

# International Journal of Agricultural Economics and Rural Development

**IJAERD**  
E-Journal

Vol. 2, No. 1, 2009

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Professor Y. L. Fabiyi





**International Journal of**  
Agricultural Economics and  
Rural Development

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Vol. 2, No. 1, 2009

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ISSN-L 1596-9916

**Published By**

Department of Agricultural Economics and Rural Development,  
Ladoke Akintola University of Technology, Ogbomoso – Nigeria

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## **Attitude and the Effect of Health-based Entertainment-Education Strategies on the Knowledge and Behaviour of Women in Lagos State**

Yahaya, M. K., O. S. Fadairo and A. O. Ogunele

Department of Agricultural Extension and Rural Development, University of Ibadan, Ibadan

**Abstract:** The need for empirical evidence to justify the effectiveness of Entertainment Education (EE) as an alternative strategy for health care information delivery to the Nigerian populace and to provide future direction for other up-coming EE channels informed this study. Using multi-stage sampling technique, 408 women were sampled from Lagos State and a combination of structured questionnaire and interview schedule methods were used to elicit information on respondents' preferred time of listening to or watching health-based EE programmes, attitude towards health-based EE programmes and impact of health-based EE on their knowledge and health behaviour. Data collected were summarized using descriptive statistics and Pearson correlation. The data indicated that majority (85.8%) of the women preferred the evening hours for listening to or watching health programmes on EE channels and majority (78.8%) showed favourable attitude towards the use of EE strategies for health education/information. It also revealed an improvement in knowledge and a positive change in the health behaviour of respondents as a result of their watching and listening to various health programmes on EE channels. Respondents' attitude to EE was positively and significantly related to its effect on their knowledge and behavior ( $r = 0.189$ ;  $p < 0.002$ ). The study concluded that women's attitude towards the use of EE strategy for health-based education/information dissemination in Lagos State is favourable and that EE strategy is effective for communicating health and other development messages to women.

**Key words:** Entertainment-Education, health-based, attitude, impact

### **INTRODUCTION**

The term Entertainment-Education (EE) has been given different names such as infotainment, edutainment and Entertainment-Education by different scholars. No matter what name label has been assigned to it, Entertainment-Education is the amalgamation of entertainment and education to harness potential benefits of combining both to achieve some goals, especially to bring about socio-behavioral change. This amalgamation is due to the synergy and the effectiveness at influencing positive behavioural changes in people, when the two individual concepts of *entertainment* and *education* are combined and utilized for passing social

messages to the people. Entertainment-Education is the process of purposely designing and implementing a media message both to entertain and educate, in order to increase audience's knowledge about an educational issue, create favourable attitude and change overt behaviour. It seeks to capitalize on the appeal of popular media to show individuals how they can live safer, healthier and happier lives (Piotrow *et al*, 1997; Singhal and Brown, 1996).

Entertainment-Education is as old as human history. From early times, people of different cultures and traditions had been engaged in Entertainment-Education through the art of storytelling and folktales to provide some form of non-formal education to



their people especially children (Yahaya, 2003). Entertainment-Education has been widely applied to the area of health and health care delivery especially in the field of family planning and HIV/AIDS prevention in recent years. The power of Entertainment-Education to effectively promote changes in health related beliefs and behavior is well documented by several past studies (Bandura, 2003; Basil, 1996; Brown and Basil, 1995; Basil and Bacarnea, 2003; Cody *et al* 2003; Brown and Cody, 1991; Brown and Singhal, 1999; Fraser and Brown, 2002; Witte *et al*, 1998.) These opportunities offered by Entertainment-Education strategy to promote social change are currently being tapped in many African countries including Nigeria, to promote sexual responsibility and health care as a whole. In the 1980's in Kenya, Entertainment-Education was used to address sexual responsibility issues like family planning, sexually transmitted diseases, husband and wife communication and respect, and the disadvantages of polygamy through the development systematic introduction of some radio and television based soap operas among which are Ushikwapo Shikamana (Hold on To he who Hold on to you), Tushauriane (Let's Discuss), Ushikwapo Shikamana II (If Assisted, Assist Yourself) etc.

Also, in Nigeria, given the high risks associated with health problems among women, several EE programmes on TV and radio are being used as strategy for sensitizing the people and for disseminating relevant health information. For example, 'Future Dreams' was a radio serial broadcast in 2001 in nine languages on 42 radio channels (Lagos inclusive). It focused on encouraging consistent condom use, increasing knowledge and increasing skills for condom negotiation in single men and women between 18 and

34. Another high profile EE campaign was prosecuted by Femi Kuti, the son of Fela Kuti, the famous Afro beat Musician who died of AIDS in 1997. He appeared on television and billboards alongside roads throughout Nigeria with the slogan 'AIDS: No dey show for face' which translates as you cannot tell someone has AIDS by looking at them (Population Services International, 2006). Also, several CSOs, NGOs and FBOs in the nation have contributed significantly towards increasing awareness on HIV/AIDS among the populace using various print and electronic media, as well as community theatre, puppets and songs (NASACA, 2006). There is however dearth of empirical evidences to justify the effectiveness of these strategies as an alternative strategy for health care information delivery to the Nigerian populace and to provide future direction for other up-coming radio and television EE strategies. It is against this background that this research was carried out.

The general objective was to investigate the effects of health-based entertainment-education strategies on the knowledge and behavior of women in Lagos State. The specific objectives of the study were to:

1. identify the personal characteristics of the respondents,
2. determine respondents preferred time of listening to or watching health-based Entertainment-Education programmes,
3. determine respondents attitude towards health-based Entertainment-Education programmes; and
4. examine the effect of health-based Entertainment-Education on respondents knowledge and health behaviour.



**METHODOLOGY**

The study was carried out in Lagos State, Nigeria. The study population comprised of all women from 18 years and above living within the State boundary. Four of the 20 Local Government Areas (LGAs) in the State were randomly selected (one from each cardinal region). 50% of the total number of wards from each of the selected LGAs was sampled making a total of 17 wards across the LGAs. A total of 24 respondents were afterwards selected from each of the wards to make a total sample size of 408 respondents, only 386 copies of questionnaire were however processed. A combination of interview schedule and use of structured questionnaire methods were employed for data collection. The instrument for data collection elicited information on respondents’ personal characteristics, their preferred time of listening to or watching health-based Entertainment-Education programmes, their attitude towards health-based Entertainment-Education programmes; and the impact of health-based Entertainment-Education on respondents knowledge and health behaviour.

Respondents indicated their preferred time as morning, afternoon and evening. Respondents also indicated their attitude towards health-based Entertainment-Education by responding to attitudinal statements on a five point Likert-type scale of SA, A, U, D and SD. Scores of 5, 4, 3, 2, and 1 were awarded to the positive statements and the reverse to negative statements. Scores of mean and above represented favourable attitude. Respondents indicated their perceived impact of EE programmes on their knowledge and behavior as No change, slightly improved and seriously improved. The data collected were summarised using descriptive statistics such as frequency, percentages and scoring

while Pearson correlation was used to test the hypothesis that “there is no significant relationship between respondents’ attitude to Entertainment-Education programmes and the effect of health-based Entertainment-Education programmes on them”.

**RESULTS AND DISCUSSION**

Table 1 revealed that majority (72.8%) of the respondents are between the ages of 26 and 40 years while Christianity (86.3%) was indicated as the prominent religion among them. With a calculated mean monthly income of N13, 718.88, majority (71.0%) of the respondents are within the low income earner group. Also, majority (79.3%) of the respondents were married while a higher proportion of them (40.9%) had tertiary level of education. The prominent occupation among the respondents were trading (39.9%) and private employment (33.9%) while very few of them were students (3.1%) and farmers (1.3%).

