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The Need for Adoption of Cassava Production Technologies in South Eastern-Nigeria: A Study of Anambra State.

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Abstract
This study on the adoption of cassava production technologies in Idemili-North Local Government Area of Anambra State, Nigeria specifically examined the adoption of improved cassava technologies; profitability of cassava production; the socio-economic characteristics of respondents; the cassava- based cropping system of the farmers; the profit efficiencies of direct factor inputs and constraints to adoption of cassava production technologies. This study used a sample size of 219 respondents gathered from the registered farmers and extension workers from the sixteen agricultural communities of the Idemili North LGA, Anambra State. Data generated were analyzed using descriptive statistics and multiple regressions. The study reveals that agricultural innovation increases the productivity of factor inputs and hence higher interest on factors of production which affects the income and general welfare of the households. Poor output of cassava has been blamed on poor adoption of improved cassava varieties among smallholder farmers in Nigeria. Socio-economic variables of the households significantly influenced level of adoption of the cassava production technologies. The study therefore recommends that government should invest in rural education through effective extension delivery programme in the current political and economic environment in the State, encourage the youths who are sources of labour and more active in cassava production by giving them financial grants/credits and subsidize fertilizers and other agro-chemicals to enhance their affordability by rural farmers. This will discourage rural-urban migration for white-collar jobs.

Keywords: Adoption, Cassava, Technologies, Production, Profitability

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I. Introduction

The importance of new technologies in agriculture is tremendous. Technology is defined as the method of doing things that are based on the modern knowledge of science and computers (Longman, 2007). Technologies that are very importance in agriculture include: improvement in agronomic practices, production of high yielding, disease resistant crops and animal hybrids with wide adaptability, the use of agrochemicals like fertilizers, herbicides and insecticides, the development of integrated pest management systems, development of irrigation methods and farm machineries with enhanced efficiency. When some of these are combined in production process, they improve productivity. For instance, the intensification of production of crops like cassava with irrigation during drought and fertilization will produce all time high level of cassava output per given land area.

Productivity is the increase in the average output per unit input. Productivity enhances increase in income and food security (WTO, 2000). However, a great deal of these agricultural activities in Nigeria is on small land holdings. More than half of the Nigerian population are in farming (largely the subsistence type) (World Bank, 2007). The major crops are sorghum, millet, soybean, peanut, cottons, maize, yam, rice, palm products, coca, cassava and rubber. In addition, poultry, goats, sheep, pigs, cattle, fisheries are raised (Wikipedia, 2007). Farmers with limited resources are the mainstay of food supply for billions of people and this situation is likely to continue for decades, perhaps centuries (Kaindaneh, 2007). The potential for increased food production therefore would rely on adoption of improved (new) technologies by this group of farmers.

Adoption of a technology is the application of knowledge that is new within a specific context like agriculture. When there is a change in the production process of goods and services, technological change is said to occur. Adoption of improved cassava varieties begins with the decision of farmers to replace old inferior varieties or to supplement their stock of planting materials with new improved varieties. The most important step in the application of the new technology is the awareness of the economic incentives accruable from it. The level of adoption entails the actual hectarage cultivation of improved cassava varieties versus the local/ traditional varieties.

The benefits of adopting improved cassava varieties are much for Nigerian farmers. Though, the hybrids have better sequential power for soil nutrients than the local/traditional varieties, they need fertilizer and irrigation in case of drought for optimum yield. Nevertheless, improved cassava varieties can survive and perform without those accompanying inputs and yet gives higher yield than the local varieties when grown under the same circumstance. Therefore, it guarantees the households with limited resources to still realize better livelihood from cassava production. In the rural households, the spread of improved cassava varieties does not usually follow commercial pathways. Family relations and neighborhood friends first receive gift of cuttings from primary recipients. Though, accidental sales of propagules only do occur where buyers appreciate the benefits which they derive from growing such new varieties. These improved varieties differ in their resistance to cassava diseases and pests such as cassava mosaic virus (CMV), cassava anthracnose diseases (CAD), cassava mealy bug (CMB) and cassava green spider mite (CGM). They also produce tubers with varying quality of roots at differing maturity duration and storage in the ground (Okigbo, 1978; Hahn, 1983; Herran and Bennett, 1984; IITA, 1984). Normally, a field of cassava in south-eastern Nigeria may contain different combination of improved and local varieties of cassava. A particular cultivar may be grown in a locality depending on the perceived quality it possesses. A wide variety of cassava including both improved and local varieties can be observed in a farmer's field but one or two can be seen more frequently in a given zone.

