Profitability Analysis of the Adoption of Improved Agricultural Technologies among Cassava Farmers in Ekiti State, Nigeria

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Abstract: The importance of improved technologies in agricultural production cannot be overemphasized. This research was carried out to analyse the profitability of the adoption of improved agricultural technologies among cassava farmers in the study area. Multistage random sampling method was used to select 180 cassava farmers while a well structured questionnaire was used to retrieve information from the selected respondents. Both descriptive statistics and partial budget analysis were used to analyse the data collected. The results show that the mean age of the farmers was 42 years and 78.9 percent of them were male while 68.9 percent were married with mean household size of 9 persons. About 88.9 percent of the farmers had formal education and 43.3 percent were members of farmers' organizations. The mean years of farming experience was 20 years. The major source of information to farmers was radio. In the study area nine improved agricultural technologies were identified. They are: improved cassava cultivars; cassava planting machine; selective herbicides for cassava; Different methods of land preparation; pests and diseases control chemical; cassava harvesting machine; cassava processing machine; Improved plant spacing 1m x 0.75m; and Application of fertilizer. The level of adoption of the improved agricultural technology was low. Marginal rate of returns (MRR) of ₦2.16 was recorded on every ₦1.00 spent, while the main constraints to adoption of improved agricultural technologies among the cassava farmers in the study area were high cost of innovation, inadequate farm input, transportation, inadequate extension visit, unstable market prices and inadequate information. It was recommended that in order to raise the level of adoption, cassava farmers should be empowered by the government on the use of the available improved agricultural technologies in the study area.
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Introduction

The importance of agriculture in economic growth, enhancing food security, rural development and poverty reduction cannot be overemphasized. It is the main source of livelihoods for about 2.5 billion people in the developing world (FAO, 2003). Farming is identified as a vital development tool for achieving Sustainable Development Goals, one of which is to end poverty in all its forms everywhere by 2030. On September 25th 2015, countries all over the world came together to adopt a set of goals to end poverty**,** protect the planet, and ensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years (United Nation, 2016). It has been advocated that agriculture should adopt climate-smart practices to better help poverty reduction worldwide. This has brought much conversation on the need to increase sustainable productivity in agriculture globally. Increasing agricultural productivity is critical to meet expected rising demand and, as such, it is instructive to examine recent performance in cases of improved agricultural technologies (Challa, 2013). Increase in demand for food as a result of increasing population globally has led man to better methods of production in order to guide against hunger and food scarcity. The use of improved agricultural technology is one of the ways to increase food productivity.

According to Oni (2009), technology is used to enhance, improve and advance human societies and conditions. Technology is used to control the forces of nature bestowed on man, into goods and services for better quality life. Broadly defined, however, technology may be regarded as any practical art which utilizes scientific knowledge (Suleman, 2011).

Cassava (*Manihot esculenta* Crantz) is a major food and industrial crop grown majorly in the tropics for its starchy and tuberous roots, which are used for both human and animal consumption, and as well as raw material for industries (Nweke, 2004). In African, cassava is regarded as a powerful poverty fighter. According to Okpetu (2012), cassava suddenly gained prominence in Nigeria following the pronouncement of the Federal Government on the need to use cassava production as the engine of growth in Nigeria. FAO (2012) stated that ability of cassava to display an

exceptional ability to adapt to climate change makes it very important to the agro-economy of several tropical countries and the use of Improved Agricultural Technologies (IATs) is expected to boost its production. Therefore the objectives of this study are to: describe the socio-economic characteristics of cassava farmers; identify the improved agricultural technologies available for cassava production; determine the level of adoption of improved agricultural technologies; analyze the profitability of the adoption of improved agricultural technologies among cassava farmers and examine the constraints to adoption of improved agricultural technologies among the respondents in the study area.

Methodology

The study area

This study was done in Ekiti State. The State is located in Southwest, Nigeria and was carved out of Ondo State on 1st October, 1996. Ekiti State population is about 2.5 million (National Population Commission, 2006). Ekiti State lies between Latitude 7^0 25^1 and 8^0 5^1 North of Equator and between Longitude 4^045^1 and 5^046^1 East of Greenwich Meridian. Ekiti State is bounded in Northwest by Kwara State, Northeast by Kogi State, Southeast by Ondo State and South by Osun State.

Ekiti State is made up of 16 Local Government Areas (LGAs). The study area enjoys luxuriant vegetation with low lands and rugged hills. It has two distinct seasons, these are rainy season (April-October) and dry season (November-March) and annual temperature ranges from 21-28 Degree Centigrade with high humidity. The primary occupation of the people in the area is farming.

