Consilience: The Journal of Sustainable Development
Vol. 15, Iss. 1 (2016), Pp. 34-49

A Comparative Analysis of Productivities in Shellfish Collection in Oil Spill and Non-Oil Spill Communities of River State, Nigeria

[1]Ndubueze-Ogaraku, Mercy Ebere, [2]Onoja, Anthony. O &
[3]Monsi, Blessing

[1,2 &3] Department of Agricultural Economics and Extension, Faculty of Agriculture, University of Port-Harcourt, East-West Road, Choba Rivers State, Nigeria
Corresponding author's address: eberem2@gmail.com

Abstract

This study compares the incomes generated from periwinkle and dog-winkle catch amongst farmers in oil spill-affected and non-oil -spill-affected areas in Gokana and Khana Local Government Areas, Rivers State, Nigeria. A total of 120 farmers were randomly selected and data were collected using structured questionnaires and personal interviews. Analytical tools used included descriptive statistics, net income model, T-test and regression analysis model. Results indicated that income realized by the farmers from shellfish sales in non-oil spill-affected Local Government was higher than that of the oil spill-affected Local Government Area per annum and was estimated as ₦407,812.79.00 and ₦182,485.00 respectively. The level of profit recorded among the farmers in the two areas was significantly different with a T-value of 14.42. The null hypothesis was rejected. The regression model employed three functional forms; linear, semi log and double log. Linear model was chosen as the lead equation because of the highest R^2 of 59%. Cost of labor and transportation had significant effect on the level of profit. Cost of labor positively influenced profit while cost of transportation negatively influenced the profit. It is recommended that government intervention programs provide a cheaper means of transportation in the area.

Keywords: comparative, shellfish, collection oil-spilled, non-oil spill communities

Introduction

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially marine areas due to human activity, and is a form of pollution (USLEGAL, 2015). The term usually applies to marine oil spills, where oil is released into the ocean or coastal water, but spills may also occur on land. Oil spills may be due to releases of crude from-tankers, offshore platforms, drilling rigs and wells - as well as spills of petroleum products (such as gasoline, diesel) and their by-products. Oil spillage is harmful to the environment, posing threats to fresh water and marine environment. It affects surface resources and a wide range of subsurface organisms that are linked in a complex food chain that includes human food resources. Spilled oil can harm the environment in several ways, including the physical damages that directly impact wildlife and their habitats such as coating birds or mammals with a layer of oil), and the toxicity of the oil itself, which can poison exposed organisms (Nomack,2010). Oil pollution threatens the health of shellfish and shellfish industry as well as other aquatic life. Oil pollution in many intertidal creeks has left mangrove-nurseries for fish and natural pollution filters-denuded of leaves and stems with roots coated in a layer of bitumen-type substance sometimes one centimeter or more thick (Lazzeri, 2011). Pollution kills shellfish and their food source and damages their ability to reproduce, causing both immediate and long-term damage, cumulative harm to shellfish. Oil spills have seriously damaged the Niger Delta mangrove, which is an important fish and shellfish breeding area (Obire & Amusan, 2003). The severity of an oil spill's impact depends on a variety of factors, including the physical properties of the oil, whether oils are petroleum-based or non petroleum-based, and the ultimate fate of the spilled oil (Nomack, 2010). Nomack further states that freshwater bodies are highly sensitive to oil spills and are important to human health and the environment. They provide drinking water and nesting grounds and food sources for various freshwater organisms. All types of freshwater organisms are susceptible to the deadly effects of spilled oil, including mammals, aquatic birds, fish, insects, microorganisms, and vegetation.

Oil spills have a widespread impact on a host of interconnected species (*John, 2010)*. According to John, lush marsh vegetation provides nurseries for shellfish and fish, a food source for many organisms, and a home for fish, birds, and mammals. Species that are not directly in contact with oil can be harmed by a spill. Predators that consume contaminated prey can be exposed to oil through ingestion. Because oil contamination gives fish and other animals' unpleasant tastes

and smells, predators will sometimes refuse to eat their prey and may begin to starve. Sometimes, a local population of prey organisms is destroyed, leaving no food resources for predators.