Technological change has been a major factor shaping U.S.A's agriculture in the last 100 years (Schultz, 1964; Cochrane, 1979). For instance, a comparison of agriculture pattern in the United States at the beginning (1920) and end of the century (1995) shows that harvested cropland has declined from 350 to 320 million acres, the share of agricultural labour to total labour force has decreased substantially (from 26 to 2.6 percent) and the number of people now employed in agriculture has declined (9.5 million in 1920 against 3.5 million in 1995), yet agricultural production in 1995 was 3.3 times greater than in 1920 (United states Bureau of Census, 1998).

This achievement which had existed in the U.S could spin from consistently high rate of return on public investment in agricultural research and extension indicating underinvestment in these activities. Public spending for research and development in agriculture shows that Federal monies tend to emphasize research on sciences and commodities which are produced in different states while individual states provide much of the public support for innovation inducing activities. These have resulted to decline in federal share in public research to the state share. This has promoted the tendency to move from one line of research to another and, thus, both dynamic and risk consideration tends to diversify innovative effort. Technological change has been the product of innovative activities while innovation is the development, adaptation or imitation and subsequent adoption of these technologies within a specific context like agriculture.

However, the innovative effort in Nigeria is significantly shouldered by federal government agencies and institutes for agricultural development. Some of the institutions charged with these responsibilities are; International Institute for Tropical Agriculture (I.I.T.A), National Root Crop Research Institute (NRCRI) National Institute for Oil Palm Research (NIFOR), Agricultural Development Projects (ADPs), River Basin Development Authorities (RBDAs) etc (CBN, 2003).

For instance, IITA in collaboration with National Agricultural Research System developed a number of improved varieties, practices, systems, and processes and these products were disseminated widely in Sub-saharan Africa. Between 1970 and 1998, 206 varieties of cassava with over 50 percent average yield advantage over traditional varieties were released in 20 countries in Sub-saharan Africa and planted on over 22 percent of the cassava area (Manyong, Alene, Sango et al., 2006). However, despite the introduction of these varieties of improved versions of cassava, most of the states in Southern part of Nigeria are yet to adopt the technology. The literature had shown that suspicion, fear and ignorance have tremendously reduced the extent of its adoption. It is based on this claim that this study is determined to examine the extent of adoption of the new technology in Southern states in Nigeria

1.2 Statement of the Problem

The roles of agriculture and the benefits of agricultural innovations like improved cassava varieties with its numerous advantages over the local varieties seem to be eluding Nigeria as a country that depends on agriculture. This is because the impact of the new technologies is conditional on adoption by farmers who do

not adopt technologies properly resulting to inadequate level of cassava production and low income generation to farm households. DFID (2006) maintained that the issue of the level and determinants of adoption of technologies, which is lacking among agrarian communities, has been as important as their impact on their livelihood.

Adoption of innovations in general is the corner stone to economic empowerment. In Nigeria and elsewhere in the world, the adoption of agricultural innovation has attracted much scholarly works. Scholars generally agree that socio economic and institutional factors affect agricultural innovation adoption. Arene (1994) reported a positive and significant relationship between family size and adoption. Education, size of holding and cosmopolitan issues according to Oladele (2005) accounted for significant variation in adoption behaviour of farmers. Manyong, Alene, and Sango (2006) reported that access to credit and household income was positively significant with adoption.

Available information show that much work has not been done to establish the factor(s) determining or affecting the level of adoption of cassava varieties in Idemili North of Anambra State. Specifically, past studies failed to discuss adoption decisions as a two-stage process. However, adoption involves a two-stage decision problem for a household. The first is a discrete decision of whether or not to adopt improved cassava varieties while the second is a continuous decision of how much of the improved cassava varieties that will be adopted conditional on the first decision of whether or not to adopt the innovation. Moreover, the variables affecting the two decisions may not be exactly the same. There could be fixed type variables affecting the first decision to adopt the improved cassava varieties but not the level of adoption. So that when the first decision is made, they do not affect the second decision (Enete, 2003). This study therefore hopes to explore the smallholder's adoption decision in this context. Moreover, above subsistence level of production, the household hopes to reduce their choice constraints and would use available resources to achieve this objective(s). The increase in income of a household from an enterprise would result to the consideration of a more efficient means by the households. However, little attention has been made to measuring profit efficiency of cassava farmers in Idemili North, Anambra State even when the prices of inputs and output are known in attempt to examine the profit efficiency of inputs and of farmers. The profit of a farm enterprise in monetary terms could be in terms of gross margin or net profit. Past studies tended to concentrate on the determination of gross margin without ascertaining the individual contribution of the inputs to the gross margin in cassava production (Onwuchekwa and Nwagbo, 1986; Olagoke, 1990; Nwakpu, 2007). This study however tries to address these issues.

