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Petroleum Exploitation and Exploration Impact on Yam Production in Niger Delta Region of Nigeria

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Abstract
The study evaluatedpetroleum exploitation and exploration impact on yam production in Niger delta region of Nigeria. The following tools of analysis was used in achieving the specific objectives: Auto regressive distributed lags (ARDL), error correction model (ECM), and ordinary least square (OLS). The Augmented Dickey-Fuller (ADF) unit root test was used to check the stationarity of the variables at both level and first difference. Johanson cointegration test was performed to determine the existence of the cointegrating relationship among the variables. The ADF unit root test showed that all logged variables were stationary after first difference I(1). The Johanson cointegration test for model showed that there is a long-run cointegrating relationship between the variables. The results of the ARDL for the model showed that in a short-run ceteribus paribus there is a significant relationship between LNCROPYLD (yam) and oil spill LNCOSP and gas flared LNGFLD. The coefficients of the oil spills and gas flared were negative and were statistically significant. The estimated coefficients of the long run relationship were statistically significant for COSP and GFLD at 1% probability level. The coefficient of error correction term ecm (-1) at 77% speed of reconvergence i.e. 0.777319 for the model is negative. The results of the OLS shows that LNCOP, LNGP, LNGFLD had effects on crop yield (yam) and were significant at 5% and 1% probability level respectively. The value of the coefficient of the multiple determination (R^2) 0.754 implies that 75% of the variation in the quantity of crop yield yam) was explained by the explanatory variables, included in the model. The study therefore recommended that the inhabitants of this region need to be educated on the process of commercial yam crop production, the Federal Government should on its part, have the political and economic will to ensure greater involvement of the people of the oil producing areas. Sustained job creation for the youth, provision of social amenities and infrastructures, will on one hand reduce unemployment, youth restiveness, and activities of doubtful values, and on the other hand, enhance peace and stability in the area.
Key Words: Petroleum, Exploitation, Oil spill, Impact, Environment, Yam, Nigeria

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I. Introduction

Crude oil exploration in Nigeria has been on the increase since 1956 when crude oil was discovered in commercial quantity in the country. The earnings from the petroleum industry in the country grew from 1960 and became high in the early 1970s during the oil boom. This replaced earnings from agriculture which was the main stay of the nation's economy (Ahmadu and Egbodion, 2013).

Petroleum is undoubtedly the main backbone of the Nigerian economy, its discovery and exploration had introduced a considerable development in the country both financially and technologically (Audu, Abdulfatai, Saka Abdulkareema, & Onyeji, 2016). Major deposits of Nigeria crude oil are found in the Niger-Delta area of the country. The Niger Delta is the major oil producing region of Nigeria, which is located by the Atlantic Coast where River Niger divides into numerous tributaries. The region is known to be the second largest delta in the world of about 450 kilometres of coast line that terminates at the Imo River entrance (Osuagwu, & Olaifa, 2018).According to (Osuagwu, & Olaifa, 2018), this region spans through 20,000 square kilometres and has been described as the largest wetland in Africa and among the three largest in the world, consisting about 2,370 square kilometres of rivers, creeks and estuaries and stagnant swamp covering about 8,600 square kilometres.

Several years of oil exploration and exploitation by Multinational Corporations, and the hazards of spillage and gas flaring which accompany it, have degraded the environment of the region and left the communities desolate. Not only have farming and fishing, the major occupations of these mostly riverine minorities been decimated, their territories have continuously lacked basic infrastructure and amenities such as electricity, roads, schools, hospitals, portable water, etc. Environmental degradation issues are of topical concern to communities of the region as it is a major cause of productivity loses. This is the main reason why exploration and exploitation impact on the region cannot be overemphasized as the dominant view blames the oil production and its attendant consequences for the declining productivity of the region which is predominantly based on fisheries and other agricultural activities (Joseph, Dickson, and Theophilus, 2013).

Oil spillage is considered the most significant source of pollution from the petroleum industry because its effects are visible. Petroleum and it components released into the environment eventually degrade into both simple and complex compounds of their constituent elements by physical, physio-chemical, and biological agents, which may cause serious damages to the environment and impede human exploitation of natural resources (Abowei et al., 1997; Sanusi, 2004; Tolulope, 2004).

Gas flaring is another major problem associated with oil exploration and exploitation, considering the serious deterioration of the basic characteristics of the environment as a result of harmful pollutants being released into the air through gas flaring. The harmful effect of gas flaring on the host communities and the inability of the oilproducing companies and the government to quantify the resultant effect of gas flaring have resulted in a violent relationship among the oil companies, government, and the host communities. It can be inferred therefore that both environmental and economic drives can be identified as the motives behind several attempts by the government at eliminating natural gas flares in Nigeria. For instance, are the promulgation of decrees and introduction of incentives for companies involved in downstream gas utilization to discontinue flaring of associated gas at well head, but none can be said to be fully successful so far (Abdulkareem and Odigure, 2010). It is argued in this study that ecologically unfriendly activities of the multinational corporations engaged in oil exploration have led to environmental degradation of the Niger Delta region which has in turn led to acute poverty in the region. It is the dynamics of this interconnectedness that this study intends to exploreEconomics of Petroleum Exploitation Impact on selected Communities in Nigeria's Niger Delta Region. According to National Bureau of statistics (NBS,2004), the incidence of poverty in the Niger Delta is alarming, increasing from 15.4% in 1980 to 52.2% in 2004. This is not unconnected with the constant incidence of oil spills which has destroyed the main source of income and productive activities of the region. Over 6,000 oil spills had been recorded in the 40 years of oil exploitation in Nigeria giving an average of 150 spills per annum. A total of 4,647 incidents of oil spills occurred between 1976 and 1996 resulting in the spillage of about 2,369,470 barrels of crude oil and only about 549,060 barrels were recovered, 1,820,410 barrels were lost to the ecosystem (Inoni et al, 2006). Between 2006 and 2012 alone a total of 127,467.96 barrels of oil were spilled (FOS, 2012). This is alarming.

1.1 Problem Statement

Earnings from agriculture were the main stay of the nation's economy. Since the early 1970s, the place of crude oil as a key revenue earner for Nigeria has remained unchanged (Ahmadu and Egbodion, 2013). The oil sector generates over 90% of the nation's foreign exchange earnings and over 80% of government annual revenue. Consequently, less attention was accorded the agricultural sector which is the source of livelihood of the nation's populace (Matthew et al, 2018). Production, over the years, continued to decline. Besides the low performance of the agricultural sector, the oil exploration activities which cause constant incidence of oil spills, especially in the Niger Delta region of the country have further affected agricultural production. This includes the production of a major staple food crop such as yam and cassava in the oil producing region of the country(Osabohien et al, 2019).