There were more than 7,000 spills between 1970 and 2000 in Nigeria, and there are 2,000 official major spillages sites, with thousands of smaller ones also waiting to be cleared up (Vidal, 2010). More than 1,000 spill cases have been filed against Shell alone. The Department of Petroleum Resources estimated 1.89 million barrels of petroleum were spilled into the Niger Delta between 1976 and 1996 out of a total of 2.4 million spilled in 4,835 incidents (Vidal, 2010).

Several efforts had been made by the government and oil companies to control oil spills in the state but the problem of oil spill has yet to be sufficiently addressed. The Nigerian government is financially dependent on oil companies and the actions of the oil companies are encouraged by the favorable regulations of the government (Pitkin, 2013). The country is so reliant on its oil that it has relatively little leverage when negotiating with the oil companies. Oil producing communities in Nigeria experience extensive environmental degradation as a result of oil company activities. According to Pitkin, reckless oil extraction has many damaging environmental impacts, from the initial clearing of sensitive ecosystem to pollution during the extraction process to the treatment of industrial wastes.

Shellfish is a term for exoskeleton bearing aquatic invertebrates used as food; it includes various species of mollusks, crustaceans and echinoderm. Despite the name, shellfish are not real fish but simply animals that live in water. Most shellfish are found in salt water environments while some others are found in fresh water environments (Pawley, 2004). Periwinkle (*Tympanotonus fuscatus*) and Dog-winkle (*Thais nodosa*) are among the most popular shellfish found in Bodo and Kaa creek in Gokana and Khana Local Government Area of Rivers State (Amnesty international, 2009). They exist in intertidal swamps where the substratum is muddy. Periwinkle (*T. fuscatus*) and Dog-winkle (*T. nodosa*) are very important sources of animal protein, especially in communities around coastal areas. The shells obtained from shellfish are good source of calcium for animal feed and for construction purposes. The shells also provide erosion control in villages around coastal regions in Nigeria (Bob-Manuel, 2011).

In Gokana Local Government Area of Rivers State, the shellfish market constitutes an important industry and means of livelihood for several people within the area (Zabbey, Hart &Wolf, 2010). Akinrotimi, Abu, Ibemere and Opara (2009), recommend that 35g out of the required minimum of 77g of reference protein should be obtained from animal products. But only 7g out the 35g available in Nigerian diets comes from animal sources. This means that only one fifth of the minimum animal protein requirement is presently supplied by animals

produced in the country. They further estimated the quantity of fish required in Nigeria to be 869,000 tons/year, whereas the quantity produced from all sources was 663,000 tons leaving a deficit of 206,000 tons. Of this deficit, a little over 106,000 tons was met by imports. It could be concluded from the trend of events between 1975 and 1985 that the deficit value must have risen higher within the decade. Aviachie (1976) as cited in Akinrotimi., *et al*, (2009) reported that maximum sustainable yield of fish from all sources was 484,000 metric tonnes while the demand for human consumption alone for the target years 1975, 1980, and 1985 were 380,000tons, 574,000 tons, and 1,229,000 metric tons respectively. Nigeria is blessed with quite a lot of marine shellfish with potential for culture but the country has recorded a disparity between demand and supply of the product.

According to Akinrotimi., et. al (2009), marine shellfish could contribute significantly to our nutritional needs in this country, as shellfish are cheaper protein source than conventional sources such as beef, chicken meat, pork, egg, and fish. The generally low fat content of shellfish makes them useful in mitigating obesity in our society. The above factors, coupled with an abundant natural seed supply, are good indicators that marine shellfish cultures such as oysters, periwinkle and cockles have good prospects for investment in Nigeria.

Periwinkle (*T. fuscatus*) and Dog-winkle (*T. nodosa*) are sources of food, livelihood and income, yet their productivity and availability has been constrained by several occurrences of oil spills on bodies of water in Gokana, especially in the Bodo community (Zabbey, 2008). It was further observed that oil pollution substantially degrades the delta network of alluvial swamps, creeks and rivers, which in turn produce undesirable impact on the environment and income levels of the people in the area.

