United International Journal for Research & Technology

Volume 04, Issue 01, 2022 | Open Access | ISSN: 2582-6832

Water Pollution, Blue Economy and Environmental Sustainability in the Niger Delta

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***Abstract*—** Despite numerous scholarly articles on the impact of water pollution and environmental sustainability, oil exploration continues to reduce annual yield, crop harvest and soil nutrients, which leads to stunted crop growth, increased food prices, and a low standard of living. Aside from its impact on agricultural activities, its environmental effects such as flooding, destroying wild lands, and disrupting wildlife habitat remain an enigma necessitating this study. The study's overarching goal was to investigate the link between water pollution, the blue economy, and environmental sustainability in the Niger Delta Region. Specifically, the research work made a comparative analysis between water pollution, blue economy and environmental sustainability in the Niger Delta Region and examined the impact of environmental institutions in reducing water pollution and environmental degradation in the region. It also registered a post COVID-19 evidence of the current situation in the region. The qualitative data relied on a well-structured questionnaire that were physically administered by the researchers to the respondents within the selected communities in Abia, Akwa Ibom, Delta, Bayelsa and Rivers state. We distributed 500 questionnaires to respondents, 483 of which were completed and used in the study, yielding a 96.6% response rate. The questionnaire was divided into two sections: demographic information about the respondent and questions about the study's specific objectives. Analysis of variance (ANOVA), correlation analysis and simple percentages were computed using SPSS 24 and findings from the analysis of variance showed that there was a significant relationship between water pollution, blue economy and environmental sustainability in Niger Delta Region. Similarly, a correlation analysis was computed to assess the impact of environmental institutions in reducing water pollution and environmental degradation in the Niger Delta Region. The correlation coefficient of (r = 31.9) shows a weak relationship between environmental institutions and water pollution in Niger Delta region of Nigeria. Though, the sig (.001) shows that the relationship is significant. It was recommended among others that government should monitor and ensure that oil explorers (engineers) tighten bolts on their engine to prevent oil leaks, replace cracked or worn hydraulic lines and fittings before they fail, outfit their engine with an oil tray or drip pan and create their own bilge sock out of oil absorbent pads to prevent oily water discharge.

***Keywords*—** Water pollution, blue economy, environmental sustainability, Niger Delta, Nigeria.

1. BACKGROUND TO THE STUDY

Water is as important to man as food. To subscribe to the fact that food is more relevant than water could vary from person to person as the usefulness of water far exceeds that of food. Water goes beyond hand to mouth consumption. Water can be used for building, agricultural and industrial purposes. However, water usage is not free from setbacks. One prominent among its setbacks is water pollution. There could be three problems with the water that is available: too little water, too much water, or dirty water (Adebola 2001; Nduka and Orisakwe, 2011). Water is gradually losing its life supporting capabilities, due to the negative activities of man-kind which pollutes it. In Nigeria, the quality and quantity of water is poorly distributed, with the demand exceeding its availability. This has led to the struggles for water between the farmers for irrigation and the industrialist for hydropower generation. Conversely, the poor in the rural communities are most impacted as they do not have enough and must make provisions for themselves. Above and beyond the insufficiency of water, most industries discharge their wastes into the water bodies, thus contaminating the water and destroying aquatic life which is the case in the Niger Delta Region of Nigeria.

Water contamination is the main environmental problem in the Niger Delta Region (Akpan and Ajayi, 2006; Raji & Abejide, 2013), and even the water that is available is frequently contaminated due to environmental pollution and the region's general deterioration (Efe, 2001). In fact, operations related to oil exploration and spills increasingly decrease access to clean drinking water (Akpan and Ajayi, 2006). Multinational oil firms in the Niger Delta Region have resulted in water contamination throughout the entire region and taken a toll on the ecology (Nduka et al. 2008). Oil exploitation

and spills are the main causes of the significant water contamination in the Niger Delta (Akpan and Ajayi, 2006; UNEP, 2011; Bodo, 2019). Corrosion of roofing materials, historical landmarks, and other commercial structures is brought on by the environment's acidified rainwater supply (Ana, 2011).