1.3 Objectives of the Study

The broad objective of the study was to analyze the level of adoption of improved cassava varieties and profitability of cassava in Anambra State drawing analysis from seventeen local government areas of the State. The specific objectives were to:

(i) Describe the socio-economic characteristics of respondents
(ii) Describe the cassava- based cropping system of the farmers
(iii) Estimate the profit efficiencies of direct factor inputs in cassava production.
(iv) Estimate the effects of inefficiency factors in cassava production
(v) Estimate the factors affecting adoption and the level of adoption of improved cassava varieties.
(vi) Identify the constraints militating against the level of adoption of the improved cassava varieties.

1.4 Research Hypotheses

i. All factor inputs do not contribute significantly to profit in cassava production.
ii. All farmers are not efficient in generating profit (gross margin)
iii. The same factors that significantly affect adoption do not affect the level of adoption of improved cassava varieties significantly and in the same direction.

1.5 Justification for the study

Productivity in agricultural activities needs to be enhanced to meet up with energy needs of the teeming population and combat the ravages of hunger and poverty. Since the foreseeable future of smallholder farmers is tied to agriculture (Marinos and Ehui, 2006), the study becomes worthwhile. This calls for the re- assessment of the position of agricultural innovation adoption by way of the extent of adoption by smallholder farmers who are production engine in developing countries like Nigeria. Equally, agricultural innovation is the engine that could drive the productivity of this vulnerable group. It is obvious that proper adoption of agricultural innovation will improve the productivity of labour among

other factor inputs. This will result in increased agricultural output of the farmer.

In addition, much of the smallholder farmers are not literate enough to avail themselves of the implication of technical efficiency indicators hence the conversion of the efficiencies of factor inputs to monetary terms. This will improve their understanding that will in turn translate to proper resource allocation decision for profit maximization. All these put together will result to income generation ability of the smallholder farmers thereby reducing their choice constraints.

Moreover, low productivity in agriculture is blamed on poor adoption of agricultural innovations and much work has been based on them but with less result. It is equally expected that the work will provide empirical information base for further research in other related fields.

Finally, this work is expected to change the perception of policy makers in agricultural development by seeing adoption as a continuum. This will encourage a redesign of program towards increasing farmers' output from agriculture, which is the main occupation of farmers that constitute 70 percent of the labour force. In this way, export base of Nigeria vis a vis primary agricultural commodities will receive a boost. This in turn will generate enough foreign exchange that affects national income positively. These create the enablement for realizing Millennium Development Goals.

II. Literature Review

Innovation or technical change plays vital role in many areas or fields of Agricultural Economics. Environmental economists are concerned with how new innovation affects the environment; Natural Resource Economists are interested in new innovation that improves the efficiency with which non-renewable resources are used. Many macro economists point to technological changes as the primary impetus for economic growth.

Jhingan (2000) posited that a technical change or innovation consist of discovering new methods of production, developing new products and introducing new techniques. Technical change is synonymous with a change in the production function, when there is a technical change; it leads to an increase in productivity of labour and capital (inputs). This is represented diagrammatically by a shift towards the origin and even a change in the slope of the isoquant. This signifies that more output can be produced either with the same inputs or with fewer inputs.

Technical change could be input neutral or specific input saving when used in an improved system of production. Under input neutrality, the input ratio is constant but when input is specific, the input ratio changes (marginal rate of technical substitution) in summary, technical change results in increase in productivity of inputs. In agricultural production, the physical inputs, that is, land, labour, and capital are transformed by the farm firm under a good management with the ultimate goal of maximization of profit, minimization of cost and maximization of satisfaction or the combination of these, (Olayide and Heady, 1982).

Oladele (2005) defines adoptions of innovation as the decision to apply an innovation and continue to use it. A wide range of economic, social, physical and technical aspects of farming influences adoption of agricultural production technology. Recent studies in Europe, Asia and Africa have identified farm and technology specific factors - institutional, policy variables and environmental factors to explain the pattern and intensity of adoption (Charmala and Hossain (1996), Frank (1997), Abdelmagid and Hassan (1996), Rao and Rao (1996) found a positive and significant association between age, farming experience, training received, socio- economic status, cropping intensity, aspiration, economic motivation, innovativeness, information source utilization, information source, agent credibility and adoption. Agbamu (1993) found only knowledge of a practice to be significantly related to its adoptions. Ikpi, Stanton and Tyler, (1992) showed that where farmers have to adopt a new crop technology that shift time from their home to production activity sector, the probability and rate of adoption of such technology is higher. Also a family time is shifted away from the farming sector to home production sector, the economic impact index increases.

Arene (1994) reported a positive and significant relationship between family size and adoption. On the other hand, Voh (1982) established that household size is not significantly related to adoptions. Abdul, Ashfag and Sultan (1993), reported a significant relationship between landholding (farm size) and adoption. Voh (1982) also reported that socio-economic status of farmers is positively and strongly related to adoption. This repot implied that the higher the socio-economic status, the higher the tendency to adopt innovations. Igodan, Oheji, and Ekpere (1988) reported that farmers who are more exposed to formal extension information have a high propensity towards adoption than those with less exposure.