The Niger Delta region is particularly famous for being the most natural resources endowed area in the country. The region is endowed with natural vegetation which are highly rich in biodiversity. It is the largest producer of cocoa, rubber, coconut, and a major producer of oil palm in the country. In view of such importance of the region, it is feared that uncontrolled oil and gas exploration and their associated activities could impact negatively on the surrounding terrestrial and aquatic ecosystem and biodiversity, institutions are not well established to effectively manage the associated environmental impacts. Meanwhile, it is apparent that such a project comes with a huge environmental impact which if not well managed could cost the nation more than the benefits derived. In extreme situations of improper environmental impact assessment and management, conflicts could be inevitable. Oil has indeed played a very significant role in the overall economic growth of the country. However, the adverse implications of petroleum exploration, exploitation and production are very severe as these have affected the micro economic indices of the host communities (Iloeje, 2016).

Before the advent of oil prospecting and production in the Niger Delta Region, the people of Niger Delta were farmers as other regions of the country. Specifically, they were fish farmers and the environment was conducive, friendly and viable (Michael et al, 2019). The soil was equally fertile and therefore good for farming. Thus, farm produce/yield was high and adequate for the subsistence and commercial needs of the people. Until oil was discovered and production began that altered the environment. One of the major problems associated with oil production is the destruction of the people's livelihood which is the soil and farmlands through gas flaring and oil spillage (Michael et al, 2019)

The consequences of oil spillage on agricultural production, the environment and humans are enormous. Nnabuenyi et al,.(2012) observed the negative effects of oil spillage on agriculture and lamented that most of the farmlands are destroyed and rivers polluted leading to the death of fishes; and most farmers and fishermen are thrown into confusion and joblessness. Chindah and Braide(2000) added that oil spills cause great damage to the oil communities due to the high retention time of oil in the soil occasioned by limited flow. This prevents proper soil aeration and affects soil temperature, structure, nutrient status and pH, and ultimately, Crops are destroyed. To be specific, one may ask, what is the effect of oil spillage on the production of an important crop such as yam in the oil producing region of Nigeria such as the Niger Delta region (Ahmadu and Egbodion 20213).

Yam plays a significant role in supplying food need to the people of Nigeria and will continue to play a remarkable role in the agricultural sector and being a means of food security to Nigerians. It has been transformed from a minor crop to a major crop and recently to an export as cash crop. Though Nigeria is the highest producer of yam in the world, she is also the world's largest consumer, leaving nearly nothing for export. This calls for concerted effort to increase the production of the commodity in the country, including combating the problem of oil spillage on its production. To make significant progress in tackling the problem of oil spills on yam production, information on the effect of oil spillage on the production of the crop is required. It is in view of this that this study was designed to examine the effect of oil spillage on the production of yam in the Niger Delta region of Nigeria.

1.2Research Question

(i) What are the effects of Petroleum exploitation and exploration on crop yield (yam) in the Niger Delta Region, Nigeria?

1.3Objectives of the Study

The broad objective of this study is to analyze the Economics of Petroleum Exploitation Impact on selected Communities in Nigeria's Niger Delta Region.

This study was therefore carried out to provide answers to the following research questions. The specific objectives were to:

(i) To determine the effects of Petroleum exploitation and exploration on crop yield (yam) in the Niger Delta Region.

II. Analytical Review

2.1Vector Error Correction Models (VECM)

Modern econometricians point out a method to establish the relational model among economic variables in a nonstructural way. They are vector autoregressive model (VAR) and vector error correction model (VEC). According to (Xiaohua, 2018) Engle and Granger combined cointegration and error correction models, to establish the trace error correction model. As long as there is a cointegration relationship between variables, the error correction model can be derived from the autoregressive distributed lag model (A)RDL. And each equation in the VAR model is an autoregressive distributed lag model; therefore, it can be considered that the VEC model is a VAR model with cointegration constraints. (Xiaohua, 2018) adopted time series vector error correction model (VECM) approach to conduct stationarity test, cointegration test, stability test, and Granger causality test on Carbon Emissions, GDP, and International Crude Oil Prices. The results indicated that, no matter in the short term or long term, oil price fluctuation is the reason why carbon emissions change, while the GDP fluctuation is not the reason for the growth of carbon emissions.

In applying the designed methodology, the first routinelyinvolvestestingforapanelunitrootusingtheIm PesaranandShin(IPS)test,ashas been used in some previous researches (Abdullah and Morkey, 2014; Breitung and Pesaran, 2008). If the variables are found to be I (1), it is then necessary to test for cointegration, in this case the Granger test is employed. Applying the following research model as used by (Jean et al, 2016):

$$Y_t = \alpha_0 + \alpha_1 X_t \quad + U_i \ldots .(2.1)$$

where Y_t is the size of land area and water bodies degraded and contaminated respectively(expressed in logarithms), α_0, α_1 are parameters to be estimated in the study and X_t is the exogenous variable considered (also if the causality testing runs in the opposite direction, X_t would be considered the dependent variable). In this case it is required further more to pre-test each variable considered in the model in order to show and determine the order of integration for each variable and highlight the best influence. By definition, any cointegration imposes the mandatory requirement that both variables of the same order be integrated. The common method that will be employed for these cases is done using the Augmented Dickey-Fuller (ADF) unit root test in order to infer the number of unit roots (if any) in each of the variables under investigation (Abdullah and Morley, 2014; Jean et al, 2016). The testing procedure for the ADF unit root test is used and applied to one of the following models as suggested by (Enders, 2004):

$$\Delta_{yt}= \gamma^{*}y_{t-1} + \sum_{j=1}^{p} \varphi_j\, y_{t-j} + U_t \ldots\ldots\ldots\ldots\ldots\ldots (2.2)$$

$$\Delta_{yt}= \alpha + \gamma^{*}y_{t-1} + \sum_{j=1}^{p} \varphi_j\, y_{t-j} + U_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.3)$$

$$\Delta_{yt}= \alpha + \beta_t\gamma^{*}y_{t-1} + \sum_{j=1}^{p} \varphi_j\, y_{t-j} + U_{it} \ldots\ldots\ldots\ldots\ldots\ldots.. (2.4)$$

The two hypotheses of the test are according to literature definitions, as following (Jean et al,2016): H0: $\gamma* = 0 \Leftrightarrow$ series is non-stationary and has a unit root; H_1: $\gamma* < 0 \Leftrightarrow$ series is stationary and has no unit root. α is a constant; β is the coefficient on a time trend series; γ∗ the coefficient ofy_{t-1}; p is the lag order of the auto regressive process; Δ_{yt} = y_t–$y_{t-1}$are first differences of y_t; y_{t-1}arelaggedvalues of order one of y_t; Δ_{yt} are changes in lagged values; and U_{it} is the white noise. For the last specification, the test is done under the joint hypothesis $\beta = \gamma* = 0$.

