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## **The Impact of Oil Spillage on the Profitability of Cassava Farmers in the Niger Delta Region of Nigeria**

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### **Abstract**

*Efforts to boost food production in the Niger Delta Region (NDR) have been hampered by the occurrence of oil spillage. This has led to low agricultural yield with negative implications on the profitability of cassava productivity. Studies on the impact of oil spillage on the efficiency and profitability of cassava amongst farming households in the NDR are limited. This situation therefore, necessitated this investigation into the influence oil spillage on the profitability of cassava farming in the NDR. A four-stage sampling procedure was applied. Three states: Delta, Rivers and Bayelsa were purposively selected from the four major oil-producing states in NDR. Nine Local Government Areas (LGAs): 4, 3, 2 respectively were purposively selected from Delta, Rivers and Bayelsa based on the prevalence of oil spillage. A total of 45 communities were chosen in the LGAs comprising 20, 15 and 10 communities with proportional allocation to size from Delta, Rivers, and Bayelsa States, respectively. A total of 450 cassava farming households comprising 338 farmers in the non-oil spill (NOS) and 112 farmers in oil spill (OS) locations were sampled. Data were collected with the aid of structured questionnaires and were analysed using descriptive statistics, gross margin and propensity score matching at  $\alpha_{0.05}$ . The study revealed that household heads in oil-polluted farms were relatively older in terms of age than their counterparts in non-polluted farms. The Nearest Neighbour Matching and Kernel Based Matching (NNM and KBM) showed that farming on oil spillage-affected land exerted negative and significant effect on the profitability or gross margin through a reduction of profit of between ₦117,645.20 and ₦136,572.39. The implication of this result is that productivity in terms of profit per hectare in non-oil polluted farms was about 50 percent better than farmlands that suffered oil pollution. Thus, the incidence of oil spillage reduced profitability in cassava production in the NDR of Nigeria.*

**Keywords:** Impact, Oil spillage, Profitability, Cassava Farmers, Niger Delta

## 1.0 Introduction

The African Countries and the Tropics have been involved in the production of Cassava since its introduction from South America. In a few parts of many of these countries, it is the primary source of nutritional energy for rural people (Immanuel *et al*, 2024).

Cassava is also used in processed food internationally in addition to cassava being consumed locally as a food crop (Sengar 2022). Presently, cassava has the potential of being recognized as an international cash crop, because it could be driven for markets as it is the case in South America. Furthermore, driving the market frontier of cassava could serve the purpose of improving the livelihoods of farmers in the rural areas because its cash crop potentials in tropical Agriculture cannot be over emphasized (Kegah *et al*, 2023)

It is on record that cassava can be planted easily (Abrell *et al*, 2022). Also, its ability to do well in different climates and poor environments with little or no rainfall and low nutritional soils make it the crop of choice for poor and low-income farmers especially in crude oil locations (Mathinya *et al*, 2022). These nutritional advantages and its ability to do well in many different soils have increased cassava propagation in Africa and beyond in the last twenty years of the 20<sup>th</sup> century (Sanusi *et al*, 2022).

There is no doubt that oil activities are responsible for most of the environmental risks in the Niger Delta (Obuah and Keke, 2022). Crude oil extraction agencies and government had impacted negatively on the financial success of cassava production and other food crops in the Niger Delta region through environmental pollution and land degradation (Adeola *et al*, 2022)

Devi *et al*, (2022) is of the opinion that with the increase in population growth, there is the necessity to increase cassava production, and the implication is that more managerial skills are required to improve cassava yields amidst poor soils in our continent. Better agricultural management skills are therefore required for us to achieve this dream.

Cassava is widely grown in the North of the Limpopo River and major African Countries. As far back as 1972, the International Institute for Tropical Agriculture came into existence in Ibadan, South West Nigeria under the Supervision of the Consultative Group on International Agricultural Research (CGIAR). Today, IITA is internationally recognised for her success story in cassava production in collaboration with Centro Internacional de Agricultura Tropical (CIAT) in Columbia and is behind African cultural orientation (Thiele *et al*, 2022).

