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Effects of Petroleum Exploitation and Exploration on Fish Production Output (Fish Catch) In Niger Delta Region of Nigeria

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Abstract
The study evaluated effects of petroleum exploitation and exploration on fish production output (fish catch) 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 the model showed that there is a long run relationship between LNFISHP and COP, COSP, GP, and GFLD. The ARDL results showed that on a short run cetiribus paribus LNGP and LNGFLD had significant relationship with LNFISHP. The results of the ECM, revealed that the coefficients of gas flared GFLD was negative and statistically significant while the coefficient of the error correction model (ECM) was positive and statically significant. The value of the coefficient of multiple determination (R^2) is 0.443 this shows that 44.3% of the variation in the fish production was explained by the explanatory variable included in the model. The study therefore recommended the inhabitants of this region need to be educated on the process of commercial fishing production. Government and oil producing industries should fast track the cleaning up of polluted areas due to oil spillage and gas flaring. that Oil companies, and corporate organizations operating in the region need to establish projects like job creations, skill acquisition centres, grants for agricultural production, health centres, that truly deal with the needs of the people.
Key Words: Exploitation, Petroleum, Oil Spillage, Fish, Niger Delta

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I. Introduction

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 kilometers 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 kilometers and has been described as the largest wetland in Africa and among the three largest in the world, consisting about 2,370 square kilometers of rivers, creeks and estuaries and stagnant swamp covering about 8,600 square kilometers.

However, the accompanying socioeconomic and ecological fallout of oil exploration and exploitation is enormous. The activities of oil-producing companies operating in the Niger-Delta area of Nigeria resulted in various forms of environmental pollution, by way of relentless flaring and venting of gas to the environment, oil spillage, site clearing, deforestation and destruction of flora and fauna, and ecological disturbance in the 70 km2 Niger-Delta wetlands (Olukoga, 2002; Akpan, 2009; Agbalino & Eyinal, 2009). Oil spillage is a global issue that has been occurring since the discovery of crude oil, which was part of the industrial revolution. In 1956, Shell British Petroleum (now Royal Dutch Shell) discovered crude oil at a village Oloibiri in Bayelsa state located within the Niger Delta of Nigeria (Onuoha, 2008; Anifowose, 2008) and commercial production began in 1958. Oil exploration and exploitation has been on-going for several decades in the Niger Delta. It has had disastrous impacts on the environment in the region and has adversely affected people inhabiting that region. The Niger Delta is among the ten most important wetland and marine ecosystems in the world. The oil industry located within this region has contributed immensely to the growth and development of the country which is a fact that cannot be disputed but unsustainable oil exploration activities has rendered the Niger Delta region one of the five most severely petroleum damaged ecosystems in the world. Studies have shown that the quantity of oil spilled over 50 years was at least 9-13 million barrels, which is equivalent to 50 Exxon Valdez spills (FME, et. al. 2006). The Niger Delta consist of diverse ecosystems of mangrove swamps, fresh water swamps, rain forest and is the largest wetland in Africa but due to oil pollution the area is now characterized by contaminated streams and rivers, forest destruction and biodiversity loss in general the area is an ecological wasteland. This affects the livelihood of the indigenous people who depend on the ecosystem services for survival (Kadafa, 2012).'

In the Niger Delta, oil spill is perceived to be a major consequence of an inordinate exploitation of petroleum resources in the region. Some recent studies have examined spatial variations in the natural mortality of particular fish species in order to assess the impact of oil spills on marine ecosystems, specifically in the Arctic area (Osuagwu and Olaifa, 2018)

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 oil producing 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 explore Economics of Petroleum Exploitation Impact on selected Communities in Nigeria's Niger Delta Region. Osuagwu and Olaifa, 2018).

Oil exploration has over the years impacted negatively on the physical environment of the oil-bearing communities (UNEP, 2011). Elum, (2016) observes that oil exploitation has increased the rate of environmental degradation and has perpetuated food insecurity as a result of death of fish and crops as well as loss of farm lands and viable rivers for fishing activities leading to loss of livelihood. There is no doubt that the disastrous effect of oil spill impedes agricultural productivity and fishing to be specific, which in the long-run has an adverse consequence on the economic life of the inhabitants of this region (Paul,2015; UNEP,2016).

Problem Statement

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).