The Organization for Economic Cooperation and Development (OECD) defines Blue Economy, also known as "Ocean Economy" or "Blue Growth," as "all activities aimed at maximizing the full potential of seas and oceans through responsible and sustainable approaches to their economic development." Ocean acidification, rising sea temperatures, and habitat loss all have an impact on the number and quality of fish species. Other harmful marine activities have hampered the production and sustainability of the ocean. Similar to this, the entire Gulf of Guinea, where Nigeria's coast is located, has been plagued by a high number of armed robbery and pirate occurrences, raising concerns in the maritime industry and seriously threatening the blue economy's operations in the area. These actions have a substantial impact on all areas of the blue economy since they slow down and disturb the overall expansion of the maritime sector.

It's far obvious and now not news that contemporary mining operations were unfavourable. The extraction of oil is sure to have some bad impacts at the Niger Delta surroundings and its humans. Many communities in the Niger Delta consider that nearby gas flares cause acid rain, which corrode the metallic sheets used for roofing. The flares affect their livelihood and expose them to an elevated threat of premature deaths, baby respiration ailments, bronchial asthma and cancer, lack of aquatic existence and biodiversity, environmental degradation, flooding, soil impoverishment, financial loss, in addition to acid rain.

Climate variations and environmental mismanagement are developing threats to the integrity, condition, and sustainability of the aquatic and marine resources on which the blue economy is based. These affects are anticipated to worsen and have already had poor consequences on livelihoods dependent on ocean and freshwater sources, inflicting internal migrations, with capacity for battle, as well as placing at chance, critical infrastructure and transportation structures. Unfavourable environmental practices because of bad environmental governance and the failures of the market economy to cost the expenses of decay have contributed to troubles which include: business pollutants, sedimentation of rivers and lakes, eutrophication, habitat loss, reducing biodiversity, overfishing, dumping of poisonous waste, and pollution from maritime and riparian delivery and these has threatened the blue economy and had wrecked environmental sustainability in the Niger Delta Region of Nigeria.

Many studies have been conducted to investigate the impact of water pollution on environmental sustainability in the Niger Delta region (Adebola, 2001; Efe, 2001; Nduka et. al, 2008; Bodo, 2019; Raji and Abejide, 2013; Nwilo and Badyo, 2015; David and Bodo, 2019; David, Bodo and Gimah, 2019 etc.). Yet, none of these literatures had jointly studied the link between water pollution, blue economy and environmental sustainability in the Region. Apart from the inability of these literatures to study the three variables together, this study is a post COVID-19 evidence to determine the current situation of water pollution and environmental degradation within the Region.

This piece is divided into six sections. The first section, which includes this section, provides a general overview of the work. Section two includes a review of the literature and a theoretical framework for the research topic, while section three covers the research methodology used in the study. Section four describes, presents and analysed the results, section five concludes while the final section makes sound recommendations based on the findings.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This section of the research gives credit to scholarly work on water pollution, blue economy and environmental sustainability within the Niger Delta. The Research work is anchored on Life Cycle Assessment Theory. Life Cycle Assessment (LCA) is a methodology for assessing the environmental impacts associated with all stages of the life cycle of a commercial product, process or service. In the case of oil extractions and explorations, environmental impacts are assessed from reduction of annual yield and crop harvest, reduce soil nutrients, flooding, baby respiratory illness, bronchial asthma, premature deaths, destroying wild lands, and disrupting wild life habitat.

Ugochukwu et al. (2008) with the goal of addressing the practices that cause environmental degradation in the Niger Delta Region and thereafter proposing ways leading to the location's environmental sustainability

and sustainable development opined on 'Environmental Sustainability and Sustainable Development issues in the Niger Delta vicinity of Nigeria'. Though the data for the study came from both secondary and primary source, the study discovered that the important social worries inside the Niger Delta area are; water supply, sanitation, and related health issues and recommends among others that the authorities should try to overcome the environmental constraints by means of simply strengthening the various Ministries and groups charged with the protection of Nigerian environment.