Once the hypothesis of the unit root test is rejected, the long-run equilibrium relationship is estimated in the form of an Ordinary Least Squares (OLS) regression line. If the variables cointegrate, the OLS regression equation yields a "super-consistent" estimator (Enders, 2004). This means that there is a strong linear relationship between the variables under study. The strong linear relationship can be tested in either of the following ways according to (Abdullah and Morley, 2014):

(a) The coefficient of X_t; yields a value that falls between 0.5 and 1. (b) The plot of y_t; against X_t; shows coordinates appearing in an increasing or decreasing direction. The next step is to estimate the error correction model (ECM) of the dynamic structure, starting from equation:

$$Y_t = \alpha_0 + \gamma_0 X_t + \gamma_1 X_{t-1}\alpha_1 X_{t-1} \quad + U_i \ldots\ldots\ldots\ldots\ldots.. (2.5)$$

The equation according to 30, 47results:

$$\Delta_{yt}= \gamma_0\Delta_{xt} - (1-\alpha_1)\{y_{t-1} - \frac{\alpha_0}{(1-\alpha_1)} - \frac{(\gamma_0+\gamma_1)}{(1-\alpha_1)}X_{t-1}\} + U_t \ldots\ldots\ldots\ldots (2.6)$$

Taking $\beta_0 = \frac{\alpha_0}{(1-\alpha_1)}$ and $\beta_1 = \frac{(\gamma_0+\gamma_1)}{(1-\alpha_1)}$

The equation becomes

$$\Delta_{yt}= \gamma_0\Delta_{xt} - (1-\alpha_1)\{y_{t-1} - \beta_0 - \beta_1 X_{t-1}\} + U_t \ldots\ldots\ldots\ldots. (2.7)$$

which is the ECM with $-(1-\alpha_1)$ as the speed of adjustment, and $U_{t-1} = y_{t-1} - \beta_0 - \beta_1 X_{t-1}$ as the error-correction mechanism which measures the distance of the system from equilibrium. Thecoefficientof U_{t-1} shouldbenegativeinsigninorderforthesystemtoconvergetoequilibrium. The size of the coefficient $-(1-\alpha_1)$ is an indication of the speed of adjustment towards equilibrium in that (Green,2011):

• small values of $-(1-\alpha_1)$, tending to −1, indicate that economic agents remove a large percentage of disequilibrium in each period;
• larger values, tending toward 0, indicate that adjustment is slow;
• extremely small values, less than−2, indicate an overshooting of economic equilibrium;
• positive values would imply that the system diverges from the long-run equilibrium path. Testing for cointegration is achieved using the Kao test (Abdullah and Morley,2014; Greene, 2011) based on a version of the ADF test on the residual (U_t) of Equation (2.1)

$$U_t = \rho U_{t-1} + \sum_{j=1}^{p} \lambda_j\, \Delta U_{t-j} + v_t \ldots\ldots\ldots\ldots\ldots\ldots (2.8)$$

This wasfurtherused to develop the following form of the ADF statistic as it is shown by the line described by Equation (2.3), which is a one tailed test and where $\hat{\sigma}_V^2$ is the estimated variance and $\hat{\sigma}_{0V}^2$ is the estimated long-run variance of the error term and follows the parameters of the standard normal distribution. Also, the τADF is the ADF statistic designed in Equation (2.9) as used by [Abdullah and Morley, 20014]:

$$ADF = \frac{\tau\text{ADF} + \sqrt{6N\hat{\sigma}_V/(2\hat{\sigma}_{0V})}}{\sqrt{\hat{\sigma}_{0V}^2/(\hat{\sigma}_{0V}^2) + 3\hat{\sigma}_{0V}^2/(10\hat{\sigma}_{0V}^2)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (2.9)$$

III. Methodology

3.1 The Study Area

The Nigeria's coastline is approximately 853km facing the Atlantic Ocean and lies between latitudes 4o 10' to 6o 20'N and longitudes 2o 45' to 8o 35' E (Nwilo and Badejo, 2001).

The Niger Delta is located in the Atlantic coast of Southern Nigeria and is the world's second largest delta with a coastline of about 450km which ends at Imo river entrance (Awosika, 1995).The Niger Delta includes the states of Abia, AkwaIbom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and Rivers. The region is blessed with abundance of human and physical resources, including the majority of Nigeria's oil and gas deposits, good agricultural lands, extensive forests, excellent fisheries, as well as with a well-developed industrial base (Duru,1999:81 in Joseph et al, 2013). The region is about 20,000sq/km as it is the largest wetland in Africa and among the third largest in the world (Powell, et al., 1985; CLO, 2002; Anifowose, 2008; Chinweze and AbiolaOloke, 2009). 2,370sq/km of the Niger Delta area consists of rivers, creeks, estuaries and stagnant swamps cover approximately 8600sq/km, the Delta mangrove swamp spans about 1900sq/km as the largest mangrove swamp in Africa (Awosika1995). The Niger Delta is classified as a tropical rainforest with ecosystems comprising of diverse species of flora and fauna both aquatic and terrestrial species (Kadafa,2012). The region can be classified into four ecological zones; coastal inland zone, freshwater zone, lowland rainforest zone, mangrove swamp zone and this region is considered one of the ten most important wetlands and marine ecosystems in the world. As of 1991, the National Census estimated about 25% of the entire Nigerian population lives within the Niger Delta region (Twumasi and Merem, 2006; Uyigue and Agho, 2007). The Niger Delta region has a steady growing population of approximately 30 million people as of 2005, accounting for more than 23% of Nigeria's total population Twumasi and Merem, 2006; Uyigue and Agho 2007).

3.2 Methods of Data Collection

This study involved the collection and analysis of data on crude oil production in Nigeria between 2000 and 2018. It also involves the analysis of data on gas production and flaring during the same period with the aim of predicting the effects of petroleum exploitation on yam production. Data were alsocollected on the volume of associated gas produced and the volume flared by multinational oil companies operating in the oil-producing region of Nigeria.This study employed time series data from 2000 to 2018 sourced from Central Bank of Nigeria Statistical Bulletin (2018), Department of Petroleum Resources (2018). The data for quantity of oil production and oil spill in barrels, was obtained from the Department of Petroleum Resources and Central Bank of Nigeria, Statistical Bulletin.

