Effects of cassava (*Manihot esculenta*) planting times on economic profitability in Nigeria: A case study of cassava farmers in Odeda Local Government Area, Ogun State

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Cassava is usually planted at three different times during the year. Early planting in May, middle planting in July and late planting in September. One of the keys to getting high yields and profit from cassava is knowing the appropriate time to plant. Knowing the best planting period will reduce losses and improve returns. In Nigeria, findings show that under ideal conditions, the best planting times for cassava are during the long rainy season which is generally from March to November depending on location. However, this study examines the effects of planting times (early and late) of cassava production on profitability in Nigeria using data from cassava farmers in Odeda Local Government Area in Ogun State as a case study. Data were analysed using descriptive statistics, budgetary analysis and ordinary least squares regression. Results show that many (43.3%) of the cassava farmers had between 10 and 20 years' experience in cassava farming. The majority (79.2%) of cassava farmers plant between April and June, and this set of cassava farmers were categorised as early planters, while 20.8% of the cassava farmers in the study plant between September and November and they were categorised as late planters. The results indicated that cassava planting time affect economic profitability of cassava. Cost of labour, extension services, planting time and farm size had a positive coefficients and significant effects on profitability level of the cassava farmers. It can therefore be concluded that despite the higher total revenue for the late planters of ₦145,005/ha (US$378.87) compared to ₦135,678/ha (US$354.50) for the early planters, early planting is still the best option for cassava farmers due to higher profitability ratio and unpredictable climate variability that usually affects the late planters.

Keywords: Relative planting time, cassava, economic profit, gross margin

Cassava (*Manihot esculenta*) is one of the fastest expanding staple food crops grown and consumed in many parts of Nigeria. This crop has continued to gain prominence among farmers while the industrial demand is also rising consistently (FAO 2018). Cassava grows well in various soil types and ecologies and can either be planted alone or in association with many other crops such as maize, melon, groundnut, cowpea and vegetables. Other less important intercrops particularly in south and south eastern Nigeria include yam, cocoyam, sweet potato, plantain and banana. No branching or high branching varieties of cassava are best for intercropping.

Several improved varieties of cassava have been recommended and released in Nigeria. The most commonly grown of these are TMS 30572, 4(2)1425, 92/0326 and NR 8082. More recently 42 new improved genotypes have been made available to farmers in the south and south eastern Nigeria for participatory selection so that specific best varieties for each of the cassava growing communities can be identified.

Globally, cassava production has experienced consistent growth of well above 3% annually (FAO 2018). Growing cassava is not very labour intensive and usually requires 75 – 125 person-days per hectare from land preparation to harvesting. The storage roots can be harvested 9 – 18 months after planting and under the traditional farming practices, one can expect between 8 – 15 tonnes of storage

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roots per hectare of land planted only with cassava (IITA 2016). According to FAO (2018), as of 2018, world cassava production stood at about 278 million tonnes; African total production was about 170 million tonnes (about 60% of world production) (FAOSTAT 2019). At the same period, Nigeria produced about 60 million tonnes (FAOSTAT 2019).The increasing importance of cassava among crops grown in Nigeria is not only connected to its increasing demand as food but also as food security (FAO 2018). The increase in demand by fast expanding feed and starch markets as well as other cassava-based industries across the globe and rising prices of close substitutes like rice and maize are rapidly reordering the dynamics of cassava markets in the tropical countries of Africa, Asia and Latin America (Ikuemonisan et al. 2020; Market Research Future 2020).

A highly tolerant cassava crop, known for its wide ecological adaptability, will always perform relatively well where other crops may not be able to produce reasonable yields (Otekunrin and Sawicka 2019). This attribute confers on cassava a reliable food security for farming households in the tropics in addition to providing dietary energy for close to a billion people and livelihood for millions of farmers/processors, traders worldwide (FAO 2018, Ikuemonisan et al. 2020). Furthermore, according to FAO (2018), cassava is a choice crop for rural development, poverty alleviation, economic growth and ultimately, food security. By-products of cassava include cassava starch, cassava flour, cassava chips, garri (eba), akpu (fufu) and abacha bobozi (flakes).