Table 1: Distribution of Respondents’ by their personal characteristics (n = 386)

<b>Personal characteristics</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Religion</b>		
Christianity	333	86.3
Islam	53	13.7
<b>Age</b>		
20-25 yrs	93	24.1
26-30 yrs	95	24.6
31-35 yrs	93	24.1
36-40 yrs	48	12.4
41-45 yrs	27	7.0
>45 yrs		
<b>Income group</b>		
High	112	29.0
Low	274	71.0
<b>Marital Status</b>		
Single	50	13.0
Married	306	79.3
Widow	30	7.8
<b>Educational Level</b>		
No formal education	22	5.7
Primary	46	11.9
Secondary	132	34.2
Tertiary	158	40.9

Vocational/functional	28	7.3
<b>Occupation</b>		
None	13	3.4
Civil servant	49	12.7
Private employee	139	33.9
Trading	154	39.9
Artisan	22	5.7
Farming	5	1.3
Student	12	3.1

Table 2 showed that (50.5%) of the respondents do listen to/watch health programmes on Entertainment-Education channels for all the three reasons of information, entertainment and education. This means that information, entertainment and education are very important to the respondents. Therefore, health communicators should always include some elements of information, education and entertainment in their health and other development messages targeted at women in order to attract or gain their attention.

Table 2. Distribution of respondents by their reasons for listening to or watching health-based programmes on Entertainment-Education

Reasons for listening/watching	Frequency	Percentage
For information only	23	5.96
For education only	46	11.92
To inform and entertain	21	5.44
To inform and educate	76	19.92
To entertain and educate	17	4.40
For all three reasons	195	50.52
For none of the reasons	8	2.07

Table 3 revealed that majority (85.8%) of the women prefer the evening hours for listening to or watching health programmes on Entertainment-Education channels. This finding agrees with what previous researchers have found. For instance, Yahaya (1995) on a study of media use among women farmers found that women farmers prefer listening to agricultural radio programmes from 8-

10pm. Olowu (1993) in similar vein reported 7-8pm as the most favoured period while Adewunmi (1990) also reported that 83% of farmers preferred 6-9pm for watching or listening to television/radio. This implies that health-based Entertainment-Education targeted at the women would be more effective in reaching a large numbers of them when it is aired during the evening hours.

Table 3: Frequency distribution of the time preferred by respondents for listening or watching health programmes on Entertainment-Education

Time of the day	Frequency	Percentage
Morning	40	10.36
Afternoon	7	1.81
Evening	331	85.75

Table 4a revealed that majority indicated strong agreement to the following statements: that Entertainment-Education is a good strategy for health communication (64%), that its use for health communication to women will be effective (64.5%), that programmes relayed on Entertainment-Education channels has power to change the health behaviours of women positively (51.8%), and that it has contributed to their knowledge about health (60.4%). Others include those who strongly agreed that they like Entertainment-Education generally (67.1%) and those who like watching programmes communicated through Entertainment-Education channels (46.7%). On the other hand, majority (80.4%) of respondents differed (sum of disagreed and strongly disagreed) to the statements that health messages on EE are difficult to understand, that health messages on EE channels are less reliable (86.8%), and that exposure to EE has not led to increase in health knowledge of respondents (91.5%). On the whole, Table 4b indicated that majority of respondents (78.8%) showed favourable attitude towards the use of EE strategies for health education/information while only 21.2% indicated otherwise. These results therefore

provide a launch-pad for health policy-makers and other agencies seeking to advance the frontiers of health development among women and children to harness the benefits offered by EE strategies for more

rapid pro-social change engineering as witnessed in several developing countries such as Mexico, Philippines and Peru.

Table 4a: Frequency distribution of the ratings on attitudinal statements on Entertainment-Education by respondents

S/N	Attitudinal Statements	Ratings of statements by respondents					No Rating
		S/Agree	Agree	Undecided	Disagree	S/Disagree	
1	EE is a good strategy	256 (67.1)	122 (31.6)	1 (0.3)		1(0.3)	3 (0.8)
2	I like EE channels	136 (35.0)	226 (58.6)	12 (3.1)		1 (0.3)	12 (3.10)
3	I prefer EE to none EE	137 (35.5)	84 (21.8)	76 (19.7)	59(15.3)	21 (5.4)	9 (2.3)
4	EE is good for health communication	247 (64.0)	118 (30.6)	11 (2.9)	4 (1.0)	2 (0.5)	4 ( 1.0)
5	I understand messages on EE channels	179 (46.7)	143 (37.1)	27 (7.0)	22 (5.7)	6 (1.6)	9 (2.3)
6	I like watching EE programmes	187 (48.5)	168 (43.5)	19 (4.9)	7 (1.8)	1 (0.3)	4 (1.0)
7	I experience increased knowledge of HIV/AIDS through EE	252 (65.3)	119 (30.8)	1 (0.3)	9 (2.3)	1 (0.3)	4 (1.0)
8	Using EE for health education of women will be effective	294 (64.5)	108 (28)	4 (1.0)	7 (1.8)	3 (0.8)	15 (3.9)
9	I find it difficult to understand health messages on EE channels	0 (0.0)	0 (0.0)	51 (13.2)	177 (45.9)	133 (34.5)	25 (6.5)
10	EE programmes can change health behaviours of women positively	200 (51.8)	134 (34.7)	12 (3.1)	15 (3.9)	3 (0.8)	22(5.7)
11	I do not like to watch/listen to health programmes on EE	0 (0.0)	0 (0.0)	22 (5.7)	185 (47.9)	148 (38.3)	31 (8.0)
12	Health messages on EE channels are less reliable than on none EE	0 (0.0)	0 (0.0)	39 (10.1)	184 (47.7)	151 (39.1)	12 (3.1)
13	The entertainment on EE overshadows the education/information contents	132 (34.2)	194 (50.3)	29 (7.5)	13 (3.4)	4 (1.0)	14 (3.6)
14	Health messages on none-EE are better understood than EE channels	38 (9.8)	58 (15.0)	70 (18.1)	146 (37.8)	68 (17.6)	6 (1.6)
15	I cannot do without some EE programmes	0 (0.0)	0 (0.0)	57 (14.8)	187 (48.5)	131 (33.9)	11 (2.9)
16	I can handle some health problems now through my exposure to EE	132 (34.2)	194 (50.3)	29 (7.5)	13 (3.4)	4 (1.0)	14 (3.6)
17	I know how to contact/avoid HIV through my exposure to EE	246 (63.7)	111 (28.8)	5 (1.3)	14 (3.6)	3 (0.8)	7 (1.8)
18	In spite of exposure to EE, my health knowledge has not increased	0 (0.0)	0 (0.0)	20 (5.2)	187 (48.5)	166 (43.0)	13 (3.4)

19	EE programmes has contributed significantly to my health knowledge	233 (60.4)	117 (30.3)	10 (2.6)	6 (1.6)	5 (1.3)	15 (3.9)
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\*Figures in parentheses represent percentages

\*EE stands for Entertainment-Education

Table 4b: Distribution of respondents by their attitude towards use health-based Entertainment Education strategy

Attitude	Scores	F	%
Favourable	1,158 – 1,930	304	78.8
Unfavourable	386 – 1,157	82	21.2

among the grassroots people especially the women who are the often the worst hit.

