

Profitability Of Farm Enterprises Among Adopters And Non-Adopters Of Improved Cassava Varieties Based Mixed Cropping System In Ebonyi State, Nigeria.

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Abstract

The study analyzed the profitability of farm enterprises among adopters and non-adopters of improved cassava varieties based mixed cropping system in Ebonyi State of Nigeria. A multistage sampling procedure was employed to select a total of 120 respondents (comprising 60 adopters and 60 non-adopters of the improved cassava varieties based mixed cropping system) on whom structure questionnaires were administered. Enterprise budget analysis per hectare and descriptive statistics such as means, frequency, percentages etc were used for data analysis. The results showed that the farm enterprise of the adopters of improved cassava varieties-based mixed cropping system was much more profitable than that of the non-adopters. This is based on the findings that whereas every one naira invested in the cultivation of one hectare of improved cassava varieties based mixed cropping system in the area earned ₦2.97 as return on investment (ROI), every one naira invested in the cultivation of one hectare of unimproved or traditional cassava varieties based mixed cropping system earned ₦1.48 as return on investment (ROI). The study further revealed that whereas the farm enterprise per hectare of the adopters recorded net profit of ₦1,221,450 that of the non-adopters recorded the net profit of ₦353,500 per hectare. The results of the sensitivity tests performed on the gross margins of the farm enterprises per hectare of the adopters and non-adopters showed that whereas the profitability index of the farm enterprises of the adopters consistently positively remained profitably stable all through, that of the non-adopters was only profitably mildly unstable implying substantial capacity of both farm enterprises to profitably withstand unexpected changes in input and output prices. The study further revealed that poor or lack of finance on the part of farmers, high cost of farm inputs, poor or weak extension education programme, high level of illiteracy of the farmers among others were major constraints to the adoption of improved cassava varieties based mixed cropping system in the area. The study recommended effective policy measures aimed at increased farmers' access to agric credit, provision of effective agricultural extension education to the farmers as well as collaborative design and implementation of improved cassava varieties out-growers scheme by relevant institutions, agencies and groups to ensure proper production and distribution to farmers of improved cassava varieties planting materials among others towards massive adoption of improved cassava varieties for the resultant attainment of food self-sufficiency and profitable cassava business in Nigeria.

Keywords: Adoption, improved cassava varieties, mixed cropping system, profitability analysis, Nigeria.

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I. Introduction

The importance of cassava (*Manihot Esculenta Crantz*) in Nigeria's food economy has steadily been on the increase in the past decades (Woosen et al, 2018). The authors emphasized that the cassava crop, its tubers, derivatives and other constituent parts serve as veritable sources of food and cash income to several million of both urban and rural households in the country. Adebayo and Weathy (2018) who stated that cassava serves as essential raw materials in the manufacture of domestic and industrial products including confectionaries, ethanol, starch, livestock feed etc added that the African Union (AU) New Partnership for Africa's Development (NEPAD) adopted the slogan "Cassava: A Powerful Poverty Fighter in Africa" for its Pan African initiatives on the ground that the importance of the crop to the livelihood of many millions of poor people has made cassava a significant target for the R & D interventions. Nigeria is reputed to be the highest producer of cassava in the world (FAO, 2016). Awolowo et al (2019), Adebayo and Weathy (2018) reported that through the Cassava Adding Value for Africa: CAVA Project Phase I (2008 – 2014) and CAVA Project Phase II (2014 – 2019): a project supported by Bill and Melinda Gates Foundation in five African countries including Nigeria, several improved cassava varieties have been developed and pushed to farmers. Some of these varieties include

the Tropical Manihot Esculenta (TME) 419, 96(1632); Tropical Manihot Species (TMS) 1412 (Vitamin A yellow cassava) NR 8082, TMS 30555, TMS 30572 etc. Although Awolowo *et al* (2019) argued that up to 60% of cassava producing households in Nigeria has adopted the cultivation of improved cassava varieties resulting to increased yields and output in the country, domestic production still lacks the capacity to meet up with the domestic consumption demand and needs for the ever-growing cassava export market NBS reports of 2022 indicate that though the production of cassava in Nigeria increased from 9.6 million metric tonnes in 1973 to 60.8 million metric tonnes in 2022 at the growth rate of 4.2%, there still exists scary gap between supply and demand of cassava and its constituents in the nation's food economy. For instance the supply-demand gap for High Quality Cassava Flour (HQCF) stood at 485,000 metric tonnes while this gap for cassava starch stood at 290,000 metric tonnes per annum during the decade, (NBS, 2022).