The activities of petroleum exploration, exploitation and production produce various wastes, which are a major source of pollution in the coastal states (Ekpo and Essien-Ibok 2013). The disposal of these wastes in the Niger Delta has polluted land and water, damaging fisheries and agriculture, which has affected the standard of living of the people. Oil spill pollutants affect aquatic life in the sediments and the open water, thus leading to massive fish kill, including all the organisms that contribute to the food web of fish species (Enyenihi, 1990).

According to Pyagbara (2004), one of the fallouts of oil pollution in Gokana in Rivers State is the destruction of the traditional local economy of fishing and farming. Fish and shellfish are driven from in-shore as a result of water pollution and gas flaring, causing poor shellfish catch, which has led to

dysfunction socio-economic fishing activities. Oil exploration and exploitation in the coastal waters and creeks causes the pollution of the aquatic environments, which poses a serious threat to the survival and development of fish stocks. In the coastal waters, especially estuaries, it destroys the nursery and feeding grounds, thereby impoverishing the artisanal fishermen. Pollution kills fish, their food sources and fish larvae, and damages the ability of fish to reproduce, causing both immediate and long-term damage to fish stocks. When oil and wastes are discharged into an enclosed body of water, fish are directly exposed to pollutants and can die (Ifunanya, 2010).

The problem of oil pollution has plagued the collection of periwinkle (*T. fuscatus*) and Dog-winkle (*T. nodosa*), which has affected the income levels as well as the living standards of the people. The reduction in the quantity supplied in the markets may have been responsible for increase in the price of shellfish in the study area. Over the past 5 to 6 years, the influence of oil spillage on water bodies in the community has resulted in very low harvest of *T. fuscatus* and *T. nodosa* (Zabbey 2008). According to Zabbey, the danger of oil pollution has threatened the locality where Periwinkle and Dog-winkle are found. According to local sources, oil spillage occurred in August, 2008 and the spill continued for over 4 years. Before the year 2008, the Bodo community was the major market for periwinkle (*T. fuscatus*) and Dog-winkle (*T. nodosa*) and the major distributor of these shellfish to Bori, Onne, and Tai markets in Ogoni (Onugbuta-Enyi, Zabbey, and Erondu 2008).

The people in these communities hardly catch enough quantity of these products for family consumption. The study was designed to compare income generation from shellfish collection in the oil spill-affected and non-oil spill-affected communities of Gokana and Khana Local Government Areas, Rivers State. The specific objectives of the study were to; estimate and compare the cost and returns from shellfish collection in oil spill and non-oil spill communities per annum and determine the effects of socio-economic variables on profit from shellfish collection in oil spill and non-oil spill communities in the study area.

Hypothesis of the study

Ho_1: The profit level from shellfish collection in non-oil spill-affected community is not significantly different from oil spill-affected communities.

Methodology

The study was carried out in Bodo and Kaa communities Gokana and Khana Local Government Areas of Rivers State, Eastern Niger Delta of Nigeria. There are 18 communities in Gokana Local Government Area, including Bodo, and 38 communities in Khana Local Government Area, including Kaa. Bodo and Kaa creeks provide opportunities for large-scale shellfish. Bodo community creek lies approximately between Latitudes 4^0 36^1 and '4^0 35 N and between Longitudes 7^0 15^1 and 7^0 16^1 "50 9. Gokana and Khana Local Government areas are located between Latitudes 4^0 33 and 4^0 50' N and Longitudes 7^0 20' and 7^0 35' E. The population of the of Gokana people according to NPC 2006 figure was estimated at 233, 813 comprising 188, 22 males and 115 females. There are 18 settlements in the study area and each settlement has a majority of fishermen and farmers, with an estimated 22,000 farmers in Kaa Khana Local Government Area (Pyagbara, 2002).

Sampling Techniques

Purposive and random sampling techniques were used in selection of the respondents. Bodo city was purposively selected from Gokana Local Government Area, which is an oil spill-affected community (Amnesty International, 2009). Kaa was purposively selected from Khana Local Government Area, which is a non-oil spill community (Zabbey, 2009). Random sampling technique was adopted in selection of respondents who are involved in shellfish catch. Sixty (60) respondents were selected from Bodo city in Gokana Local Government Area and 60 respondents were selected from Kaa in Khana Local Government Area, giving a total of 120 farmers in the entire study area.