Table 5 showed that the respondents adjudged Entertainment-Education to be effective for health-based information delivery. The summary of responses indicated that they experienced a serious improvement in knowledge and a positive change in their health behaviour as a result of their watching and listening to various health programmes on Entertainment-Education channels. For instance, 61.2% indicated serious improvement in knowledge while 59.8% had a positive change in their health behaviour due to programmes on family planning on television and radio respectively. Similarly, 46.4% indicated serious improvement in knowledge while 53.6% had a positive change in their health behaviour due to the serial drama on television known as ‘Images’. Other programmes showed a similar trend. This implies that Entertainment-Education strategies is effective for communicating health and other development messages to women and is capable of creating positive impact in their health behavior and knowledge. Nigeria can thus borrow a leaf from the experiences of “Masagana 99” rice-promotion campaign in the Philippines (which energized the national rice-growing programme and helped to transform the Philippines from rice-importing to a rice-exporting nation) by ensuring support for entertainment education packages to further promote health care delivery and other development initiatives

Table 5. Perceived effects of EE programmes on the knowledge and behavior of respondents

S/N	EE Programmes	Knowledge				Behaviour	
		No change	Slightly improved	Seriously improved	Negative change	No change	Positive change
1	Image: TV drama on HIV	35(9.1)	55(14.3)	79(46.4)	33(8.6)	15(3.9)	207(53.6)
2	Abule Olokemerin: Radio drama on HIV	35(9.1)	55(14.3)	159(41.2)	36(9.3)	28(7.3)	194(50.3)
3	Zip up: TV media comic advert on STD's	57(14.8)	61(15.8)	216(56.0)	47(12.2)	39(10.1)	243(63.0)
4	IRHIN Project: family planning programme	45(11.7)	21(5.4)	236(61.1)	48(12.4)	20(5.2)	231(59.8)
5	Yemkem ½ hour: female repro. prog. On TV and Radio	79(20.5)	65(16.6)	156(40.4)	45(11.7)	82(21.2)	170(44.0)
6	If U love me, wait for me: music prog. On sexual bahaviour	58(15.1)	41(10.6)	225(58.3)	42(10.9)	16(4.2)	237(61.4)
7	Behind the siege: TV drama on HIV/AIDS	40(10.4)	48(12.4)	130(33.7)	32(8.3)	31(8.0)	164(42.5)
8	The compromises: family planning	44(11.4)	21(5.4)	148(38.3)	34(8.8)	19(4.9)	153(39.6)

\*Figures in parentheses represent percentages

Table 6 showed that the respondents' attitude to Entertainment-Education is positively and significantly related to its effect on their knowledge and behavior ( $r = 0.189$ ;  $p < 0.002$ ). This suggests that the attitude of women towards Entertainment-Education determines the effect the strategy produce on their health knowledge and behavior. This result therefore implies that use of health-based EE strategies will produce a significant impact on the knowledge and health behavior of beneficiaries giving the revelation of favourable attitude of majority of women to its use (table 4).

Table 6: Relationship between respondents' attitude to Entertainment-Education programmes and the effect of health-based Entertainment-Education programmes on them

Variables	r-value	p
Respondents attitude to EE programmes	0.18969	0.002

**Vs**  
 Effects of health-based EE programmes on respondents

## CONCLUSION

The study concluded that Lagos women's attitude towards the use of Entertainment-Education strategy for health-based education/information dissemination is favourable. Also, Entertainment-Education strategy is effective for communicating health and other development messages to women and is capable of creating positive impact in their health behaviour and knowledge. It is recommended that the government and other health development organizations should intensify efforts on the use of Entertainment-Education strategy for promoting health care education/information among women as a surer way of attaining the health-related Millennium Development Goals.

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## Determinants of yield performance in small scale fish farming in Alimosho local government area of Lagos state

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**Abstract:** The ever decreasing catch of fishes due to over exploitation warranted the adoption of simple random sampling in selecting the respondents to examine the determinant of yield performance in small scale fish farming. Structural interview schedule was used to obtain information from eighty (80) respondents. Descriptive analysis was used to analyse the socio-economic characteristics, while budgetary analysis was used to determine the profitability, and multiple regression analysis was the inferential statistic used.

The result showed that about 70.0 percent of the fish farmers produce above 5000 kilograms per year, while a mean of 5150.75 kilograms per year was obtained. The budgetary analysis revealed that the average total cost of production per annum was N3,694,586.00 while the total revenue was N12,680,490.00; which gives a net farm income of N8, 985,904.00 per annum. The profitability ratio gives a benefit cost ratio of 3.43, and a gross margin ratio of 1.41. This indicates profitability of small scale fish farming in the study area. The significant variables of sex and age are positively related to output resulting in more than a tonne and 13 tonnes increase respectively in output difference in male to female fish farm and an older fish farmer's pond while educational level of the respondents, family and hired labour were negatively related to output, each resulting in not less than 2 tonnes decrease in output with their unit increase. The study therefore recommends, among others, that seminars and trainings should be held at intervals so as to update small scale fish farmers' knowledge on fish farming procedures and practices.

### INTRODUCTION

In Nigeria, Agriculture provides between 80 to 90 percent of the country's food needs (Odife, 2002). It however has diverse aspects and this includes fish farming which involves the rearing of fish for the purpose of consumption or sale. Fish is acclaimed to be the principal source of animal protein for over one billion people globally and provides many important nutritional and health benefits. Fish has the highest level of easily metabolisable proteins; it is reputed for its high quality proteins, fats, vitamins, calcium, iron and essential amino acids. The per caput consumption

of animal protein in the country has been put at 5gm per day. This is a far cry from the FAO's recommended level of 35gm per day (Afolami and Oladimeji, 2003). Fish farming is a profitable venture and it is rapidly expanding and it will continue to be profitable if the planning and management are well taken care of. Fish farming started in Nigeria over 40 years ago (Ekwegh, 2005). The Nigerian government has recognized the importance of the fishery sub-sector and it has made several attempts over the years to increase their productivity through institutional reforms and the various economic measures. Some of these



measures provided subsidy for inputs and exemption from tax for fishermen. Despite the efforts of government, there is still a deficit in the supply and demand for fish by the population (Dada, 2004). Most of the fish farming in Nigeria is carried out by small scale operators in small fresh water ponds (UNDP). Nigeria has a population of over one hundred million people and has her national fish demand at over 1.5 million metric tonnes. The current annual aquaculture production hovers around 500,000 metric tonnes. These combined with ever decreasing catch (due to over exploitation) from the capture fisheries have not been able to meet the ever-increasing protein demand of the country. Thus the challenge to increase protein consumption in Nigeria appears to be more urgent now than ever (Mbanasor, 2002).

Poor people are facing new barriers in both their production and returns on fish. Even by the standards of developing countries, artisanal fishers and fish workers are often among the poorest people and they generally operate on a small scale and use traditional fishing practices yet new technologies and environment requirement favour large scale capital intensive operation at the expense of traditional and small scale commercial fishing (Delgado *et al*, 2003). Whereas small scale fish farming supplies the greatest percentage of the Nigerian's annual fish production output (FDF, 1995). Thus, it is worthy of note to study the determinants of yield performance of these small scale farmers.

It is for this reason that the questions of what the socio-economic characteristics of the small scale fish farmers are? what the cost-return relationship of the business is? and what determine

the yield performance of small scale fish farming? are addressed in the study.

*Objectives of the study:* The main objective is to investigate the determinants of yield performance in small scale fish farming.

The specific objectives are to:

- examine the socio-economic characteristics of the small scale fish farmers.
- determine the cost-return relationship in small scale fish farming.
- investigate the determinants of yield performance in small scale fish farming.

## **METHODOLOGY**

The study was conducted in Alimosho local government area of Lagos State. The State, according to the National Population Commission, has the largest population of urban dwellers, virtually all other states have their indigenes living and working in Lagos. There are several small scale fish farmers in Alimosho local government area. This local government area has subdivisions, which include Ipaja Ayobo, Egbeda Akowonjo, Egbe Idimu, Igando Ikotun, Agbado, oke- odo and Mosan Okunola local development areas.