Agronomic practices such as crop arrangement, planting times, and planting densities can increase productivity. Planting at the right time will ensure healthy sprouting and good crop establishment (Aiyelari et al. 2019). Cassava may be planted at any season, but it is better if the soil is always wet during the first 4 – 5 weeks after planting. Planting is ideal soon as the rains become steady. The best time to plant cassava in Nigeria according to general practice is in April, it can, however, be extended to October. This varies from March to November in the rain forest, April to August in the derived savanna, May to July in the Southern Guinea Savanna (SGS) and July to August in the Northern Guinea Savanna (NGS). Planting is done either early in the morning or late in the afternoon when the sun is cool, to prevent excessive heat on the crops. Depending on the variety, harvesting of cassava for food may begin from the seventh month after planting the cuttings for early varieties, or after the tenth month for late varieties. Optimising rainfed cassava production requires careful attention to planting dates, planting methods, planting positions and soil management practices that help to conserve water. Cassava produces reasonable yields on poor soils; many varieties perform better with fertilization.

Recent findings by Ani et al. 2019 revealed that net return of the farmers is affected positively by the use of fertiliser, price per cassava truck and the total revenue. Similar studies by Ogunleye et al. 2017 showed that cost of ridge making, cost of land clearing, cost of weeding, type of labour used, cost of feeding, cost of cassava stem cutting, and cost of transportation to point of sale were negative and significant to the net returns of the farmers. Also, a study by Sanusi et al. 2020 further emphasised on the profitability of cassava production. However, these studies did not reveal the effect of planting time as an important factor influencing profitability of cassava production.

Currently, there is a knowledge gap regarding the effects of planting times on profitability of cassava production in Nigeria. This study is motivated because the performance of smallholding cassava farms in Nigeria is observed to be unsatisfactory in terms of yield and profitability. The main objective of this research study therefore was to examine the effects of planting times on profitability of cassava farmers in Nigeria using sampled farmers from Odeda Local Government Area, Ogun State, while the

specific objectives were to: describe the socio-economic characteristics of the cassava farmers in the study area, determine the profitability from cassava by farmers based on cassava planting times and finally, analyse the effects of planting times and other socioeconomic variables on cassava profitability.

Material and methods

Study area

The study was carried out in Odeda Local Government Area, Ogun State, Nigeria. Odeda Local Government Area has headquarters at Odeda, situated along the Abeokuta- Ibadan Road, about 10 km from Abeokuta (the state capital). The Odeda Local Government Area vegetation is mainly orchard and thick grasses. Thus, the land is suitable for agriculture and livestock rearing. The area of land is 1,560sq km and the population is between 99,000 – 115,000. The Local Government shares boundaries with Ibarapa and Iddo Local Government Areas of Oyo State in the North and East, with Obafemi Owode Local Government Areas to the south and west respectively. The area enjoys a tropical climate, with double maxima of rainfall between April and July and from September to October. There is a short dry season in August and the long dry season starts from November.

Sample size and sampling procedure

A multi-stage sampling technique was used to select 120 respondents for the purpose of this study. The first stage entailed a purposive sampling of two zones (Ilugun and Opeji) among the three political zones in the Local Government Area; the two zones were selected due to the higher economic value and relative concentration of cassava. The second stage involved a simple random sampling of three villages from each of the two political zones. From Ilugun zone, Olodo, Ilugun and Apesin were randomly selected, while from Opeji zone, Alabata, Obete and Opeji were randomly selected. The last stage involved a purposive selection of 20 cassava farmers in each of the three selected villages per zone to give a total of 120 respondents which were used for the analysis.

Method of data collection

The study mainly used primary data. Data on farmers' socio-economic characteristics, cost of inputs used and output, were collected through a structured questionnaire.