Data Sources and Collection Method

The study relied on both primary and secondary sources of data. Primary sources of data were collected using questionnaires, personal observations and interviews to obtain relevant information from farmers while secondary sources of data were collected from journals, textbooks, and internet publications. The study used a questionnaire including questions about the type and quantity of shellfish collected, unit price, cost of labor, transportation and sales. Interviews and personal observation were used to obtain other relevant information from the respondents.

Method and Technique for Data Analysis

Objective one (1), which is estimation of cost and returns from periwinkle and dog-winkle, was analyzed using net farm income model and Objective two (2) was analyzed using multiple regression model.

Net Income Model

TC = TVC + TFC

Where:

TC = Total cost of shell fish collection

TVC = Total variable cost shellfish collection which include; cost of labor (₦), cost of transportation (₦), cost of packaging materials (₦) and miscellaneous expenses (₦)

TFC = Total fixed cost ie the depreciation value of the fixed assets; depreciation value of basins (₦), basket in (₦), lantern in (₦), bowls in (₦)

TR = P x Q;

Where:

TR = Total revenue of the shellfish collector

P = Price of shellfish per unit

Q = Quantity of periwinkle and dog-winkle harvested (collected);

NI = GM – TFC

Where: NI = Net Income of the farmers

GM = Gross Margin

Regression Analysis Model

$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + e$

Where

Y = Amount of net income in naira

X_1 = Amount of labor in naira

X_2 = Age in years

X_3 = Educational level

X_4 = Household size in numbers

X_5 = Gender (Female (1), Male (2))

X_6 = Years of experience in numbers

X_7 = Marital status

X_8 = Cost of transportation in naira

a = Constant term

e = Random term assumed to have zero mean and constant variance.

The functional term is fitted below using three (3) functional forms:

Linear Production Function

$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + e$ …….. (1)

Semi-Log Production function.

$LogY = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + e$ …….. (2)

Cobb-Douglas' Production Function (double log)

$LogY = a + b_1 logx_1 + b_2 logx_2 + b_3 logx_3 + b_4 logx_4 + b_5 logx_5 + b_6 logx_6 + b_7 logx_7 + b_8 logx_8 + e$ …….....(3)

Where; x_1-----x_8 = independent variables

b_1----b_8 = regression coefficients

a = constant term

e = error term

t-test Analysis

$$t = \frac{\bar{x}_1 - \bar{x}_2 - \Delta}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where

$\bar{x}_1$ and $\bar{x}_2$ are the means of the two samples

Δ is the hypothesized difference between the population means

s_1 and s_2 are the standard deviations of the two samples

n_1 and n_2 are the sizes of the two samples.

Results and Discussion

Table 1 presents the result of the profitability of shellfish collection in Gokana and Khana Local Government Areas, Rivers State.

Table 1: Cost and returns of shellfish collection in the non- oil spill community in Khana Local Government Area of Rivers State.

Items	Amount in Naira (₦)
Cost of Labor	61,285.42
Cost of Transport	3,860.34
Packaging Materials	768.86
Miscellaneous Expenses	4,717.97
Total variable cost	70,632.59
Revenue	
Revenue from Periwinkle	163,848.22
Dog-winkle	243,964.57
Total Revenue from Dog-winkle	407,812.79
GROSS MARGIN	337,180.20
Total Fixed Cost	3,059.32
Total costs	73,691.91
NET PROFIT	334,120.88

Source: Field Survey, 2013.

The results in Table 1 show the cost and returns of shellfish farmers in the non-oil spill community (Kaa) in Khana Local Government Area, demonstrating that variable cost was seventy thousand six hundred and thirty two naira fifty nine kobo (**₦70,632.59),** fixed cost was estimated as three thousand fifty nine naira thirty two kobo **(₦3,059.32)** and the total cost was seventy three thousand six hundred and ninety one naira ninety one kobo (**₦ 73,691.91**). The total revenue was four hundred and seven thousand eight hundred and twelve naira seventy nine kobo (**₦407,812.79**). The gross margin was estimated as three hundred and thirty seven thousand one hundred and eighty naira twenty kobo (**₦337,180.20**) while the net profit was found to be three hundred and thirty four thousand one hundred and twenty naira eighty eight kobo (**₦334,120.88**).