The data used are essentially from primary source i.e. the small scale fish farmers in the area. Structured interview schedule was used to collect information on the socio-economic characteristics of the respondents as well as input-output data. The sampling frame was obtained from the fish farmers association, out of which 100 fish farmers were randomly selected. However, only 80 farmers responded adequately and the data supplied were analysed. Descriptive analysis was used to highlight the socio-economic characteristics of the



respondents. Budgetary analysis was used to determine the profitability of the enterprise. It was done by estimating the total variable and fixed cost as well as total revenue to determine the net profit of an average small scale fish farmer. Also multiple regression analysis was used to analyse and explain the relationship between the dependent (the fish yield) and the independent variables from where the major yield determinants were obtained. The various functional forms fitted include linear, semi-log, Cobb-Douglas and exponential functions. Implicitly, the function is:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8)$$

Where

Y= yield (kg)

X<sub>1</sub>= sex (dummy)

X<sub>2</sub>= marital status (dummy)

X<sub>3</sub>= age (years)

X<sub>4</sub>= education (years)

X<sub>5</sub>= fixed cost (N)

X<sub>6</sub>= hired labour (manday)

X<sub>7</sub>= family labour (manday)

X<sub>8</sub>= variable cost (N)

## RESULTS AND DISCUSSION

Table 1 revealed that 73.8 percent of the fish farmers were male while 26.3 percent were female. This implies that more males were involved in small scale fish farming which is in line with the culture of the people in the area that men engage in fish farming more than women and that women are mostly involved in processing and other post harvest activities. About 81.3 percent of the respondents were married. This shows that most of the small scale fish farmers are settled family men and women with responsibilities. These responsibilities would likely make them willing to

seek innovations so as to increase their income earning capacity and improve their standard of living.

The largest percentage (41.3%) of the farmers fall between the ages of 40-50 years. This implies that most of the small scale fish farmers were in their middle age group. About 63.8 percent of the respondents were HND/B. Sc holders while 1.3 percent of them have OND/NCE qualifications. More than half (51.3%) of the respondent produce between 260kg and 2,000kg per cultured period, while only 16.3 percent produce above 12,000kg per cultured period. The mean production of the respondent was 5,150.75kg.

Furthermore, 55 percent of the respondents practice semi-intensive culture system, 40 percent practice intensive system while only 5 percent practice extensive culture system. Thus, it could be said that the fishing systems in the study area are gradually moving away from the extensive (low production rate) culture system into more productive systems (intensive and semi-intensive). About 51.3 percent of the farmers culture their fish for an average period of six months. The choice of culture period is usually influenced by factors such as timing towards festive period or due to the lack of feeds as explained by Okoye and Omorinkoba (1994). Also, 33.8 and 61.3 percent of the respondents sourced water from taps and underground water respectively. Only 1.3 percent of the respondents in the study area sourced water from streams/rivers. This may be due to the fact that Lagos State is a city that is highly congested and most of the inhabitants dug well and drilled boreholes while some get water from government sources (Water Corporation). The largest percent (62.9 %) of the fish farmers obtained their

fingerlings from fish farms while 25.9 percent do self breeding and only 11.2 percent obtained fingerlings from streams/rivers. The fact is that the fingerlings sourced from fish farms are more likely to be healthier and well bred.

**Table 1: Socio Economic Characteristics of Respondents**

Characteristics	Frequency	Percentage
<b>Gender</b>		
Male	59	73.8
Female	21	26.3
Total	80	100.0
<b>Marital Status</b>		
Single	8	10.0
Married	65	81.3
Divorced	3	3.8
Widowed	4	5.0
<b>Age</b>		
20-30	9	11.0
30-40	17	21.4
40-50	33	41.3
Above 50	21	26.3
<b>Educational Level</b>		
No formal education	1	1.3
Primary school	3	3.8
Secondary school	3	3.8
OND/ NCE	12	15
HND/ BSC	51	63.8
Post graduate	10	12.5
<b>Cultural System</b>		
Extensive	4	5.0
Semi-intensive	44	55.0
Intensive	32	40.0
<b>Water Sources</b>		
Streams/Rivers	1	1.3
Taps	27	33.8
Rainfall	3	3.8
Underground water	49	61.3
<b>Fingerlings Sources</b>		
Fish Farms	56	62.9
Streams/Rivers	10	11.2
Self Breeding	23	25.9
<b>Total</b>	<b>80</b>	<b>100.0</b>

Source: Field survey, 2007

Table 2 showed the cost and return analysis where the total variable cost and total fixed cost represents 32.5 percent and 67.5 percent of the total cost of production respectively. The

higher value for fixed cost may be due to the high cost of land acquisition in the area as well as high cost of construction materials like cements used in constructing a high standard fish pond. The gross margin of N11, 479, 304 and a net farm income of N8, 985, 904 indicates that small scale fish farming is profitable in the study area.

**Table 2: Budgetary Analysis**

Variable	Amount (N)
Total variable cost	1,201,186
Total fixed cost	2,493,400
Total cost	3,694,586
Total revenue	12,680,490
Gross margin	11,497,304
Net farm income	8,985,904

Source: Field survey, 2007

The analysis of ratios in Table 3.0 revealed that the benefit cost ratio (BCR) is above one emphasising the profitability of the business. The rate of returns, 2.43, implies that for every one naira invested, N2.43 was gained and a gross revenue ratio of 0.29 indicates that for every N1.00 returns to fish farming enterprise, 29 kobo is being spent. Also, the expense structure ratio 0.67 shows that 67 percent of the total cost of small fish farming was made up of fixed cost items and a gross margin ratio of 1.41 further confirm that the business is profitable.

Considering the function with variables with highest level of significance, adjusted R<sup>2</sup> value as well as parameter estimates that conform to a priori expectation, the linear function was chosen as the lead equation. By the adjusted R square of 0.813, it indicates that 81.3 percent variability in Y (fish output) is due to the joint effects of the various explanatory variables in the model.

Some of the parameter estimates are significant at different levels. The gender of the respondents (X<sub>1</sub>) has a significant effect on fish output at 10 percent and it is positively related to

the output. This may be due to the fact that most farmers are male who gave all its demands in terms of management practices to the fish output. The age of respondent ( $X_3$ ) is also positively related to fish output. This means that as their age increases so is the output. This may be due to the fact that years of experience increase with age and the effect is significant at 5 percent level.

Also, the level of education ( $X_4$ ) is negatively related to fish output and it has a significant effect at 1 percent significant level. This may be due to the fact that people with higher levels of education may not have time to take care of their fish farms. Moreover, Table 1.0 revealed that majority (63.8 percent) of the fish farmers had a degree in academics. As a result, they may have other occupations that earn them income. Construction cost ( $X_6$ ) has a positive association with fish output at 10 percent significant level. This implies that a naira increase in construction cost brings about 0.025 kg increase in output. This may be due to the fact that the more money spent on constructing a suitable fish pond, the better their chances of survival and their conditions of living leading to an increase in output. Both hired and family labour are negatively related to fish output suggesting pilfering and home consumption leading to significant reduction in output.

The linear function, which was chosen as the lead equation, is stated as follows:

$$Y = 1760723 + 13284.44X_1 - 158.36X_2 + 1104.83X_3 - 18641.25X_4 + 0.025X_5 - 3745.81X_6 - 4218.95X_7 - 2253.03X_8 + E$$

$(1.565) \quad (2.075)^* \quad (-0.029)$   
 $(0.451)^{**} \quad (-4.027)^{***} \quad (1.027)$   
 $(-1.998)^* \quad (-5.982)^{***} \quad (-1.445)$

Adjusted  $R^2 = 81.3$  percent

\*\*\*: statistically significant at 10 percent level of significance  
 \*\*: statistically significant at 5 percent level of significance  
 \*: statistically significant at 1 percent level of significance

**Table 3: Profitability Ratio**

Ratio	Value
Benefit Cost Ratio	3.43
Rate of Return	2.43
Expense Structure Ratio	0.67
Gross Revenue Ratio	0.29
Gross Margin Ratio	1.41

Source: field survey, 2007

Respondents affirmed that the major problems encountered in fish farming include electricity failure, lack of funds, high cost of feed, bacterial infections, predators, waste management and cannibalism, among others.