However, Abdul, Ashfag and Sultan (1993) did not establish any relationship between education and adoption. Education, size of holdings and cosmopolitans accounted for significant variation in communication behaviour of farmers. Goswami and Sagar (1994) identified some factors associated with knowledge level of an innovation. They found educational level, family educational status, innovation proneness and utilizations of mass media to be positively and significantly correllated with knowledge level. Earlier evidences of Rogers (1962), Ryan and Gross (1943) led to the categorization of adoption

behaviour into innovators, early adopters, early majority, late majority and laggards.

III. Methodology

Descriptive survey design was used for the study. According to Akuezuilo and Agu (2007) descriptive survey design is one to be representatives of the entire group. The choice of this design was made because it documented events in the most naturally occurring settings.

This study was carried out in Anambra State Nigeria. Anambra State has twenty- one local government areas. From these local governments, balloting system was used to select the local government areas where agriculture was majorly practiced in the state to partake for the study.

The population of the study comprised 1,840 registered farmers, 212 extension workers and 304 industrial workers from the sixteen agricultural communities of Anambra State. This made the total population of the study to be 2,356 respondents. This information was obtained from the available data of the Anambra State Agricultural Development Programme (ADP), Headquarters, Awka as at March, 2015.

The cassava farmers, extension workers and industrial workers were chosen for the research because they were the people assumed to have been involved in the field work.

The sample size used in this study was divided into two: sample size of the quoted estimated population within the local governments under discuss and sample size of the respondents for questionnaires administration. The two samples were drawn from their populations scientifically.

According to Taro Yamani (1964), to determine a sample from a population:

$n = N/\{1+ Ne^2\}$

Where n = sample size

N= Population size

e = error limit.

A sample size of 272 was calculated from the formula and accepted for study, while proportionate stratified random method was used to allocate it to the sixteen community groups at the rate of 17 respondents drawn from each community making a total sample size of 272 used for the study.

The face validity of the measuring instrument was established through the expert judgment of the supervisor and other professionals in the department for the reliability; a pilot study was carried out using 20 participants drawn from Orji River LGA's in Enugu State to test for the reliability of the measuring instrument. The test-retest method of reliability with interval of two weeks was used, and a coefficient alpha of 0.75was obtained. This indicated that the instrument was reliable.

Data collection was achieved through the distribution of 272 copies of questionnaires and personal interviews. Out of the 272copies of the questionnaire distributed, 219 were returned/ representing a return rate of 80.5%.

The data collected were analyzed using descriptive statistics such as tables and percentages while test of hypothetical proposition was done using Pearson product coefficient of correlation (r) to analyze and interpret responses connected with the main variables of the hypothesis.

IV. Result Presentation

Table 4.1: Sex description of respondents

Sex	Frequency	Percent	Cum. Freq.
Male	161	73.5	73.5
Female	58	26.5	100.0
Total	**219**	**100.0**	**100.0**

Table 4.1 showed that the male constituted 73.5 percent of respondents while female accounted for 26.5 percent of the sample. This is in contradiction with the traditional belief that females grow more of cassava while males grow yam. It could be that cassava production was becoming more economically viable.

Table 4.2: Age Description of Household heads

Age	Frequency	Percent	Cum. Freq.
≤20	2	0.9	0.9
21-30	23	10.5	11.4
31-40	49	22.4	33.8
41-50	49	22.4	56.2

>50	96	43.9	100.0
	219	**100.00**	**100.00**

The age distribution of respondents as shown in table 4.2 revealed that 56.2 percent of them fall within the age category of less than or 50 years, while 43.9 percent fall within the age category of greater than 50 yrs. This implies that young and vibrant people are still involved in cassava production in the study area.

4.3 Marital Status of Respondents

Marital status	Frequency	Percent	Cum. Freq.
Married	174	79.5	79.5
Single	11	5.0	84.5
Divorced	8	3.7	88.1
Widowed	26	11.9	100.0
Total	**219**	**100**	**100**

Table 4.3 showed that 79.5 percent of respondents were married, 5.0 percent single, 3.7 percent widowed, and 11.9 percent divorced. Married heads of households are most likely to have available labour for cassava production.