Similarly, Chinago, (2017) investigated the sustainability development in the fragile Niger Delta Region: a project for environmentalists and opined that the Niger Delta has delicate surroundings due to its soil. However, it facilitates massive human activities without adequate care. He further states the challenges experienced by the inhabitants to include, water and land pollution, soil degradation, poor harvest, hunger, and disease. Tonnes of waste are hulled into rivers, which could be sources of drinkable water; greenhouse gas emissions are increasing by the day; and gasoline flaring in the Niger Delta is the highest in the world. Unsustainable oil exploitation in the region has resulted in cultism, militancy, and an untold number of deaths among the region's youth. The paper demonstrates, among other things, that environmental impact evaluation, auditing, and monitoring must be taken seriously, and that stakeholders should include environmentalists. Campaigns and collaborations with international firms aimed at compelling governments and businesses to invest in long-term development and provide basic human services. Firms must be forced to clean up polluted areas. Finally, it became recommended that legal action, even on a global scale, be pursued to resolve the issues within the research area. The outcomes of the investigation of Emuedo et al. (2014) confirmed that oil activities have impacted negatively on the mangrove atmosphere, causing a significant depletion of fish inventory in the area. The authors advocate for the adoption of best practices in the oil industry in order to reduce the negative consequences of oil operations in the Niger Delta. They investigated Oil Pollutants and Water Quality in the Niger Delta: Implications for Mangrove Ecosystem Sustainability. Water pollution from crude oil spills in the mangrove atmosphere was studied using water samples collected from three different locations in the Niger Delta.

Bodo and Gimah (2020) was fast to point accusing fingers on the stakeholders. Their research work was titled “The pollution and destruction of Nigeria's Niger Delta Environment: who is to blame?” The study discovered that the stakeholders (government, running oil companies, and host network representatives) in the petroleum exploration business have consistently denied their involvement in the pollution and destruction of the environment. However, the operating oil companies are responsible for the numerous spills from their rusted or outdated pipelines and the gases that have been flared in the area; illegal refining and pipeline vandalism that may have been perpetrated by a few individuals (militant corporations) of the host communities have resulted in a more polluted environment; and government negligence in monitoring and supervising the oil operations within the area. All the stakeholders, within the business of petroleum exploration ought to take delivery of duty of defending the environment in opposition to further pollution via fending off acts and practices that destroys the surroundings. In the end, the blame at once is going to the government, operating oil agencies and the community representatives (militant groups, political leaders, traditional ruler, and village chiefs), as culprits for the destruction of the Niger Delta atmosphere.

Deeyah and Akujuru (2021) provide an outline of the professionally everyday factors that must guide the selection of strategies for valuing infected land afflicted by oil spills in order to ensure environmental sustainability in the Niger Delta. We examine approaches to improving current valuation approaches, as well as the various factors that property surveyors and valuers must consider when deciding which technique(s) to use. The researchers discovered that the resulting compensation is rarely adequate, that it discourages recipients from continuing with their profession prior to the infection, that it exacerbates the negative network's dating between oil exploration groups and their host communities, and that it reinforces the perception that oil activities cause the majority of problems in the Niger Delta.

To understand the importance of blue economy and the factors militating against its success, Akintola and Gbadegesin (2021) examines the capacity for a blue financial system in Nigeria, as well as the adequacy of current prison regimes on marine environmental safety, with the goal of reducing the dangers of increased ocean-based activities that result in unsustainable environmental effects. The paper contends that generating long-term wealth from ocean-based activities in Nigeria is feasible given the current legal framework

for marine environmental protection in the United States. It does, however, recommend tightening the noose around the implementation protocols of those laws in order to better integrate the health of the ocean environment into the improvement of the United States' Ocean sources.

Oyebode (2019) conducted a similar study on "Water Resource Management and Environmental Sustainability in the Niger Delta States." Data on ancient and traditional water management strategies were obtained from national documents and various water-related public organizations. The environmental implications of water supply had been investigated, with a focus on the link to sustainable development. Against this backdrop, the issues impeding effective management of the wetland's water supply were highlighted.

Nigeria's budget for water supply calls for development. The conclusion reached was that the chances of success of water improvement projects are very high if proper financing, professional ethics free of corruption, adequate production techniques, manpower development, and maintenance measures are considered.

In all the empirical literature reviewed, to the best of our knowledge, no author has carried out a study in water pollution, blue economy and environmental sustainability in the Niger Delta. Based on this perceived gap, this present study will try to fill this gap by examining the link between water pollution, blue economy and environmental sustainability in the Niger Delta and examine the impact of environmental institutions in reducing water pollution and environmental degradation in the region. Additionally, the study is a post COVID-19 evidence of water pollution and environmental degradation in the region.

3. RESEARCH METHODOLOGY

The qualitative data relied on a well-structured questionnaire that was physically administered by the researchers to the respondents within the selected communities in Abia, Akwa Ibom (AKS), Delta, Bayelsa and Rivers States. We distributed 500 questionnaires to respondents, 483 of which were completed and used in the study, yielding a 96.6% response rate. Appendix 1 contains a summary of the questionnaire. To ensure that the respondents were residents of the region and were in the Niger Delta Region at the time of response, a section of the questionnaire inquired about their residence at the time of response. After the collection of the data, Analysis of variance (ANOVA) was used to analyze the study. This model was appropriate for this study because, it is a collection of statistical models and their associated estimation procedures (such as the "variation" among and between groups) used to analyse the differences among means.