### SUMMARY

The study revealed that small scale fish farming is considered a viable option of increasing income of the family as likewise observed by Olukunle, 2004.

Among the independent characteristics, education, hired labour, and family labour had significant relationship with yield performance

### RECOMMENDATION

Based on the findings of the study, the following recommendations are suggested to improve the productivity/ yield performance of the respondents:

- ❖ The extension agent-farmer coverage needs to be improved upon, so that regular and prompt visits could be made to fish farmers in order to intensify their awareness and adoption of improved technology, formal fund sourcing etc.

- ❖ Extension agents should train fish farmers on effective utilization of funds so as to reduce unnecessary costs or expenses.
- ❖ Literate farmers need to pay adequate attention and commitment to fishing activities in order to improve output.
- ❖ Seminars and trainings should be held at intervals so as to update small scale fish farmers' knowledge on fish farming procedures and practices.
- ❖ Small scale fish farmers should come together to form co-operative unions to complement individual efforts.
- ❖ Fingerlings should be sourced from healthy fish farms.
- ❖ Inputs such as feeds should be subsidized and made available to small scale fish farmers through the fish farming associations.

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## **Dynamics of technology adoption in rural-based cassava processing enterprises in South-West Nigeria**

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**Abstract:** This study explores the intricacies of technology adoption in rural based cassava processing enterprises in southwest Nigeria. Primary data were obtained from 265 rural based cassava processors selected through a multistage sampling procedure and 37 purposively selected researchers/extension personnel. The data were collated and presented with the use of descriptive statistical tools and other descriptive frameworks. The data obtained on the key factors influencing the technology adoption process were used to test the two null hypotheses tested in the study. The results show that most of the cassava processors (57.74%) have adopted the cassava grater. Other cassava processing innovations that they are aware of are the improved method of cassava processing to *gari*, *fufu*, flour, chips and starch. Adopters and non-adopters of the cassava grater differ significantly in most of their social, economic and innovation related characteristics. The two exceptions are the estimated value of cassava processing enterprise (Naira) and the average distance regularly traveled (km/week). The adopters perceive the use of the innovation as less complex than existing practice and have been in contact with the innovation for longer than non-adopters. There were significant relationships between the adoption of the cassava grater and processors' household size, number of groups affiliated to, average distance regularly traveled, the relative advantage from using the grater, its compatibility with existing practice and the processors' attitude to adopting the grater. The research subsystem dominated the technology development processes of cassava processing sector. The study concluded that approaches for promoting cassava processing interventions need to be flexible to accommodate the intricacies in the system. It then proposed three complementary approaches for promoting cassava processing innovations in southwest Nigeria.

**Keywords:** Adoption, Cassava, Processing, Technology, Rural

**Acknowledgement:** This work was supported by a research grant provided by the International Foundation for Science (IFS) - S/3612.

### **INTRODUCTION**

Nigeria produces more than half of total world cassava. But most of the cassava is traditionally consumed by processing the fresh roots into *gari*, *fufu*, and flour (Adebayo *et al.*, 2003a; Adebayo *et al.*, 2003b). The crop gained national prominence as a potential foreign

exchange earner for the nation following the pronouncement of a Presidential Initiative on Cassava in 2002. But this cannot be achieved without the uptake of key innovations that tend toward higher levels of commercialisation in cassava production and processing. Since, traditional cassava processing takes place

predominantly in rural areas, it is important that rural people adopt appropriate cassava processing technologies along with cassava production technologies for any meaningful impact to be made on the food system.

The study of adoption and diffusion of innovations are central to understanding the process of change in human societies. But, approaches to exploring the adoption process have changed over time. While early studies have simply focussed on measuring the awareness of innovations (Ryan and Gross, 1943; Patel and Anthonio, 1971, Obibuaku and Hursh, 1974), the focus in the 1980s and 1990s was on establishing relationships between various 'independent' factors and the adoption of new innovations (Chikwendu *et al.*, 1995; Arene, 1994; Apantaku and Apantaku, 1998; Onu, 1991). More recent studies are using various kinds of dynamic models to explore the adoption process, both from predictive and evaluative perspectives (Siegmond-Schultze and Rischkowsky, 2001; Sinclair, 2001; Adebayo, 2002; Neupane *et al.*, 2002). The current study adopts a synthesis of methods involving the use of a predictive model and a more participatory data gathering and analysis using multi-framework models as in the works of Grassi (2003) and Garforth *et al* (2003). It is important however that as new post-harvest technologies emerge, adoption and diffusion researchers need to re-evaluate existing assumptions and models about the technology adoption and diffusion process. Against this background, this study explores the intricacies of technology adoption in rural based cassava processing systems with a view to contributing to a greater understanding of the process. Furthermore the study tested a null hypothesis that: there are no

significant differences between the socio-economic characteristics of adopters and non-adopters of selected cassava processing technologies.

## METHODOLOGY

Southwest Nigeria is bounded in the north and east by the Kwara and Kogi States of Nigeria; in the West by the Republic of Benin and in the south by the Atlantic Ocean (Figure 1). The 3 main agro-ecological zones in the area are the swamp, on the Atlantic coast; tropical rainforest, in the middle; and guinea savannah in the north. Cassava is grown widely in all three zones. ADPs are responsible for field level agricultural extension services in Nigeria. This area is also home to the International Institute of Tropical Agriculture, (IITA) Ibadan; the University of Agriculture, Abeokuta, eight (8) conventional Universities with faculties of agriculture and four (4) National Agricultural Research Institutes. A random sampling technique was used to select 3 rural locations from each of these agro-ecological zones, from the village listing available with the Agricultural Development Programmes (ADPs) operating in the area.

In each of the nine (9) locations selected for this study, a systematic sample of 30 rural based cassava processors were selected from a list purposively compiled for this study. The study thus interacted with 270 rural based cassava processors. Of these, only 265 responses were complete and therefore considered valid for further analysis. An interview schedule was used to facilitate interviews with the selected rural based processors. The interview schedule was administered by 3 trained enumerators. However, more detailed participant observation and focus group discussions were held

in 3 locations (Oja-Agbe, Iseyin in the savannah; Igbatoro, Akure in the forest and Ibiade, Ogun Waterside in the swamp) to obtain qualitative data that provided detailed insights into technology adoption and non-adoption amongst cassava processors. The study also systematically selected a sample of 50 researchers and extension personnel from the staff list of some of the research and extension institutions in Southwest Nigeria. Of these, only 37 respondents made up of 15 extension personnel and 21 researchers returned the mailed questionnaires.

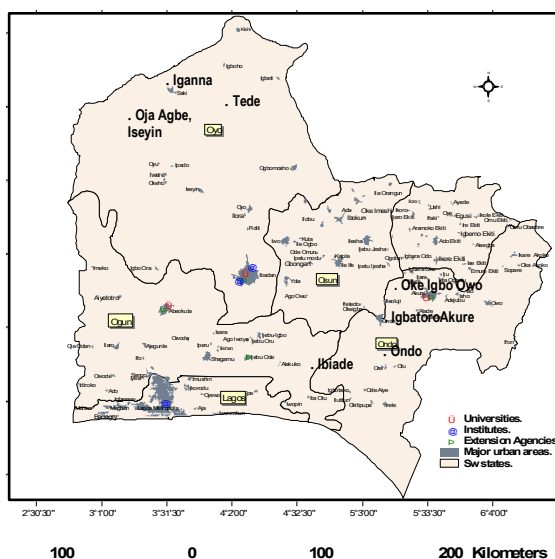


Figure 1: Map of southwest Nigeria showing the relative position of study locations

Both descriptive and inferential statistical tools were used in this study. The descriptive tools (means, percentages, ranking, and charts) were obtained using Microsoft Excel<sup>®</sup> while the inferential tools analysis (students' t - test and Spearman (rho) rank correlation) for testing the null hypothesis were obtained using the Statistical Package for the Social Sciences (SPSS) version 10.0. Furthermore, the framework described by Garforth *et al* (2003) was used to explore the process of development of selected cassava

processing technologies and determine the extent to which the process predisposes the technologies to adoption. The multi-framework model used in characterising food processing innovations has been used by Grassi (2003).