The exploitation of oil in the Niger Delta region has brought to bear oil spillage and its numerous problems. Such problems include contamination of water bodies, danger to aquatic life, and destruction of farmlands, [Nwilo and Badejo, 2008]. According to [Nwilo and Badejo, 2008], between 1976 and 1996, it was estimated that over 6,000 oil spills occurred in the Niger Delta region and about 2-million barrels of crude oil leaked into the environment. This calls for serious concern knowing that this ecosystem is a major source of livelihood for the inhabitants of the region (Osuagwu and Olaifa, 2018)

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The motivation for this study draws from the increasing importance of fish to the economic life of this region and the country at large, with the attendant negative effect of oil exploration activities. In this study, we provide specific answers to the problem of environmental degradation through oil spills on fish production in the Niger Delta region by applying econometric techniques to determine its effects as the result of oil spillage and gas flaring.

Research Questions

The following question was raised to the study.

(i) What are the effects of petroleum exploitation and exploration on fish production fish (catch) in the Niger Delta Region, Nigeria?

1.4 Objectives 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 evaluate the effects of Petroleum exploitation and exploration on fish production (fish catch) in the Niger Delta Region,

1.5 Hypotheses of the Study

$H_{01:}$ Petroleum exploitation and exploration variables (crude oil produced, crude oil spilled, gas produce and gas flared) has no significant effects on fish production (fish catch) in the Niger delta region

II. Methodology

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, Akwa Ibom, 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).

Methods of Data Collection

This study involved the collection and analysis of data on crude oil production in Nigeria between 2000 and 2018. Data was also collected on the volume of associated gas produced and the volume flared by multinational oil companies operating in the oil-producing region of Nigeria. Economic analyses were conducted on the revenue generated from the sales of crude oil and loss of revenue due to oil spillage and flaring of associated gas; these analyses was based on the average selling price of the crude oil per barrel and price per gallon of gas per year. This study will employ 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.

Methods of Data Analysis

The following tools of Analysis was applied to achieve the specific objectives of the study

Autoregressive Distributed Lags (ARDL)

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.

Cointegration 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.

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

$$Z_{t-1} = LnFISH_{t-1} - \beta_0 - \beta_1 LnCOP_{t-1} + \beta_2 LnCOSP_{t-1} + \beta_3 LnGP_{t-1} + \beta_4 LnGFLD_{t-1} + U_t \quad (3.5)$$

where,

Z_{t-1}= Cointegrating Equation

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 study adopts 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;

$$Y = f(X_1, X_2, X_3, U_i) \ldots (3.1)$$

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

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

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

Model Specification
The explicit function is stated thus:

$$LnFISHP = \beta_0 + \sum_{i=1}^{4} \beta_0 + \beta_1 LnCOP_t + \beta_2 LnCOSP_t + \beta_3 LnGP_t + \beta_4 LnGFLD_t + U_t . (3.5)$$

Where,
$LnFISHP$ = Natural Logarithm of Fish Produce (Tons)
$LnCOSP_t = Quantity\ of\ Oil\ Spilled\ (barrells)$
$LnGFLD_t$ = *Volume of Gas Flared (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*

Hypotheses Testing
t-Test
Hypotheses (i) and (ii) were both tested with t-Statistics

$$t = \frac{\beta}{s\beta}$$

where,

$$\beta = is\ the\ Estimated\ Coefficient\ of\ the\ Parameters$$
$$s\beta = is\ the\ Standard\ Error\ of\ the\ Estimated\ Parameters$$

III. Results And Discussion

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 observations i.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 1: Results 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
LNFISP	-1.244447	-4.171475	-4.616209	-3.7104	-3.29779	I(1)	Stationary

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

Cointegration Test Results for the Model

Given that all the variables were stationary at first difference as shown in table 4.3 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 4.4.1 is less than 0.05, this means that the null hypothesis is rejected. The value of trace statistic (191.2672) 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 LNFISHP cannot be accepted. More so the value of the trace statistic corresponding to "At most 1", is 69.38947 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 4.4.2 is less than 0.05, indicating that the null hypothesis can be rejected. Furthermore, the value of the max-eigen statistic 121.8777 is greater than 0.05 critical value of 33.87687 this confirms that the null hypothesis that there is no cointegrating relationship between FISHP Output and the other variables is rejected.