3.3 Methods of Data Analysis

The following tools of Analysis was applied to achieve the specific objectives of the study
Time Series Analysis of variables (ADF Unit Root Test)
Autoregressive Distributed Lags (ARDL)

3.3.1 Time Series Analysis of variables(ADF Unit Root Test)

Before estimating the model, the dependent and independent variables are separately subjected to unit roots tests using the Augmented Dickey Fuller Test (ADF) (Dickey and Fuller, 1979) and 61 Philips Perron (Philips and Perron, 1988) (PP) Test for testing the stationarity and order of integration. Usually, all variables are tested with an intercept with and without a linear trend. The ADF test is based on the following regression:

$$\Delta Y_t = C + \alpha_t + pY_{t-1} + \sum_{i=1}^{m} \beta_0 \, \Delta Y_{t-1} + \varepsilon_t$$

Where,
C represents the intercept,
αt represents the deterministic time trend; m is the lag length and ε_t is a white noise process. Null Hypothesis H_0 : ρ = 0 or Y_t is non stationary H_1 : ρ < 0 or Y_t is stationary As long as the t-statistic on ρ is larger than the relevant critical value the null hypothesis of unit root cannot be rejected.

3.3.2Cointegration Analysis: In the econometric literature different methodological approaches have been used to empirically analyze the long run relationships and dynamic interactions between two or more time-series variables. The most widely used methods for estimating the cointegrating vector between a set of time series variables include the EG two step procedure (Engle and Granger, 1987) and the maximum-likelihood approach (Johansen and Juselius 1990). Both these methods require that all the variables under study are integrated of order one, I(1). This in turn requires that the variables are subjected to pre-testing for ascertaining their orders of integration before including them in particular cointegrating regressions. This introduces a certain degree of uncertainty into the analysis. The main advantage of the ARDL method over the Johansen and Juselius (1990) approach is that it allows for a mix of I(1) and I(0) variables in the same cointegration equation. Also, as shown by Pesaran et al (2001), the ARDL models yield consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying regressors are purely I(0), purely I(1) or mutually cointegrated. Another advantage of this procedure is that it has superior statistical properties in small samples.

The ARDL test is more efficient and the estimates derived from it are relatively more robust in small sample sizes.

$$Z_{t-1} = y_{t-1} - \beta_0 - \beta_1 X_{T-1}$$

$Z_{t-1} = LnCROPYLDYAM_{t-1} - \beta_0 - \beta_1 LnCOP_{t-1} + \beta_2 LnCOSP_{t-1} + \beta_3 LnGP_{t-1} + \beta_4 LnGFLD_{t-1} + U_t$(3.6)

where,

Z_{t-1}= Cointegrating Equation

3.3.3 Autoregressive Distributed Lags(ARDL)

In order to capture the causal relationship between crude oil spilled and gas flared and physical environment to account for possible feedback impacts from the short run to the long run steady state of the relationship between the key variables, the model is expressed in the form that allows for the testing of both unit root and co-integration.

This studyadopts a dynamic methodology of the form of ARDL regression model to examine the dynamic impacts of petroleum i.e crude oil spilled, and carbon emission from gas flaring on physical environment and further employ the Autoregressive Distributed Lag (ARDL) approach developed by pesaran and shin (1999) and (pesaran et al. 2001 in Jeyhun et al, 2019) as it outperforms cointegration methods in small samples as in our own case with 19 observations bounds testing framework to establish the petroleum impacts response which serves as the methodological rationale for the study.

The econometric methods adopted include Augmented Dickey Fuller Stationarity test, Johansen co-integration test (ADF, Dickey and Fuller 1981), as used by Osuagwu and Olaifa (2018). This study employed the Augmented Dickey Fuller unit root to test for stationarity of variables because most time series are non-stationary at their levels, Co-integration was used to test for long run relationship between the dependent variable and the independent variables, Autoregressive distributed lag (ARDL) was used to estimate the long run effect of the independent variables on the dependent variables.

In addition to the advantages of ARDL estimation technique as indicated above, the choice of ARDL bounds testing procedure as a tool for investigating the existence of a long-run relationship is based on the important consideration that both dependent and the independent variables can be introduced in the model with lags.

The ARDL analysis also provides estimates of the corresponding Error Correction Model (ECM) which shows how the endogenous variable adjusts to the deviation from the long-run equilibrium.

Mathematically or econometrically it can be expressed in two models to follow the hypotheses

The Implicit Model is stated thus;

$$Y= f (X_1, X_2, X_{3,,,} U_i)\ldots(3.1)$$

$$Y= f (X_1, {}_{,}U_i)\ldots(3.2)$$

$$LnY = \beta_0 + \sum_{i=1}^{3} \beta_0 \, LnX_t + LnX_t + LnX_t + U_i \ldots.(3.3)$$

$$LnY = \beta_0 + \sum_{i=1}^{1} \beta_0 \, LnX_t \quad + U_i \ldots.(3.4)$$

3.4Model Specification

The explicit function is stated thus

$$LnCROPYAM = \beta_0 + \sum_{i=1}^{4} \beta_0 + \beta_1 LnCOP_t + \beta_4 LnQCOSP_t + \beta_3 LnGP_t + \beta_4 LnGFLD_t + U_t$$

Where,

$$LnCROPYLDYAM = Natural\ Logarithm\ of\ Crop\ Yield\ Yam\ in\ (Tons)$$

$$LnCOSP_t = Quantity\ of\ Oil\ Spilled\ (barrells)$$

$LnGFLD_t$ =*Volume of Gas Flared (Gallon(M^3)*

$LnGP_t$ = *Volume of Gas Produced (Gallon(M^3*

$LnCOP_t$= *Quantity of Oil Produced (barrels)*

β_0= *Constant Term*

$\beta_1 - \beta_4$ = *Regression Coefficients for model 1 and model 2*

U_i= *Errow Term*

This was used to achievespecific objective (ii) and (iii)

IV. Results And Discusion

4.1 Unit Root Test of the Variables included in the Models

The econometric approach is, first, to test for the time series properties of the variables using Augmented Dickey-Fuller (ADF) unit root test. The variables in the Models 1 & 2 were subjected to Unit Root Tests, the ADF Test was performed in order to ascertain their stationarity and order of integration properties for the annual data on the variables for the period of 2000-2018. Augmented Dickey-fuller (ADF) unit root test was used to test the stationarity of the variable the result is presented in table 4.3.The null hypothesis states that the series has a unit root and a rejection of the null hypothesis implies the absence of a unit root which means the series is stationary, and, therefore appropriate for our analysis. The results show that all the logged variables were stationary at first difference 1(I). The ADF test for the first differences of these series indicate that null hypothesis of unit root is rejected for the first differences and that they are stationary and integrated of order I(1). Hence, the null hypothesis which tests for the presence of unit root in our series is rejected at 5% significant level for the parameters which implies our variables are stationary after first difference given the acceptance of the alternative hypothesis of no unit root. This provides justification for performing cointegration test, ARDL and ECM analysis, vector error correction test was not performed due to small number of observationsi.e small sample. Therefore, the suitability of the ARDL technique in the analysis of long run relationship between estimates can be confirmed by pre-testing for unit root to ensure the absence of I (2) series since the presence of I (2) series could produce spurious result in a model designed for I (1).

