EFFECTS OF OIL SPILLS ON FISH PRODUCTION IN THE NIGER DELTA OF NIGERIA

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Abstract
The oil producing area of Nigeria, known as the Niger Delta region consist of highly diverse ecosystems that is supportive of numerous species of terrestrial and aquatic fauna and flora. The region is the largest wetland in Africa and it is among the ten most important wetlands and marine ecosystems in the world. Incident of oil spill raises concern about seafood safety. Crude oil endangers fish hatcheries in coastal water and also contaminates commercially valuable fish flesh. Hence, this study examines the effects of oil spills on fish production in Niger Delta of Nigeria from 1981-2015 by using an estimable production function based on a Cobb Douglas production function model. The variables included in the model are captured fish production, number of fishers, loan to fishery, oil spills data and oil production data sourced from FAOSTAT, CBN and Department of Petroleum Resources (DPR) respectively. The findings established that oil spills and oil production negatively affect fish production, while labour positively affects fish production. On the other hand, fishery loan exerts a negative effect on fish production and this can be ascribed to the bottlenecks in trying to access these loans. Looking at the Pairwise Granger Causality test result, it was established that the number of times oil is spilled on the environment affect the level of fish production negatively.

Keywords: environment, oil spills, fish production, aquatic life, fishery, Niger Delta,
JEL Classification Code: P28, Q53, Q56

INTRODUCTION

Fish is an important contributor to the population's nutritional requirements, constituting about 50 percent of animal protein intake (FAO, 2017). Nigeria fisheries sub sector of the agricultural sector contributes about 3-4 percent to the country's annual GDP. Nigeria has a big potential in both marine and fresh water fisheries including aquaculture. In spite of this high potential, domestic fish production still falls far below the total demand, which was estimated at 2.2 million metric tons per year in 2008. As a result, the country imports about 60 percent of the fish consumed (FAO, 2017).

The Oil producing area of Nigeria known as Niger Delta is located in the Atlantic Coast of southern Nigeria where River Niger divides into numerous tributaries. It is the second largest delta in the world with a coastline spanning about 450 kilometres terminating at the Imo River entrance (Awosika, 1995). The region spans over 20,000 square kilometres and it has been described as the largest wetland in Africa and among the three largest in the world. About 2,370 square kilometres of the Niger Delta area consist of rivers, creeks and estuaries and while stagnant swamp covers about 8,600 square kilometres. Oil producing area ecosystem is highly diverse and supportive of numerous species of terrestrial and aquatic flora and fauna and human life. As opined by Iyayi (2004), it is richest wetland in the world. Oil was first discovered in the region in 1958 and since the early 1970s, oil has dominated the country's economy (African Network for Environment and Economic Justice, 2004). Oil exploration has over the years impacted negatively on the physical environment of the oil-bearing communities.

It is massively threatening the subsistence peasant agricultural economy and environment; hence the entire livelihood and survival of the people (Stephen and Udofia, 2015). Oil spillage is the release of petroleum substance or product into the streams, lakes, rivers, beaches, seas, oceans and land. When this occur, it becomes poisonous and thus makes the water and land fouled and threatened by the rich coastal habitat. Oil poisons algae, disrupts major food chains and decrease the yield of edible crustaceans. Both actual and potential contamination of seafood can substantially affect commercial and recreational fishing and the attendant loss of confidence in seafood safety and quality can impact seafood market long after any actual risk to seafood from oil spill has subsided, resulting in serious economic consequences (Yender and Michel, 2002).

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 Eyinla and Ukpo, (2006), between 1976 and 1996, it was estimated that over 6,000 oil spills occurred in the Niger Delta region and about 2,369,471 barrels of crude oil leaked into the environment. Therefore, the main objective of this study is to examine the effect of oil spillage on fish production in the Niger Delta of Nigeria. This study is presented in six sections, the first is the introductory section, the second is a review of related literature, the third section presents the stylized facts, while the fourth section features the method of analysis, the fifth is the interpretation and discussion of results and the study is concluded in the sixth section.