Sampling technique and sampling size

A multi-stage random sampling method was used to select the respondents. The first stage involved a random selection of two agricultural zones out of the three agricultural zones in the State. The second stage involved a random selection of three Local Government Areas (LGAs) from the selected zones. At the third stage, random selection of three communities from each of the LGAs was carried out and at the last stage, randomly ten respondents from each of the communities were selected to give a total of 180 respondents. Primary data were obtained through the aid of a well-structured questionnaire.

Data analysis

The statistical tools used include, descriptive statistics and partial budget analysis. Descriptive statistics such as frequency counts, percentage and mean were employed to: analyze the socio-economic characteristics of the respondents; identify the improved agricultural technologies available in the study area; examine the level of adoption of improved agricultural technologies; and identify the constraints to adoption of improved agricultural technology in cassava production. Partial budgetary analysis was used to determine the profitability of adoption of IATs in cassava production.

Partial budget analysis

Partial budget technique was used to analyse the costs and returns of improved agricultural technologies (IATs) adopters and non-adopters. Such analysis allows assessment of the impact of a change in the production systems on a farmer's net income.

The followings were computed for two categories of farmers:

(1) Total Revenue (TR): The total revenue is the sum of all the product of the output price (P) and yield (Q)

$$TR = \sum_{i=1}^{n} P_i\, q_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

(2) Total variable cost (TVC): The TVC is the sum of all the products of the price for all the variable inputs and their respective quantities.

$$TVC = \sum_{j=1}^{m} c_j\, x_j \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

(3) Gross Margin (GM): Total variable cost (TVC) was deducted from Total Revenue (TR) to arrive at the gross margin (GM)

$$GM = \sum_{i=1}^{n} P_i\, q_i - \sum_{j=1}^{m} c_j\, x_j \ldots\ldots\ldots\ldots\ldots \quad (3)$$

Where:

GM = Farm gross margin

p_i= Market price of output for farmer i

q_i= Quantity of output of farmer i

c_j= Unit price of the variable input j

x_j= Quantity of variable input j used

m = Number of input used

n = Number of farmers

(4) The marginal rate of return (MRR) to improved agricultural technology adopted was estimated using the equation below according to Alimi and Manyong (2000)

$$MRR = \frac{(GM_1 - GM_2)}{(TVC_1 - TVC_2)} = \frac{\delta GM}{\delta TVC} \ldots\ldots\ldots (4)$$

where:

MRR = Marginal rate of return

GM_1 = Average gross margin for AIATs per ha

GM_2 = Average gross margin for NIATs per ha

TVC_1 = Average total variable cost for AIATs per ha

TVC_2 = Average total variable cost for NIATs per ha

δGM = Change in gross margin per ha

δVC = Change in variable cost per ha.

AIATs = Adopters of Improved Agricultural Technologies

NIATs = Non-Adopters of Improved Agricultural Technologies

Results and Discussion

Socio-economic characteristics of cassava producers

Results in Table 1 show that the age of cassava farmers ranged from 18 to 67 years with the mean age of 42 years. This implies that the respondents are still in the active and productive age. Sex distribution of the respondents revealed that 78.9 percent were males while 21.1 percent were female. This shows that there are more male cassava farmers in the study area. About 68.9 percent were married. According to Omolehin, *et al*., (2007), the marital status of a farmer could have significant effect on production decisions. They opined that in African traditional society, married persons are considered to be more responsible and reliable. It is assumed that a person having family would be eager to meet the households' basic necessities of life. The mean value for household size was 9 members. The result shows that household size in the study area is fairly large which may be an indicator for availability of labour, provided there are more people within the age range of active labor force as stated by Rahemeto, (2007) in his study of the determinants of adoption of improved haricot beans.

Educational status of the respondents revealed that 88.9 percent had formal education. This implies that the farmers can easily comprehend whatever they are taught on improved agricultural technology. Ajala *et al.,* (2012) stressed that education is an important instrument needed for successful implementation of technologies in agricultural production.

Halve of the respondents (50%) got their land via inheritance, while 22.2 percent rented the farm land. This shows that most of the respondents still rely on inherited lands which are mostly small and fragmented in nature. This may reduce rate of adoption. About 62.2 percent of the respondents had less than 4 hectares for cultivation of cassava. The result shows that most of the cassava farmers in the study area operate on a small scale which may not encourage adoption of improved agricultural technologies.