More so, the value of the max-eigenvalue which correspond to "At most 1", is 45.91235 which is higher than 0.05 critical value at the level (27.58434), this indicates 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. This result is consistent with the findings of (Osuagwu and Olaifa, 2018). Hence there is a long run relationship between dependent variable LNFISHP and independent variables COP, COSP, GP, and GFLD.

The normalized cointegration equation which show the long-run cointegration among the variables is written as;

LNFISHP = 1.000000 - 0.415631COP - 0.353405COSP - 0.945833GP - 3.958453GFLD

Table 2: Results of the Johansen's Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999230	191.2672	69.81889	0.0000
At most 1 *	0.932843	69.38947	47.85613	0.0002
At most 2	0.569236	23.47712	29.79707	0.2234
At most 3	0.343268	9.159819	15.49471	0.3508
At most 4	0.111600	2.011669	3.841466	0.1561

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

Maximum Eigenvalue
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.999230	121.8777	33.87687	0.0000
At most 1 *	0.932843	45.91235	27.58434	0.0001
At most 2	0.569236	14.31731	21.13162	0.3395
At most 3	0.343268	7.148150	14.26460	0.4718
At most 4	0.111600	2.011669	3.841466	0.1561

Max-eigenvalue test indicates 2 cointegrating eqn(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	176.4087

Normalized cointegrating coefficients (standard error in parentheses)

LNFISHP	LNCOP	LNCOSP	LNGFLD	LNGP
1.000000	-0.415631	-0.353405	-0.945833	-3.958453
	(0.03633)	(0.00308)	(0.01282)	(0.02962)

Adjustment coefficients (standard error in parentheses)

D(LNFISHP)	-0.192108
	(0.29217)
D(LNCOP)	0.066193
	(0.09701)
D(LNCOSP)	0.111649
	(1.51247)
D(LNGFLD)	0.421481
	(0.24177)
D(LNGP)	0.483132
	(0.06291)

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

Autoregressive Distributed Lag (ARDL) Estimation Results of Econometric Model

Test for the existence of long run relation between variables for Econometric Model

In the first stage of ARDL modeling for Model 1 that specifies the relationship between LNFISHP (dependent variable) and crude oil produced LNCOP and other explanatory variables, the existence of long run cointegration relationship for the variables is investigated by computing the F test statistic. Given the few observations available for estimation the maximum lag order for the various variables in the model was set at one (m=1) and the estimation was performed for the period 2000 to 2018. The F statistic for testing the joint null hypothesis that there exists no long run relationship between the variables as shown below is given in the last row of the results table of the Hypothesis testing Menu using E-views 9.0. The computed F statistic is F = 4.268109. The relevant critical value bounds for this test as computed at the 10% level is given by 3.03 lower bound and 4.06 upper bound. Since the F- statistics exceeds the upper bound of the critical value, the null hypothesis of no long run relationship between the variables is rejected. We proceed with the analysis while acknowledging our relatively small sample size could lead to potential bias in our inferences. However, the application of the ARDL methodology being suitable for small sample size validate our finding according to (Pesaran et al., 2001). This test result suggests that there exists a long-run relationship between LNFISHP, LNCOP, LNCOSP, LNGP, LNGFLD. Having rejected the null hypothesis of no long run cointegrating relationship between the variables in Econometric Model 1, the ARDL Model was therefore estimated using Univariate ARDL Cointegration Test option of E-views 9.0 with the maximum lag m = 1. The ARDL model specifications was selected based on Akaike Information Criterion (AIC). The ARDL (1, 0, 0, 1, 1) estimates for these models are presented in the Table 4.4.3 below.

The results show that on a short run cetiribus paribus LNGP and LNGFLD had significant relationship with LNFISHP and were statistically significant at 10% and 1% respectively.

Table 3: Autoregressive Distributed Lag Estimates of Model

Selected Model: ARDL(1, 0, 0, 1, 1)Dependent Variable is LNFISHP

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNFISHP(-1)	0.668073	0.190249	3.511565	0.0066
LNCOP	-0.469602	1.098416	-0.427527	0.6790
LNCOSP	-0.046014	0.052274	-0.880238	0.4016
LNGP	-0.908787	0.686206	-1.324366	0.2180
LNGP(-1)	-1.445491	0.808102	-1.788748	0.1073
LNGFLD	0.216438	0.466603	0.463859	0.6538
LNGFLD(-1)	1.387118	0.443073	3.130677	0.0121