4.4 Educational Level Description of Respondents

Education Level	Frequency	Percent	Cum. Freq.
No formal education.	38	17.4	17.4
Primary	76	34.7	52.1
Junior secondary	9	8.7	60.7
Senior secondary	71	32.4	93.2
Tertiary	15	6.9	100.00
Total	**219**	**100.0**	**100.0**

Table 4.4 showed that 17.4% of the respondents had no formal education while 82.7% had one form of education or the other; primary education accounted for 34.7 percent, secondary education, 41.1percent while tertiary education was 6.9 percent. This is in contradiction with Kaindaneh (2007) that farmers cultivating small farms are illiterate or uneducated. This implies that farmers in the area are relatively educated and hence likely to be receptive to new innovations, and will easily adopt them for greater productivity.

4.5 Primary Occupation Description of Respondents

Primary Occupation.	Frequency	Percent	Cum. Freq.
Farming	149	68.0	68.0
Trading	23	10.5	78.5
Civil servant	33	15.1	93.6
Artisan	14	6.4	100.0
Total	**219**	**100.0**	**100.0**

Table 4.5 revealed that 68.0 percent of the respondents had farming as primary occupation while 10.5% were traders, 15.1% were civil servants and 6.4% were artisan. This showed that majority of the respondents engaged in farming for livelihood.

4.6 Distribution of Land Acquisition Methods

Land acquisition	Frequency	Percent	Cum. Freq.
Leasehold	8	3.7	3.7
Rent	69	31.5	35.2

Exchange	1	0.5	35.6
Inheritance	125	57.1	92.7
Communal	16	7.3	100.0
Total	**219**	**100.0**	**100.0**

Table 4.6 below showed that 3.7% of respondents acquired land through leasehold, 31.5% rented land for farming activities and 57.1% acquired land through inheritance while 0.5% and 7.3% acquired land through exchange and communal methods respectively.

Table 4.7 Distribution of Respondents by Method of Capital Acquisition

Capital acquisition.	Frequency	Percent	Cum. Freq.
Government	2	0.9	0.9
Personal saving	182	83.1	84.0
Banks	2	0.9	84.9
Informal lenders	33	15.1	100.0
Total	**219**	**100.0**	**100.0**

Table 4.7 showed the four means of capital acquisitions, namely; government subsidy or projects grants, personal savings, Bank loans and informal lenders. 83.1% of the respondents' acquired capital through personal savings, 15.1% acquired through informal lenders, while those who acquired through government (0.9) and banks (0.9) were very low. This could mean that the respondent had no collateral securities to borrow from banks or that the banks interest rate was high. This suggests that the respondents may be under credit constraints.

Table 4.8 Distribution of Respondent according to Household Size

Household size	Frequency	Percent	Cum. Freq.
1-3	21	9.59	9.95
4-6	101	46.12	55.71
7-9	80	36.53	92.24
10-12	14	6.39	98.63
13-15	3	1.37	100.0
Total	**219**	**100.0**	**100.0**

A household comprised of all persons who live under the same roof and eat from the same pot (F.O.S 1985). Lipsey (1986) defined household as all people who live under one roof and make joint financial decision. For the purpose of this study, a household implies the head, wife or wives, children and other dependents that live under the same roof. From the survey (table 4.8) households with sizes ranging from 4-6 accounted for 46.12% of respondents. Those whose sizes ranged from7-9 in number accounted for 36.53%, the range of1-3 persons accounted for 9.59%, and the household range of 10-12 and 13-15 accounted for 6.9% and 1.37% of the respondents respectively.

Table 4.9 Farm Size Distributions of Respondents

Farm size (Ha)	Frequency	Percent	Cum. Freq.
0.01-0.39	1.75	79.9	79.9
0.40-0.74	21	9.58	89.48
0.75-1.17	8	3.65	93.13
1.18-1.50	11	5.02	98.15
$>1.5 \leq 2.0$	4	1.83	100.0
Total	**219**	**100.0**	**100.0**

Farm size is affected by many factors including household size, available arable land, level of capital of the farmer among others (Kaindaneh, 2007). Table 4.9 showed that on the average, respondents had farm size of 0.3125 hectares. Majority (79.9 percent) of the respondents had farms whose sizes ranged from 0.01 to 0.39 ha. This was followed by that of 0.42ha-0.74ha representing 9.58 percent. Farm size of range 1.5ha-2.0ha was rare accounting for 1.85 percent. This result agrees with Ndubuizu (1990) that arable land per farmer was small. The farm size distribution also agrees with Brundtland commission categorization of agricultural system (WCED 1987), which suggested that resource poor agriculture generally had small farm units, fragile soil and rain dependent and minimum inputs.

Table 4.10 Distribution of Household Income of Respondents

Household income (₦,000)	Freq.	Percent	Cum. Freq.
98,000.00-255,000	77	35.16	35.16
260-415	68	31.05	66.21
420-575	45	20.55	86.76
580-727	17	7.76	94.52
738-890	12	5.48	100.0
Total	**219**	**100.0**	**100.0**

The household income is a source of capital for farm operation. Family income may be channeled to any enterprise depending on the utility it provides to the household. Table 4.10 showed that of the 219 respondents, 35.16 percent generated income within the range of ₦98, 000.00 to ₦255, 000.00 annually. While the income ranges of ₦260, 000.00 to ₦415, 500.00 accounted for 31.5 percent. The respondents' information did not show the proportion of income accruing from off- farm activities.