Farming experience of the respondents ranged from 1 to 42 years. The mean farming experience was 20 years. This means that respondents in the study area are experienced cassava farmers. Ani (2006) reported that farming experience to a large extent affects farmers' managerial know-how and decision making. The table further shows that 43.3 percent were members of at least one farmers' organization, while 56.7 percent did not belong to any farmers' organization. The distribution of respondents on credit accessibility in the table shows that 41.1 percent, of the respondents had access to credit facilities, while 58.9 percent had no access. Non accessibility to credit facilities could hinder farmers from adopting improved agricultural technologies. About 73.4 percent employed both family and hired labour on their farms while few (2.2%) used family only. Also those that used hired labour only were just 10 percent. About 44.4 percent of the respondents mentioned radio as their main source of information on IATs while 20 percent got theirs mainly from co farmers. Also through extension agents, 18.9 percent of the cassava farmers were informed about IATs, while 16.7 percent heard about IATs through other media such as, cooperative societies, IITA officials, village heads bulleting, etc. Radio as a source of information is common in the study area because it is more accessible, cheaper, mobile and easy to operate.

Improved agricultural technologies adopted

In the study area 9 IATs are available. They are: improved cassava cultivars; cassava planting machine; selective herbicides for cassava; Different methods of land preparation; pests and diseases control chemical; cassava harvesting machine; cassava processing machine; Improved plant spacing 1m x 0.75m; and Application of fertilizer.

Table 2 shows that 38.9 percent of the respondents adopted improved cassava cultivars. It implies that in the study area few farmers used improved cassava cultivars which are needed to boost cassava production. These varieties are noted for high yielding and pest resistance. Large number of the respondents (80%) employed the use of selective herbicide in controlling weeds in their cassava farms. This means that cassava famers in the study area could afford the purchase of herbicides in controlling weeds and this will definitely reduce the cost of labour and enhance productivity among farmers.

Also, just 8.9 percent used pests and diseases control chemicals. This might be attributed to the fact that some of the respondents can not afford the chemicals. Cassava processing machine was used by 66.7 percent. The availability of this processing machine encourages farmers to cultivate more cassava because they know they can process cassava to non-perishable products. This is also an indication that most of the cassava farmers in the study area are processors. In addition, about 13.3 percent used the recommended improved planting spacing of 1m x 0.75m. This might be due to the fact that the gaps between the heaps are already guide for the farmer as touching spacing in between one plant and the other.

Table 1: Frequency distribution of socio-economic characteristics of respondents

	Frequency	Percentages
Age (year)		
≤ 20	4	2.2
21-30	24	13.3
31-40	52	28.9
41-50	54	30.0
>50	46	25.6
Gender		
Female	38	21.1
Male	142	78.9
Marital Status		
Single	26	14.4
Married	124	68.9
Divorced	12	6.7
Widowed	18	10.0
Household size		
1 – 5	62	34.5
6 – 10	112	62.2
11 – 15	6	3.3
Educational status		
No formal education	20	11.1
Primary education	52	28.9
Secondary education	64	35.5
Tertiary education	44	24.5
Mode of land acquisition		
Inheritance	90	50.0
Communal	42	23.4
Rent	40	22.2
Purchase	8	4.4
Cassava farm size		
≤3	112	62.2
4 – 8	62	34.5
≥9	6	3.3
Farming experience		
1 – 10	74	41.1
11 – 20	74	41.1
>20	32	17.8
Members of farmers organization		
Yes	78	43.3
No	102	56.7
Credit access		
Yes	74	41.1
No	106	58.9
Source of Labour		
Family labour	8	2.2
Hired labour	22	10.0
Communal labour	22	14.4
Hired & family labour	128	73.4
Main source of information		
Radio	80	44.44
Co-farmer	36	20.0
Co-operative societies	34	18.9
Others	30	16.7

Table 2: Distribution of respondents by the improved agricultural technologies adopted

Improved Agricultural Technology (IATs)	Frequency	percentages
Improved cassava cultivars	70	38.9
Cassava planting machine	0	0
Selective herbicides for cassava	144	80.0
Different methods of land preparation	44	24.4
Pests and diseases control chemical	16	8.9
Cassava harvesting machine	0	0
Cassava processing machine	120	66.7
Improved plant spacing 1m x 0.75m	24	13.3
Application of fertilizer	110	61.1

Respondents adoption level of improved agricultural technologies.

Results in Table 3 reveal that, 70.7 percent adopted between 1 and 4 IATs. These farmers could be classified as low adopters. The moderate adopters (5-6 technologies) were 26.6 percent while, only 2.7 percent adopted above 6 technologies and this group is categorized as high adopter of improved agricultural technologies. The results show that the level of adoption of the improved agricultural technologies in the study area is still very low.

Table 3 Distribution of respondents by number of technologies adopted.