C	9.101674	9.988749	0.911193	0.3859
@TREND	0.064651	0.022588	2.862136	0.0187

R-squared	0.902555	Mean dependent var	5.688889
Adjusted R-squared	0.815937	S.D. dependent var	0.167925
S.E. of regression	0.072044	Akaike info criterion	-2.116225
Sum squared resid	0.046713	Schwarz criterion	-1.671039
Log likelihood	28.04603	Hannan-Quinn criter.	-2.054840
F-statistic	10.41994	Durbin-Watson stat	2.531487
Prob(F-statistic)	0.000981		

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

Test Statistic	Value	k
F-statistic	4.268109	4

Critical Value Bounds

Significance	I0 Lower Bound	I1 Upper Bound
10%	3.03	4.06
5%	3.47	4.57
2.5%	3.89	5.07
1%	4.4	5.72

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

Estimated Long Run Coefficients for Model 1

In the second stage of the ARDL modeling for the univariate cointegration test, the estimates of the long-run coefficients of the model were computed using the Akaike Information Criterion (AIC). Table 5.7 presents the estimated long run coefficients for Model 1 based on the ARDL (1, 0, 0, 1, 1) specifications selected using (AIC) criterion. The estimated coefficients of the long run relationship were not statistically significant for the variables LNCOP, LNCOSP, LNGP, LNGFLD. The coefficients for LNCOP, LNOSP and LNGGFLD were negative and were not significant this implies that they have negative impact on fish production output (fish catch) in the Niger delta region but not statistically significant on the longrun. The long run model corresponding to ARDL (1, 0, 0, 1, 1) for the natural log of fish produce can be presented as:

Cointeq = LNFISHP- (-1.4148*LNCOP -0.1386*LNCOSP -7.0928*LNGP +4.8310*LNGFLD + 27.4207 + 0.1948*

Table 4: Estimated Long Run Coefficients using the ARDL Approach for Model 1

Selected Model: ARDL (1, 0, 0, 1, 1) Model
Dependent Variable: LNFISHP

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCOP)	-0.469602	1.098416	-0.427527	0.6790
D(LNCOSP)	-0.046014	0.052274	-0.880238	0.4016
D(LNGP)	-0.908787	0.686206	-1.324366	0.2180
D(LNGFLD)	0.216438	0.466603	0.463859	0.6538
D(@TREND())	0.064651	0.022588	2.862136	0.0187
CointEq(-1)	-0.331927	0.190249	-1.744695	0.1150

Cointeq = LNFISHP - (-1.4148*LNCOP -0.1386*LNCOSP -7.0928*LNGP + 4.8310*LNGFLD + 27.4207 + 0.1948*@TREND)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCOP	-1.414775	3.896241	-0.363113	0.7249
LNCOSP	-0.138626	0.206095	-0.672635	0.5181
LNGP	-7.092758	5.526255	-1.283466	0.2314
LNGFLD	4.831049	3.432099	1.407608	0.1928
C	27.420706	41.380044	0.662655	0.5242
@TREND	0.194775	0.138424	1.407096	0.1930

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

Error Correction Model (ECM) Estimates for Model 1

In the next stage an error correction model for the selected ARDL Model was estimated. Table 4.4.4 presents the results of the estimated ECM corresponding to the long run estimates for Model 1 selected Aikake Information Criterion (AIC) 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 results revealed that the coefficients of gas flared GFLD was negative and statistically significant at 5% probability level, while the coefficient of the error correction model (ECM) was positive and statically significant at 1% level this implies that the speed of adjustment whereby the short-run dynamics converge to the long-run equilibrium path doesn't exist in the model therefore the relationship between fish production (fish catch) and the petroleum exploitation and exploration practices only exist on the short run.

Table 5: Error Correction Representation for the Selected ARDL Model for Model 1
Selected Model: ARDL (1, 1, 1, 0, 1, 1) DEPENDENT Variable is LNFISHP

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNFISHP(-1)	0.611824	0.193683	3.158898	0.0196
LNCOP	0.913181	0.810030	1.127342	0.3027
LNCOP(-1)	-0.763502	0.679087	-1.124307	0.3038
LNCOSP	-0.091695	0.063857	-1.435944	0.2010
LNCOSP(-1)	0.048573	0.042925	1.131581	0.3010
LNGP	0.140845	0.575031	0.244934	0.8147
LNGFLD	-0.670496	0.335996	-1.995549	0.0930
LNGFLD(-1)	1.240044	0.365325	3.394356	0.0146
ECM	1.425284	0.363724	3.918586	0.0078
ECM(-1)	0.777319	0.552986	1.405677	0.2094
C	-1.016908	8.304168	-0.122458	0.9065

