



Effect of Oil Spillage on Cassava Production in Niger Delta Region of Nigeria

J. Ahmadu^{1*} and J. Egbodion¹

¹Department of Agricultural Economics and Extension Services, Faculty of Agriculture, University of Benin, Benin City, Nigeria.

Authors' contributions

The lead author JA designed the research questionnaire, carried out the field work, and wrote the first draft of the manuscript. The second author JE joined the lead author in literature searches and data analysis. All authors read and approved the final manuscript

Research Article

Received 3rd April 2013
Accepted 27th June 2013
Published 24th July 2013

ABSTRACT

Aims: To examine the effect of oil spillage on cassava farm land, yield and land productivity.

Place and Duration of Study: Niger Delta region of Nigeria between January and October, 2012.

Methodology: Delta State was purposively chosen from the Niger Delta region for the study. A random sampling technique was employed to select 17 cassava farmers each from three (3) oil spillage communities (Otor-Udu, Olomoro and Uzere) and three (3) non-oil spillage communities (Egini, Aradhe and Ellu), giving a total sample size of 102 respondents for the study. Data analysis was done using descriptive statistics, Likert scale, t-statistic and regression analysis.

Results: The results showed that the major significant effects of oil spillage on cassava production perceived by the farmers included crop failure, poor yield, rotting tubers, and stunted crop growth with mean scores of 4.80, 4.78, 4.75 and 4.75 respectively. Others included increased soil temperature and toxicity (mean: 4.73), reduction of soil fertility (mean: 4.70), degradation of farm land (mean: 4.70) and low land productivity (mean: 4.70). The results further indicated that the cassava farm size, yield and land productivity in oil spillage affected communities were significantly ($p < 0.01$) lower than those of the non-oil spillage communities by 0.61 ha, 6119 metric tonnes (MT) and 1447 MT/ha respectively. These represent significant reduction of 36, 48 and 20% of these variables in the oil

*Corresponding author: Email: joahma@yahoo.com;

spillage affected communities respectively. About 45% of the variation in land productivity in cassava production was influenced by oil spillage and the farmers' farming experience. The productivity increased with increase in farming experience but decreased with increase in oil spills.

Conclusion: Constant maintenance of the oil pipelines and tankers to prevent corrosion and checking of the activities of saboteurs which often destroy oil pipelines will reduce the incidence of oil spillage, hence increasing cassava production in the Niger Delta region. There is need for further study to know the adaptation measures the farmers employed to minimize the adverse effects of oil spillage on their production; and the mitigating measures by government and the oil companies to deal with oil spillage.

Keywords: Effect; oil; spillage; cassava; production; Nigeria.

1. INTRODUCTION

Crude oil exploration in Nigeria has been on the increase since 1956 when crude oil was discovered in commercial quantity in the country. The earnings from the petroleum industry in the country grew from 1960 and became high in the early 1970s during the oil boom. This replaced earnings from agriculture which was the main stay of the nation's economy. Since the early 1970s, the place of crude oil as a key revenue earner for Nigeria has remained unchanged. The oil sector generates over 90% of the nation's foreign exchange earnings [1] and over 80% of government annual revenue [2]. Consequently, less attention was accorded the agricultural sector which is the source of livelihood of the nation's populace. Production, over the years, continued to decline. Besides the low performance of the agricultural sector, the oil exploration activities which cause constant incidence of oil spills, especially in the Niger Delta region of the country have further affected agricultural production. This includes the production of a major staple food crop such as cassava in the oil producing region of the country.

The bulk of the nation's oil production comes from the Niger Delta region [3] with Delta State being the second largest producing state. Statistics show that the crude oil production in Delta State accounts for about 35% of the total crude oil production in Nigeria [4]. The Niger Delta region is an area consisting of vast plain of alluvial sedimentary deposits exposed to flooding. It is crisscrossed by a lot of rivers and creeks where banks are made of levees, bordered by areas mainly consisting of black swamps of equatorial forest and numerous lake-like water-logged depressions. This makes it difficult for heavy rainfall and surface flow, including spilled oil to be drained easily by gravity [3].