Benneth *et al* (2012); Adebayo and Weathy (2018) Amin (2018) all attributed Nigeria's inability to meet with the required supply capacity to the fact that cassava production in the country is dominated by smallholder farmers heavily characterized by reliance on unimproved traditional technologies, low productivity, and low farm yields, little or no profitability occasioned by myraids of challenges especially poor farm management practices as well as poor input and output records. Suggesting a solution to the food and economic crises in Africa, Amin (2018); Odhiambo (1997) averred that the newly designed and constructed paradigm for the sustainable transformation of Africa's agricultural economy for food and cash income in the 21st century would be hinged on market-based agricultural system under which both food and cash crop production systems are adapted to most efficiently allocate and optimize costs and returns factors for profitable farming. Ladebo (1999) insisted that recommended agricultural innovations are more often than not more massively adopted by farmers for increased output in so far as farm enterprises under such technologies are profitably more rewarding. Although there has been attempts to document the issues of profitability analysis of agricultural enterprises in Nigeria, Akerele *et al* (2019), Erhabor and Okoror *et al* (2018), Alufohai *et al* (2018) Katanya *et al* (2018), Anuebunwa (2008), Ben-chendo and Nwachukwu (2008), there has, over time and location, been great variations in input and output prices across different enterprise-mix and agricultural commodity value chains. With these conflicts in focus, this study was conducted to empirically examine and document the profitability of farm enterprises among adopters and non-adopters of improved cassava varieties-based mixed cropping system in Ebonyi State of Nigeria. Specifically the research determined and compared the costs and returns of farm enterprises per hectare of adopters and non-adopters of improved cassava varieties based mixed cropping system in the area, determined and compared the relative sensitivity of farm enterprises of adopters and non-adopters to unexpected changes in input and output prices, described constraints to adoption of improved cassava varieties based mixed cropping system in the area and advanced recommendations based on findings.

II. Methodology

The Study Area

The study was conducted in Ebonyi State of Southeast Nigeria. The State was selected for the study based on the fact that Ebonyi is a major food producing area in the country and cassava production, processing and marketing represent key agricultural enterprises for farmers in the State.

Ebonyi State was created out of the former Abia and Enugu States on 1st October 1996. According to National Population Commission (NPC), Ebonyi State has 2022 population projection of 2006 National Population Census of about 3.4 million people. Out of this population, 80% engage in agriculture growing different types of food and cash crops including cassava, yam, rice, cocoyam, maize etc wherein most of these crops except rice are grown through mixed cropping system; the farmers also tend small ruminants and keep cattle (Echiegu, 2002). Geographically, the state lies between latitudes 7°30' N and 8°30' N and longitudes 5°40' E and 6°45' E. The State has a landmass of 5,935Km² most of which are arable and fertile for agricultural production (Egwu, 2002). The state lies in the tropical rainforest zone characterized by heavy rainfall and equable temperatures. The mean annual temperatures is 80° F while the mean annual rainfall varies between 2250mm to 2000mm with a marked dry season from November to March and rainy season between April and October (Eze and Idike, 1997).

Ebonyi is made up of thirteen Local Government Areas and divided by the Ebonyi State Agricultural Development Programme (EBADEP) into three agricultural zones; Ebonyi North Zone, Ebonyi Central Zone and Ebonyi South Zone.