Methods of data analysis

Data were analysed using both descriptive (percentages, frequency distribution tables, mean standard deviation) and inferential statistics (ordinary least square regression and budgetary techniques). The budgetary analysis enables the estimation of the total costs as well as total revenue accrued to an enterprise, gross margin, farm net profit and profitability of an enterprise within a specific production period (Nandi et al. 2011).

The gross margin was calculated as follows:

$$GM = GR - TVC$$

Where GM = gross margin; GR = gross revenue or gross income (sale of cassava root and stems); and TVC = total variable cost.

$$TVC = TOC + TLC$$

Where TOC = total operating cost and TLC = total labour cost.

The total cost of production (TC) was defined as:

$$TC = TVC + TFC$$
$$TFC = TOC + TLC + TFC$$

Where *TFC* = total fixed cost and *TVC, TOC and TLC* are as previously defined.

The net farm income (NFI) and the return on investment (ROI) used as a measure of profit and profitability respectively were calculated as:

$$NFI = GM - TFC$$

$$ROI = GM/TC$$

Ordinary least square regression model

Ordinary least square regression was used to determine the effect of cassava planting times on profitability. This is an economic tool for predicting the value of dependent variable given the values of the independent variables. The coefficient of determination (R^2) shows the level of variation in dependent variable (Y), which is explained by variations in the independent variables (X_i). The model for this analysis was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \text{----------} + \beta_{10} X_{10} + \varepsilon$$

Where:

- Y = profitability (measured as returns on naira invested in cassava production and equal to the ratio of gross margin to the total cost of production)
- X_1 = planting time (April/July=1, September/November=0)
- X_2 = stem cuttings per hectare (number of bundles)
- X_3 = fertiliser used (kg)
- X_4 = experience (years)
- X_5 = farm size (hectare)
- X_6 = educational level (years)
- X_7 = family size (number)
- X_8 = cost of cassava (naira)
- X_9 = cost of labour (naira)
- X_{10} = access to extension service (1= if yes, 0=otherwise)
- β_0 is the constant term and $\beta_1, \beta_2, \beta_3, \ldots \beta_{10}$ are the parameters estimated
- ε is the error term or the disturbance term.

Note that almost all the selected farmers planted the same variety (TME 419), so cassava variety was not included in the model.

Results and discussion

Socio-economic characteristics of the respondents

The results of the summary of socio-economic characteristics showed that the average age of cassava farming households in the study area was 45 years (Table 1). The majority (70.8%) of respondents were Christians, 28.7% were Muslims, while 2.5% of the respondents practiced other religions. Most of the farmers (60.8%) were married. The large proportion of married respondents may be as a result of the fact that early marriage is a common practice in the study area. Table 1 also shows that 28.3% had secondary school education, 27.5% had no formal education, while 37.5% and 6.7% had primary education and tertiary education respectively. A large proportion (72.5%) of the respondents had one form of formal education or the other, this high level of education could affect the level of technology adoption and skill acquisition among the farmers since education enhances technology adoption and the ability of farmers to plan and take risks. Farmers with higher levels of education are likely to be more efficient in the use of inputs than their counterparts with little or no education. The average household size of the farmers in the area was six persons; 72.5% of farm households had 3 – 6 members, 11.7% had less than 3 and between 7 – 10 members, while only 4.2% had over ten household members. Thus, the majority of the sampled farmers had between 3 – 6 family household members. In the sample, 43.3% of the cassava farmers had between 10 – 20 years' experience in cassava farming, while 28.3% of them had

less than 10 years' experience in cassava farming. The average experience of the cassava farmers was 16 years. This showed that the majority of the cassava farmers had considerable experience in cassava farming and this may have a positive effect on participation in cassava markets, and hence, higher profitability.