LITERATURE REVIEW

Akpokodje and Salau (2015) examined oil pollution and agricultural productivity in the Niger Delta of Nigeria. The study employed an empirical analysis derived from a unique estimable production function based on Ramon Lopez's Cobb Douglas production function model. The findings established that increasing levels of oil spills and forest loss negatively affect agricultural productivity, while land, labour and capital positively improved agricultural productivity in the Niger Delta. Ogwu, Badamasuity and Joseph (2015) explore the environmental effects of petroleum activities and policies in Nigeria employing descriptive techniques to attain logical interpretations. Findings from this study revealed that the actions of the oil companies operation in the country have tremendous influences on the health of ecosystems and biodiversity of the region in Nigeria.

Ekpenyong and Udeme (2015) investigated the consequences of oil spill on sea-foods safety in coastal areas of Ibeno, Akwa Ibom State observed that the mean concentration of total petroleum hydrocarbons (TPH) in the tissues of various fish species sampled increased as a result of oil spills. Similarly, Paul (2015) evaluates the historical influence of petroleum activities on various episodes of economic crisis in Nigeria. The study employed descriptive technique to analyse data obtained from secondary sources. The study affirmed that the transmogrification of the economy from agricultural-based to petroleum-based which laid the foundation for the current economic crisis in Nigeria. Also, Ekanem and Nwachukwu (2015) explore the extent of the environmental degradation in the Niger Delta region; determine the efforts of the oil companies in remediating the degraded farmlands in the Niger Delta. They found that oil pollution causes damage to human health, agricultural land and fish ponds as well as long-standing ecological malfunctioning and poor environmental well-being. Atubi, et al. (2015) examined the effects of environmental degradation on human health in nine selected oil communities in Delta State, Nigeria using cluster and principal component analysis. The study employed both primary and secondary data. The primary data was collected through administration of questionnaires while secondary data was from archival records of in-and-out patients from the Government hospitals or clinics located in Okpai, Kwale, Benekuku, Ubeji, Bomadi, Ekakprame, Erhoike, Afiesere and Uzere for a year. One year hospital data was used based on data availability and consistency on the required ailments such as bronchitis, cough, asthma, cardiovascular diseases, eye infection and skin infection. The study found that gas flaring has a significant effect on human health in the study area. Odalonu (2015) examine the upsurge of oil theft and illegal bunkering in the Niger Delta region of Nigeria covering 2009 to 2014. Secondary data was generated for the study, while content analysis was used for data interpretation and analysis. The study revealed that different individuals and groups were involved in oil theft and illegal bunkering activities. The study further proved that persistence oil theft in the Niger Delta is due to the enthroned corruption by Nigerian elites, high level of youth unemployment, ineffective and corrupt law enforcement agencies and international crime collaborations. Also, Abdullahi, Madu and Abdullahi (2015) analyse the influence of petroleum on Nigerian economy using secondary annual data from 2000 to 2009. The technique employed for the analysis include linear regression model and found that petroleum has substantial direct influence on the economy.

Ebegbulem, Ekpe and Adejumo (2013) critically assess the effect of oil exploration on poverty in the Niger Delta region of Nigeria. The authors extensively a review literature and drew conclusion from the findings from literature. The study concludes that the greatest negative tendency associated with the exploration and exploitation of oil in this region is environmental degradation. Kadafa (2012) examine the environmental impact of oil exploration and exploitation in Niger Delta of Nigeria. The author employed tabular analysis of data obtained from secondary sources. The oil industry sited within this region has contributed enormously to the economic growth of the country but unsustainable oil exploration activities has rendered the Niger Delta region one of the five most severely petroleum damaged ecosystems in the World. Also, Adati (2012) assessed oil exploration and spillage in the Niger Delta region of the country. This study adopted comparative analysis of secondary data covering periods from 1976 to 2000. Study employed descriptive techniques such as line and bar graphs, and found that decrease in oil spillage quantity but increase in oil spillage. Ojimba (2012) examined the effects of oil pollution on crop production in Rivers State, Nigeria using a stochastic trans-log production function. A total of 296 questionnaires were administered in 17 out of 23 Local Government Areas using a multi-stage sampling technique. The results showed that the effect of crude oil pollution on crop farms reduced the size of farmland (-2.5842), significantly at 1%, thereby reducing marginal physical product (MPP) with respect to land by 1.0186 and 1.9016 tons, respectively, while in non-polluted farms output increased by 0.3814 tons. Physical inputs, crude oil pollution variables and their interactions showed strong negative (diminishing) returns to scale in oil polluted farms, but in non-polluted farmlands showed strong positive returns to scale. The technical efficiency results indicated that less than 22% of crop farmers were over 80% efficient in resource use in oil polluted farmlands, while technical efficiency in non-polluted farmlands indicated a high efficiency of 33%.