The location of the Niger Delta region in the rainforest and mangrove forest vegetative zones of Nigeria makes possible all-year-round agricultural production activities. The inhabitants of the region are engaged in fishing due to the presence of creeks and rivers. They are also engaged in crop production, especially arable crops. Findings by FOS [5] showed that 50% of the active labour force in Delta State is engaged in one form of agricultural activity or another, with cassava, yam, plantain, maize, cocoyam and vegetable as the predominant food crops in the area. With high level of involvement in agriculture in the Niger Delta region and the increasing revenue from crude oil exploitation, one would expect high level of food security and very low (if not zero) poverty level in the region but the reverse is the case. Agriculture is a shadow of itself in the communities in which this black gold (oil) flows and the inhabitants of the communities continue to wallow in conditions of social deprivation and

abject poverty. According to National Bureau of statistics [6], the incidence of poverty in the Niger Delta is alarming, increasing from 15.4% in 1980 to 52.2% in 2004. This is not unconnected with the constant incidence of oil spills which has destroyed the main source of income and productive activities of the region. Over 6,000 oil spills had been recorded in the 40 years of oil exploitation in Nigeria giving an average of 150 spills per annum. A total of 4,647 incidents of oil spills occurred between 1976 and 1996 resulting in the spillage of about 2,369,470 barrels of crude oil and only about 549,060 barrels were recovered, 1,820,410 barrels were lost to the ecosystem [1]. Between 2006 and 2012 alone a total of 127,467.96 barrels of oil were spilled [7]. This is alarming.

The consequences of oil spillage on agricultural production, the environment and humans are enormous. Nnabuenyi [8] observed the negative effects of oil spillage on agriculture and lamented that most of the farmlands are destroyed and rivers polluted leading to the death of fishes; and most farmers and fishermen are thrown into confusion and joblessness. Chindah and Braide [9] added that oil spills cause great damage to the oil communities due to the high retention time of oil in the soil occasioned by limited flow. This prevents proper soil aeration and affects soil temperature, structure, nutrient status and pH, and ultimately, Crops are destroyed. To be specific, one may ask, what is the effect of oil spillage on the production of an important crop such as cassava in the oil producing region of Nigeria such as the Niger Delta region?

Cassava has played and will continue to play a remarkable role in the agricultural development of Nigeria. It has been transformed from a minor crop to a major crop and recently to an export or cash crop. Though Nigeria is the highest producer of cassava in the world, she is also the world's largest consumer, leaving nearly nothing for export. This calls for concerted effort to increase the production of the commodity in the country, including combating the problem of oil spillage on its production. To make significant progress in tackling the problem of oil spills on cassava production, information on the effect of oil spillage on the production of the crop is required. It is in view of this that this study was designed to examine the effect of oil spillage on the production of cassava in the Niger Delta region of Nigeria. Specifically, the study examined the socio-economic characteristics of cassava farmers in the study area, causes of oil spillage in the region and the effect of oil spillage on the farmland, cassava crop, yield and land productivity.

2. METHODOLOGY

2.1 Study Area

The study was carried out in the Niger Delta region of Nigeria. The Niger Delta region, which spans over 20,000 square kilometers, is located in the Atlantic coast of Southern Nigeria where the River Niger divides into numerous tributaries. The region which cuts across nine (9) states of the Federation (Abia, Akwa-Ibom, Bayelsa, Cross- River, Delta, Edo, Imo, Ondo and Rivers States) lies between latitude 4° 49' 60" North of Equator and longitude 6° East of Greenwich Meridian. It is the third largest delta in the world with a coastline spanning about 4500 kilometers. About 2,370 square kilometers of the Niger Delta consist of rivers, creeks and estuaries. Stagnant swamp covers about 8,600 square kilometers, being the largest mangrove swamp in Africa [10]. The region falls within the tropical rain forest zone with high rainfall and thick vegetation cover. The ecosystem of the area is highly diverse and supportive of numerous species of terrestrial and aquatic flora and fauna. Major occupation

of the inhabitants of the area is agriculture. Some of the arable crops produced by the farmers include cassava, yam, cocoyam, maize and rice.