Table 2: cost and returns of shellfish collection in oil spill community in Gokana Local Government Area

Items	Amount in Naira (₦)
Cost of Labor	35,800
Cost of Transportation	7,008.00
Packaging Materials	539.08
Miscellaneous Expenses	4,696.00
Total variable cost	48,043.08
Revenue	
Periwinkle	78600.1

Dog-winkle	182,485.74
Total revenue from Periwinkle and Dog-winkle	182,485.74
GROSS MARGIN	**134,442.66**
Total Fixed Costs	3,074.50
Total Cost	51,117.58
NET PROFIT	**131,368.16**

Field survey, 2013

The results in Table 2 show the cost and returns of shellfish farmers in the non-oil spill community (Bodo city) in Gokana Local Government Area, demonstrating that the variable cost was estimated at forty thousand forty-three naira eight kobo (**₦48,043.08**), fixed cost was estimated at three thousand seventy-four naira fifty kobo (**₦3,074.50**) and the total cost was fifty-one thousand one hundred and seventeen naira fifty-eight kobo (**₦51,117.58**). Total revenue of farmers in oil spill area was one hundred and eighty-two thousand four hundred and eighty-five naira seventy-four kobo (**₦182,485.74**). Gross margin was estimated at one hundred and thirty-four thousand four hundred and forty-two naira sixty-six kobo (**₦134,442.66**) while the net profit was one hundred and thirty-one thousand three hundred and sixty-eight naira sixteen kobo (**₦131,368.16**). Net profit from oil spill community was one hundred and thirty-one thousand three hundred and sixty-eight naira sixteen kobo (**₦131,368.16**).

Table 3: Difference in profits level between oil spill and non-oil spill communities

Parameter	Mean profit from Non oil spill community (₦)	Mean profit from oil spill community(₦)
Mean profit	89,296.84	27,532.22
Person correlation	0.067	
Std. Deviation	29084.38	18040.43
Std. Error	3754.78	2329.01
Hypothesized Mean Difference	0	
Df	59	
t Stat	14.420	
P(T<=t) one-tail	5.3193572E-4	
t Critical one-tail	1.671	
P(T<=t) two-tail	7.0335676-E4	
t Critical two-tail	2.000	

Source: Field survey, 2013

The results in Table 3 show the mean net profit of farmers of shellfish collection in non-oil spill community in Khana Local Government Area, which was estimated as eighty-

nine thousand two hundred and ninety-six naira eighty-six kobo (**₦89,296.84**), while the mean Net profit of farmers in oil spill community in Gokana Local Government Area was twenty-seven thousand five hundred and thirty-two naira twenty-one kobo (**₦27,532.21**). The t-value was (14.42) which indicates that the mean profit value between the two Local Government Areas is significantly different at 1 percent level of significance.

The null hypothesis was rejected. The alternative hypothesis that the mean profit from non-oil spill community was higher than the mean profit from oil spill community was accepted. This implies that people in non-oil spill community made higher profit than those in oil spill community. The oil pollution in the study area may have damages some aquatic life, causing the low catch recorded by the collectors in the oil spill-affected community. This is in line with the report of Zabbey (2008), which observed that oil pollution substantially degrades the delta network of alluvial swamps, creeks and rivers, which in turn produces undesirable impacts on the environment and local income levels.

Table 4: Determinants profit for Periwinkle and Dog-winkle in the study area

	Linear		Semi-log		Double log	
Variables	Coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	124273.500	5.435***	12.508	8.440***	21.478	2.593**
Sex	-12800.800	-1.609	-0.473	-0.917	-0.019	-0.330
Education	3990.388	1.055	0.160	0.654	0.390	0.909
Household	-5595.95	-1.419	-0.149	-0.583	-0.196	-0.445
Experience	-2325.338	-0.787	-0.038	-0.200	0.106	0.206
Labor cost	0.347	2.181**	0.000	1.146	0.448	0.925
Transport cost	-11.534	-8.882*	0.000	-3.852***	-1.890	-3.956***
Age	-396.885	-1.077	-0.011	-0.481	0.029	0.036
Marital Status	2774.262	1.015	-0.120	-0.677	-0.201	-0.548
R- Squared =	0.585		0.228			0.216
Adjusted R-square	0.555		0.172			0.159