R-squared	0.951808	Mean dependent var	5.689412
Adjusted R-squared	0.871487	S.D. dependent var	0.173078
S.E. of regression	0.062046	Akaike info criterion	-2.469215
Sum squared resid	0.023098	Schwarz criterion	-1.930077
Log likelihood	31.98833	Hannan-Quinn criter.	-2.415624
F-statistic	11.85012	Durbin-Watson stat	1.739622
Prob(F-statistic)	0.003383		

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

Effects of Petroleum Exploitation and Exploration on Fish Production

The ordinary least square estimation method was used to determine the effects of the petroleum exploitation and exploration practices on the fish production (fish catch) and test the null hypothesis that there is no relationship between fish production and petroleum exploration and exploitation variables in the Niger delta region. The results revealed that there is an association between crude oil production LNCOP and Fish production (fish catch) LNFISHP in the Niger delta region, the coefficient of the crude oil produced influence fish production positively and was statistically significant at 5% probability level this results was contrary to a priori expectation. The coefficient of LNCOP (2.946183) indicates that a unit increase in crude oil production will result in 2.94% increase in fish production (fish catch) this is contrary to a pprirori expectation. The coefficients of LNCOSP crude oil spills, LNGP gas produced and LNGFLD gas flared were negative but not statistically significant. The value of the coefficient of multiple determination (R^2) is 0.443 this shows that 44.3% of the variation in the fish production was explained by the explanatory variable included in the model.

Table 6: Results of the Estimated Ordinary Least Square (OLS) Regression for model 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.03737	9.804553	-1.737700	0.1042
LNCOP	2.946183	1.192215	2.471184	0.0269
LNCOSP	-0.040613	0.083720	-0.485108	0.6351
LNGP	-0.769994	0.713784	-1.078749	0.2989
LNGFLD	-0.275900	0.374848	-0.736032	0.4739
R-squared	0.443319	Mean dependent var		5.686316
Adjusted R-squared	0.284267	S.D. dependent var		0.163578
S.E. of regression	0.138389	Akaike info criterion		-0.896563
Sum squared resid	0.268121	Schwarz criterion		-0.648026
Log likelihood	13.51735	Hannan-Quinn criter.		-0.854500
F-statistic	2.787261	Durbin-Watson stat		0.988551
Prob(F-statistic)	0.067979			

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

Hypothesis Tested

$H_{01:}$ Petroleum exploitation and exploration variables (crude oil produced, crude oil spilled, gas produce and gas flared) has no significant effects on fish production (fish catch) in the Niger delta region.

The results of the ARDL, ECM and OLS which determined the short-run, long-run relationship and the effects of petroleum exploitation and exploration variables and fish production shows that the coefficients of crude oil produce was positive and significant at 5% probability level while the coefficients of Crude oil spilled and gas flared was negative and statistically significant at 5% and 1% level respectively. Therefore, the null hypotheses that petroleum exploitation and exploration variables has no effects on the fish production (fish) catch in the Niger delta region is rejected while the alternative hypothesis is accepted

IV. 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 also shows that the exploration variables crude oil produce, oil spilled, volume of gas produce and volume of gas flared has a significant negative effect on fish production and crop yield in the region, there is a trade-off between oil exploitation and exploration activities and fish production due to the effect of oil spills and gas flaring. the study demonstrates that increasing levels of oil spillage and oil production negatively affects fish production in the Niger Delta region of Nigeria. However, changes in fish production may be stimulated by other seasonal and environmental factors not accounted for in our estimated models. Absolutely, the incidence of oil spills, gas flaring and other environmental factors depress agricultural outputs particularly fishing 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 because providing credit for agricultural purposes may not yield significant results because of the short supply of arable land for cultivation and clean water for the survival of an aquatic ecosystem. In the same vein, since most of these riverine communities are traditionally into peasant fish production a destruction of the habitat completely dispossesses them of their productive capacity. The inhabitants of this region need to be educated on the process of commercial fishing production. Government and oil producing industries should fast track the cleaning up of polluted areas due to oil spillage and gas flaring.

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