Delta State, the sampled area for the study, is located within the south-south region of Nigeria, with a total land area of about 17,000km² and a coastline spanning about 122km [11]. It has a total population of 4, 098,391 people according to the 2006 Nigeria population census. It is bounded in the north by Edo State, Bayelsa State in the south-west, and in the east and north-east by Anambra and Kogi States respectively, while to the south is the Atlantic Ocean. Administratively, the State is divided into 25 Local Government Areas (LGAs). It has a tropical climate, characterized by two distinct seasons – the wet and dry seasons. The annual rainfall ranges between 190 and 260cm. There is high level of oil exploration and agricultural production activities in the state. Cassava is one of the major staple crops produced in the region.

2.2 Sampling Procedure

Delta State was purposively chosen from the nine (9) states of the Niger Delta for the study. This is because of the high level of oil exploitation in the state. Three (3) Local Government Areas (LGA), (Isoko North, Isoko South and Udu) with high level of oil production and agricultural activities were purposively selected from the state for the study. Also, a purposive sampling technique was applied to select 2 communities from each LGA making a total of 6 communities. Three (3) of the communities had suffered oil spillages while the other 3 had not suffered from oil spillage. The communities that had suffered from oil spillages include Otor-Udu (Udu LGA), Olomoro and Uzere (both in Isoko South LGA); and those that had not suffered from oil spillage include Egini (Udu LGA), Aradhe and Ellu (both in Isoko North LGA). Thereafter, a random sampling technique was employed to select 17 cassava farmers from each community to give a total sample size of 102 farmers (51 respondents each from oil spillage and non-oil spillage communities respectively).

2.3 Data Collection

Data for the study were collected using a well-structured, pre-tested questionnaire administered to the respondents, and complemented with personal interview. Data were collected on the socio-economic characteristics of the cassava farmers, their production inputs and output, causes of losses in cassava production, causes of oil spillage and the effects of the oil spillage on the cassava crop, yield and farmland.

2.4 Data Analysis

Data were analyzed using descriptive statistics, Likert scale, t-statistic and regression analysis.

2.4.1 Descriptive statistics

The descriptive statistics used included the mean, frequency count, percentages and standard deviation.

2.4.2 Likert scale

This was used to measure the perceived causes of oil spillage, and the effect of oil spillage on farmland and the cassava crop. For the causes of oil spillage, the scale of strongly agree (score 4), agree (score 3), disagree (score 2) and strongly disagree (score 1) were used. A mean score of ≥ 2.5 was considered significant. The scales used for the effects of the oil spillage were extremely serious (5), very serious (4), serious (3), moderately serious (2) and not serious (1). The mean score of ≥ 3 was significant.

2.4.3 t-Statistic

The t-statistic was used to test for significant difference between the farm size, output and land productivity of farmers in the oil spillage and non-oil spillage communities. The t-test is given as:

$$t = \frac{\bar{X}_{2i} - \bar{X}_{1i}}{\frac{S_{2i} + S_{1i}}{\sqrt{N_2} \sqrt{N_1}}} \text{----- eqn. (1)}$$

$i = 1, 2, 3$

where:

$t = t - \text{test}$

\bar{X}_{1i} = means of variables $X_1 - X_3$ for farmers in oil spillage communities

\bar{X}_{2i} = means of variables $X_1 - X_3$ for farmers in non-oil spillage communities

S_{1i} = Standard deviation of variables $X_1 - X_3$ for farmers in oil spillage communities

S_{2i} = Standard deviation of variables $X_1 - X_3$ for farmers in non-oil spillage communities

N_1 and N_2 = Sample size of respondents from oil spillage and non-oil spillage communities respectively.