## RESULTS AND DISCUSSION

### *Description of cassava processors*

Most (97.36%) of the cassava processors interviewed were between 21 and 60 years old. The majority in the rainforest zone (61.18%) are younger than those in the Guinea savannah and the swamp zones (Table 1). While most (96.67%) of processors in the guinea savannah are females, over half (50.6% and 55.6% respectively) of the cassava processors in the rainforest and swamp zones are males. This finding corroborates the findings of some earlier studies in the region indicating that as cassava processing gets capital intensive, the proportion of men involved in the business tend to surge (Adebayo *et al.*, 2003a). In all, over 80% of the cassava processors are married (Table 1). The modal household have between 3 and 6 persons, even though a wider spread is observed in the swamp agro-ecological zone. This finding is similar to that of Adebayo *et al* (2003b) in Ogun State of Nigeria where the average household size was found to be 7 persons. Most of the respondents claim to occupy the first or second position within their households. This signifies the relative position of income from cassava processing within the selected households in southwest Nigeria. The involvement of heads of households (first position) and their immediate lieutenants (first wife or first sons) in an economic activity is an indication of the role of that activity in sustaining the livelihood of members of that household (Fabusoro, 2005). Table 1 also shows



that the possession of a secondary education is common amongst the cassava processors interviewed. In fact, some of the cassava processors hold higher degrees in the formal education system. This may be due to recent focus of national policy on the cassava post-harvest sector as a key industrial and export sector under the Presidential Initiative on Cassava.

Unlike in the Guinea savannah, where there is a clear dominance of natives in cassava processing, almost two-fifth and one-quarter of the respondents in the rainforest and the swamp zones respectively are non-natives. While there are more Muslims in cassava processing in the Guinea savannah and the swamp zones, Christians dominate in the rainforest. In addition, most of the respondents travel less than 40km/week. Fabusoro (2005) noted that regular trips of more than 5km are an indication of low level of livelihood

diversification. In this case, it seems that the cassava processors' activities is mainly focussed on cassava processing with little diversification. Finally, Table 1 shows that except in the Guinea savannah, group membership is unpopular among the cassava processors. This is similar to the findings of Adebayo *et al* (2003a). In the Guinea savannah, it seems that the activities at Oja-Agbe (Farmers' Market) in Iseyin are a strong force for keeping cassava processors more active in group membership than other zones. Almost all the cassava processors interviewed in the Guinea savannah belonged to *Gari Gbayi*, the umbrella association for all cassava processors in the zone. Other groups found in the study are various forms of cooperatives in the rainforest and swamp zone are the farm settlements' farmers' group at Ibiade in Ogun Waterside as well as various farmer's groups and cassava growers' associations.

Table 1. Some characteristics of cassava processors interviewed in the study

Variables	Zones			Total (N = 265)
	Guinea savannah (N = 90)	Rainforest (N = 85)	Swamp (N = 90)	
Age (years)	21-40 (56.7)*	21-40 (61.2)	41-60 (77.8)	21-40 (44.5) 41-60 (52.8)
Sex	Female (96.7)	Male (50.6)	Male (55.6)	Female (63.8)
Marital status	Married (60.0)	Married (84.7)	Married (96.7)	Married (80.4)
Household size (persons)	3-6 (71.1)	3-6 (78.8)	3-6 (33.3)	3-6 (61.1)
Position in household	2 <sup>nd</sup> (54.4)	2 <sup>nd</sup> (38.8)	1 <sup>st</sup> (52.2)	2 <sup>nd</sup> (44.5)
Education	Primary (17.8) Secondary (56.7)	Primary (32.9) Secondary (42.4)	Primary (30.0) Secondary (35.6)	Primary (26.8) Secondary (44.9)
Ancestry	Native (97.8)	Native (54.1)	Native (72.2)	Native (76.2)
Religion	Islam (52.2)	Christianity (65.9)	Islam (53.3)	Christianity (49.1)
Average distance regularly travelled (km/week)	Less than 40km (80.0)	Less than 40km (50.6)	Less than 40km (34.4)	Less than 40km (55.1)
Membership of groups	2 or more groups (56.7)	No groups at all (70.6)	(68.9)	No groups at all (52.1)

Source: Field survey, 2006

\*Figures in parentheses are percentages

#### Description of research and extension personnel

Research and extension personnel have a mean age of about 40 years. They are mainly (89.25%) male, married (94.6%) and with more than 18 years of formal education consisting of 24% Higher National Diploma (HND) holders and

43.2% Master of Science Degree (MSc) holders (Table 2). They have attended an average of 2.4 training sessions on cassava processing and have organised an average of 1.7 training sessions on cassava processing. Their mean income is N38,773.48 (about (\$388) per month and over 60%



have less than 10 years experience in cassava research and extension. They belong to an average of 7 professional associations and are mainly natives of their areas of activity. They are mainly (64.9%) Christians and more than half travel more than 200km regularly (Table 2). All these seem to indicate some homogeneity amongst the cassava processors and extensionists and researchers interviewed. According to the theories of message

reception and processing, these similarities in the socio-economic characteristics of participants in a the communicative processes leading to the adoption of cassava processing innovation may mean that effective information exchange in terms of shared meaning would take place, but does not guarantee visible change in the either group at the end of the communication exercise (Littlejohn, 1999; Ostrom *et al*, 1994; Krippendoff, 1993).

Table 2. Some characteristics of research and extension personnel interviewed in this study (N = 37)

Variable	Mean/Mode	Standard deviation
Age (years)	40.41 years	4.01 years
Sex	89.2% Male	n.a.
Marital status	94.6% Married	n.a.
Level of formal education (years)	18.3 years	6.7 years
Highest educational qualification	HND (24.3), M.Sc. (43.2)	n.a.
Number of cassava training attended	2.4	2.4
Number of training organized	1.7	2.6
Income (Naira/month)	N38,773.48	N29,509.45
Experience in cassava res. and extension (yrs)	Less than 10 years (64.9)	n.a.
Number of professional bodies belonged to	7	5
Ancestry	Non-native (35.1)	n.a.
Religion	Christianity (64.9)	n.a.
Average distance regularly travelled (km)	Less than 200 Km (47.4)	n.a.

Source: Field survey, 2006

*Cassava processing technologies adopted by rural-based cassava processors in Southwest Nigeria*

Cassava processing in the rural areas of Southwest Nigeria has gone through several changes over time. This is more evident in the range of technologies found in the cassava processing systems. They vary from completely manual processing systems to partially and fully mechanical cassava processing systems. In this study, extension officers and researchers ranked the cassava processing technologies they have worked with over time. The cassava grater emerged the most prominent with 13 out of 37 respondents ranking it as first. This finding may explain the variety of cassava graters available to cassava processors in southwest Nigeria. Other cassava

processing technologies on which extension personnel and researchers had worked are the processing of cassava tuber into chips and flour for industrial use; drying of cassava products; processing of cassava root into high quality starch and odourless *fufu* as well as improved packaging and storage technologies. This group of technologies are particularly favoured by the Presidential Initiative on Cassava which seeks to facilitate industrial use of cassava to diversify the economic base of the nation and promote foreign exchange earning opportunities from the export of high quality cassava products from Nigeria.