Table 1: Distribution of respondents by their socio-economic characteristics

Variable	Frequency	Percentage	Mean (Standard Deviation)
Age			
20 – 29	31	25.8	45.2 (0.62)
30 – 39	41	34.2	
40 – 59	30	25.0	
60 – 69	16	13.3	
Above 70	2	1.7	
Total	120	100	
Religion			
Christianity	85	70.8	
Islam	32	26.7	
Others	3	2.5	
Total	120	100	
Educational status			
No formal education	33	27.5	
Primary education	45	37.5	
Secondary education	34	28.3	
Tertiary education	8	6.7	
Total	120	100	
Marital status			
Single	14	11.7	
Married	73	60.8	
Divorced	12	10.0	
Widowed	21	17.5	
Total	120	100	
Household size			
Less than 3 persons	14	11.7	5.49 (0.713)
3–6 persons	87	72.5	
7–10 persons	14	11.7	
More than 10 Persons	5	4.2	
Total	120	100	
Farming experience (years)			
Below 10 years	34	28.3	16.17 (0.853)
10 – 20 years	52	43.3	
21 – 30 years	23	19.2	
31 – 40 years	7	5.8	
41 – 50 years	4	3.2	
Total	120	100	

Gross margin per hectare of early and late cassava planters

Table 2 presents the gross margins per hectare of early and late cassava planters**.** The early cassava planters had a higher gross margin of ₦40,714/ha (US$106.38) though lower total revenue of ₦135,678/ha (US$354.50) compared to the late planters who had a gross margin of ₦39,031/ha (US$101.98) and total revenue of ₦145.005/ha (US378.87). The profitability level that measured the level of performance based on available resources used measured in returns on naira invested implied that the early cassava planters had a higher profitability when planting is carried out in May compared to the late planters (September). These values are relatively lower than those of Ogisi et al. (2013), who reported that cassava farming had a gross margin of ₦61, 901 (US$196.5) in their study of cassava farming in Ika area of Delta State, Nigeria. They are however, very close to another study by Angba and Iton (2018) who reported a gross margin of ₦45,652 **(**US$144.93) in Cross River State. Ebukiba (2010) found a gross margin that was twice as large (₦141,950 or US$933.88) in her economic analysis of cassava farming in Akwa Ibom State Nigeria, while Daud et al. (2015) reported a much higher gross margin of ₦162,487.07 (or US1,076) in another study carried out in Oyo North area, Nigeria. This low gross margin in our study could be attributed to the high cost of labour for both the early and late planters.

The rate of return on investment

The returns on naira invested in the early and late cassava production were ₦0.40 and ₦0.35 respectively (Table 2). This implies that for every one naira invested by the early cassava planter, a gain of 40 kobo is realized, while 35 kobo were realised by the late planters showing that early planters are more profitable than the late planters. Many other studies had reported different profitability ratios (Ebukiba 2010, Nandi et al. 2011, Odoemenem and Otanwa 2011, Ogisi et al. 2013, Toluwase and Abduraheem 2013, Zaknayiba et al. 2014). These results should not be surprising given the differences in total costs and the gross margins, which could have partly accounted for the variations in the findings. While acknowledging the major findings from this study, it should be noted that there is a great potential for higher gross margin and returns on investment in cassava production if the planting time beside other agronomic management practices are taken into consideration.

Table 2: Costs and returns of cassava per/ha in different planting times in the study area

	Early planters	**Late planters**
Costs and returns	**Amount(₦/ha)**	**Amount(₦/ha)**
Variable costs		
Land preparation (clearing and ridge making)	20,784	25,774
Stem cuttings	18,000	18,000
Planting cost	3,600	4000
Cost of replacement of non-surviving stems	-	3,700
Insecticide	845	1500
Fertilizer application	10,000	10,000
Herbicide spraying	4,735	2,000
Harvesting of root	15,000	18,000
First weeding	12,000	10,000
Second weeding	10,000	13,000
Total variable cost (TVC)	**94,964**	**105,974**

Table 2: Costs and returns of cassava per/ha in different planting times in the study area continued…