Field survey, 2013

Table 4 presents the regression results of determinants on profitability for periwinkle and dog-winkle, showing that linear functional form had the highest R^2 (i.e. coefficient of multiple determinants of 58.5% was chosen as the lead equation and used for discussion. The estimated R^2 of 58.5% implies that 58.5% of the variability of the exogenous variable is attributable to the explanatory variables used in the model.

Cost of transport had a significant and negative coefficient, which indicates that an increase in money spent on transportation resulted to decrease in profitability from shellfish collection. This implies that transportation plays a significant role in the profit level of shellfish collection in Khana and Gokana Local Government Areas. This is in consistent with the finding of Yesufu and Ayanwale (2013) which showed that cost of transportation negatively influenced the level of profit realized in broiler processing in southwestern Nigeria.

The results also show that the cost of labor was statistically significant and positively correlated with revenue. This is consistent with the findings of Dziwornu (2014), who found that costs of day-old chicks, feed, labor, medicine/vaccines, and other cost had positive and significant correlation with profit. The study also agrees with the finding of Adebayo, Anyanwu, Ikenwachukwu and Onyia (2014), which indicated that amount of the labor used in harvesting fish in Nigeria positively influenced the quantity of fish harvested at a statistically significant1% level. This implied that more labor expended in the business led to greater output and therefore greater revenue and profit.

The positive correlation between labor and net profit in shellfish collection implies that increased cost of labor results in increased net profit for the farmers. This is because if farmers employ more labor, they will harvest a greater quantity of periwinkle and dog-winkle, resulting in increased sales and revenue and increased profit levels.

Conclusion

This study estimated mean profit differentials in non-oil spill-affected and oil spill-affected communities. It found that productivity of non oil spill-affected communities was higher than their counterparts engaged in shellfish collection activities in oil spill community. The significant difference in mean profit value between the two Local Government Areas suggests that crude oil pollution may have contributed to the low catch recorded in the oil spill-affected communities. Given the above findings, it is recommended that immediate and proactive measures to be taken to avert further degradation of the fishery

resources in the area, which could jeopardize the livelihood of the fishermen in the area. In light of these findings, the authors recommend that;

Crude oil drilling companies in the area should replace faulty oil drilling pipes with new ones. They also suggest that educational and research institutes including National Institute for Fishery, Oceanography and Marine Research should fund studies and experiments on the domestication of shellfish in the study area. They further suggest that the government and oil companies involved in crude oil drilling should ensure that oil spillage be controlled in the study area and that efforts should be made to reduce the cost of transportation through programs that subsidize transportation costs.

References

Adebayo E. F., Anyanwu S. O, Ikenwachukwu N. & Onyia L. U. (2014). Economics of fish harvesting in Nigeria: A Case Study of Yola North Local Government Area of Adamawa State.

IIFET 2014 Australia Conference Proceedings. https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/54437/ADEBAYO%20135.pdf?sequence

Akinrotimi, O.A., Abu O.M.G, Ibemere, I.F., Opara. C.A., (2009). Economic viability and marketing strategy f periwinkle in Rivers State, Nigeria. Retrieved on 12/12/13 from www.aquaticcommons.org/7321/1/Vol_5_2

Amnesty International (2009). Nigeria*:* petroleum, population and poverty in Niger Delta. London: *Amnesty International publication*. Retrieved on 20/03/13 from http:amnesty.org

Amnesty Report (2011). Nigeria: oil giant shell criticized over Niger Delta pipelines "Sabotage" claims. *Amnesty International Publication. Retrieve on 20/08/2013* from www.amnesty.org/en/news/shell-

Bob-Manuel, F. G., (2011). Food and feeding ecology of the Mudskipper *Periopthalmiskoelreuteri*(PALLAS) Gobiidae at Rumuolumeni Creek, Niger Delta, Nigeria. *Agriculture and Biology Journal of North America*. 2 (6): 897 – 901

Dziwornu, R.K (2014). Econometric analysis of factors affecting competitive advantage of broiler agribusinesses in Ghana. Journal of Development and Agricultural Economics. Vol. 6(2), pp. 87-93.