Table 1Results of the Augmented Dickey-Fuller (ADF) Unit Root Test of the Logged Variables

Variables	ADF Test Statistics		Critical Value 1st Difference			Order of Integration	Remarks
	Level	1st Difference	1%	5%	10%		
LNCOP	-2.682927	-4.496428	-4.532598	-3.6736	-3.27736	I(1)	Stationary
LNCOSP	-3.455146	-4.941923	-4.616209	-3.7104	-3.71048	I(1)	Stationary
LNGP	-4.252868	-4.673321	-4.616209	-3.7104	-3.29779	I(1)	Stationary
LGFLD	-2.586823	-4.070915	-4.571559	-3.6908	-3.28690	I(1)	Stationary
LNCROPYLDYAM	-2.787264	-6.306566	-4.616209	-3.7104	-3.29779	I(1)	Stationary

Source: Author (2020) Extracted from E-views 9.0

Results of the Cointegration Test for Model

Given that all variables were stationary at first difference as shown in table 2, Johansen multivariate cointegration test was performed to determine the existence of cointegrating relationship between the variables. The p-value of the trace statistic for null hypothesis that there is no cointegrating relationship in table 2 is less than 0.05, this means that the null hypothesis can be rejected. The value of trace statistic (145.5856) is greater than the critical value 0.05 critical value of (69.81889) indicating that the null hypothesis that there is no cointegrating relationship between CROPYLDYAM and the exogenous variables cannot be accepted. More so the value of the trace statistic corresponding to "At most 1", is 63.34875 which is greater than 0.05 critical value of (47.85613) implying that the null hypothesis that At most 1" cointegrating relationship exists between the variables cannot be rejected.

The p-value of the max-eignvalue statistics for the null hypothesis that there is no cointegrating relationship as presented in table 2 is less than 0.05, indicating that the null hypothesis can be rejected. Furthermore, the value of the max-eigen statistic 82.23687 is greater than 0.05 critical value of 33.87687 this affirms that the null hypothesis that there is no cointegrating relationship between CROPYLDYAM Output and the other variables is rejected.

More so, the value of the max-eigenvalue which correspond to "At most 1", is 47.34452 which is higher than 0.05 critical value at that level (27.58434) this indicated that the null hypothesis that "At most 1" cointegrating relationship exist among the variables cannot be rejected, this can be interpreted that there is a long-run cointegrating relationship between the variables.

Table 2 Johansen coeintegration Results for the Model

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.992073	145.5856	69.81889	0.0000
At most 1 *	0.938269	63.34875	47.85613	0.0009
At most 2	0.453221	16.00422	29.79707	0.7120
At most 3	0.267023	5.741139	15.49471	0.7259
At most 4	0.026710	0.460240	3.841466	0.4975

Trace test indicates 2 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.992073	82.23687	33.87687	0.0000
At most 1 *	0.938269	47.34452	27.58434	0.0000
At most 2	0.453221	10.26308	21.13162	0.7196
At most 3	0.267023	5.280899	14.26460	0.7060
At most 4	0.026710	0.460240	3.841466	0.4975

Max-eigenvalue test indicates 2 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

1 Cointegrating Equation(s): Log likelihood 167.7700

Normalized cointegrating coefficients (standard error in parentheses)

LNCROPYLDYAM	LNCOP	LNCOSP	LNGP	LNGFLD
1.000000	1.027748	0.039753	-1.007021	-0.196441
	(0.04094)	(0.00367)	(0.03633)	(0.01336)

Adjustment coefficients (standard error in parentheses)

D(LNCROPYLDYAM)	0.512897
	(0.31930)
D(LNCOP)	-0.106684
	(0.26760)
D(LNCOSP)	-4.208638
	(4.68171)
D(LNGP)	1.155366
	(0.25877)
D(LNGFLD)	1.494960
	(0.48376)

Source: Author (2020) Extracted from E-views 9.0

4.2 ARDL Estimation Results of Econometric Model

4.2.1 Test for the existence of long run relation between variables for the econometric Model

For the Model that specifies the relationship between crop yield (Yam) LNCROPYLDYAM and the components of crude oil produced (COP), crude oil spilled (COSP), gas produced (GP), and gas Flared (GFLD), the F test statistic is computed for investigating the existence of long-run relationship between the variables, the maximum lag order for the various variables in the model is set at one (m=1). The estimation was carried out for the period of 2000 to 2018. The F statistic for testing the joint null hypothesis namely there exists no long run relationship between the variables as defined below in table 3 is given in the last row of the results table 3 of the Hypothesis testing Menu using E-Views 9.0. The computed F statistic is F = 4.721910. The relevant critical value bounds for this test as computed by Pesaran, Shin, and Smith (1996) at the 95% probability level is given by 2.86 I(0) lower bound and 4.01 I(1) upper bound. Since the F statistics exceeds the upper bound of the critical value band this implies that the null hypothesis of no long run relationship between the variables is rejected and that there exists a long-run relationship between LNCROPYLDYAM, COP, COSP, GP and GFLD. Having rejected the null hypothesis of no long run cointegrating relationship between the variables in the Model, the ARDL Model is estimated using Univariate ARDL Cointegration Test option of E-views with the maximum lag (m = 1). The ARDL model specifications selected based onAkaike Information Criterion (AIC) are ARDL(1, 0, 1, 0, 1).The ARDL estimates for these models are presented in the Tables 3

The results of the ARDL show that in a short-run ceteribus paribus there is a significant relationship between LNCROPYLD (yam) and oil spill LNCOSP and gas flared LNGFLD. The coefficients of the oil spills and gas flared were negative and were statistically significant at 10% probability level. the negative sign of the coefficient of LNCOSP implies that a unit increase in the crude oil spill will results in 0.43% decrease in the LNCROPYLDYAM crop yield (yam) in the short run. Also the coefficient of gas flared is negative this indicates that a unit increase in LNGFLD quantity of gas flaring implies 0.49 % decrease in the crop yield (yam) in the Niger delta region.