	Early planters	**Late planters**
Fixed costs		
Land renting	5,000	5,000
Depreciation on fixed items (hoes and cutlasses)	710	710
Total fixed costs	**5,710**	**5,710**
Total cost (TC)	100,674	111,684
Total revenue (TR)	**135,678**	**145,005**
Gross margin (GM = TR – TVC)	**40,714**	**39,031**
Net farm income	**35,004**	**33,321**
Rate on naira investment (GM/TC)	**0.40**	**0.35**

Effects of cassava planting times on economic profit

Table 3 shows the effects of cassava planting times on profitability. The value of the coefficient of determination (R-square) of 0.711 shows that 71.1% variations in profitability of cassava is explained by specified factors (independent variables) in the regression model.

Planting time has a positive effect on the profitability of cassava farmers ($P \leq 0.01$). Farmers who adopt the practice of planting early (between April to July) are more profitable than the late planters who plant between September to November due to the fact that the early planters enjoy more of the seasonal benefits that enhance production and at the same time reduce the production cost and once the production cost is reduced, the return to investment and profit will increase. Hence an increase in income and standard of living of the farmers.

Farm size also has a positive coefficient and significant ($P \leq 0.01$) effect on the probability level of the cassava production by farmers in the study area. This means that cultivation of large hectares of land will lead to an increase in the profitability of cassava production by farmers in the study area. This agrees with the findings of Okike (2006), Umoh (2006), Amodu et al. (2011) and Onubuogu (2014) who all reported that farm size has a significant effect on cassava profitability in the South-South and Savanna Zones of Nigeria. Moreover, cassava cuttings also have a positive coefficient and significant ($P \leq 0.05$) effect on the profitability level of the cassava by farmers. This implies that an increase in the number of cuttings (bundles of cassava stems) increases cassava profitability. This result agrees with that of Eze and Nwibo (2014) who reported that cassava cuttings have a positive coefficient and significant relationship with cassava profitability in Delta State, Nigeria.

Contrary to *a priori* expectation, the cost of labour has a positive coefficient and significant ($P \leq 0.05$) relationship on the profitability of cassava production. Paying farmers better wages motivates them to work more, thereby leading to greater harvests which probably translate to higher profitability.

Table 3: Effects of cassava planting times on profitability

Variables	Coefficient (β)	Standard Error	t-value
Planting time	0.762***	0.215	3.542
Stem cuttings per hectare	54.395**	25.065	2.170
Fertiliser used (kg)	1.263	14.266	0.088
Experience (years)	-355.359***	68.501	-5.187
Farm size (hectare)	1.253***	0.094	13.193
Educational level (years)	809.241	526.114	1.538
Family size	0.0049	2450.000	0.000002
Cost of cassava root (₦)	12.213	31.026	0.394
Cost of labour (₦)	54.395**	25.065	2.170
Access to extension service	0.0049	0.0034	1.429
Intercept	5.161	2.010	2.570
R-squared = 0.7108			
Prob > F = 0.0000			
Adjusted R-squared = 0.6938			

***, ** Significant at $P \leq 0.01$ $P \leq 0.05$ respectively

Conclusion

Planting time is one of the most important management decisions that farmers make each year. Planting time has a significant effect on cassava's yield when all other factors are equal. Findings from this study show that the level of profitability in cassava production is a function of planting times in the year. The study concludes that for a higher profitability in cassava production in Nigeria using Odeda Local Government Area as a case study, it is better for farmers to plant during the early rain which starts around April and lasts until July, for farmers to take advantage of the regular rainfall even though with a higher labour cost in terms of weeding, than to wait till September–November when the late planters plant.

Based on the findings of this study, the following suggestions can assist to improve the profitability level of cassava:

i. Cassava farmers should adopt the early planting time. That is, planting of cassava between April to July will enhance profitability compared to planting in September to November every year.
ii. Extension agents should visit more in order to assist cassava farmers to improve their profitability through training on the right planting time and introduction of improved cassava varieties.

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