Sylized Facts

The Extent of Oil Spillage

Oil spill incidents have occurred at different times along the Nigerian coast. From the records of the Department of Petroleum Resources (DPR) an estimated 1.9 million barrels of crude oil were spilled into the Niger Delta between 1976 and 1996 out of a total of estimated 2.4 million barrels produced in 4,581 incidents. Also DPR 2002 data on oil spills show that, a total of 6,194 oil spills between 1976 and 2001, which account for about 3 million barrels of crude oil spilled into the environment. More than 70% was not recovered 69% of these spills occurred off-shore, a quarter was in swamps and 6% spilled on land. (United Nations Development Programme 2006)

The Nigerian National Petroleum Corporation places the quantity of crude oil spilled into the environment yearly at 2,300 cubic metres with an average of 300 individual spills annually. (Bronwen, 1999). However, the World Bank argues that the true quantity of petroleum spilled into the environment could be as much as ten times the officially claimed amount due to the fact that the amount spilled does not take into account "minor" spills. Also Nwilo and Badejo (2001) stated that the largest individual spills include the blowout of a Texaco offshore station which in 1980 dumped an estimated 400,000 barrels (64,000 m3) of crude oil into the Gulf of Guinea and Royal Dutch Shell's Forcado Terminal tank failure which produced a spillage estimated at 580,000 barrels (92,000 m3). Moffat and Linden (1995), opined that the total amount of petroleum in barrels spilled between 1960 and 1997 is upwards of 100 million barrels (16,000,000 m3). Baird (2010) reported that between 9 million and 13 million barrels have been spilled in the Niger Delta since 1958.

From the records of DPR (2016), within the period of 1976-2015, a total no of 16,476 spills occurred at different occasions and a total quantity of 2,801,704.05 barrels was spilled into the environment.