Table 3:Autoregressive Distributed Lag Estimates for the Model
ARDL(1, 0, 1, 0, 1) selected based on Akaike Information Criterion Dependent Variable CROPYLDYAM
Selected Model: ARDL(1, 0, 1, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNCROPYLDYAM(-1)	-0.178374	0.262214	-0.680262	0.5118
LNCOP	-0.250165	0.348175	-0.718501	0.4889
LNCOSP	-0.041956	0.022251	-1.885584	0.0887
LNCOSP(-1)	-0.043869	0.024742	-1.773024	0.1066
LNGP	0.155332	0.276547	0.561685	0.5867
LNGFLD	0.049160	0.151418	0.324665	0.7521
LNGFLD(-1)	-0.341745	0.179580	-1.903020	0.0862
C	11.78498	4.412683	2.670708	0.0235

R-squared	0.911651	Mean dependent var	7.551667
Adjusted R-squared	0.849807	S.D. dependent var	0.086245
S.E. of regression	0.033424	Akaike info criterion	-3.657974
Sum squared resid	0.011172	Schwarz criterion	-3.262253
Log likelihood	40.92176	Hannan-Quinn criter.	-3.603409
F-statistic	14.74105	Durbin-Watson stat	2.285225
Prob(F-statistic)	0.000157		

ARDL Bounds Tests Results
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	4.721910	4
Critical Value Bounds		
Significance	I0 Lower Bound	I1Uper Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Author (2020) Extracted from E-views 9.0

4.3 Estimated Long Run Coefficients for the Model

In the second stage of the ARDL modeling for the univariatecointegration test, the estimates of the long-run coefficients of the model are computed. Table 4 presents the estimated long run coefficients for the Model based on the ARDL (1, 0, 1, 0, 1) specifications selected using Akaike Information Criterion (AIC).

The estimated coefficients of the long run relationship are statistically significant for COSP and GFLD at 1% probability level. The estimated coefficients were negative for COSP and GFLD and were statistically significant at 1% probability level. This indicates that crude oil spill COSP andgas flared GFLD have negative association with crop yield (yam) CROPYLDYAM in the Niger delta region. This implies that a unit increase in crude oil spill will results in 7.2% decrease in crop yield (yam). This result is in line with Osuagwu and Olaifa,(2018) who reported that the long-term effect of an oil spill incidence is usually associated with a reduction in crop yield. Likewise, a unit increase in the quantity of gas flared implies 24.8% decrease in crop yield (yam) in the long run in the Niger delta region. This study confirms the adverse effect of increase in oil spills on crop production in the Niger delta region of Nigeria. Oil spills are usually due to continuous incidence of vandalism and corrosion of oil pipelines, which destroy aquatic life and pollute the environment such that agricultural activities become impossible in the affected areas as reported by (Osuagwu and Olaifa, 2018). This result is also consistent with Iloeje (2016) who in his work, revealed that environmental degradation caused by the oil spill and other oil and gas activities has worsened the economic levels of the people by destroying the once abundant fishing grounds and decreasing availability of quality agricultural land, thereby furthering impoverishment of those affected.

The long run model corresponding to ARDL ((1, 0, 1, 0, 1)) for the relationship between crop yield (yam) and crude oil produced and the components of the other explanatory variables can be written as:Cointeq= LNCROPYLDYAM= **-** (-0.2123*LNCOP -0.0728*LNCOSP + 0.1318*LNGP-0.2483*LNGFLD + 10.0011

Table 4: Estimated Long Run Coefficients for Model 2 using the ARDL Approach
ARDL ((1, 0, 1, 0, 1)) selected based on Akaike Information Criterion

Dependent Variable: LNCROPYLDYAM

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCOP)	-0.250165	0.348175	-0.718501	0.4889
D(LNCOSP)	-0.041956	0.022251	-1.885584	0.0887
D(LNGP)	0.155332	0.276547	0.561685	0.5867
D(LNGFLD)	0.049160	0.151418	0.324665	0.7521
CointEq(-1)	-1.178374	0.262214	-4.493943	0.0012

Cointeq = LNCROPYLDYAM - (-0.2123*LNCOP -0.0728*LNCOSP + 0.1318 *LNGP -0.2483*LNGFLD + 10.0011)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCOP	-0.212296	0.271855	-0.780918	0.4529
LNCOSP	-0.072833	0.028021	-2.599229	0.0265
LNGP	0.131819	0.228981	0.575676	0.5776
LNGFLD	-0.248295	0.094050	-2.640050	0.0247
C	10.001055	2.299651	4.348945	0.0014

Source: Author (2020) Extracted from E-views 9.0

4.3 Error Correction Model (ECM) Estimates for the Model

In the next stage an error correction model for the selected ARDL Model is estimated. Table 5 presents the results of the estimated ECM corresponding to the long run estimates for the Model selected using AIC Criterion using E-Views 9.0. The estimated ECM has two parts. First part contains the estimated coefficients of short run dynamics and the second part consists of the estimates of the error correction term (ECT) that measures the speed of adjustment whereby short-run dynamics converge to the long-run equilibrium path in the model.

The short-run coefficients estimates show the dynamic adjustment of all variables. The short run coefficients for COSP, GFLD are statistically significant at the 5% probability level the implication of this result could lead to wilting of crop leave and reduction in crop yield. This is in agreement with (Ahmadu and Egbodion, 2013) who reported that Wilting of the crops was not unconnected with the accumulation of the oil on the crops' shoots which blocked the stomata thereby inhibiting photosynthesis, transpiration and respiration and the toxic chemical substances from the spilled oil were responsible for the burning of the crop leaves, inhibition of growth and ultimately reduction of yield. The coefficient of error correction term ecm(-1) is negative indicating that the crude oil spilled and gas flared are cointegrated which implies that the speed of adjustment whereby the short-run dynamics converge to the long-run equilibrium path exist in the model therefore, the relationship between crop yield (yam) production and the petroleum exploitation and exploration practices exist on the long run. The estimated value of the coefficient indicates that about 39.1932 percent of the disequilibrium in crop yield (yam) is offset by the short run adjustment in the same year.