Sampling and Data Collection

Multistage sampling technique was employed to select a total of 120 smallholder farmers involved in cassava-based mixed cropping production systems (comprising 60 adopters and 60 non-adopters of improved cassava-based mixed cropping system). In the first stage, one Local Government Area was purposively selected from each of the three agricultural zones in the State. These Local Government Areas include Izzi from Ebonyi

North Zone, Ikwo from Ebonyi Central Zone and Onitsha from Ebonyi South Agricultural Zone. Their selection was based on the fact that cassava is greatly produced in these areas, accessibility to the farmers and exposure on the part of farmers. In the second stage, four autonomous communities were randomly selected from each of the three Local Government areas making it a total of 12 autonomous communities. In the third and final stage and using farmers' listing from the three Zonal Offices of Ebonyi State Agricultural Development Programme (EBADEP) as sample frame, five households each for adopters and for non-adopters of improved cassava varieties based mixed cropping system were randomly selected from each of the 12 communities to give a total of 120 respondents on whom structured questionnaire were administered for the study during the 2022/2023 cropping season. In determining who was an adopter and a non-adopter, the researcher defined a farmer as an adopter if he or she had cultivated at least one of the improved cassava varieties in his or her cassava-based mixed cropping system for at least one cropping season. On the other hand, a farmer who did not plant any of the improved cassava varieties but stuck to the traditional unimproved practices in his or her unimproved or local cassava varieties-based mixed cropping system is considered a non-adopter.

Method of Data Analysis

Enterprise budget otherwise referred to as costs and returns analysis was used to determine and compare the costs and returns of farms enterprises per hectare of adopters and non-adopters of improved cassava varieties based mixed cropping system in the area. Sensitivity analysis was performed on the Gross Margins of farm enterprises per hectare of adopters and non-adopters to estimate the extent to which cassava production in the area can withstand sudden or unexpected price changes (sustainability issues) under improved cassava varieties based mixed cropping system relative to the unimproved or traditional cassava varieties based cropping system. Descriptive Statistics such as frequency, means, percentages etc were used to describe the constraints to increased cassava production in the area.

Model Specification.

Enterprise budget or costs and returns analysis that was employed to determine and compare the profitability of farm enterprise per hectare of adopters and non-adopters of improved cassava varieties based mixed cropping system in the area was stated as follows;

$$NP = (TR - TVC) - TFC \text{ -----(i)}$$

Where:

NP = Net Profit or Net Revenue (in Naira)

TR= Total (or Gross) Revenue (in Naira)

TVC = Total Variable Cost (in Naira)

TFC = Total Fixed Cost (in Naira)

And (TR-TVC) = Gross Margin

This form of analysis per hectare was applied to the farm enterprises of adopters and non-adopters of the improved cassava varieties based mixed cropping system in the area. With some hypothetical assumptions of certain percentage decreases in revenue factors and percentage increases in variable cost factors, sensitivity analysis was performed on the gross margins of the farm enterprise of adopters and non-adopters.

III. Results And Discussion

Enterprise Budget or Costs and Returns Analysis of the Cassava Based Farm Enterprises

The costs and returns of farm enterprises per hectare for adopters and non-adopters of the improved cassava varieties based mixed cropping system were analyzed by preparing the enterprise budget for the two categories of farm enterprises and they are as presented in tables 1 and 2.

Table 1 Costs and Returns Enterprise Budget per Hectare for Adopters of Improved Cassava Varieties Based Mixed Cropping System.

| | Quantity | Unit | Unit Price/Cost (₦) | Total Value (₦) |
|----------------------------|----------|----------|---------------------|-----------------|
| 1. Gross Revenue | | | | |
| Main Crop (cassava tubers) | 9.5 | tonne | 150,000 | 1, 425, 000 |
| Minor Crops | 1.2 | tonne | 300,000 | 360, 000 |
| Cassava stems | 80 | bundles | 700 | 56, 000 |
| Total Revenue | | | | 1, 841, 000 |
| 2. Variable cost | | | | |
| Cassava stem | 36 | bundles | 700 | 25, 200 |
| Minor seeds | 12 | kg | 800 | 9, 600 |
| Labour | 180 | manday | 1, 500 | 270, 000 |
| Fertilizer | 0.4 | 50kg bag | 20, 000 | 8, 000 |
| Herbicides | 0.5 | litre | 2, 500 | 1, 250 |
| Jute bags | 50 | nos | 500 | 25, 000 |

| | | | | |
|---|---|---------|------|---------|
| Twines | 1 | roll | 500 | 500 |
| Transportation cost | | | lump | 80,000 |
| Misc including interest on loans | | | lump | 80,000 |
| Total Variable Cost (TVC) | | | | 499,550 |
| 3. Fixed Cost | | | | |
| Value of land/rent | 1 | hectare | | 80,000 |
| Depreciation on fixed assets | | | | 40,000 |
| Total Fixed Cost (TFC) | | | | 120,000 |
| 4. Net Profit = (TR - TVC) - TFC = (1,841,000 - 499,550) - 120,000 = 1,341,450 - 120,000 = 1,221,450 | | | | |