Similarly, most of the cassava processors interviewed have tried the use of the cassava grater at least once in their processing experience. As

such, in this study, the cassava grater was selected for the purpose of describing adopters and non-adopters. Adoption of the cassava grater was measured in terms of the length of time the cassava processors devote to the use of the technology and adopters are considered as at least devoting some of their time more than zero to the use of the technology. Of the 265 cassava processors whose responses were subjected to analysis in this study, 153 (57.74%) adopted the cassava grater (Table 3). The reasons for the widespread adoption of the

technology were explored during the focus group discussions. Five major themes emerged during the discussions. These are that “they require less labour”, “they are easy to practice”, “they give good quality products”, “they are faster than the old method and compatible with existing practice”. These reasons are consistent with characteristics of a good innovation as evident in the literature (Adebayo and Adedoyin, 2005; Adebayo, 1997; Adams, 1988)

Table 3. Innovations adopted by cassava processors interviewed

Practices adopted	Zones			Total N = 265
	Guinea N = 90	Rainforest N = 85	Swamp N = 90	
Cassava grater	86.67	41.18	44.44	57.74
Screw press	11.11	14.12	10.00	11.70
Improved method of processing <i>gari</i>	0.00	8.24	15.56	7.92
Frying machine	0.00	3.53	6.67	3.40
Steel frying pot	0.00	0.00	7.78	2.64
Processing cassava flour	0.00	2.35	3.33	1.89
Processing cassava to starch	0.00	5.88	0.00	1.89
Hygienic methods of processing	1.11	0.00	2.22	1.13
Curumbus grinder	0.00	0.00	3.33	1.13
Mechanical peeler	1.11	1.18	0.00	0.75
Others	0.00	9.43	1.11	3.41
None	0.00	14.12	5.00	6.42

Source: Field survey, 2006

#### *Test of hypothesis*

The null hypothesis that there are no significant differences between the social, economic and innovation related characteristics of adopters and non-adopters of the cassava grater was tested. The descriptive analysis results show that adopters of cassava grater are older, with larger household sizes and stayed longer in school than the non-adopters. They also have longer cassava processing experience and run larger cassava processing enterprises where more persons are also employed. The adopters travel more widely than non-adopters and consider the innovation more compatible to their existing

practices perceives the use of the innovation as less complex than existing practice and have been in contact with the innovation for longer than non-adopters.

Table 4 presents the results of the Student’s t-test for the hypothesis. All the listed characteristics of the adopter-non-adopter respondents are significantly different but two exceptions are the estimated value of cassava processing enterprise (Naira) and the average distance regularly travelled (km/week). This finding suggests that the savings in labour use occasioned by the adoption of the cassava grater are not converted to higher outputs from the

processing enterprises. This may be due to the dominance of traditional institutions in the marketing of traditional food commodities (including most cassava products) with strong influence in the control of quantities that each processor is allowed to supply on a given market day (Adebayo, 2005).

Studies have shown that the factors influencing technology adoption can be social, economic, innovation related, process related or exogenous (Chickwendu *et al.*, 1995; Collinson, 2001; Agbamu, 1995, Adebayo *et al.*, 2002).

Table 4. Results of test of difference of means

Independent variables	t	df	p (2-tailed)	Decision*
Age (years)	-8.311	264	0.00	Reject Ho
Household size (persons)	-28.563	264	0.00	Reject Ho
Education (years)	-27.239	255	0.00	Reject Ho
Number of cassava training attended	-32.820	264	0.00	Reject Ho
Income (N/month)	10.591	262	0.00	Reject Ho
Cassava processing experience (years)	-23.456	264	0.00	Reject Ho
No. of employees in cas. processing ent. (pers.)	-25.607	264	0.00	Reject Ho
Est. value of cassava processing ent. (Naira)	1.801	244	0.07	Accept Ho
Number of groups affiliated to	-33.011	264	0.00	Reject Ho
Average distance regularly travelled (km/week)	1.741	261	0.08	Accept Ho
Relative advantage index	-33.099	264	0.00	Reject Ho
Compatibility index	-33.048	264	0.00	Reject Ho
Risk level	-33.156	264	0.00	Reject Ho
Complexity index	-33.193	264	0.00	Reject Ho
First contact with innovation (years)	-25.871	264	0.00	Reject Ho
Attitude score	16.122	264	0.00	Reject Ho

\* = Decision criterion is reject null hypotheses when  $p > 0.05$  df = Degrees of freedom

*The process of development of selected cassava processing technologies*

During the focus group discussion with some researchers, they were asked to describe the research process they utilised in their chosen cassava processing technology. The processes described varied from ‘laboratory-based controlled experimental situations later demonstrated to processing groups’ to ‘in-situ study of existing local technologies for “modelling and upgrading” to more farmer-oriented approaches involving technology adaptation and adoption’. Furthermore, data obtained from the questionnaire survey of researchers and extension personnel was used to

rate the processes of developing cassava processing technologies mentioned by the respondents. As shown in Table 5, the dominant research process is demand-driven, target specific, locally funded, easily adaptable, compatible with local practices and cheap to adopt. This finding suggests a close interaction between cassava processing technologies developed and promoted in southwest Nigeria and processors’ needs. It however implies that the high level of local relevance of the technologies may impinge on the regional or wider relevance except possibly for any basic science output from the process.

Table 5. Rating of the process of developing cassava processing technologies

Criterion	Very high	High	Moderate	Low	Very low
Demand driven	10	13	10	2	2
Target specific	10	16	5	4	2
Locally funded	9	17	3	3	5
Easily adaptable	16	12	6	0	3
Compatible with local practices	19	10	7	1	0
Cheap to adopt	13	12	7	2	3

Adapted from: Grassi (2003)

The researchers and extension personnel interviewed in this study were asked to rank the dominant extension and advisory approaches adopted for cassava processing innovations in southwest Nigeria. The result presented in Table 6 adapted from the work of Garforth *et al* (2003) shows that the focus of the advisory approach is business rather than social policy goals; client specific. The advisory service sought to promote a specific view (possibly influenced by researchers' and institutional goals) rather than helping clients to achieve their own objective. The objective of technology promotion exercises is mainly technology transfer rather than sustainably influencing the process. Technology management

decisions are made at the individual entrepreneurial level and the scope of advice offered is for information and does not include financial incentives; in fact clients are sometimes required to pay for the advisory service. Respondents agree that the process is essentially top-down and delivered by the public sector (mainly the ADPs) and are short-term in nature given on one-to-one basis. This characterisation suggests that the extension and advisory services in southwest Nigeria are essentially traditional and dominated by the research sub-sector. They provide top-down services with individual enterprises as their targets and aims mainly to transfer technology "developed" by the research sub sector.

Table 6. Rating of the extension or advisory approaches for cassava processing technologies

Dimension	One extreme	Rating				The other extreme
		X				
<b>Focus</b>	Business	X				Social policy goals
<b>Specificity of clientele</b>	Narrow target category		X			Broad or unspecified target
<b>Means of influence</b>	Promote specific view		X			Help client achieve own objectives
<b>Programme objectives</b>	Technology transfer	X				Process oriented
<b>Scale of decision</b>	Individual management unit	X				Group, community or area (collective decision)
<b>Scope of advice</b>	Information and advice	X				Financial incentives within the scheme
<b>Payment for service</b>	Clients pay		X			Free to clients
<b>Direction of information flow</b>	Top-down	X				Bottom-up
<b>Information delivered by</b>	Public sector	X				Private sector
<b>Duration</b>	Short term campaign		X			On-going
<b>Intensity</b>	No one-to-one advice		X			All one-to-one advice

Adapted from: Garforth *et al* (2003)

In this study, three complementary approaches are proposed; “innovation mapping”, communication and “meeting the expectations” approach.