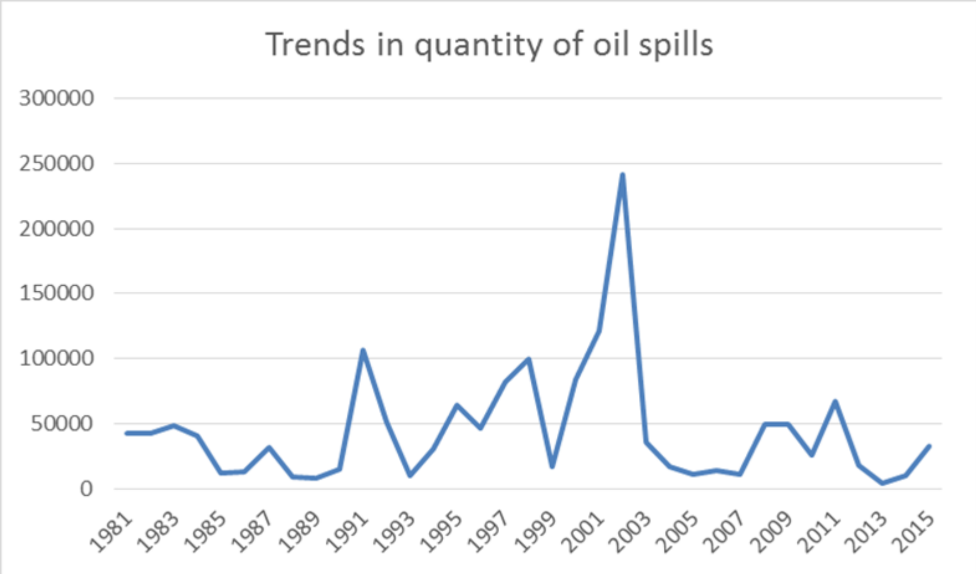

Figure 1: Bar graph showing the volume of oil spills in barrels 1981-2015

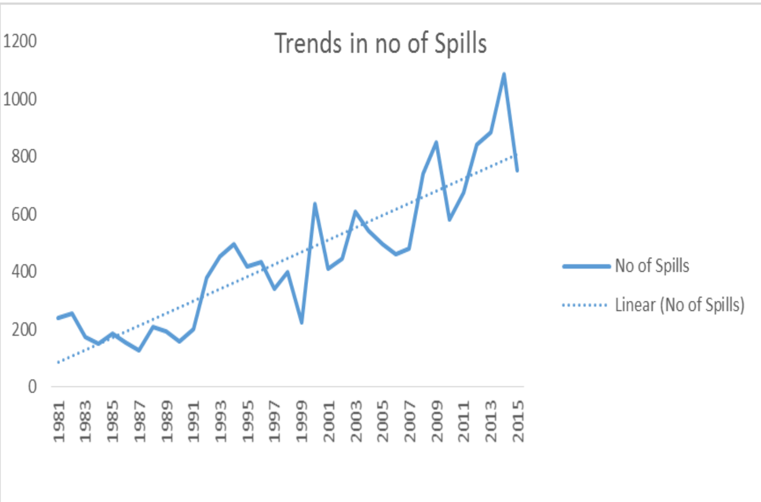

Figure 2: Trend of oil spills in barrels (1981 – 2015) (DPR 2016: Arthur's compilation) (in N' billion) of Nigeria (1981 – 2015)

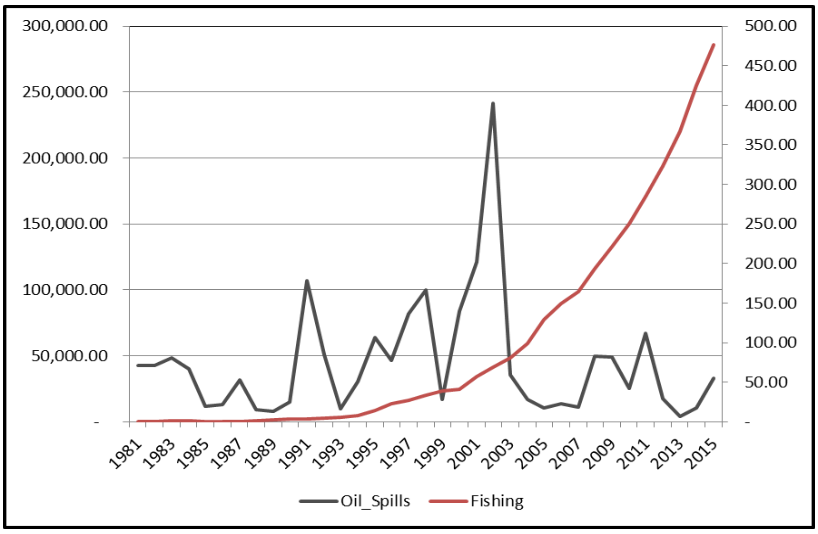

Figure 3: Graph of Oil Spills (in Barrels) and Fishing Outputs (DPR 2016. Arthur's compilation (2017))

METHODOLOGY

Data

This study employed time series data covering periods from 1981 to 2015 sourced from Central Bank Statistical Bulletin (2015), Department of Petroleum Resources (2016), and Food and Agricultural organisation (2017).

Model Specification

This study adapts a Cobb Douglas production model as specified by Akpokodje and Salau (2015) which was employed to assess the influence of oil pollution on agricultural productivity in the Niger Delta of Nigeria.

$$FISP_t = f(OILS_t, OILP_t, FCAP_t, FLAB_t) \quad (1)$$

Where;

$FISP_t$: Fish production by captured fishes measured in tones at period t.

$OILS_t$: Quantity of oil spills in barrels in period t.

$OILP_t$: Oil production in barrels in period t.

$FCAP_t$: Fish capital proxy by no of fishery loan

$FLAB_t$: Fish labor captured by number of fishers in period t

The dependent variable is Fish production (FISP) and it is the total fish production or output captured from inland and marine, all measured in metric tons. Aquaculture value is excluded because this research work is natural fish production and not agricultural source. Also, the fishery statistical data presented excludes the production for marine mammals, crocodiles, corals, sponges, pearls, shells and aquatic plants. It is sourced from FAO. (2017) and independent variables are: Oil spills (OILS) measured in barrel during production, transportation and vandalization process officially recorded annually by oil companies in barrels, Oil production (OILP) is the value of total quantity of crude oil produced and measured in barrels yearly in Nigeria that is officially recorded, from the different oil companies, Fishery labour (FLAB) is the total amount of fishers involve in fish production, which include both artisanal and industrial sectors in fishing business and Fish capital (FCAP) is proxy by the value of Fish production loan through Agricultural Credit Guarantee Scheme Funds.