Africa has become the giant of cassava production as her yields now exceed the rest of the world together (Adebayo, 2023). Moreso, it is on record that Nigeria alone controls about 35% of the entire Africa cassava production and currently an estimate of about 19% of world production while Democratic Republic of Congo has an estimate of almost 19% of cassava production in the continent. In the same vein, Ghana produces 8%, Tanzania 7% and Mozambique 6%. To date, Nigeria remains the world's largest producer of cassava, with an annual output exceeding 34 million tonnes of tuberous roots (Onyediako and Adiele, 2022). The country accounts for a significant portion of both African and global cassava production, with over 31% of African production and 20% of global production. While Nigeria leads in production, its yields per hectare are relatively low compared to other cassava-producing nations (FAO STAT 2024). The last 20 years have witnessed a tremendous increase in cassava production as the above African major producers from about 70 percent to 80 percent. Nigeria which comes first in this regard has increased her cassava productive capacity from 22 % to 35 % while Ghana that comes second now has about 8% productive increase compared to her earlier 4% productive capacity (Enesi *et al*, 2022).

Recently, many changes have been made to the productive capacities of African countries in cassava production. DRC has moved from first to second place. Akerele, *et al* (2019) in their works opined that cassava production is a profitable venture among households whose primary occupation is farming. At a national level, cassavas have made tremendous economic progress. Despite the economic potentials of cassava in the fight against food insecurity, its full potential is yet to be achieved, as production hardly grows beyond 11 metric tons per hectare (Fasakin *et al*, 2023). This is due to several factors, including environmental degradation across the country and in the Niger Delta region. For instance, Amusa *et al*, (2018) revealed that the yield and productivity of cassava and agriculture in general are subject to environmental conditions because it provides farmers with the resources such as forest, vegetation, and biodiversity for agricultural production.

Oladoyin *et al*, (2022) did a study in Akoko area of Ondo State, using well-structured questionnaires and interview schedules. Data was analyzed using descriptive statistics, budgetary techniques, and multiple regression models. The results demonstrated that 72.7% of cassava farmers were male households, with a mean age of 50 years and a mean household size of 5. It is estimated that 80.7% were married and had spent about 13 years in the farming business out of which about 82.0% had no formal education. The results from the profitability analysis showed that net farm income was NGN149,101.92 with a return on investment of N1.5. The implications are that for every NGN1 plowed into the business, there is a profit of 50k. This result however reflects the reality of the food situation in the country as the profitability will not be able to account for the agricultural inputs inflation in Nigeria today.

Assessment of the impact of programs in agriculture and the reducing trend in productivity requires proper measurement of the impact of other courses of action, which raises issues that are conceptual and even methodological. Critical look on the literature of productivity in Nigeria shows several measurements that requires analytical approaches too.

The production differentials presently found in the Niger Delta region requires a holistic approach in both public and private sectors to change. This therefore calls for total effort to improve on the production of this crop in the country, including effort to reduce the problem of oil spillage on its production in the Niger Delta region (Aiyabakari and Ebisine, 2022). To achieve this, statistics on the impact of oil spillage on the production of this crop is therefore necessitated. It is in this regard that this study was designed to examine the effect of oil spillage on the profitability of Cassava farmers in the Niger Delta region of Nigeria.

The overall objective of the study is to determine the impact of oil spills on the profitability of cassava farmers in the Niger Delta region of Nigeria. The specific objectives include to:

- Describe the socioeconomic characteristics of the Cassava farmers.
- Assess the extent by which farm yield and income of cassava farmers is affected by oil spillage.
- Determine the impact of oil spillage on the gross margin of cassava farmers.

## 2.0 Materials and Methods

### 2.1 Study Area

The Niger Delta is defined to encompass the nine states that produce the vast majority of the oil and gas, which drive the country economy, namely: Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo, and Rivers, and their 185 local governments; 13,329

settlements, aggregated into 800 communities of 12 major ethnic groups. Cassava as a food crop confers several comparative advantages in marginal environments, where farmers face the challenges of resources to improve the income-generating capacity of their land through purchased inputs. Most cassava species can survive in acid soils, periodic and extended drought, and even defoliation by pests. It is compatible with a variety of intercrops and can be adjusted for harvest times. The geographical map of the Niger Delta region is that the 9 states of the region are found in the three southern geopolitical zones of: Southwest, South-South, and the Southeast. The six oil and gas producing states in the South-South geopolitical zone (Delta, Bayelsa, Rivers, Akwa Ibom, Cross River, and Edo) and their adjacent offshore accounted to 91.5 per cent of the total national oil production, but only 15 per cent of the entire population in 2022. Ondo State, in the Southwest zone, and Imo and Abia States, in the Southeast zone, are the other producing states; and together, the three peripheral states accounted for only the remaining 8.5 per cent of total oil production in 2022 (Obiam and Amadi, 2022). In Delta State, the LGAs are Ughelli South, Ughelli North, Ethiope East and Isoko North LGAs. As for Bayelsa State, they include Ogbia and Yenagoa LGAs while we have Tai, Khana and Gokhana LGAs for Rivers State. Cassava and its based products are the most important food for the people of Niger Delta, Nigeria. Cassava is almost a daily menu in households especially in the area (Osuji *et al.*, 2024). It is widely grown in the Niger Delta and is a source of income and food to millions of farmers, processors, and traders.