X_1 = Farm size (ha)

X_2 = Cassava yield (MT)

X_3 = Land productivity (MT/ha)

2.4.4 Regression analysis

Multiple Regression analysis using the Ordinary Least Squares (OLS) estimation technique was employed to examine the determinants of land productivity in cassava production. The relationship adopted from Doll and Orazem [12] is implicitly expressed as:

$$Q_L = f(Z_1, Z_2, Z_3, Z_4, Z_5, ei) \text{----- eqn. (2)}$$

Where:

Q_L = Land productivity (yield in metric tonnes/hectare)

Z_1 = Labour (Man days)

Z_2 = Planting material (Number)

Z_3 = Farming experience (years)

Z_4 = Depreciated fixed cost (₦)

Z_5 = Oil spillage (Oil spills = 1, No oil spill = 0)

ei = error term

Three (3) regression models, including linear, semi-log and Cobb-Douglas were fitted for the analysis. Based on the criteria for the selection of lead equation (size of coefficient of determination, signs and the significance of the independent variables and the standard

error of the estimate), the linear function was selected as the equation with the best fit. The linear regression model adopted from Doll and Orazem [12] is explicitly expressed as:

$$Q_L = a_0 + a_1Z_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + a_5Z_5 + e_i \text{ ----- (3)}$$

where:

a_0, a_1, \dots, a_5 are the unknown parameters to be estimated and all other variables are as earlier defined.

Depreciation cost for variable Z_4 is the loss of value of fixed inputs (such as tractor, hoes, cutlasses, wheelbarrow, etc.) due to usage or obsolescence. This was computed using the straight-line method of depreciation given as the original value of input minus its salvage value divided by the years of its life expectancy.

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristics of Respondents

The socio-economic characteristics of cassava farmers in the oil spillage and non-oil spillage communities of the study area are presented in Table 1. The results showed that 63 and 55% of females were involved in cassava production in oil spillage and non-oil spillage affected communities respectively. This indicates the dominance of females in cassava production in the study area. It, therefore, means that boosting cassava production in particular and agricultural production in general, women must be given central focus in the policy thrust of the government. The average ages of the farmers under both oil spillage and non-oil spillage communities (48 and 47 years old respectively) indicated low involvement of the youth in the cassava production enterprise. This confirms the known fact that majority of the youths in Nigeria find agricultural production unattractive. They migrate from the rural areas to the urban centres in search of white collar jobs. The oil spills in the oil spillage communities which degraded the farm land for agricultural production worsen the rural-urban migration of the youth from the communities, leaving farming to older people. Evidently, farmers in the oil spillage communities were older than those of the non-oil spillage communities.

With regard to marital status and family size, 36 and 38 farmers in oil spillage and non-oil spillage communities were married with 6 and 7 family sizes respectively. This shows that married farmers from the non-oil spillage communities were 4% more than those from the oil spillage communities. Their family size was also higher by one (1) person. Large family size would have positive effect on farm production if there is significant family labour contribution to the production. It would, however, affect production negatively if the household members are not actively involved in farming.

On educational level, 71 and 82% of the farmers in the oil spillage and non-oil spillage communities respectively had at least primary education, indicating that majority of the farmers were literate. Farmers from the non-oil spillage communities were 11% more educated than those from the oil spillage communities, mainly because they were younger. Higher literacy level would make them more favourably disposed to accessing information that would increase their productivity more than their counterparts in the oil spillage communities. Though both categories of farmers had high level of farming experience (24

and 23 years for oil spillage and non-oil spillage communities respectively), those from the oil spillage communities were one (1) year more experience, mainly because they were older. Experience in the farming business would enhance the farmers' ability for efficient management practices that will ensure increased productivity, all things being equal.

Table 1. Socio-economic characteristics of cassava farmers in the study area

Category	Oil spillage communities		Non-oil spillage communities	
	Frequency (51)	Percentage (100)	Frequency (51)	Percentage (100)
Gender				
Male	19	37	23	45
Female	32	63	28	55
Age (years)				
< 31	1	2	2	4
31 – 40	15	29	14	27
41- 50	17	33	19	37
51 – 60	13	26	10	20
> 60	5	10	6	12
Mean	48		47	
Marital status				
Single	1	2	3	6
Married	36	70	38	74
Divorced	4	8	2	4
Widow/Widower	10	20	8	16
Household size				
1 – 5	22	43	22	43
6 – 10	26	51	22	43
> 10	3	6	7	14
Mean	6		7	
Educational level				
No formal education	15	29	9	18
Primary school	24	47	22	43
Secondary school	12	24	19	37
Tertiary institution	0	0	1	2
Farming experience (years)				
< 11	3	6	4	8
11 – 20	17	33	17	33
> 20	31	61	30	59
Mean	24		23	
Nature of farming				
Full-time	19	37	30	59
Part-time	32	63	21	41