ANOVA provided a statistical test of whether two or more population means were equal, and therefore generalizes the t-test beyond two means. The Statistical Package for Social Sciences (SPSS) version 24 was used to conduct the analysis. To ensure that the non-bogus estimates agreed with the assumption of the Classical Linear Regression Model (CRM), (covariance between μ and X must sum to zero), Cov μ/X = 0, we estimated the correlation coefficient to determine the level of collinearity among the regressors, and subsequently, ensure that the independent ability of each of the regressors was not diffused. We evaluated the objectives of this study using the One-Way ANOVA.

4. DATA PRESENTATION AND ANALYSIS

4.1 Presentation by simple percentages of respondents from the 5 selected states in Niger Delta Region.

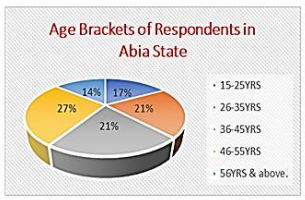


Fig.1

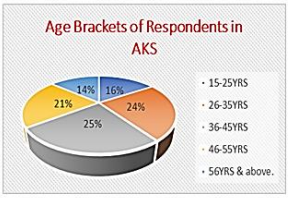
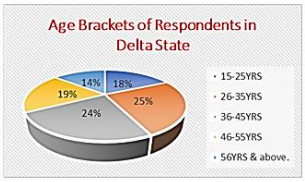


Fig.2



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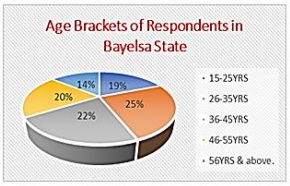

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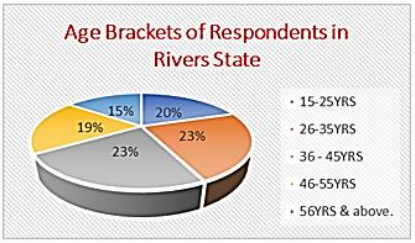

Fig. 5

Figs. 1 to 5: *Distribution of Respondents by Age Brackets. | Source: Computed by Authors from a 2022 Niger Delta field survey.*

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Volume 04, Issue 01, 2022 | Open Access | ISSN: 2582-6832

Figures 1 to 5 above shows the age brackets of respondents surveyed in all 5 selected Niger Delta states. However, from the figures, most respondents fell between the ages of 26 to 46.

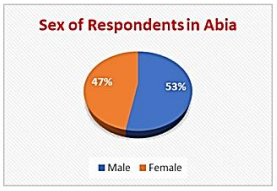
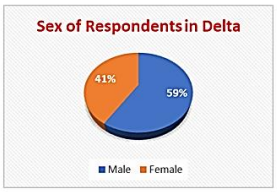


Fig. 6

Fig. 7



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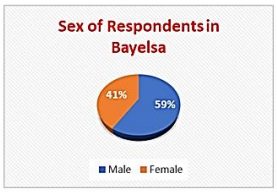


Fig. 9

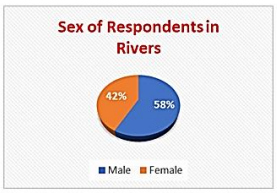


Fig. 10

Figs. 6 to 10: *Distribution of Respondents by Sex.*
Source: Computed by Authors from a 2022 Niger Delta field survey.

Figures 6 through 10 reveal that most of our respondents in the five selected states were female except for Akwa Ibom State that had a balanced gender response.

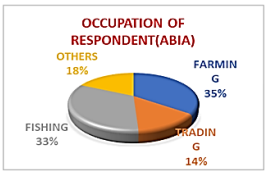
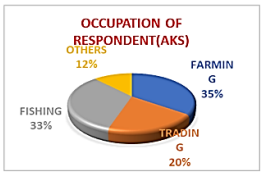


Fig. 11



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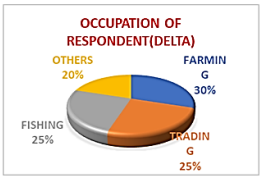

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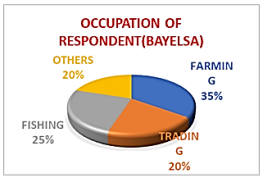

Fig. 14

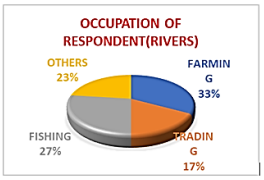

Fig. 15

Figs. 11 to 15: *Distribution of Respondents by occupation.*

Source: Computed by Authors from a 2022 Niger Delta field survey.