## 2.2 Sampling and Data Collection

A 4-stage sampling procedure was used in this study to select the sample. The first stage was the purposive selection of the three states chosen from the four (4) major oil producing states in Niger Delta (states that have suffered oil spillage in the last ten years and include Bayelsa, Delta and Rivers States) (Odesa *et al.*, 2024). The second stage involved the purposive selection of four Local Government Areas (LGAs) chosen from Delta State, two Local Government Areas from Bayelsa State and three Local Government Areas in Rivers State. These selected Local Government Areas from each of the chosen states have records of farmlands that have been affected by oil spillage as well as farmlands not affected by oil spillage. The third stage involved the proportionate selection of twenty communities in Delta State, ten communities in Bayelsa State, and fifteen communities in Rivers State. The fourth and final stage involved the random selection of three cassava farming households from each community in Delta State, three cassava farming households in Bayelsa State and two cassava farming households from Rivers State that farmed in oil spilled locations. Also, eight cassava farming households in Delta State, nine cassava farming households in Bayelsa State and seven cassava farming households in Rivers State were chosen from locations where there is no oil spillage incidence proportionate to the size of the population. A total of 475 cassava farming household heads were used for this work out of which only 450 cassava farming household heads were suitable for analysis.

## 2.3 Analytical Techniques and Models

The research tools applied in this work for the analysis of the survey data include the following: Descriptive statistics such as percentage distribution, frequency tables, mean, and standard deviation. They were applied to analyse the socioeconomic and demographic variables of the respondents (sex, age, marital status, income, farm yield, household size and inputs amongst others) for objective one. Gross Margin was used to carry out a budgetary analysis of the respondents in the study area to answer objective two. In analysing objective 3, we employed the results from objective 2 and gross margin figures using the Propensity Score Matching.

## 2.4 Method of Data Analysis

Objective one was met by the application of descriptive and inferential statistics. Means, standard deviations, percentages and frequencies were applied in analysing the demographic variables of the farmers such as input and output variables and the distribution of efficiency levels.

Objective two measures the profitability of the cassava farming enterprises in polluted and non-polluted areas using gross margin analysis so that comparison can be made between farms and at different locations. This analysis will serve the purpose of identifying the cost, returns and profitability of the farmers. The study made use of rate of returns to investment to measure profitability and gross margin. According to Apata and Rahji (2008) Gross Margin can be illustrated as.

$$GM = \sum P_i Y_i - C_i \quad i = 1, 2, 3, 4, \dots n \dots\dots\dots(1)$$

Where:

GM= Gross Margin

$P_i$  = the market price of the  $i$ th output (N/unit) in the activity

$Y_i$  = the annual yield of the  $i$ th output (unit/ha)

$C_i$  = the imputed cost of producing the  $i$ th output (N/ha)

On the other hand, rate of returns to investment is calculated thus:

$$RORI = TR - TC / TC = \Pi / TC; \dots\dots\dots(2)$$

Where:

RORI = Rate of returns on investment

TR = Total revenue

TC = Total Cost

$\Pi$  = Profit

Also, Net Farm Income (NFI) is: Gross Farm Income - Total Farm Expenses. Moreso, Net Farm Income = Gross Cash Income - Total Cash Expenses +/- Inventory Changes - Depreciation. Fixed costs are constant whether a farm produces one unit, or not. Fixed costs examples include rent, lease payments, salaries for farm staff, insurance, property taxes, and interest payments on loans. Fixed costs were depreciated for these assets as in normal practice for the study.

$$\text{Operating Ratio} = (\text{COGS} + \text{Operating Expenses}) / \text{Net Sales} \dots\dots\dots(3)$$

(this is expressed as a percentage by multiplying by 100)

Where:

COGS = cost of goods sold

Objective three made use of propensity score matching arising from the results we had from objective two. Propensity score analysis of observational data was used in place of multiple linear regression and are used for two groups of treated and control units that have (characteristics that are similar so that comparisons can be made within these matched groups Rubin, 1997). To achieve a more robust finding in this study, the use of Propensity Score Matching was required to evaluate the effects of oil spillage on crop yield, and income of farm household. This statistical analysis explains how changes caused by Oil Spillage subsequently impact changes in the farmers' livelihoods. The main livelihood outcomes of interest report changes are in crop yield/productivity, and household income. Each of these outcomes are binary, recorded as one for treated farmers in the indicator and zero otherwise that is farmers that are not treated by oil spillage. In evaluating the primary outcomes among the farming population, we use the Propensity Score Matching method which has two major advantages over other evaluation methods, namely that the advantage of Propensity Score Matching estimation is that matching estimators highlight the problem of common support since treatment effects can only be estimated within the common support. Also, in some cases, despite the Propensity Score Matching burden of data requirement, data generation is usually cheaper compared to those of experiments since the experiment needs adequate attention to get the random allocation.

#### 2.4.1 Computing the Impact of the Matching

The Nearest Neighbour and Kernel-based matching techniques were applied to evaluate the Average Treatment Effect for the treated. It was calculated as follows:

$$ATT = E(Y^1 - Y^0/D = 1) = E(Y^1/D = 1) - E(Y^0/D = 1) \dots\dots\dots (4)$$

Where:

$D = 1$  Denotes programme attendance and  $X$  is a set of socioeconomic variables on which the farmers will be matched.

$E(Y^1/D = 1)$  is the observed outcome of the treated that is, the expected income loss by those farmers that suffered oil spillage while those that did not suffer from oil spillage.

$E(Y^0/D = 1)$  is the counterfactual outcome. The counterfactual outcome here represents outcome of the non – oil spillage affected farmers since this groups of farmers have similar characteristics to those that suffered from oil spillage.

ATE = is the mean impact of oil spill on the population

ATT = is the impact of oil spill on the mini population of the farmers in the oil spilled group.

ATU = is the impact on the mini population of the farmers in the non-oil spilled affected group. This is very important in case the program is to be extended to those farmers who presently do not suffer oil spillage. The propensity score was estimated using the probit model. The results of the ATE could not be used as the impact of the oil spillage, because ATE results do not take away from unobserved bias and the problem of non-compliance.

According to literature, selection on observables and hidden (selection on unobservable) biases are the two most prominent biases in impact evaluation (Rosenbaum, 2001) and inability to reduce them could result in poor program impact and thereby produce wrong policy suggestions.

### 3.0 Results and Discussion

#### 3.1 Socio-economic Characteristics of Cassava Farming Households

The distribution of cassava farmer's age in Table 3.1 showed that 72.3% of the cassava farmers in oil spill locations were between the age brackets of 35-54 years while 27.7% were more than 54 years. Therefore, these age brackets indicate that the majority of the farmers are not young and strong, since they are not in their vibrant age and will be less productive (Olomola, 1998). This finding is consistent with that of Ozondu and Egbunike, (2023). These researchers agreed that such age category in human development is a stage when people are less ready to take the maximum risk associated with modern farming and its related challenges.

On the other hand, about 97.9% of the cassava farmers in non-oil spill location were between the ages of 35- 54 years and 2.1% of them were between the ages of 54 -69 years. This has revealed that the age category of cassava farmers in non-oil spill locations was relatively young and should be risk takers with increasing ability for innovations on productive economic activities. Asinansi, (2023) in their work revealed that the age of farmers positively affected their technical efficiency and productivity. They noted that as the farmers advanced in age, their expertise in combining resources and curtailing wastage increases thereby leading to increased technical efficiency. The result also conforms to the work of Achichi *et al*, (2023) that age is one of the socio-economic attributes which affects the level of farmers' productivity.