Source: Field Survey 2022/2023 cropping season.

Note= Total cost of production = TVC + TFC = 499,550 + 120,000= 619,550.

Thus Net Profit of ₦1,221,450 represents 197.15% of the total cost of production. (₦619,550) and the improved cassava varieties-based mixed cropping farm enterprise by adopters in the area is therefore considered highly profitable.

$$\text{Benefit Cost Ratio (BCR)} = \frac{TR}{TC} = \frac{1,841,080}{619,550} = 2.97$$

The ratio 1:2.97 indicates that every one naira invested in the production of one hectare of improved cassava varieties-based mixed cropping system by adopters in the area resulted in ₦2.97 return on investment (ROI). The farm enterprise by adopters is therefore highly profitable.

Table 2 Costs and Returns Enterprise Budget per Hectare for Non-Adopters of Improved Cassava Varieties Based Mixed Cropping System.

| | Quantity | Unit | Unit price/cost (₦) | Total Value (₦) |
|---|----------|---------|---------------------|-----------------|
| 1. Gross Revenue | | | | |
| Main crops (cassava tubers) | 6.6 | tonne | 150,000 | 900,000 |
| Minor Crops | 0.70 | tonne | 250,000 | 175,000 |
| Cassava stems | 30 | bundles | 500 | 15,000 |
| Total Revenue | | | | 1,090,000 |
| 2. Variable Cost | | | | |
| Cassava stem | 42 | bundles | 500 | 21,000 |
| Minor crops | 200 | kg | 600 | 120,000 |
| Labour | 240 | mandays | 1,500 | 360,000 |
| Jute bags | 30 | nos | 500 | 15,000 |
| Twines | 1 | roll | 500 | 500 |
| Transportation Cost | | | | 50,000 |
| Misc expenses | | | | 30,000 |
| Total Variable Cost (TVC) | | | | 596,500 |
| 3. Fixed cost | | | | |
| Value of land/rent | 1 | hectare | | 80,000 |
| Depreciation of fixed assets | | | | 60,000 |
| Total Fixed Cost (TFC) | | | | 140,000 |
| 4. Net profit = (TR - TVC) - TFC = (1,090,000 - 596,500) - 140,000 = 493,500 - 140,000 = 353,500 | | | | |

Source: Field Survey 2022/2023 cropping season.

Note Total cost of production = TVC + TFC = 596,500 + 140,000 = ₦736,500. Thus Net Profit of ₦353,500 represents 48.00% of the total cost of production (₦736,500) and the unimproved or traditional cassava varieties-based mixed cropping farm enterprise as cultivated by non-adopters in the area is marginally profitable.

$$\text{Benefit Cost Ratio (BCR)} = \frac{TR}{TC} = \frac{1,090,000}{736,500} = 1.48$$

The ratio of 1:1.48 indicates that every one naira invested in the production of one hectare of unimproved or traditional cassava varieties based mixed cropping system by non-adopters resulted in ₦1.48 return on investment (ROI). This farm enterprise by non-adopters is therefore only marginally profitable especially when compared to that of the improved cassava varieties based mixed cropping system farm enterprise which is highly much more profitable.