Source: Field survey, 2012

Majority (59%) of the farmers in non-oil spillage communities were full-time farmers. The reverse is the case in the oil spillage communities as 63% of the respondents were into farming on a part-time basis. This is not unconnected with the problem of constant oil spills in the communities which had made the farm land unavailable and unproductive for farming thereby compelling the farmers to be engaged in other occupation. Consequently, farming

was giving secondary priority. If urgent measures are not taken to arrest the problem of oil spillage in the oil producing areas of the country, efforts to revamp agricultural production in Nigeria will be a chase after the shadow.

3.2 Causes of Losses in Cassava Production

Table 2 presents the results of the multiple responses on the causes of losses in cassava production in the study area. Oil spillage is the major cause of losses in cassava production in the oil spillage affected communities as admitted by all the respondents. This is expected as the effects of the oil spillage on both the crop plants and farm land are grave (Table 4). Inoni et al. [1] confirmed this result when they lamented the negative effects of oil spillage on agricultural production. Other causes of losses in cassava production in both the oil spillage and non-oil spillage communities in descending order of severity included flooding/climate change, pest/disease incidence, poor transportation and inadequate processing facilities. Flooding as one of the causes of losses in cassava production is connected with the fact that most of agricultural lands in the Niger Delta region are exposed to flooding from many crisscrossed of rivers and creeks. Besides, 2012 was a year of national flood disaster in Nigeria and agricultural production was the worst hit by the disaster. Losses caused by climate change were expected because climate change is a global phenomenon whose negative effect on agriculture is grievous [13]. From experience, pest and disease incidence is one major challenge which cassava farmers always grapple with, thus, confirming this finding. The bulky nature of cassava tubers makes it difficult for easy transportation from the farm to processing centres. Besides, the tubers are susceptible to deterioration if not processed on time. As a result, poor transportation and inadequate storage facilities accounted for losses in the production of the commodity.

Table 2. Causes of losses in cassava production

Causes	Oil spillage communities		Non-oil spillage communities	
	Frequency (51)	Percentage (100)	Frequency (51)	Percentage (100)
Pest/Disease incidence	20	39	20	39
Flooding/Climate change	22	43	21	41
Oil spillage	51	100	0	0
Poor transportation facilities	20	39	18	35
Inadequate processing facilities	15	29	14	28
Inadequate storage facilities	3	6	3	6
Poor market for product	2	4	2	4

Source: Field survey, 2012

3.3 Causes of Oil Spillage

The causes of oil spillage in the study area were many as presented in Table 3. The most significant cause was corrosion of oil pipelines (mean: 3.73). Corrosion of the oil pipelines was due to the poor maintenance of the pipelines by the oil companies and the fact that the pipelines had outlived their estimated life-span. This corroborates the finding of Ndinwa et al. [14] who reported that corrosion of oil pipelines and tankers accounted for 50% of the total oil spillage in the oil producing region of Nigeria. The second most significant cause of oil spillage in the study area was sabotage (mean: 3.60). Sabotage, popularly known as

bunkering, is the damage of oil pipelines by saboteurs with a view to stealing oil from them. Shell Petroleum Development Company, however, claimed that oil spills caused by corrosion of pipelines had decreased drastically over the years due to the concerted effort to replace the pipelines. It further claimed that sabotage had taken over the lead in oil spillage, accounting for over 60% of the oil spills at its facilities in Nigeria [14]. Other significant causes of oil spillage included drilling of oil wells (mean: 3.53) and vandalization of oil pipelines (mean: 2.72). The vandalization of the oil pipelines was caused by the aggrieved members of the oil producing communities due to the neglect accorded them by both government and the oil companies. This fact is evidenced by the youth restiveness in the Niger Delta region over the past decade.