Equation (1) can be rewritten explicitly as follows:

$$FISP_t = A\ OILS_t^{\beta 1} . OILP_t^{\beta 2} .\ FCAP_t^{\beta 3} . FLAB_t^{\beta 4} . \varepsilon_t \qquad (2)$$

By adopting a double-log transformation of the model specified in equation (10) through taking the natural logarithm of both sides of equation and assuming linearity among the variables. The usefulness of this transformation include minimization of the huge differences in the magnitude of different variables thereby bringing out the coefficient of co-variation better and the explanation of the results is in the form of elasticity with easily understandable interpretation devoid of complication from measurement unit.

$$IogFISP_t=\beta_0+\beta_1 IogOILS_t+\beta_2 IogOILP_t+ \beta_3 IogFCAP_t+ \beta_4 IogFLAB_t +\varepsilon_t \qquad (3)$$

Where

Log: Natural log of the respective variables.

ε_t: stochastic term (with the usual properties of zero and non-serial correlation)

$log\beta_0$: constant term;

β_1, β_2, β_3, β_4 are elasticities showing the degree of responsiveness of the dependent variable FISP to a proportional change in the independent variables; OILS, OILP, FCAP, FLAB

A priori Expectation

$\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 \geq 0$, $\beta_4 > 0$

Estimation Techniques

This study employed econometric technique to assess the relationship between oil spillage and fish production among other associated variables. The descriptive method consists of trend graph as shown in Figure 1, 2 & 3 to show the trends of oil spillage and fish production thus explaining the behaviour of the variables from 1981 to 2015. This scope provides a long period dynamic variables and their effect on fish production in the Niger Delta of Nigeria. The econometric methods adopted include Augmented Dickey Fuller Stationary test, Johansen co-integration, Fully Modified Ordinary Least Square (FMOLS) and Pairwise Granger Causality Test. 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 is used to test for long run relationship between the dependent variable and the independent variables, Fully Modified Ordinary Least Squares is used to estimate the long run effect of the independent variables on the dependent variables after correcting for the endogenity problem in the time series and Pairwise Granger Causality Test.

1. Interpretation and Discussion of Results

This study deals with the presentation of data, analysis of data and interpretation of findings from the model put forward as well as testing of the research hypothesis. The parameter estimates were subject to various economic and econometric tests. The logarithms of the variables were obtained to bring the time-series data on the variables to the same base.

i. Stationarity Test

The decision rule for the Augmented Dickey Fuller (ADF) Unit root test states that the PP Test statistic value must be greater than the Critical Value at 5% absolute term for stationarity to be established at level and if otherwise, differencing occurs using the same decision rule. Thus, the summary of results of the Augmented Dickey Fuller (ADF) unit root presented in table 5.1 shows that all the variables are stationary after first difference at 5% significant level. Therefore, this implies that the variables are I (1) series.

Table 1. Results of Augmented Dickey Fuller (ADF) Unit Root Test

Variables	ADF Test Statistics		Critical Value		Order of integration	Remarks
	Level	1ST diff	1%	5%		
LOGFISP	0.9628	-8.3643	-3.6463	-2.9540	I(1)	First Difference
LOGFLAB	-1.0359	-7.8305	-3.6395	-2.9511	I(1)	First Difference
LOGFLON	-0.5447	-9.3702	-3.6537	-2.9571	I(1)	First Difference
LOGOILP	-1.6021	-5.6437	-3.6394	-2.9511	I(1)	First Difference
LOGOILS	-0.3276	-6.2749	-2.6347	-1.9510	I(1)	First Difference

Source: Author's computation (2017) from E-view (8.0)

ii. Co-integration Test

The co-integration test establishes whether a long-run equilibrium relationship exist among the variables of interest. Since the unit root test employed revealed that all the variables are integrated of order 1, thus, Johansen Co-integration test can be employed.