The distribution of the cassava farming population sex in oil spill-affected area revealed that 55.4% of the farmers were female while 44.6% belonged to the male category as shown in Table 3.2. This gender ratio has further confirmed that both males and females were actively engaged in cassava farming. This could be because cassava is gender friendly as it is being planted by both men and women in the region. The result agrees with the work of Madu *et al*, (2024), who observed that female farmers contributed significantly to agricultural production in the region. Conversely, large populations of the farmers (56.5%) in non-oil spill locations were male while 43.5% were female. Hence, a larger proportion of the males were involved in cassava production in non-oil spill locations while a larger proportion of females were involved in cassava farming in oil spill locations. Also, Akwara *et al*, (2023) found out that gender disparity in household headship is due to traditional patriarchal ownership and inheritance patterns associated with land usage which dispossess women of the right to own land. Women in many parts of the world lag behind men in land ownership and other resources about land (Schling and Pazos, 2024).

The profile of respondents by size of household members as shown in Table 3.3 revealed that majority of the households in the oil spill (65.2%) and non-oil spill (68.6%) location had relatively large household size between 5 to 8 persons. This is followed by 25.8% and 30.2% of the household head in the oil spill and non-oil spill locations with member(s) between 1 and 4. Only a few of them showed a large household size of above 9 persons per household in the region. The means of household size for oil spillage and locations was 6.29 and 5.70 respectively (Table 3.7). The standard deviations for the oil spillage household size mean and that of the non-oil spillage household size was 2.26 and 1.99 respectively. Large household size is a characteristic of the rural setting because household members serve as a source of farm and off-farm labour to generate income. Rahman and Connor (2022) stated that although large household size amounts to taking more money for food and clothing from the income realized from the farm, they equally provide family labour during planting and harvesting season. A study carried out by Jatana and Tesfahun (2025) confirmed that there is

a positive and significant effect of family size on productivity among small-scale vegetable farming households in Ethiopia.

**Table 3.1: Age distribution of household heads**

Age of household heads (years)	Oil spill affected farmers		Non-oil spill affected farmers		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
35 – 54	81	72.3	331	97.9	412	91.6
55 – 69	31	27.7	7	2.1	38	8.4
Total	112	100	338	100	450	100

Source: Field Survey, 2024

**Table 3.2: Sex distribution of household heads**

Sex of household heads	Oil spill affected farmers		Non-oil spill affected farmers		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Male	50	44.6	191	56.5	241	53.6
Female	62	55.4	147	43.5	209	46.4
Total	112	100	338	100	450	100

Source: Field Survey, 2024

**Table 3.3: Distribution of household heads by household size**

Household size (Members)	Oil spill affected farmers		Non-oil spill affected farmers		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1 to 4	29	25.8	102	30.2	131	29.1
5 to 8	73	65.2	232	68.6	305	67.8
9 to 12	5	4.5	1	0.3	6	1.3
13 to 16	5	4.5	3	0.9	8	1.8
Total	112	100	338	100	450	100

Source: Field Survey, 2024

**Table 3.4: Distribution of household heads by years of formal education**

Years of formal education	Oil spill affected farmers		Non-oil spill affected farmers		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
No formal education	7	6.2	10	3.0	17	3.8
Basic Education	14	12.5	33	9.8	47	10.4
Secondary Education	53	47.3	174	51.5	227	50.5
Tertiary Education	38	34.0	121	35.9	159	35.3
Total	112	100	338	100	450	100

Source: Field Survey, 2024

Distribution of cassava farming households by formal western education is shown in Table 3.4. The result revealed that 47.3% and 51.5% of the respondents had secondary western formal education in oil spill and non-oil spill locations, respectively. Also, about 34% and 35.9% of the respondents in oil spill and non-oil spill location had tertiary western formal education, respectively. Again, larger percentage of the farmers in non-oil spill location had higher level of western formal education than the farmers in oil spill location and a relatively few had no western formal education in both locations. The pooled data show that 96.2% of cassava farming households had formal education which draws credence from a similar finding by Antia-Obong *et al* (2021) that found poultry farming households to have 95.29% formal education. The mean year of western formal education is 12.47 years with a standard deviation of 5.21. This shows that on the average, the cassava farming household heads had appreciable basic western formal education. Education has an important implication particularly for skill acquisition and efficient use of inputs needed to raise yield mostly in polluted locations (Chinasa *et al*, 2022).