Ekpo, I.E and Essien-Ibok, M.A (2013). Development, prospects and challenges of artisanal fisheries in Akwa Ibom State, Nigeria. International Journal of Environmental Science, Management and Engineering Research Vol. 2 (3), pp. 69-86, Jul-Aug., 2013 Available online at http://www.ijesmer.com

Enyenihi U.K. (1990). Biological conservation for environmental stability and food production. Trans. Nig. Soc. Boil. Conserve. 1: 4 – 10.

Ifunanya A.S. (2010). The impact of oil spillage on agricultural production: a case study of Ibeno Local Government Area, Akwa Ibom State, Nigeria. Pp 117.

Lazzeri, T (2011). Shell accepts liability for two oil spills in Nigeria', *The Guardian*, 03/08/2011,

http://www.guardian.co.uk/environment/2011/aug/03/shell-liability-oil-spills-nigeria

National Population Commission (NPC)(2006). Legal notice on publication of 2006 census final results. *Federal Republic of Nigeria Official Gazette*, Abuja 2 (96), 1 – 42.

Nomack, M. (2010). Environmental impacts of oil spills. Retrieved from http://www.eoearth.org/view/article/158443

Obire, O. &Amusan, F.O., (2003). The environmental impat of oilfield formation water on a fresh water stream in Nigeria. *Journal of Applied Science & Environmental management.*

Onwugbuta-Enyi, J., Zabbey, N. and Erondu, E.S. (2008). Water quality of Bodo Creek in the Wet Niger Delta basin. *Advance Environmental Biology*. 2(3): 132-136.

Pawley A, (2004). *Are Crustaceans Shellfish*. Retrieve 2013-03-17 from en.wikipedia.org/wiki/Shellfish.

Pitkin, J (2013) Oil, Oil, Everywhere: Environmental and Human Impacts of Oil Extraction in the Niger Delta. An Unpublished B.A thesis submitted to the department of Art for Environmental Analysis. *Theses.* Paper 88. http://scholarship.claremont.edu/pomona_theses/88

Pyagbara, S. L. (2004). Impacts of Oil Pollution on the Environment and Wellbeing of a Local Indigenous Community: A paper prepared for *Movement for the Survival of the Ogoni People (MOSOP) of Nigeria.* Retrieved on 04/04/2013 from www.un.org/esa/socdev/unpfii

USLegal, Inc (2015). Oil spill law and legal definition. definitions.uslegal.com › Legal Definitions Home.

Vidal, J (2010) Nigeria's agony dwarfs the Gulf oil spill. The US and Europe ignore it. The Guardian newspaper Sunday 30th May, 2010. http://www.theguardian.com/world/2010/may/30/oil-spills-nigeria-niger-delta-shell. Accessed on 16th November, 2015

Yesufu, O. A and Ayanwale, A.B (2013). Economic Analysis of Factors Affecting the Profitability of Broiler Processing in South western Nigeria. Learning Publics Journal of Agriculture and Environmental Studies Vol 3 (2). 1-19. Retrieved on 16/06/2015 form learningpublics.org/index.php/agric-journal/article/download/26/23.

Zabbey. N., (2008). Oil and water: the Bodo spill and the destruction of traditional livelihood structures in Niger Delta. *Oxford*

University Press and Community Development Journal. Retrieved on 2/04/2012 from http://cdj.ofordjournals.org

Zabbey, N., (2009). *Pollution and poverty in the Niger Delta Region*-what is the responsibility of oil companies in Nigeria. (Electronic version).

Zabbey, N., Hart, A.I, and Wolf, W.J. (2010). Population structure, biomass and production of the West Africa Lucinid kelestis-les *rhizoecus* (*bivalua*, *mollusca*) in sivibilagbara swamp at sido creek, Niger Delta, Nigeria Hydrobiologia 654, 193-203.

Appendix 1

(a) Pictures of Periwinkle (*Tympanotonus fuscatus*) (b) Dog-winkle (*Thais nodosa*)