Table 4.11: Rate (years) Distribution of Cassava based Crop Cultivation

Rate	Freq.	Percent	Cum. Freq.
Yearly	127	58.0	58.0
Not yearly	92	42.0	100.0
Total	**219**	**100.0**	**100.0**

Table 4.11showed that 58.0 percent of the farmers grew cassava based crop yearly while 42.0 percent did not. This could be that 42.0 percent of farmers have limited supply of arable land as evident in the farm size distribution of farmers in the study.

Table 4.12 Fallow System of Respondents

Fallow practice	Freq.	Percent	Cum. Freq.
Continuous cropping	39	17.8	17.8
Fallow practice (1-4 years)	180	82.2	100.0
Total	**219**	**100.0**	**100.0**

Table 4.12 showed that 17.8 percent of respondents grew cassava continually on a given plot of land while 82.2 percent grew it for a year or two and left the land to fallow for 1-4 years before coming back to it again.

Table 4.14: Distribution of cassava-based intercrop in the study area Cassava

Base	No of Respondent	Percent
+ maize + yam	84	38.3
+ yam + maize + melon	64	29.2
maize + yam + cocoyam	34	15.5
+ melon + maize	37	16.9
Total	**219**	**100.0**

Table 4.12 showed that 17.8 percent of respondents grew cassava continually on a given plot of land while 82.2 percent grew it for a year or two and left the land to fallow for 1-4 years before coming back to it again.

Table 4.15: Fallow year description among respondents

Fallow years	Frequency	Percentage
One year	25	11.4
Two years	109	49.8`
Three years	67	30.6
Four years	18	8.2
Total	**219**	**100.0**

Fallow year is a period during which farmland is allowed to regenerate by natural means the nutrient level that can support future agricultural production. The fallow period could be affected by urbanization, population growth, availability of fertilizer and other agrochemicals, and the incidence of pest on the farm. Table 4.15 revealed that 49.8 percent of the farmers practiced two years fallow period. This was followed by periods of three, one, and four year's fallow with 30.6, 11.4 and 8.2 percent of respondents respectively. This suggests that the fallow years were short such that fertilizer addition maybe required in keeping farmers in production.

Table 4.16: Summary Statistics of Variables for the estimation of the stochastic profit frontier model

	Variable	Min	Max	Mean	Standard Dev.
1	Gross margin (₦)	100.0	182,200.00	19,228.40	7,658.02
2	Average price of labour (₦)	600.00	1,800.00	977.63	212.67
3	Farm size (Ha)	0.01	2.0	0.31	0.38
4	Output price (₦)	300.00	3,000.00	1149.77	423.91
5	Average price of fertilizer	3,750.00	5,200.00	4,038.81	738.77
6	Age (years)	20.0	50.0	43.0	10.70
7	Education level (years)	0.0	16.0	8.0	4.95
8	Year of experience (years)	1.0	56	18.70	10.99
9	Household size (No)	1.0	15.0	6.24	2.34

Table 4.16 gives the summary statistics of variables for the estimation of stochastic profit using frontier model. The mean gross margin of ₦19, 228.4 and standard deviation of ₦7, 658.02 were recorded. The average farm size was 0.31ha with a standard deviation of 0.38 ha. In addition, the average output price of ₦1149.77 with N423.91 standard deviation per barrow load measure was recorded. The price of fertilizer had an average price of N4,038.81 and standard deviation of N738.77 per bag. The price of labour was comparatively stable with average of N977.63 and standard deviation of N212.67.

The maximum likelihood estimations of the parameters of the stochastic profit frontier model are presented in Table 4.17. The estimated coefficient of the parameters of the normalized profit function based on the assumption of competitive market and a rational producer were negative except for fertilizer that was positive. The study also revealed that there was presence of profit inefficiency effects among cassava farmers in the study area. It is confirmed by a test of hypothesis for the presence of inefficiency effects using the generalized likelihood ratio test and significance of gamma (δ^2) estimate. The generalized likelihood ratio test which is defined by the chi-square (x^2) distribution shows that the computed chi square of 32.13 was significant at P<5%. The null hypothesis was strongly rejected leading to the preference of model 2.

Furthermore, the estimated gamma (δ^2) of model 2 (0.99) was highly significant at p < 1%. This implies that one sided random inefficiency component strongly dominates the measurement error (and other random disturbance) indicating that about 99 percent of the variation in actual profit arose from the difference in farmers' practices rather than random variability.