Table 3.5 shows that 79.5% of the cassava farmers in the oil spillage affected locations had between 1 - 10 years farming experience. 13.4% of the cassava farming household heads had between 11 and 20 years, while only 7.4% had farming experience between 21 and 40 years. Again, 87.9% of the cassava farmers in the non-oil spillage-affected locations had about 10 years or less of farming experience similar to their counterparts in oil spill-affected locations. Also, 11.5% of the cassava farming population had farming experience between 11 and 20 years. The means and standard deviations of the farming experience of cassava farmers in the oil spillage location and non-oil spillage location were 10.51 years, 6.81: and 9.01 years, and 3.79 respectively (Table 3.7). Farming experience as a factor is supposed to have a positive relationship with the productivity of farmers because farmers over the years get used to a lot of these farming practices (Bojago and Abraham, 2023).

**Table 3.5: Distribution of household heads by years of farming experience**

Years of farming experience	Oil spill affected farmers		Non-oil spill affected farmers		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1 to 10 years	89	79.5	297	87.9	386	85.8
11 to 20 years	15	13.4	39	11.5	54	12
21 to 30 years	6	5.4	0	0	6	1
31 to 40 years	2	2.0	2	1	4	1
Total	112	100	338	100	450	100

Source: Field survey, 2024

**Table 3.6: Distribution of household heads by association**

Response	Oil spill affected farmers		Non-oil spill affected farmers		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	48	42.9	225	66.6	148	32.9
No	64	57.1	113	33.4	302	67.1
Total	112	100	338	100	450	100

Source: Field survey, 2024

Being a member of an association, such as a cooperative society or farmer's association provides a forum in which farmers can exchange information necessary for improving their production as well as solving crucial problems, which might be technical, logistical, or financial. Table 3.6 revealed that belonging to an association was accepted by the sampled cassava farming population in the Niger Delta region. Thus, the results showed that most farmers (66.6%) in non-oil spill locations belong to an association while 42.9% of the farmers in oil spill locations were members of one association or the other.

Furthermore, a larger population of the farmers (57.1%) in oil spill locations declined from being a member of any association compared to their counterparts in non-oil spill locations (33.4%). Pertinently, this implies that most of the farmers in these locations belong to one form of agricultural association or the other and have identified with cooperatives as an avenue for pooling their resources together for productivity growth.

### 3.2 Profitability of an average farmer in oil spill and non-oil spill areas

Cost and returns analysis were undertaken to evaluate the gross margin of cassava production in non-oil spill and oil-spill locations in the study area. Table 3.8 revealed that the average total revenue of cassava produced for a farmer was ₦636,319.50 and the total variable cost was ₦261,176. The result also showed that the mean gross margin was ₦178,866.55 per hectare.

The gross return realised by cassava producers in oil-spillage was ₦101, 984.00 per hectare (Table 3.9). The return on investment was 32 kobo. The result shows that the total revenue was more than the total cost incurred by the farmers. All things being equal, greater effort in cassava production will enhance the respondents' income, but much still needs to be done because of the impact of the oil spillage that has necessitated the excessive use of inputs in producing output in these locations.

The profitability of the farm is shown in Table 3.10. Higher gross margin implies a farm was profitable and the smaller the gross margin implies a lesser profit possibility.

Although there are good resource allocations in the input mix by farmers in the non-oil spill affected locations, farmers need to be educated on the inputs needed to give the right gross margin to ensure sustainable production. Consequently, the net return on investment (ROI) of 0.70 means every one naira (₦1.00) invested in cropping enterprise in the area, gives back (net profit) of 70k. The rate of return (ROI) indicates that the cost of labour affects the net profit of the farmer. These results agree with the findings of Xie *et al*, (2023) in which they discovered that the gross margin of farmers in oil spill locations in Ondo State were lower than those farming in non-oil spill locations. Akerele (2022) and (Olaoluwa *et al*, 2022) also reported similar results.

The profitability analysis as shown in Table 3.10 revealed that total variable cost (TVC) forms 69.76% of total cost (TC) while total fixed cost (TFC) was just 30.24%. These results imply that a farmer who wants to be cost-efficient would reduce total variable costs, especially labour cost which accounted for about three-quarter of the total variable cost. The total fixed cost is small (30.24%), this may be due to land acquisition associated with rent as land is given as trust through inheritance which is typical of core rural villages in Niger – Delta region. The estimates in Table 3.10 also show the revenue, total variable cost, total fixed cost, gross margin, and net farm income across the two affected groups of farmers.