Table 5: Error Correction Representation for the Selected ARDL Model for the Model

Dependent Variable: LNCROPYLDYAM
Selected Model: ARDL(1, 0, 1, 0, 1, 1) Aikaike Information Creterion

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNCROPYLDYAM(-1)	-0.232737	0.276705	-0.841102	0.4281
LNCOP	-0.248997	0.359393	-0.692827	0.5107
LNCOSP	-0.011658	0.032463	-0.359113	0.7301
LNCOSP(-1)	-0.050850	0.026208	-1.940242	0.0935
LNGP	0.263389	0.296886	0.887171	0.4044
LNGFLD	0.067530	0.156503	0.431496	0.6791
LNGFLD(-1)	-0.390046	0.186551	-2.090831	0.0749
ECM	-0.269170	0.201337	-1.336916	0.2231
ECM(-1)	-0.391932	0.301105	-1.301647	0.2342
C	11.80815	4.685960	2.519901	0.0398

R-squared	0.925226	Mean dependent var	7.559412
Adjusted R-squared	0.829088	S.D. dependent var	0.082194
S.E. of regression	0.033980	Akaike info criterion	3.636905
Sum squared resid	0.008083	Schwarz criterion	3.146780
Log likelihood	40.91370	Hannan-Quinn criter.	-3.588186
F-statistic	9.623955	Durbin-Watson stat	2.450453
Prob(F-statistic)	0.003456		

Source: Author (2020) Extracted from E-views 9.0

4.4Effects of Petroleum Exploitation and Exploration on Crop yield (Yam)

Table 6 presents the results of the analysis of OLS that determines the effects of petroleum exploration and exploitation on the LNCROPYLDYAM crop yield (yam) in the Niger delta region. the results show that the estimated coefficient of LNCOP crude produced positively influence the crop yield yam and was statistically significant at 1% level this is contrary to a priori expectation. The coefficient of the LNCOP 0.754221 indicates that a unit increase in the crude oil production will lead to 0.75 % increase in the quantity of crop yield (yam) in the Niger delta region. The coefficient of LNCOSP crude oil spill negatively influence crop yield but statistically insignificant, also the estimated coefficients of LNGP gas produced and LNGFLD gas flared were statistically significant at 5% and 1% probability level respectively. The coefficient of gas produced 0.537205 was positive and this implies that a unit increase in the quantity of gas produce results in 0.54% increase in the quantity of crop yield (yam) this contradicts the a priori expectation. More so the coefficient of gas flared -0.331435 indicates that a unit increase in gas flaring will lead to 0.33 % decrease in the crop yield (yam) the implication of thisresult could be an indication of the failure of firms to use natural gas flaring reduction technologies in crude oil exploration which, consequently, led to the raising level of natural gas flaring despite several legislations to this effect as manifested in multiple shifts in natural gas flaring reduction (Dimitrios and Stathopoulou, 2013). The value of the coefficient of the multiple determination (R^2) 0.754 implies that 75% of the variation in the quantity of crop yield yam) LNCROPYLDYAM was explained by the explanatory variables LNCOP, LNCOSP, LNGP and LNGFLD included in the model.

Table 6:Results of the Estimated Ordinary Least Square Regression (OLS) for the model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCOP	0.754221	0.115567	6.526271	0.0000
LNCOSP	-0.014113	0.026171	-0.539257	0.5976
LNGP	0.537205	0.225595	2.381285	0.0309
LNGFLD	-0.331435	0.104360	-3.175890	0.0063

R-squared	0.798557	Mean dependent var	7.544737
Adjusted R-squared	0.758268	S.D. dependent var	0.089092

S.E. of regression	0.043803	Akaike info criterion	-3.233552
Sum squared resid	0.028781	Schwarz criterion	-3.034722
Log likelihood	34.71874	Hannan-Quinn criter.	-3.199902
Durbin-Watson stat	1.124005		

Source: Author (2020) Extracted from E-views 9.0

V. Conclusion and Recommendations

The findings from this study revealed that petroleum exploitation and exploration has a negative impact on the socioeconomic and livelihood of the residents of the Niger delta region, the country has generated billions of dollars over the period studied but the inhabitants of the area could not benefit from the resources on their land. The study demonstrates that increasing levels of oil. Absolutely, the incidence of oil spills, gas flaring and other environmental factors depress agricultural outputs particularly yam crop production.A major policy implication arising from the empirical evidence in this study is the need for an enhanced social protection policy for the inhabitants of the Niger Delta. The inhabitants of this region need to be educated on the process of commercial yam crop production, the Federal Government should on its part, have the political and economic will to ensure greater involvement of the people of the oil producing areas. Sustained job creation for the youth, provision of social amenities and infrastructures, will on one hand reduce unemployment, youth restiveness, and activities of doubtful values, and on the other hand, enhance peace and stability in the area.It is the responsibility of the government to protect the vulnerable group of the society. Environmental protection laws and policies should be carried out with utmost sense of responsibility. It is not just enough to enact stringent and lofty laws on papers alone. Government must ensure strict compliance of its policies by the oil companies. the study recommends the establishment of a framework for collaboration through training and financial support by government to strengthen environmental agencies and organizations in their role as watchdog for ensuring the exchange of information, especially for high risk oil extracting activities.Government and oil producing industries should fast track the cleaning up of polluted areas due to oil spillage and gas flaring.On the other hand, government should be prompt in the clean-up of the affected areas, by enacting and enforcing stringent environmental laws that will protect oil producing areas.

References

[1]. Abdulkareem, A. S., &Odigure, J. O. (2010). Economic benefit of natural gas utilization in Nigeria: A case study of the food processing industry. J. Energy Source Part B 5:106– 114

[2]. Abdullah, S.; Morley, B. (2014) Environmental taxes and economic growth: Evidence from panel causality tests. Energy Econ. 2014, 42, 27–33. [CrossRef]

[3]. Abowei, M. F. N., Susu, A. A., &Onyeme, J. O. (1997). Oil Spill in Marine Environment.Lagos, Nigeria: CJC press (Nigeria) Ltd

[4]. Ahmadu, J and Egbodion, J (2013) Effect of Oil Spillage on Cassava Production in Niger Delta Region of Nigeria *American Journal of Experimental Agriculture 3(4):* 914-926, 2013

[5]. Anifowose, B. (2008). Assessing the Impact of Oil & Gas Transport on Nigeria's Environment. U21 Postgraduate Research Conference Proceedings 1, University of Birmingham UK

[6]. Awosika L.F. (1995). Impacts of Global Climate Change and Sea Level Rise on Coastal Resources and Energy Development in Nigeria. In: Umolu J.C., (ed). Global Climate Change: Impact on Energy Development. DAMTECH Nigeria Limited, Nigeria

[7]. Breitung, J.; Pesaran, M.H. (2008). Unit roots and cointegration in panels. In The Econometrics of Panel Data; Springer: Berlin, Germany, 2008; pp. 279–322. Enders, W. Applied Econometric Time Series; Wiley: New York, NY, USA, 2004

[8]. Chindah AC, Braide AS. The Impact of Oil Spills on the Ecology and Economy of the Niger Delta. Proceedings of the workshop on Sustainable Remediation Development Technology held at the Institute of Pollution Studies, River State University of Science and Technology, Port-Harcourt; 2000.