Table 4.17: Maximum Likelihood Estimates of the Stochastic Profit Frontier function

Variable	Parameters	Model 1	Model 2
General model			
Constant	B_0	3.3853***	3.212***
		(7.2052)	(10.37951)
Farm size	B_1	-0.005530	-0.2856**
		(0.189279)	(2.704912)
Average price of labour	B_2	0.0974469	-0.003110789
		(0.80722)	(0.119733)
Average price of Fertilizer	B_3	-0.003268	0.04296***
		(0.086741)	(4.4423)
Inefficiency			
Constant	α_0	0	-0.3485850
			(0.37534)
Age (years)	α_1	0	0.0526978**
			(2.27415)
Educational level (yrs)	α_2	0	-0.268489*
			(2.15022)
Yrs of experience (yrs)	α_3	0	-0.6975**
			(3.18980)
Household size (No)	α_4	0	-0.0179547
			(0.28980)
Sigma square	$\sigma^2 = \sigma^2 + \sigma^2$	0.238	0.2253***
			(3.8672)
Gamma	$\gamma = \sigma^2 \quad \sigma^2 + \sigma^2$	0	.99**
			(45.6727)
Log likelihood	LLF	47.653923	65.7198

Figures in parenthesis are t-ratio
* Estimate is significant at P < 10%
** Estimate is significant at P < 5%6
*** Estimate is significant at P < 1%

The positive coefficient of fertilizer was expected because the farmland in the sampled area was generally under continuous cultivation with few cases of short fallow years hence the fertility status is expected to be poor. The effect is significant at p< 1 percent. The coefficients suggest that for every one naira spent on fertilizer, it generates additional four (4) kobo to gross margin. The average price of labour was negative as expected but was not significant. For farm size, a unit increase in farm size reduces gross margin by 28 percent and is significant at p< 5 percent. This may be because of the level of poverty among the farmers. Poor farm households are usually undercapitalized (Enete and Achike 2008) and hence may not proportionately increase other inputs as farm size increased. This result of the estimates leads to the rejection of the hypothesis that all inputs have significant effect on the gross margin.

The parameters for the determinants of profit inefficiency were reported in the lower part of Table 4.20. The analysis of inefficiency models shows that the signs and significance of the estimated coefficient in inefficiency models have important implication on the profit efficiency of farmers. Based on this, all variables in the inefficiency model have negative coefficients excerpt for age which was positive. This implies that educational level; farm experience and household size decrease with increased inefficiency. In other words, increase in these factors except age increases the efficiency of the farmer. For age, inefficiency increases with aging. This result is expected due to degenerating effect of age (senescence).

The positive effect of age is in agreement with the work of Abdulail and Huffman (1998). While the negative coefficients of educational level, years of experience and household size agree with the work of Kumbhakar and Bhatta Charya (1992b) and Ogundari (2006).

Table 4.18: Parameter estimates of the sample selection (Heckman two- stage) model (Stata version 11.1 analysis result)

Variable	Selection equation Result (probability of adoption)	Outcome equation Result (extent of adoption)
Price/barrow	0.0002771	0.0000327
	(1.08)	(0.76)
Farm size	-0.35961***	-0.0469508
	(-4.82)	(0.31)
Average price of labour	0.0009702**	-0.0000195
	(2.16)	(0.18)
Household income	1.07*e*-07	3.65*e*-8
	(0.19)	(0.51)
Future year's profit	0.2745696	0.01515
(expectation)	(1.31)	(0.39)
logeducational level	0.130408	0.0114568
	(1.13)	(0.53)
Years of experience	-0.0086576	0.0023604
	(-0.89)	(1.49)
logaverage price of	0.0884329***	-.0006042
Fertilizer	(3.50)	(-0.07)
Household size	0.1512229**	-0.0013902
	(3.13)	(-0.10)
Age of respondent	0.0178763*	0.0008087
	(1.69)	(0.46)
Constant	-3.083594***	0.354707
	(-3.73)	(0.86)
Mills		
Rho	-0.39800	
Sigma	0.23608918	

No of observation Censored = 219
observations Uncensored = 91
observations Wald Ch2 (10) = 128
Prob>Ch^2 = 0.8745
Variables in parenthesis are t-ratios indicate significance at p<10%, p<5% and p<1% levels respectively

Table 4.18 showed that the farm size was negatively related with the discrete decision of whether or not to adopt and the continuous decision of extent of adoption of improved cassava varieties. While the relationship with the extent of adoption was not statistically significant, that of the discrete decision was highly significant (p< 0.01). This agrees with the previous observation on farm size and profitability, which was explained with the level of poverty among farm households.

