.113	1.713	0.1924
5	Technological_Innovation	1	0.8	0.804	0.442	0.5069
6	International_Partnerships	1	1.19	1.195	0.658	0.4186
7	Economic_Factors	1	0.5	0.497	0.274	0.6017
8	Political_Stability	1	2.22	2.221	1.222	0.2705
9	Market_Demand	1	2.63	2.626	1.445	0.2311
10	Technological_Readiness	1	10.42	10.416	5.733	0.0178
11	Public_Awareness_Acceptance	1	2.37	2.371	1.305	0.255
12	Environmental_Performance	1	0.01	0.013	0.007	0.9323
13	Economic_Productivity	1	2.23	2.226	1.225	0.2699
14	Green_Economy_Performance	1	0.07	0.068	0.038	0.8466
15	Blue_Economy_Growth	1	2.15	2.153	1.185	0.2779
16	Residuals	162	294.32	1.817	NA	NA

--- Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

1. **Economic Growth**: The independent variable "Economic_Growth" has an F-value of 0.461 and a p-value of 0.4981. This suggests that economic growth is not statistically significant in explaining the variation in the dependent variables being studied. In other words, changes in economic growth do not appear to have a significant influence on the outcomes related to sustainability and economic performance in this context.
2. **Other Independent Variables**: Most of the other independent variables, including Environmental Impact, Investment in Green Infrastructure, Government Policies and Regulations, Technological Innovation, International Partnerships, Economic Factors, Political Stability, Market Demand, Public Awareness and Acceptance, Environmental Performance, Economic Productivity, Green Economy Performance, and Blue Economy Growth, also do not show statistically significant effects on the dependent variables, as indicated by their high p-values.
3. **Technological Readiness**: The independent variable "Technological_Readiness" stands out with a relatively low p-value of 0.0178, marked with an asterisk (*). This suggests that technological readiness is statistically significant in explaining the variation in the dependent variables. Changes in technological readiness may have a meaningful impact on the outcomes being studied.
4. **Residuals**: The residuals represent unexplained variability in the dependent variables. The sum of squares for residuals is 294.32, indicating that there is still a substantial

amount of variability in the dependent variables that is not accounted for by the independent variables included in the analysis.

5. **Environmental Performance and Green Economy Performance**: Environmental Performance and Green Economy Performance have very low sum of squares and p-values above 0.05, indicating that they are not statistically significant in explaining the variation in the dependent variables.
6. **Blue Economy Growth**: Blue Economy Growth also does not appear to be statistically significant in this analysis.

In summary, the results suggest that most of the examined independent variables, including Economic Growth, do not have a statistically significant impact on the outcomes related to sustainability and economic growth in the context of the study. However, Technological Readiness does show some statistical significance, indicating that it may play a role in influencing the outcomes. Further investigation and potentially a more refined model may be necessary to better understand the relationships at play in this context.

In conclusion the analysis examined how various factors impact three key outcomes - economic growth, environmental impact, and sustainable transport - in the context of maritime infrastructure in Nigeria. The results showed that economic growth did not have a statistically significant effect on any of the three outcomes. This indicates that changes in economic growth are not strongly linked to changes in the other variables studied.

Additionally, most factors that were analyzed, including government policies, technological innovation, international partnerships, and others, also did not demonstrate significant relationships with the outcomes. The only exception was that green economy performance had a borderline significant link with economic growth, suggesting it may be impacted by some factors to a limited extent.

When looking at environmental impact as the outcome, environmental performance and blue economy growth stood out as having statistically significant relationships. This shows that changes in these two factors are likely linked to changes in environmental impact in this context.

For sustainable transport as the outcome, technological readiness was the only factor that showed a significant relationship, meaning it may affect sustainable transport outcomes when changed.

A substantial amount of the variation in the outcomes remains unexplained by the factors included in the analysis. Clearly, more research is required to fully understand the dynamics at play. Overall, the results indicate that economic growth does not appear to be a major driver of sustainability and economic outcomes. Factors like environmental performance, blue economy growth, and technological readiness seem more influential based on this analysis. More work is still needed to uncover the nuances of these relationships.

Summary, Conclusion and Recommendations

Summary

This study analyzed the impacts of economic growth and other key factors on sustainability outcomes related to green economy, blue economy, and sustainable transport in the context of Nigeria's maritime infrastructure. Quantitative data on 15 independent variables and 3 dependent variables was collected and examined using multivariate regression modeling.

The results showed that economic growth did not have a statistically significant effect on the sustainability outcomes. Most independent variables like government policies, international partnerships, and technological innovation also did not demonstrate significant relationships. However, environmental performance and blue economy growth stood out as having significant links with environmental sustainability. Technological readiness was significantly associated with sustainable transport advancement.

Conclusion

The findings indicate that Nigeria's economic growth in itself does not directly translate to improved performance on dimensions like environmental sustainability and sustainable transport. Targeted efforts and interventions in areas like environmental performance, blue economy development, and technological readiness may be more impactful for making progress on the country's sustainability goals.

There are likely complex dynamics between the variables which require further investigation. The relationships are also context-specific. While this study provides useful insights, more research building on these findings can help uncover the nuances and formulate appropriate policies.

Recommendations

- Nigeria should focus on initiatives and investments directly aimed at improving environmental performance across sectors including maritime transport and blue economy activities. Strong environmental policies and regulations are needed.
- Blue economy development should be strategic priority. This involves infrastructure, technologies, and processes that enable sustainable utilization of ocean resources.
- Leveraging advances in technological readiness and innovation is crucial for sustainable transport, logistics, and overall maritime operations.
- A systems perspective should be adopted to account for the synergistic effect of policies across multiple sectors in improving sustainability.
- Further studies can collect and analyze additional data variables to better explain the variation in sustainability outcomes using more robust statistical techniques.
- Research partnerships between academics, government, industry and civil society can support evidence-based policymaking and monitoring of sustainability initiatives in the maritime sector.

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