Table 3. Causes of oil spillage

Causes	Mean	Standard deviation
Drilling of oil wells	3.53*	0.60
Explosion of oil wells/terminals/stations	2.30	0.73
Spills from vandalized oil pipelines	2.72*	1.03
Leakages from oil tanks	2.20	0.60
Corrosion of oil pipelines	3.73*	0.44
Spills from loading of oil vessels	2.12	0.50
Maintenance activities of oil companies	2.30	0.80
Sabotage	3.60*	0.73

Source: Field survey, 2012

*Significant (mean \geq 2.5)

3.4 Respondents' Perception of the Effects of Oil Spillage on Farm Land and Cassava Crop

The gravity of the effects of oil spillage on both farm land and the cassava crop was enormous. This was evidenced by the fact that all the parameters under consideration were significant (Table 4). The most significant effect on the farm land was the increased soil temperature/ toxicity (mean: 4.73). Other effects of the oil spillage on the farm land included reduction of soil fertility (mean: 4.70), degradation of the farm land (mean: 4.70), low land productivity (mean: 4.70), destruction of soil structure (mean: 4.62), poor soil aeration (mean: 4.60) and destruction of soil micro-organisms (mean: 4.53). In confirmation, findings have shown that oil spills have degraded most agricultural lands in the oil producing areas of the country and have turned hitherto productive areas into wastelands. With increasing soil infertility due to the destruction of soil micro-organisms, and dwindling agricultural productivity, farmers have been forced to abandon their land to seek non-existent alternative means of livelihood [1].

Total crop failure (mean: 4.80) was the most significant effect of the oil spillage on the cassava crop. Other effects included poor yield (mean: 4.78), rotting of the cassava tubers (mean: 4.75), stunted growth (mean: 4.75), yellowing of the crop leaves (mean: 4.63) and wilting of crops (mean: 4.58). Wilting of the crops was not unconnected with the accumulation of the oil on the crops' shoots which blocked the stomata thereby inhibiting photosynthesis, transpiration and respiration. The toxic chemical substances from the spilled oil were responsible for the burning of the crop leaves, inhibition of growth and ultimately reduction of yield. These results are in agreement with the findings of Dabbs [15].

Table 4. Perceived effects of oil spillage on farm land and cassava crop

Effect	Mean	Standard deviation
On farm land		
Reduction of soil fertility	4.70*	0.50
Poor soil aeration	4.60*	0.64
Degradation of farm land	4.70*	0.53
Increased soil temperature/ toxicity	4.73*	0.44
Destruction of soil micro-organisms	4.53*	0.70
Destruction of soil structure	4.62*	0.60
Low land productivity	4.70*	0.51
On crop		
Yellowing of leaves	4.63*	0.61
Stunted growth	4.75*	0.50
Crop failure	4.80*	0.50
Poor yield	4.78*	0.46
Rotting tubers	4.75*	0.47
Wilting of crop	4.58*	0.56
Crop leaves appear burnt	4.23*	0.20
Bad taste of produce	4.27*	0.62

Source: Field survey, 2012

*Significant (mean \geq 3.0)

3.5 Effect of Oil Spillage on Farm Size, Yield and Land Productivity in Cassava Production

Table 5 shows the comparison between the average farm size of cassava, yield and land productivity of oil spillage and non-oil spillage communities of the study area. The cassava farm size, yield and land productivity in oil spillage affected communities were significantly ($p < 0.01$) lower than those of the non-oil spillage communities by 0.61 ha, 6119 metric tonnes (MT) and 1447 MT/ha respectively. These represent significant reduction of 36, 48 and 20% of these variables in the oil spillage affected communities respectively. These results are expected due to the diverse adverse effects of the oil spillage on both the farm land and the crop (Table 4). The lower farm size of the farmers in the oil spillage areas suggests that farmers in such areas were compelled to have their farm size reduced when part of their farm land had been damaged by the oil. Where the farm land was not completely destroyed, crop yield and land productivity were drastically affected, thus, making them lower than those from the non-oil spillage communities.