Among occupation of respondents identified and sampled as the most vulnerable of gas flare and spillage within the Niger Delta Region, famers took the lead with 35% in Abia, Akwa Ibom, Bayelsa and 33% Rivers States.

Fishing was the second by ranking with 33% in Abia and Akwa Ibom, 25% in Delta and Bayelsa and 27% in Rivers States.

Similarly, 20% in Akwa Ibom and Bayelsa, 25% for Delta, 17% for Rivers and 14% for Abia in terms of trading.

Other occupations were the last with 20% between Delta and Bayelsa, 23% for Rivers, 18% for Abia and 12% for Akwa Ibom States respectively.

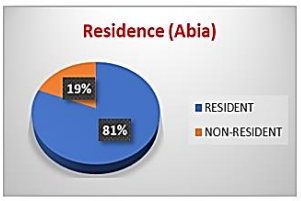

Fig. 16

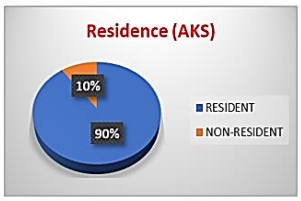

Fig. 17

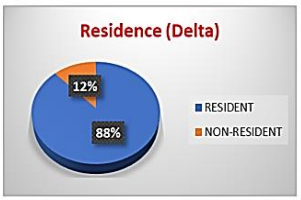

Fig.18

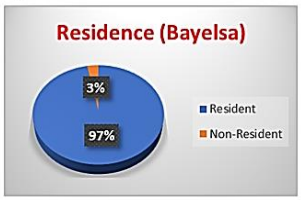

Fig.19

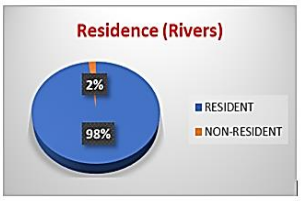

Fig.20

Figs.16 to 20: *Distribution of Respondents b Residence.*
Source: Computed by Authors from a 2022 Niger Delta field survey.

The distribution of respondents by residence revealed that more than 80% of the respondents were residents in the Niger Delta Region.

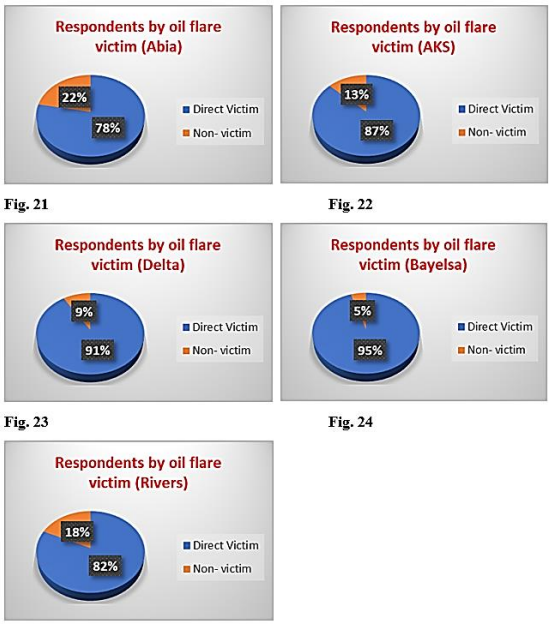

Fig. 21 Fig. 22

Fig. 23 Fig. 24

Fig. 25

Figs. 21 to 25: *Distribution of Respondents by Victims. Source: Computed by Authors from a 2022 Niger Delta field survey.*

Another vital question raised by the researchers was to determine the victims of oil spills and gas flares which is the crux of the research objectives.

The result from the respondents showed that Bayelsa State (95%) was the number one victim of oil spills and environmental degradation in recent times, followed by Delta State (91%).

Akwa Ibom State came third with 87%, Rivers State (82%), and then 78% for Abia State.