Comparative Costs and Returns Analysis

Data in tables 1 and 2 indicate that the farm enterprise of improved cassava varieties based mixed cropping system had a gross margin of ₦1,341,450 and a net profit of ₦1,221,450 which represents 197.15% of the total cost of production (₦619,550) per hectare. On the other hand, the farm enterprise of the non-adopters who cultivated unimproved or traditional cassava varieties based mixed cropping system had a gross margin of ₦493,500 and a net profit of ₦353,500 representing 48% of the total cost of production (₦736, 500) per hectare. Therefore the farm enterprise of adopters of the improved cassava varieties based mixed cropping system is highly more profitable than that of the non-adopters. The higher profit margin of the farm enterprise of the adopters is clearly attributable to the higher physical yield which is in turn attributable to the fact the survey farmers adopted the recommended technologies and cultivated the resistant and high yielding Tropical Manihot Esculenta (TME) 419, 96 (1632); Tropical Manihot Species (TMS) 1412 (Vitamin A yellow cassava) NR 8082, TMS 30555, TMS 30572 among others, some applied fertilizers and herbicides (though midly) early planting among other improved production techniques. The findings are in agreement with earlier ones by Nwakpu, 2022, Bolaji et al (2019) Anozie *et al* (2008) Audu *et al* (2008) who reported that farm enterprises under improved agricultural technologies were more profitable than those of the farmers that stuck to the old unimproved traditional technologies. The finding that the farm enterprises under both categories were all profitable also confirmed earlier reports by Erhabor and Okoror (2018) that cassava production enterprises across the three agricultural zones of Delta State were all profitable, though with varying levels of profitability rate.

Sensitivity or Risk Analysis

To assess the consequences of possible changes in non-controllable variables or occurrences and or the extent to which both farm enterprises can withstand unexpected input and output price changes, sensitivity texts were performed on the gross margin of each farm enterprise. This was based on the hypothetical assumptions that the total variable costs (TVC) and the total revenues (TR) changed by specific percentages and their effects on the respective gross margins of the farm enterprises of the adopters and non-adopters are as presented in table 3.

Table 3 Percentage Changes in the Farm Enterprises Total Variable Costs (TVC) and Total Revenues (TR) and Their Effects on the Gross Margins

| (Variations) percentage changes | Effect on GM for: | |
|---------------------------------|---------------------|-----------------|
| | Adopters | Non-Adopters |
| 1. No variation in GM | 1,341,450 | 493,500 |
| 2. No variation in TR | 1,841,000 | 1, 090,000 |
| 3. No variation in TVC | 499, 550 | 596, 500 |
| 4. 50% increase in TVC | 1, 091, 675 | 195, 250 |
| 5. 25% increase in TVC | 1, 216, 562.5 | 344, 000 |
| 6. 10% increase in TVC | 1, 291, 495 | 433, 850 |
| 7. 50% decrease in TR | 420, 950 | -51, 500 |
| 8. 25% decrease in TR | 879, 200 | 221, 000 |
| 9. 10% decrease in TR | 1, 656, 900 | 384, 500 |
| 10. (4) + (7) above | 171, 175 | -349, 750 |
| 11. (5) + (8) above | 754, 312.5 | 68, 500 |
| 12. (6) + (9) above | 1, 107, 395 | 324, 850 |
| Stability of Profit | Consistently stable | Mildly unstable |

Source: Field Survey 2022/2023 cropping season.

Results in table 3 indicate that the profitability index or situation for farm enterprise per hectare for the adopters of the improved cassava varieties based mixed cropping system in the area was highly and consistently stable. This is because in all the several situations of the sensitivity tests, the gross margins consistently remained profitably positive.

On the other hand, the profitability index for the farm enterprise per hectare for the non-adopters of the improved cassava varieties mixed cropping system in the area is only mildly unstable. This is based on the finding that the gross margins were profitably positive during several occasions of the sensitivity tests but remained negative only on, two occasions when;

i. The total revenue (TR) was decreased by 50%

ii. Total variable costs (TVC) was increased by 50% and the total revenue (TR) decreased by 50%.

On comparative basis, the results imply that the farm enterprise of the adopters has greater capacity to withstand sudden or unexpected changes in input and output prices than that of the non-adopters. The findings are in agreement with earlier ones by Audu *et al* (2008) who reported that farm enterprise using improved rice technologies in Ankpa Local Government Area of Kogi State were highly profitable and Nwakpu 2008 who

reported that the profitability index of rice enterprises by adopters of recommended rice technologies in Ebonyi State were very positively profitably stable whereas those of the non-adopters were unstable.