Test of co-integration Hypothesis:

H_0: $\varphi = 0$ (No Co-integrating equation)

H_1: $\varphi \neq 0$ (Co-integrating equations)

The results of unrestricted trace co-integrating rank test suggest that the null hypothesis (H_0) of no co-integrating equation is rejected and suggests the presence of one co-integrating equation at 5 percent significance level. Also, the unrestricted max-eigen co-integrating rank test rejects the null hypothesis (H_0) of no co-integrating equation and suggests the presence of one co-integrating equation at 5 percent significance level (as shown in Table 2). Hence, conclude that both unrestricted trace co-integrating rank test and unrestricted max-eigen co-integrating rank test confirmed the presence of co-integrating equation. Hence, there is a long run relationship between the dependent variable (LOGFISP) and the independent variables (LOGOILS, LOGOILP, LOGFLAB, and LOGFLON).

Table 2 Co-integration Rank Test Result

Ho	Ha	Eigen value			Max-Eigen Statistics	
r=0		0.7183	85.2021	76.9728**	39.2774	34.8059**
		0.4901	45.9246	54.0790	20.8779	28.5881
		0.3570	25.0467	35.1928	13.6909	22.2996
		0.2251	11.3558	20.2618	7.90561	15.8921
		0.1053	3.45017	9.16455	3.45017	9.16455

Source: Author's computation (2017) from E-view (8.0)
NOTE: (**) denotes rejection of hypothesis at 5% level of significance.

iii. Fully Modified Ordinary Least Square (FMOLS)

The long run adjustment dynamics can be usefully described by the Fully Modified Ordinary Least Square (FMOLS). FMOLS models are categories of multiple time series models that directly estimate the long run effect of the independent variables on the dependent variables after correcting for the endogenity problem in the time series (Robin, 2008). FMOLS is also referred to as co-integrating equation model.

iv. Goodness of Fit

The goodness-of-fit is good; this can be seen from the coefficient of determination R squared. The adjusted R squared of 0.7013 indicate the explanatory variables in the model explains that 70 percent variations in fish production is jointly explained by number of fishers (FLAB), credits to fish, oil production and oil spills (independent variables) in Nigeria, while 30 percent of variation in the dependent variable was due to error term. The F statistics confirmed that the model is statistically significant at 5 percent significant level (as shown in Table 3)

v. Statistical Test

The long run estimates presented in Table 3 revealed that number of fishers (FLAB), oil production (OILP) and oil spills (OILS) in Nigeria are statistically significant at 5 percent significant level. But, loan to fishery or fish production is statistically insignificant to explain changes in fish production in Nigeria at 5 percent significance level.

Specifically, 1 percent increase the number of fishers induces 0.72 percent raise in fish production in the long run. However, 1 percent increase in oil production induce 0.43 percent decline in fish production and 1 percent raise in oil spills induces 0.04 percent fall in fish production in the long run (as shown in Table 3).

Table 3 Summary of FMOLS results

Dependent Variable: LOGFISP	Coefficient	Std. error	t-statistic	P-value
LOGFLAB	0.7153	0.019609	39.47806	0.0000**
LOGFLOAN	-0.0051	0.004644	-1.090872	0.2846
LOGOILP	-0.4319	0.036292	-11.90307	0.0000**
LOGOILS	-0.0359	0.006375	-5.638374	0.0000**
Constant	12.4855	0.647376	19.28704	0.0000**
Adjusted $\boldsymbol{R^2}$=0.70				

Source: Researcher's computation (2017) from E-view (8.0)

NOTE: (**) denotes rejection null hypothesis at 5% significance level

vi. Pairwise Granger Causality Test

Granger's (1969) concept of causality occurs when time series Xt and Yt are co-integrated; a linear combination of them must be stationary. Granger causality test states the differences between the two type of causation that exist between two variables (unidirectional and bidirectional causation). Unidirectional causality states that if A Causes B, B cannot cause A while bidirectional causality test states that if A Causes B, Then B causes A.

Table 4 Pairwise Granger Causality Tests

Pairwise Granger Causality Tests			
Sample: 1981 2015			
Null Hypothesis:	Obs	F-Statistic	Prob.
LFISP does not Granger Cause LNO_SPILLS	34	5.14301	0.305
LNO_SPILLS does not Granger Cause LFISP		4.10906	0.0513

Source: Author's Compilation using EVIEWS 9.0

Using this concept, we do not reject the null hypothesis which states that fish production does not Granger cause the number of times oil is spilled on the environment since its P-value (0.30) is greater than 0.05 significance level. However, we reject the null hypothesis in favour of the alternative hypothesis which states that the number of times oil is spilled on the environment affect the level of fish production thus we make a case of unidirectional relationship arguing that the environmental effect of oil spillage as proxied by the number of times oil is spilled influences the level of fish production of Niger Delta of Nigeria.