[9]. Chinweze, C. and Abiol-Oloke, G. (2009). Women Issues, Poverty and Social Challenges of Climate Changes in the Nigerian Niger Delta Context. 7th International Conference on the Human Dimension of Global Environmental Changes, UN Campus, Bonne, Germany

[10]. CLO, Civil Liberties Organization, (2002). Blood Trail: Repression and Resistance in the Niger Delta, Ikeja: CLO

[11]. Department of Petroleum Resources Statistical Bulletin, (2018)

[12]. Dimitrios, V. and Stathopoulou (2013). Corruption,Entry and Pollution , Leicester: University of Leicester

[13]. Duru, C. U. (2014). Environmental Degradation: Key Challenge to Sustainable Economic Development in the Niger Delta. Doctoral Thesis, Walden University

[14]. Federal Office of Statistics. Volume of Oil Spilled Annually from 2006 – 2012. Unpublished statistics. FOS, Lagos; 2012.

[15]. Granger, C. (1988). Some recent development in the concept of causality. J. Econ. 1988, 39, 199–211. [CrossRef]

[16]. Greene, W.H. Económétrie, 7th ed.; Pearson Education France: Paris, France, 2011; p. 958.

[17]. Iloeje, A. F. (2016). Crude Oil Exploitation: The Environmental and Economic Implications to the Niger Delta People. IOSR Journal of Environmental Science, Toxicology and Food Technology .Volume 10, Issue 7 Ver. II (July 2016), PP 47-53 www.iosrjournals.org

[18]. Inoni EO, Omotor DG, Adun FN. The effect of oil spillage on crop yield and Farm Income in Delta State, Nigeria. J Cent Eur Agric. 2006;7(1):41–48. Accessed 7th February, 2013. Available: Freedownloads.is/pdf/oil-spills-n-n.

[19]. Jean, A., Mihai, M., Gheorghe H. P, Elvira. N and Manole, C. (2016). The Impact and Determinants of Environmental Taxation on Economic Growth Communities in Romania MDPI, Basel, Switzerland. (http://creativecommons.org/licenses/by/4.0/). Energies 2016, 9, 902; doi:10.3390/en9110902 www.mdpi.com/journal/energies

[20]. Jeyhun, I. M., Shahriyar, M., Eyhun, M., Mayis, A. (2019). Re -evaluating the environmental impacts of tourism:does EKC exist?

[21]. Kadafa, A.A.,(2012) Environmental impacts of oil exploration and exploitation in the Niger Delta of Nigeria. Global Journal of Science Frontier Research Environment & Earth Sciences, 2012. 12(3): p. 19-28.
[22]. Matthew, O., Osabohien, R., Fagbeminiyi, F., Fasina, A. (2018b), Greenhouse gas emissions and health outcomes in Nigeria: Empirical insight from auto-regressive distribution lag technique. International Journal of Energy Economics and Policy, 8(3), 43-50.
[23]. Michael O. E ,Lasbrey, A . F. Tobechi, A. ,Iyke U U , Uma K. E.,. Kelvin, O .O , Sunday, A. OIkwor, O .O (2019). Oil Exploration and Exploitation in Nigeria and the Challenge of Sustainable Development: An Assessment of the Niger Delta. International Journal of Energy Economics and Policy 9(4), 369-380. available at http: www.econjournals.com
[24]. Michael O. E ,Lasbrey, A . F. Tobechi, A. ,Iyke U U , Uma K. E.,. Kelvin, O .O , Sunday, A. O Ikwor, O .O (2019). Oil Exploration and Exploitation in Nigeria and the Challenge of Sustainable Development: An Assessment of the Niger Delta. International Journal of Energy Economics and Policy 9(4), 369-380. available at http: www.econjournals.com
[25]. Nnabuenyi UM. Impact of Oil Exploration and Exploitation on the Niger Delta Region: Environmental Perspective. In: Akpotor AS, Egboh SH, Ohwona AI, Orubu CO, Olabaniyi SB Olomo RO, Editors. Five Decades of Oil Production in Nigeria: Impact on the Niger Delta. Ibadan: Centre for Environmental and Niger Delta Studies. 2012;193–197.
[26]. Nwilo, P. C. and Badejo, O. T. (2001). Impacts of Oil Spills along the Nigerian Coast. Association for Environmental Health and Sciences Magazine
[27]. Osabohien, R., Oluwatoyin, M., Aderounmu, B., Olawande, T. (2019), Greenhouse gas emissions and crop production in West Africa: Examining the mitigating potential of social protection. International Journal of Energy Economics and Policy, 9(1), 57-66.
[28]. Osabohien, R., Oluwatoyin, M., Aderounmu, B., Olawande, T. (2019), Greenhouse gas emissions and crop production in West Africa: Examining the mitigating potential of social protection. International Journal of Energy Economics and Policy, 9(1), 57-66
[29]. Osuagwu, E.S, Olaifa E (2018) Effects of oil spills on fish production in the Niger Delta. PLoSONE 13(10):e0205114.https://doi.org/10.1371/ journal.pone.0205114
[30]. Pesaran M, Shin Y (1999) An autoregressive distributed lag modeling approach to cointegration analysis. In: Strom S (ed) Econometrics and economic theory in the 20th century: the Ragnar Frisch centennial symposium. Cambridge University Press, Cambridge
[31]. Pesaran MH, Shin Y, Smith RJ (2001) Bounds testing approaches to the analysis of level relationships. J Appl Econ 16:289–326
[32]. Powell, C.B., White, S.A., Ibiebele, D.O., Bara, M., DutKwicz, B., Isoun, M. and Oteogbu, F.U. (1985).Oshika Oil Spill Environmental Impact; effect on Aquatic biology. Paper presented at NNPC/FMHE International Seminar on petroleum industry and the Nigerian Environment 11 – 13 Nov. 1985, Kaduna, Nigeria 168 – 178
[33]. Sanusi, S. (2004). Mathematical Modelling and Computer Simulation of Oil Spillage in Soil.B.Eng Degree Project Unpublished. Federal University of Technology, Minna, Niger State, Nigeria, pp 1–53
[34]. Tolulope, O. A.(2004). Exploration and environmental degradation: The Nigerian experience. Environ. Info. Arch. 2:387–393.
[35]. Twumasi, Y. and Merem E. (2006). GIS and Remote Sensing Applications in the Assessment of Change within a Coastal Environment in the Niger Delta Region of Nigeria. International Journal of Environmental Research & Public Health, 3(1):98- 106
[36]. Uyigue, E. and Agho, M. (2007). Coping with Climate Change and Environmental Degradation in the Niger Delta of Southern Nigeria. Community Research and Development Centre Nigeria (CREDC)