**Table 3.7: Summary of farmers' characteristics**

Characteristics	Values		
	Oil spill affected farmers	Non-oil spill affected	Pooled
<b>Age(years)</b>			
Minimum	41	36	36
Maximum	68	68	68
Mean	55.76	49.77	51.26
Std. Deviation	6.41	6.00	6.62
<b>Sex (% of farmers)</b>			
Male	44.6	56.5	53.60
Female	55.4	43.5	46.40
<b>Household size</b>			
Minimum	2	2	2
Maximum	13	16	16
Mean	6.29	5.7	5.87
Std. Deviation	2.26	1.99	2.07
<b>Marital status (% of farmers)</b>			
Single	2.7	4.4	4
Married	85.7	80.8	82
Divorced	7.1	11.8	10.70
Widowed	4.5	3	3.30
<b>Years of formal education</b>			
Minimum	1	1	0
Maximum	20	21	21
Mean	12.47	13.52	13.26
Std. Deviation	5.21	4.85	4.96
<b>Years of farming experience</b>			
Minimum	2	2	2
Maximum	35	40	40
Mean	10.51	9.01	9.38
Std. Deviation	6.81	3.79	4.76
<b>Farm size (hectare)</b>			
Minimum	1.05	1.03	1.05
Maximum	5	3.8	5
Mean	2.01	2.17	2.13
Std. Deviation	0.79	0.57	0.63
<b>Association membership (% of farmers)</b>			
No	42.9	29.6	32.90
Yes	57.1	70.4	67.10

Source: Field Survey, 2024

**Table 3.8: Cost, returns and profit of an average farmer in non-oil-spillage location**

Revenue Items	Total Hectares	Amount (₦)	Total Number of Farmers
Cassava tubers	708.90	636319.50	338
Cassava stems			
<b>Average Cost of Items</b>			
Cost of Planting			
Material		92336.84	
Cost of fertilizer		11111.76	
Cost of family labour		109777.3	
Cost of hired labour		47950.05	
Total variable cost		261176.00	
Gross Margin/Ha		178866.55	

Source: Field Survey, 2024

**Table 3.9: Cost, returns and profit of an average farmer in oil-spillage location**

	Total Hectares	Amount (₦)	Total Number of Farmers
<i>Revenue Items</i>			
Cassava tubers and stems	243.12	516000.00	112
<b>Average Cost Items</b>			
Cost of Planting material		70099.01	
Cost of Fertilizer		14197.66	
Cost of family labour		145560.06	
Cost for hired labour		64764.28	
Total Variable cost		294621.00	
Gross Margin/Ha		101984.00	

Source: Field Survey, 2024

The profitability analysis (Table 3.10) showed that total variable cost forms (75.4%) of the total cost while the total fixed cost was 24.6%. This means that efficient farmers must reduce total variable cost especially labour cost which account over three-quarters of the total variable cost. The total fixed cost percentage is small (24.6%), this may be due to the low cost of land rent as rent is given as trust through inheritance which is typical of core rural areas.

The operating ratio (OR) is a measure of efficiency in the use of resources by cassava farmers, and it can be obtained by dividing total cost by total revenue. Thus, the OR is an indicator of the ability of farmers to control cost of production. When the ratio is rising, it implies that variable costs are increasing or that revenue is falling as a result of declining product prices. The OR among OS and NOS impacted farmers is 75.7% and 58.8% respectively (Table 3.10). The low revenue due to the comparatively low cassava yield in oil-

spill impacted farms may be implicated for the higher OR amongst cassava farmers in oil spill areas. Agribusiness enterprises with very high operating ratios around 90% have difficulty in making adequate returns on investment, owing to the effects of high variable costs, poor yield, and low prices; but a very low ratio in the neighbourhood of 50%, is an indication that some costs may have been omitted or grossly underestimated (Moro- Visconti, 2022).

**Table 3.10: Profitability of oil-spill and non-oil spill affected farms in Niger Delta Regions (₦)**

Variables	Non-Oil Farm	Spill Affected Farm	Oil Spill Affected Farm
Total Revenue	636,319.53		516,000.00
Total Variable Cost	261,176.00		294,621.00
Total Fixed Cost	113,197.89		96,107.13
Total Cost	374,373.92		390,728.56
Percentage of TVC to Total Cost	69.76		75.40
Percentage of TFC to Total Cost	30.24		24.60
Total hectares cultivated	708.90		243.12
Gross Margin (TR-TVC)	261,945.60		129,156.44
Gross Margin/ha	178, 866.55		101,984.00
Operating ratio	58.8%		75.7%
Benefit Cost Ratio [ $\sum TR/\sum TVC$ ]	2.44		1.75
Cost Benefit Ratio [ $\sum TVC/\sum TR$ ]	0.41		0.57
Profit (TR-TC)	261945.60		
Net Farm Income (GM-TFC)	148747.70		125271.40
			33049.31
Net Returns to Investment [NFI/TC) *100]		0.70	0.32