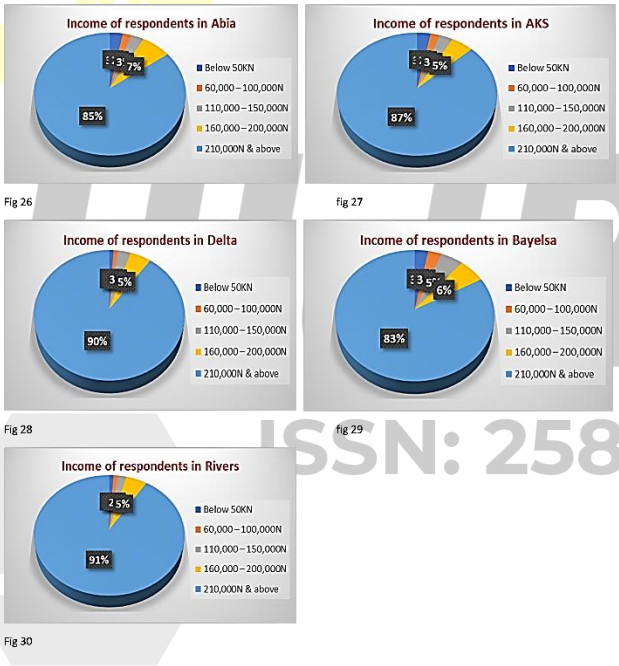

Fig 26 Fig 27

Fig 28 fig 29

Fig 30

Figs. 26 to 30: *Distribution of Respondents by Income.*
Source: Computed by Authors from a 2022 Niger Delta field survey.

To understand the environmental impact of oil spills on the income of the Niger Delta inhabitants, the question of what income range was raised. From the chart above, more than 80% of all the respondents in the selected Niger Delta states accent that they earn more than N210,000 per annum. Rivers took the led with 91%. Very many Most of those residing in the region earned above the minimum wage. This is because the Niger Delta states are among the richest states in Nigeria. Analysis of variance (ANOVA) was used to made comparison between water pollution, blue economy and environmental sustainability in the Niger Delta region, while the correlation table2 was used to examined the impact of environmental institutions in reducing water pollution and environmental degradation in the region. To know the true situation of water pollution and environmental degradation within the Niger Delta Region after the pandemic, a section of the questionnaire thus asked “Is the environmental impact of petroleum hydrocarbons on soil and water still the same after the pandemic?” This question was analysed using simple percentages.

Table 1 below is a summary table of the ANOVA result used in comparing the relationship between water pollution, blue economy and environmental sustainability in the Niger Delta.

Tests of Between-Subjects Effects

Table1: *Dependent Variable: Environmental Sustainability in Niger Delta*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.080a	3	.027	10.091	.000	.058
Intercept	1.153	1	1.153	433.637	.000	.466
POLLUTION	.058	2	.029	10.877	.000	.042
Exploration	.001	1	.001	4.70	.043	.020
POLLUTION * Exploration	.000	0	.	.	.	.000
Error	1.319	496	.003			
Total	3.517	500				
Corrected Total	1.399	499				

a. R Squared = .058 (Adjusted R Squared = .052)
b. DECISION RULE: SPSS decision rule for ANOVA state that reject the null hypothesis if sig. or p < 0.05 and vice-versa.

A p-value of less than .05 was required for significance. The pollution significant at F (10.877), P = .000. and blue economy significant value at F (4.70), P = 0.43, this result allows to reject the null hypothesis. H0 with water pollution and blue economy accounting for 62 percent of variance in environmental sustainability in Niger Delta region of Nigeria. The partial Eta squared result shows that 42% of changes in environmental sustainability has been accounted for by water pollution while 20 percent has been accounted for by exploration activities.

A factoral ANOVA was conducted to make a comparative analysis between water pollution, blue economy and environmental sustainability in Niger Delta Region. The independent variables, blue economy and water pollution index included two levels, low SS and high SS. The dependent variable environmental sustainability score. The ANOVA was significant F (1, 498) = 433.63, P = .000. The strength of the relationship between blue economy, water pollution and environmental sustainability was accessed by $\eta 2 = 62$ was high as blue economy and water pollution accounted for 62 percent of changes in environmental sustainability. Hence, the result allowed for rejection of the null hypothesis given the mean difference therefore, we conclude that there is a significant relationship between water pollution, blue economy and environmental sustainability in Niger Delta Region (Emuedo et al, 2014).