It can be observed from the results that the average farm size and cassava productivity of the farmers from the non-oil spillage communities were also low (1.72ha and 7,398MT/ha respectively). The low farm size was occasioned by pressure on the farm land by farmers from the neighbouring oil spillage communities whose farm lands had been destroyed by the spilled oil, besides other factors such as the problem of land tenure system. Worgu [16] reported that farmers in the communities of oil exploitation had lost their farm lands and are forced to emigrate to other communities in search of livelihood, exerting additional pressure on farm lands in such areas. The low land productivity in the non-oil spillage communities was due to the indirect effect of the oil spillage such as climate change which is adversely affecting agricultural production and the environment at large, among other factors.

Table 5. Average farm size, crop yield and land productivity of cassava production in oil spillage and non-oil spillage communities

Category	Oil spillage communities (A)		Non-oil spillage communities (B)		% mean reduction from B to A	t-ratio
	Mean value	Standard deviation	Mean value	Standard deviation		
Average farm size (ha)	1.11	1.14	1.72	0.58	36	2.533*
Average yield (MT)	6,605	888.50	12,724	689.37	48	27.62*
Land Productivity (MT/ha)	5,951	527.63	7,398	91.10	20	16.70*

Source: Field survey, 2012; *Significant at 1%

3.5.1 Regression Results

A regression analysis was carried out to examine the relationship between land productivity in cassava production and the factors affecting it. The factors included labour, planting material, farming experience, depreciation of fixed inputs and oil spillage. The results of the analysis as presented in Table 6 indicated that the combined effect of these factors significantly ($p < 0.01$) explained about 45% of the variation in the land productivity of cassava production in the study area ($R^2 = 0.4478$). The coefficient of determination (R^2), though significant, was less than 50% of the total variation in the productivity which was due to the fact that only 2 of the variables under consideration (farming experience and oil spillage) were significant. Farming experience correlated positively with land productivity, indicating that the higher the level of farming experience, the higher the productivity. This is so because experience, it is said, is the 'greatest teacher' and 'practice makes perfect'. The more experienced farmers would be more conversant with the management practices to adopt to increase productivity and also for curbing the effect of oil spillage on their farm land and production. Oil spillage, on the other hand, correlated negatively with the productivity, implying that land productivity decreased with increased oil spills. This confirms the result in table 4 where low productivity is one of the significant effects of oil spillage on cassava production. It also confirms the result in Table 5 where land productivity in cassava production from oil spillage communities was significantly lower than that of the non-oil spillage communities. Furthermore, the results of labour and oil spillage in this study are similar to those of Inoni et al. [1] while those of planting material, farming experience and capital depreciation are at variance.

Table 6. Regression results of determinants of cassava productivity

Variable	Parameter	Coefficient	t-ratio
Constant	a_0	2496.846	8.255*
Labour (X_1)	a_1	- 29.629	- 0.596
Planting material (X_2)	a_2	0.022	0.275
Farming experience (X_3)	a_3	5.854	9.133*
Depreciation of fixed inputs (X_4)	a_4	- 0.005	- 0.255
Oil spillage(X_5)	a_5	- 1146.149	- 4.550*
R-squared	R^2	0.4478	
F-statistic		13.243*	

Source: Field survey, 2012; *Significant at 1%

Having established the significant adverse effect of oil spillage on cassava production, the questions now are, what adaptation measures did the farmers employ to minimize the adverse effect of oil spillage on their production; and what mitigating measures did government and the oil companies employ to deal with oil spillage? Providing answers to these questions is a subject for further study.