Source: Field Survey, 2024

### 3.4 Impact of Oil Spillage on Profitability of Cassava Farming Households

Oil spillage impact on the gross margin of cassava farming households was determined using the two most adopted matching methods Nearest Neighbour Matching and Kernel Based Matching (NNM and KBM) and the results shown in Table 3.11. The NNM results showed a negative and significant effect of oil spillage on gross margin. This is the average difference between the gross margin of similar pairs of cassava-based farming households but with each belonging to a different farming option status. However, in this study, we were focused on the Average Treatment Effect on the Treated (ATT), which measures the average impact of oil spillage on the gross margin of farmers affected by the oil spillage. Specifically, the NNM and KBM causal effect of farming on oil spillage affected land on gross margin suggests that the profitability of farmers that farmed on oil spilled affected location were lowered by

₦117645.20 – ₦136572.39 than those farmers not affected by oil spillage. The NNM and KBM showed that farming on oil spillage-affected land exerted negative and significant effect on the probability or gross margin through a reduction of profit of between ₦117645.20 and ₦136572.39. These results align with Amusa *et al.* (2021), which state that an increase in cassava cultivation in oil-producing communities decreases the profitability of cassava production.

In terms of scope, this study focused on only small-scale cassava farmers and the data collected were for one cropping season. Limitation on data collection was faced most especially on issue of questionnaire administration. The respondents were all interviewed due to the importance of all information stated in the questionnaire. Also, the information provided by the farmers that were used in this study were mainly from memory recall as most of them do not take adequate records on their day-to-day operations. This therefore prolonged the collection of data which took more time than was required for the survey. In spite of these limitations, the data used for the study were adjudged to be error free because of the removal of irrelevant information that was not useful for the study.

This study focuses solely on cassava production and only from the producers' perspective with respect to only one level of impact of oil spillage without recourse to the levels of the degradation. To make a more valid conclusion, analysis involving different levels of oil spillage degradation should be carried through a multi-disciplinary approach. Further research on the coping strategies of the farmers in oil spillage affected farmlands and other related measures capable of remediating the impact of oil spillage on farmland is necessary.

**Table 3.11: Impacts of oil-spill on average treatment on treated (ATT), average treatment on untreated (ATU) and average treatment effect (ATE) on gross margin**

Variable	Sample	Treated	Controls	Difference	Standard Error	T-ratio
GMargin	Unmatched	295932.73	437255.70	-141322.97	34597.71	-4.1
Index	ATT	294381.04	430953.43	-136572.39	40941.71	-3.3
KBM	ATU	437637.48	322148.17	-115489.31		
	ATE			-120857.68		
GMargin	Unmatched	295932.73	437255.70	-141322.97	34597.70	-4.1
Index	ATT	294381.04	412027.25	-117646.20	106388.38	-1.1
NNM	ATU	437256.14	310318.47	-126937.66		
	ATE			-124577.25		

Source: Author's Compilation

## 4.0 Conclusion

It is pertinent to note that the quest to bridge the gap on food production and a sustainable environment has been compromised by the pollution of farmlands in Niger Delta region of Nigeria as revealed by the study. This study primarily aimed to answer the question of how oil spills have impacted the production and gross margins of cassava-based farming households. Additionally, it examined how these oil spills have contributed to the overall reduction of profits in the Niger Delta region of Nigeria. The study revealed that household heads in oil-polluted farms were relatively older in terms of age than their counterparts in non-polluted farms. Despite the much increase in size of farmlands in areas affected by oil

spillage, the gross margin per hectare was relatively lower than farmers who operated in non-polluted farms.

#### 4.1 Policy Recommendation

Government at all levels in the Niger Delta region should encourage young people into farming most especially in the oil spill-affected location through agricultural programmes such as young farmers club and farm settlement schemes. More so, in order to increase farm level efficiency and productivity in the oil spill affected location, increased use of planting materials and fertilizer should be considered by the farmers through farm inputs subsidies from the government. Finally, Government at all levels in the Niger Delta region should make more land available to farmers for agricultural purposes to boost productivity in the region.

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