Numbers of IATs Adopted	Frequency	Percentages
1 – 2	36	24.0
3 – 4	70	46.7
5 – 6	40	26.6
>6	4	2.7

Partial budget analysis of cassava farms

Partial budget analysis was performed on the respondents' cassava farms to determine the implications from non-adopter of IATs (NIATs) to the adopters of IATs (AIATs) in cassava production. In addition, partial budget analysis allows ascertaining the effect of gross margin of changing from different technology (Alimi and Manyong, 2000).). In this case, we have changing from the non-adopter of IATs to adopter of IATs in cassava production.

According to Table 4, the average yield of 11.69ton/ha was realized by the AIATs, while that of NIATs was 7.12tons/ha. The average recorded by the two categories of the farmers (AIATs and NIATs) differed significantly (T_c = 4.92). Only those costs which varied between alternative practices (AIATs and NIATs) were considered. The average total variable input cost (TVC) incurred by the farmers due to adoption of IATs (AIATs) was ₦70855.56/ha while ₦47045.44/ha was for NIATs. Average total revenue earned by AIATs was ₦192164.79/ha while NAITs earned ₦116981.60/ha. Gross margin of ₦121309.23/ha accrued to AIATs while NIATs realized ₦69936.16/ha as gross margin.

The Marginal Rate of Return (MRR) was obtained using equation (4) for the financial implication of changing from NIATs to AIATs MRR measure the increase in Gross Margin (GM) due to the adoption of IATs as generated by each additional unit of variables Cost (VC). Changes in farmer's gross margin due to IATs adoption was ₦51373.07/ha while the changes in TVC due to IATs was ₦23810.12/ha. Hence, the MRR of ₦2.16 was recorded in the study area. This means that an investment of ₦1.00 in IATs for cassava production would result to a return of ₦2.16 after recovering the ₦1.00 invested. This further confirmed the economic superiority of IATs in cassava production.

Constraints to adoption of improved agricultural technologies

Table 5 shows the constraints to the adoption of improved agricultural technologies among cassava farmers. The result indicates that 76.7 percent of the respondents said high cost of the innovation was a constraint to them. This implies that most of the IATs available in the study area are beyond the reach of the farmers. An inadequate farm input is another factors militating against the adoption of IATs in the study area. About 85.6 percent of the respondents were faced with inadequate farm inputs problem while 91.1 percent said inadequate information was a problem to them. This shows why the level of adoption is low in the study area.

Moreover, 86.7 percent of the respondents from the area of study were faced with transportation problem. This problem may be due to the bad roads linking the rural areas to the urban areas which eventually make transporter to charge high fares to

convey produce to markets or inputs to farms. The respondents faced with pests and diseases attack problem were just 28.9 percent. Also, most of the respondents (90%) did not have regular contact with the extension agents. There were very few responses (10%) to the cumbersome nature of planting operation as a limitation. This means that nature of planting operation is not a problem beyond their control.

Table 4: Partial budget analysis for cassava production

	Items	NIATs	AIATs
A	**Average total revenue**		
1	Average yield / ha(kg)	7120.00	11695.97
2	Average price (₦/kg)	16.43	16.43
3	Total revenue (2x1)	116981.6	192164.79
B	**Average variable inputs costs (₦/ha)**		
4(a)	Agrochemical	41748.30	3213.01
(b)	Fertilizer	4640	8251.60
5	Labour	657.14	53337.26
6	Harvesting	47045.44	5231.27
7	Transport		822.42
8	Average Total variable input cost (4+5+6+7)		70855.56
C	**Gross margin**		
9	Gross margin (₦/ha) (3-8)	69936.16	121309.23
D	**Marginal analysis**		
10	Changes in gross margin from NIATs to AIATs		51373.07
11	Changes in TVC in NIATs to AIATs		23810.12
12	Marginal Rate of Return (MRR) (10/11)		2.16

Source: Data analysis, 2016

Table 5: Constraints to adoption of improved agricultural technologies among cassava farmers.

Constraints Encountered	*Frequency	Percentages
High cost	138	76.7
Culture	8	4.4
Complexity	130	72.2
Inadequate Farm input	138	85.6
Inadequate information	164	91.1
Insufficient land	42	23.3
Unstable market price	156	86.7
Lack of storage facilities	122	67.8
Lack of processing facilities	54	30.0
Transportation problem	156	86.7
Pest and diseases attack	52	28.9
Inadequate rainfall	34	18.9
Inadequate credit facilities	112	62.2
Inadequate extension visit	162	90.0
Cumbersome nature of planting operation	18	10.0

Multiple choices recorded

Conclusion and Recommendation

The study concluded that adoption of the improved agricultural technology is a profitable venture in the study area. In order to raise the level of adoption, cassava farmers should be empowered by the government on the use of the available improved agricultural technologies in the study area.

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