4. CONCLUSION

The study found that the negative consequences of the oil spillage on both farm land and cassava crop were enormous. The oil spillage significantly reduced the farmers' farm size, yield and land productivity by 0.61 ha, 6119 MT and 1447 MT/ha respectively. About 45% of variation in land productivity in cassava production was significantly explained by the farmers' years of farming experience and oil spillage. In view of the adverse effects of oil spillage on cassava production, it is vital to know the adaptation measures the farmers employed to minimize the adverse effects of oil spillage on their production. Also, it is essential to know the mitigating measures government and the oil companies employed to deal with oil spillage in the study area. These are subjects for further study. Meanwhile, the oil companies should ensure constant maintenance of the oil pipelines and tankers to prevent corrosion and avoid oil spills from them. Effort should be intensified by security agencies in checking the activities of saboteurs which often destroy oil pipelines to steal oil, thus, resulting in oil spillage. Also, the aggrieved oil producing communities should be accorded adequate attention by both the oil companies and government in terms of developmental strides to prevent them from vandalizing oil pipelines.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Inoni EO, Omotor DG, Adun FN. The effect of oil spillage on crop yield and Farm Income in Delta State, Nigeria. *J Cent Eur Agric.* 2006;7(1):41–48. Accessed 7th February, 2013. Available: [Freedownloads.is/pdf/oil-spills-n-n](http://freedownloads.is/pdf/oil-spills-n-n).
2. Wikipedia. Petroleum Industry in Nigeria. Wikipedia, the free encyclopedia; 2012. Accessed 13th June, 2013. Available: www.en.wikipedia.org/wiki/petroleum_industry_in_Nigeria.
3. World Bank. Environmental Economic Study of the Niger Delta, Nigeria. A Report on the Niger Delta; 1995.
4. Delta State Government. Economy of Delta State. Delta State of Nigeria: Nigeria Information and Guide; 2013. Accessed 13th June, 2013. Available: <http://www.deltastate.gov.ng>.
5. Federal Office of Statistics (FOS). Annual Abstract of Statistics. FOS, Lagos. 1995;343.
6. National Bureau of Statistics. Poverty Profile of Nigeria. Abuja; 2004.
7. Federal Office of Statistics. Volume of Oil Spilled Annually from 2006 – 2012. Unpublished statistics. FOS, Lagos; 2012.

8. Nnabuenyi UM. Impact of Oil Exploration and Exploitation on the Niger Delta Region: Environmental Perspective. In: Akpotor AS, Egboh SH, Ohwona AI, Orubu CO, Olabaniyi SB Olomo RO, editors. Five Decades of Oil Production in Nigeria: Impact on the Niger Delta. Ibadan: Centre for Environmental and Niger Delta Studies. 2012;193–197.
9. Chindah AC, Braide AS. The Impact of Oil Spills on the Ecology and Economy of the Niger Delta. Proceedings of the workshop on Sustainable Remediation Development Technology held at the Institute of Pollution Studies, River State University of Science and Technology, Port-Harcourt; 2000.
10. Awosika LF. Impacts of Global Climate Change and Sea Level Rise on Coastal Resources and Energy Development in Nigeria. In: Umolu JC, editor. Global Climate Change: Impact on Energy Development, DAMTECH Nigeria Limited. 1995;24.
11. Delta State Environmental Protection Agency (DESEPA). Report on the State of the Environment in Delta State. Ministry of Environment, Delta State Government of Nigeria. 1996;51.
12. Doll JP, Orazem F. Production Economics: Theory with Applications. Columbus, Ohio, USA: Grid Inc. 1978;11–28.
13. Nicholas O, Madukwe MC, Enete AA, Amaechina EC, Onokala P, Eboh EC, Ujah O Garforth CJ. A Framework for Agricultural Adaptation to Climate Change in Southern Nigeria. Int J Agric Sc. 2012;4(5):243–251. Accessed 20th March, 2013. Available: <http://www.bioinfo.in/contents..php?id=26>.
14. Ndinwa C, Chukwuka G, Akpafan S. Environmental Impacts of Oil Exploration in Niger Delta Region of Nigeria. In: Akpotor AS, Egboh SH, Ohwona AI, Orubu CO, Olabaniyi SB, Olomo RO, editors. Five Decades of Oil Production in Nigeria: Impact on the Niger Delta. Ibadan: Centre for Environmental and Niger Delta Studies. 2012;334.
15. Dabbs WC. Oil Production Cases. A research paper of Oil Production and Environmental Damage. 1996; No 15. Accessed 30th November, 2012. Available: www.american.edu/ted/projects/tedCross/xoilpr15.htm.
16. Worgu SO. Hydrocarbon Exploitation, Environmental Degradation and Poverty in the Niger Delta Region of Nigeria. Lund, Sweden: Lund University Lumes Programme. 2000;2–11.

© 2013 Ahmadu and Egbodion; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sciencedomain.org/review-history.php?iid=236&id=2&aid=1729>