Price of labour was positively and highly significantly related with the discrete decision of whether or not to adopt, but negatively, though not significantly related with continuous decision of extent of adoption. The positive relationship is surprising because high price of labour is supposed to act as a disincentive for engaging in new cassava varieties. However, the data collected for this study was a cross-sectional data. It is therefore possible that those farmers who paid higher wages were also those who hired in more labourers and hence those who have the greater capacity to adopt improved varieties.

The price of fertilizer was positively and significantly related with the first decision of whether or not to adopt but negatively, though not significantly, related with the second decision of the extent of adoption of improved cassava varieties. Its negative relationship with the extent of adoption is to be expected, as higher price of fertilizer will curtail the quantity of fertilizer to be bought for use in cassava field and

hence also reduce the level of adoption. However, the positive and significant relationship between price of fertilizer and whether or not to adopt is surprising. A plausible explanation for this phenomenon is that higher fertilizer prices are interpreted by some cassava farmers as signal of impending fertilizer scarcity, motivating them to stocking fertilizer (Enete and Igbokwe 2009)

Household size was positively and significantly related with the discrete decision of whether or not to adopt but negatively, though not significantly related with the extent of adoption of improved cassava varieties. The positive and important relationship with the first decision is to be expected as farmers with large household size would expectedly be endowed with available household labour for use in the farm. However, the negative relationship with the extent of adoption suggests that this expectation may not have been met because of rural-urban migration.

The age of the farmer was positively related with both the first decision of whether or not to adopt and the second decision of the extent of adoption, with the former's relationship being statistically significant. Experience, which comes with age, may endow the farmer with the ability to take healthier production decision than younger ones (Enete et al, 2002).

Table 4.19: Constraints to extent improved Cassava Production; descriptive table

Constraints	Min	Max	Mean	Standard error	Rank
Land scarcity	1	4	3.3	.87	4th
Cost of playing material	1	4	2.9	.85	9th
Poor price of cassava root	1	4	3.1	.81	8th
Lack of processing facilities	1	4	3.2	.74	6th
Lack of capital	1	4	3.7	.65	1st
Labour scarcity	1	4	3.1	.79	7th
Poor access of credit	1	4	3.3	1.15	2nd
Low income of farmers	1	4	3.4	0.81	3rd
Poor price of finished products	1	4	2.9	.79	5th

During the fieldwork component of the study, the respondents were asked to indicate the extent to which some hypothesized constraints were binding on them. This was done using a four point Likert scale namely Strong =4, Mild =3, Not at all=2, Do not know =1.

Table 4.19 represents the result of the analysis. Constraints whose average rank we equal or above the average of 2.5 were considered as binding, while those below 2.5 were considered not binding. The table shows that all constraints listed were binding on the respondents with the most critical of them being lack of capital. Enete and Achike (2008), reported undercapitalization as a major factor inhibiting smallholder farmers from adopting modern inputs. This also explains the second and third most critical constraints- poor access to credit and low income of farmers respectively. The respondents reported land scarcity as a binding constraint (mean = 3.3).

This may be due to the problem of land tenure which leads to unnecessary fragmentation of farm lands and generally prevents farmers from having complete ownership of farm lands (Nweke and Enete 1999). There were also constraints such as poor price of farm products (mean = 2.9), lack of processing facilities (mean = 3.2) labour scarcity (mean = 3.1) and cost of planting materials (mean = 2.9).

V. CONCLUSION

This study analyzed the adoption and the profitability of cassava production in Idemili North, Anambra State, Nigeria. The study found out that socio-economic variables of the rural households were limiting, typical of subsistence production. However, households were willing to adopt improved cassava varieties but the business environment would not help them do so in large scale. This was evident in the profit indices of factors of production where increase in land allocated to cassava was associated with great losses. This is a justification for intercropping cassava with other crops.

VI. RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made towards achieving increased production of cassava by properly adopting improved cassava varieties in Idemili North, Anambra State;

- Government should increase investment in rural education through effective extension delivery programme in the current political and economic environment in the State. This will provide farmers

with skills necessary for increased efficiency.

- The government should secure enough arable land from communities that have enough and make it available to individuals from the same communities for agricultural production.
- The Government should invest in agricultural sector to encourage diversification of cassava products, that is- value addition, with effective demand to favour the purchase of cassava roots at a profitable price.
- Government should establish agricultural banks in the rural areas of the State to provide soft loan and for easy accessibility to rural dwellers.
- There should be subsidization of fertilizers and other agro-chemicals to enhance their affordability by rural farmers. In addition, there should be provision of credit input materials to farmers. These will encourage undercapitalized farmers to adopt improved cassava varieties for better production.
- Generally, the Government should encourage the youths who are sources of labour and more active in cassava production by giving them financial grants and/credit. This will discourage rural-urban migration for white-collar jobs.

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