Constraints to the Adoption of Improved Cassava Varieties.

This section described constraints to the adoption of the technology on the cultivation of improved cassava varieties. The constraints include; lower dry matter than traditional varieties, higher post harvest spoilage than traditional varieties, poor or lack of finance on the part of the farmers, scarcity and high cost of improved cassava stem cuttings among others. Results of the analysis are as presented in table 4.

Table 4 Distribution of Respondents by Their Ranking for Major Constraints to the Adoption of Improved Cassava Varieties.

| Constraints | Freq = 120 | Percentage | Rank |
|--|------------|------------|-----------------|
| 1. Lower dry matter than traditional varieties. | 8 | 6.67 | 6 th |
| 2. Higher post harvest spoilage than traditional varieties. | 6 | 5.00 | 7 th |
| 3. Poor or lack of finance. | 28 | 23.33 | 1 st |
| 4. Scarcity and high cost of improved cassava stem cuttings. | 12 | 10.00 | 5 th |
| 5. High cost of farm inputs. | 24 | 20.00 | 2 nd |
| 6. Poor or weak extension education. | 20 | 16.67 | 3 rd |
| 7. High level of illiteracy among farmers. | 18 | 15.00 | 4 th |
| 8. Technology incompatible with the farmers cropping system | Nil | Nil | Nil |
| 9. Lack of processing or storage facilities. | 4 | 3.33 | 8 th |

Source: Field Survey 2022/2023 cropping season.

Results from table 4 show that, with 23.33% of the survey farmers, poor or lack of finance on the part of farmers, ranked first as the major constraint to the adoption of improved cassava varieties in the area. This was followed by 20%, 16.67%, 15% and 10% of the respondents who ranked for high cost of farm inputs, poor or weak extension education system, and high level of illiteracy among farmers as 2nd, 3rd, 4th, and 5th major constraints to the adoption of improved cassava varieties respectively. Other factors ranked as 6th, 7th and 8th major constraint include lower dry matter of the improved cassava varieties than the traditional varieties, higher post harvest spoilage of the improved cassava varieties than the traditional varieties and lack of processing/storage facilities respectively. The findings confirm earlier ones by Lawal *et al* (2018) who reported that poor capital, inadequate government support, scarcity of improved varieties and high cost of farm inputs were major constraints to increased cassava production in Gwazo Local Govt Area of Kano State, Nigeria.

IV. Conclusion And Recommendations.

The study revealed that the farm enterprise of the adopters of improved cassava varieties based mixed cropping system in the area is more profitable than that of the non-adopters. This is based on the findings that every one naira invested in the farm enterprise per hectare by adopters earned ₦2.97 as return on investment (ROI) whereas every one naira invested in the farm enterprise per hectare by non-adopters earned ₦1.48 as return on investment (ROI). The study further revealed that whereas the farm enterprise per hectare of the adopters recorded net profit of ₦1,221,450 that of the non-adopters recorded the net profit of ₦353,500 per hectare. The result of the sensitivity analysis revealed that the profitability index of the farm enterprise of the adopters remained consistently positively stable indicative of higher capacity to withstand sudden change in input and output than the farm enterprise of the non-adopters which profitability index was rather mildly unstable. Poor or lack of finance on the part of the farmers, poor or weak extension education, high level of illiteracy of the farmers among others were found to be major constraints to the adoption of improved cassava varieties in the area. The study therefore recommended for effective policy measures aimed at increasing farmers access to agric credit especially through the Agric Guarantee Credit Scheme and Anchor Borrowers' Programme of the Central Bank of Nigeria (CBN), Agric Credit Facilities of the Bank of Agriculture (BOA), provision by relevant agencies of Governments and Non Governmental Organizations (NGOs) of effective agricultural extension education programme to farmers as well as collaborative design and implementation of improved cassava out-growers scheme by National Root Crop Research Institute (NRCRI); Faculties of Agriculture in some Nigerian universities, states ADPs and farmers' groups involving the production and distribution of improved cassava varieties planting materials for increased yields and profitable cassava farming in Nigeria.

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