A correlation analysis was further computed (table2) to assess the impact of environmental institutions in reducing water pollution and environmental degradation in Niger Delta Region. From the table above, the correlation coefficient of (r = 31.9) shows a weak relationship between environmental institutions and water pollution in Niger Delta Region of Nigeria. though, the sig (.001) shows that the relationship is significant.

Table 2: *Correlations*

		Water pollution in Niger Delta	Environmental institutions in Nigeria
Water pollution in Niger Delta	Pearson Correlation	1	.319**
	Sig. (2-tailed)		.001
	N	100	100
Environmental institutions in Nigeria	Pearson Correlation	.319**	1
	Sig. (2-tailed)	.001	
	N	100	100

a. **. Correlation is significant at the 0.01 level (2-tailed).

b. DECISION RULE: SPSS decision rule for correlation states that if the Pearson's correlation coefficient is greater than 0.5, we accept the alternative hypothesis and reject the null and vice-versa.

Table 3: *Is the environmental impact of petroleum hydrocarbons on soil and water still the same after the pandemic?*

N	Valid	483
	Missing	0
Mean		1.0849
Std. Deviation		.27900

Table 4: *Is the environmental impact of petroleum hydrocarbons on soil and water still the same after the pandemic?*

Responses from Niger Delta	Frequency	Percent	Cumulative Percent
YES	442	91.5	91.5
NO	41	8.5	100.0
Total	483	100.0	

Source: computed by SPSS 24.

Table 4 above shows the collective response from the 5 selected states in Niger Delta viz; Abia, Akwa-Ibom, Bayelsa, Delta and Rivers on whether the environmental impact of petroleum hydrocarbon on soil and water bodies were still the same after the covid-19 Pandemic. However, out of 500 distributed questionnaires, 483 respondents successfully submitted their responses. 442 respondents representing 91.5 percent of the total responses affirmed that the devastating impact of oil exploration on the environments of the surveyed states had not improved after the covid-19 pandemic, whereas 8.5 percent respondents said the impact has improved after the Pandemic. Drawing from majority responses, we conclude that the negative impacts of oil exploration on the environment had not reduced in terms of oil spillage, gas flaring, decreasing rate of aquatic animals and depreciating agricultural yields. Hence, we accept the alternative hypothesis and conclude that the environmental degradation resulting from the exploration of petroleum hydrocarbon on soil and water is still the same in the post covid-19 era.

5. CONCLUSION

The research work made a comparative analysis between water pollution, blue economy and environmental sustainability in the Niger Delta Region, examined the impact of environmental institutions in reducing water pollution and environmental degradation in the region and had a post COVID-19 evidence of water pollution and environmental degradation in the region. To achieve these three specific objectives of the study, Analysis of variance (ANOVA), correlation analysis and simple percentages were computed using SPSS 24 and findings from the survey results showed that there was a significant relationship between water pollution, blue economy and environmental sustainability in Niger Delta Region. The correlation coefficient of (r = 31.9) shows a weak relationship between environmental institutions and water pollution in Niger Delta Region of Nigeria, though, the sig (.001) shows that the relationship is significant. Further findings reveal that the environmental degradation resulting from the exploration of petroleum hydrocarbon on soil and water is still the same in the post covid - 19 era. This is to say that, the negative effects of human activity on the sensitive Niger Delta environment are also harmful to sustainable development; the pressure has made poverty, hunger, thuggery, cultism, militancy, and unreasonable killings and property destruction worse (Chinago, 2017).

6. RECOMMENDATIONS

Based on the foregoing conclusions, the following policy recommendations are germane:

- The government should monitor and ensure that oil explorers (engineers) tighten bolts on their engine to prevent oil leaks;
- The government should supervise and make sure that engineers working as oil explorers replace hydraulic lines and fittings that are damaged or worn before they fail;
- The government should monitor and ensure that oil explorers (engineers) outfit their engine with an oil tray or drip pan;
- The government should also ensure that oil explorers (engineers) make their own bilge sock out of oil absorbent pads to prevent oily water discharge.
- The government should urgently enhance its financial allocations to the environmental sector of the economy in order to ensure the environmental

sustainability of the Niger Delta region and Nigeria as a whole;

- Cost recovery is one of the sustainable techniques that must be used in order to efficiently harness and manage water; and
- Nigeria requires institutional capacity to combine economic and environmental policies, among other things, in order to transition to a green economy.

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