DISCUSSION OF RESULTS

This study confirmed the adverse effect of increase in oil spill on fish production in Nigeria. These oil spills are usually due to continuous incidences of vandalism and corrosion of oil pipe lines which destroy aquatic life and pollute the environment such that agricultural activities becomes impossible in the affect area especially in the Niger delta region of the country. The long term effect of this incidence is usually a reduction in crop yield and death of fish. This study corroborates the findings in Akpokodje and Salau (2015) that oil spills is a major impediment to agricultural activities in the Nigeria Delta region of the country. Also, several studies have shown that the pollution caused by oil spillage does not end with the mopping up of the spilled oil. It is now known that health risk is not averted by abstinence from fish killed by spilled oil. Some of the fishes and animals that escape instant death from pollution are known to have taken in some of the toxic substances, which in turn get into human beings that eat them. This will in turn cause infections on man coupled with other "side effects inform of genetic mutations" (Agahlino, 2000; Anejionu et al., 2015).

In fact, oil activity depresses fish production in the long run because of the unwholesome environmental degradation that accompany exploration of crude oil in the country. These oil driven environmental factors affecting fishing activities include gas flaring, oil well blowouts, and improper disposal of drilling mud, and pipeline leakages as observed in Ojakorotu & Okeke-Uzodike (2006).

Furthermore, this study finds that more labour involvement in fish production improves fish outputs in the country, exerting the positive and substantial influence on the fish outputs. Sustainable improvement in agricultural sector required skilled and able-bodied youths to engage in agricultural process. This would drastically increase agricultural outputs in the country providing jobs for the unemployment youths and reducing incidences of restiveness in the country. However, credits to fish farmers through the agricultural credit guarantee scheme funds (ACGSF) exert negligible, inverse and insignificant effect on fish outputs in the long run. This finding confirmed the outcome of the study by Anetor, et al (2016), Nwosu et al. (2010), and Akinleye, Akanni, & Oladoja (2005) that the agricultural credit guarantee scheme fund has no significant impact on agricultural production. This may be as a result of some challenges affecting the effectiveness of the scheme. Some of the challenges include a high rate of loan default by farmers; lack of full cooperation by participatory banks.

CONCLUSION

This study concludes that there is a trade-off between oil activities and fish production due to the effect of oil spills. This research work has demonstrated that, increase in levels of oil spillage and oil production negatively affects fish production or productivity in the Niger Delta of Nigeria. The incidences of oil spills among other environmental factors depress agricultural outputs particularly fishing. Also, agricultural interventions in Nigeria such as Agricultural Credit Guarantee Scheme Fund (ACGSF) failed to substantially improve fish production in Nigeria. Furthermore, labour input in fishing agricultural sub-sector can be employed to improving productivity in the subsector.

The Federal government and Department of Petroleum Resources should, enforce policies on pipeline life span duration, in order to reduce corrosion of pipelines. The adoption of the Special partnership framework (SPF) will help significantly in reducing oil-induced environmental diseconomies in the Niger Delta of Nigeria, including second-round consequences that undermine peace in the region which adversely affect both oil and agricultural outputs from the region. It would also lessen the incidences of vandalism and restiveness in the area.

Also, the federal government should be prompt in the clean-up of the affected areas, management of spills (both of catastrophic and local dimensions) and play a leading role by enacting and enforcing stringent environmental laws that will protect the oil producing areas. Government should also be able to identify natural resources (such as wetlands and coastal zones) in the Nigeria and monetary investment in environmental protection of vulnerable areas should be seriously looked into. There should be standard enforcement of the existing water quality and water promotion quality monitoring, in addition to active monitoring and evaluation systems for water-related projects and services in the three tiers of government in Nigeria.
In addition, the establishment of a framework for collaboration through training and financial support by government to strengthen environmental agencies and organizations in their role as a watch dog thereby ensuring the exchange of information, especially for high risk oil production projects.

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