**The innovation mapping approach** is based on the observed level of cosmopolitanism among researchers and extension personnel interviewed in this study and the spatial distribution of innovative centres (universities, research institutes and extension organisations) in relation to locations where cassava processors are residents. Most of the researchers and extension personnel studied travel regularly. This suggests that information flow within the cassava processing system in southwest Nigeria can benefit from a system which allows innovative centres within the geographical bounds of southwest Nigeria to freely share information on what each entity in the technology subsystem is working on, with whom are the innovations being tried, what are its prospects and its failures?

**The communication approach** is based on the assumption that communication is intertwined with all aspects of human life. Much of people’s communication experiences are shaped by the sources of their information and the sources of information they regularly use. In this study, cassava processors’ main sources of information about cassava processing innovation are the radio, extension agents, colleagues and friends, research institutes and television. The implication of all these is that when efforts are applied at technology dissemination to provide information about cassava processing on radio, through extension agents and television, more personal sources such as colleagues and friends can facilitate their further spread within the technology utilisation subsystem.

This position is corroborated by the fact that most cassava processors, irrespective of the agro-ecological zone, will adopt cassava processing innovations from known sources of information. Such a feeling could be put to good use in the promotion of cassava processing innovations. Sources perceived as “good” offers ample fora for the conscious use of information dissemination to influence the opinion of cassava processors.

**The “meeting the expectations” approach** is based on the assumption that in a learning process, interest is essential for learning, memory and use of what is learnt. One of the key motivators for keeping the interest of adult learners is meeting their expectations. In this study, cassava processors look for equipment that will reduce the drudgery associated with each stage of cassava processing. At the same time, they expect cassava processing innovations to be “available at affordable prices”, “require less labour and save time”. They expect researchers to organize training workshops for extension personnel and cassava processors on new innovations, develop affordable innovation and to concentrate on research on innovation that could be utilized locally. Their expectations from government are to provide fund and make processing equipment available at subsidized rate, assist processors in getting the equipment for new innovation, fund the technology developing process and provide fund for all people involved in processing innovation. They expect consumers of cassava product to be ready to buy the products emerging from new innovations, desist from discriminating against machine produced goods and offer suggestions or observations. One key advantage of this approach is that it provides all key actors in the rural-based

cassava processing systems to know exactly what to provide to attain an expected goal of the cassava processors.

#### CONCLUSION AND RECOMMENDATIONS

Cassava processing methods are many and processed products are diverse. As such, the approaches for promoting cassava processing intervention must be flexible enough to accommodate the diversity and intricacies in the system as well as produce sustainable response to promotional efforts.

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## Economic analysis of snail production in Ibadan, Oyo state

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**Abstract:** This study analyzed the economics of snail production in Ibadan Zone of Oyo state. A multistage random sampling procedure was used to select sixty respondents from the study area; a well structured questionnaire was used to collect data. The data were analyzed using frequency counts, percentages, budgetary technique and stepwise regression analysis. The findings showed that most of the snail farms are owned by individuals who were part-time snail farmers (84.9%) and financed their snail production (98.1%) through their personal savings. Management practice revealed that most of the respondents reared *Archachatina marginata* (98.1%). Budget analysis showed that snail production is profitable with the farmers making an average profit of ₦24, 089.03k while regression result revealed that years of education ( $t=2.835$ ), years of experience ( $t=2.786$ ) and farm size ( $t=2.197$ ) are statistically significant and explain about 25% of the total variation in the profit made by the snail farmers. Due to its profitability and low capital investment nature, it is recommended for farmers without substantial capital, unemployed and those aspiring to augment their income.

**Keywords:** Snail, Gross Margin, Profitability Ratio, Stepwise Regression, Oyo State.

### INTRODUCTION

In recent times raising of micro livestock by rural household is becoming popular due to the fact the (i) the households have realized the need to diversify their source of income, thereby reducing the risk involved in depending on crop production as the main source of income. (ii) there is need to bridge the gap between protein requirement and actual protein consumed by the people which are not sufficiently supplied by crop production (Ajibefun, 2000).

Snail is one of such micro livestock that has recently attracted attention among farmers in Nigerians as an aftermath of the alarm raised by FAO on animal protein deficiency among Nigerians (Adesope, 2000; Akinnusi, 2000). It has been reported by FAO (1986) that the average

animal protein intake in Nigeria is low, calling for concerted effort towards alleviating this crises of protein shortage. Unfortunately, the conventional and regular sources of animal protein supply in the country like beef, pork, goat meat and poultry are getting out of reach of the common populace due to the economic down-turn. There is therefore the need to look inward and integrate into our farming system some non conventional meat sources (Ebenebe, 2000). These will complement the conventional animals as source of animals protein supply. The challenge thus falls on the micro-livestock in which Nigeria is richly endowed. This research work therefore focuses on snail as one of such micro livestock.

Snail meat is socially well accepted in many parts of Nigeria. It is commonly known as



“Congo meat” and it also one of the most delicacies in Nigeria. Many species of edible land snails are recognized in Nigeria but the popular species of economic interest in the West Africa giant snails *Archatina achatina* and *Archachatina marginata*.

Snail farming has numerous advantages which are highlighted below: can be cheaply maintained in terms of housing, feeding, health care etc; highly adaptable to a variety of conditions (villages, farms backyard, shed, cities etc); they reproduce rapidly; they are efficient producers of meat; they have high medicinal value-they are used in the prevention and care of diseases like hypertension; Due to the fact that snail are small, noiseless and easy to handle, they can be reared in the urban areas without infringing on the peace of the neighbours (Odunnaiya, 1991).

In spite of the considerable external and local demand, commercial snail farms such as those in Europe, South-East Asia and the Americas do not exist in West Africa. In Nigeria and Ghana, where snail meat is particularly popular, snails are gathered from the forest. However, wild snail population is declining rapidly due to indiscriminate hunting of snails before they reach maturity, bush burning, use of agro chemicals, deforestation and change in weather (Efarmspro,2006).From the above observation, it is therefore important that snail farming (heliculture) should be encouraged, because it is only through conscious efforts made by man to farm snails would conservation of these species of animals be made possible.

In view of the above problems, there is the need to analyze the economics of snail production in Ibadan zone of Oyo State, Nigeria.

Specifically, this study seeks to:

- (i) examine the socio-economic characteristic of the snail farmers;
- (ii) determine the cost and returns of snail production;
- (iii) identify the factors influencing snail production; and
- (iv) examine the problems faced by snail farmers in the study area.

## METHODOLOGY

*The Study Area-* The study was carried out in Ibadan zone of Oyo state. Ibadan is the largest city in West Africa, South of Sahara. It is located in the tropical zone lying between latitudes 7<sup>o</sup>N and 9<sup>o</sup>N of the equator and longitudes 3<sup>o</sup>E and 5<sup>o</sup>E of the Greenwich Meridian. The mean daily maximum temperature of 24.5<sup>o</sup>C is experienced in August when there is dense cloud cover. An annual rainfall of 1120mm-1140mm is experienced.

Ibadan zone consist of fourteen Local Government Areas (LGAs). According to 2006 census, a population of 2,872,890 peoples was recorded in the study area out of which 49.38% were male and 50.42.% were female (NPC , 2006). The major occupation of the people in the study area is trading. Crops such as maize, cassava, vegetables, etc are grown there while livestock such as sheep, goat, local poultry (chicken and duck), swine and micro-livestock (snails, honey-bees and rabbits) are raised in the zone.

*Population, Sampling Procedure and Sample Size-* The population of the study is the snail farmers in the study area. A multistage random sampling procedure was used to select the respondents. In the first stage, the city was stratified into four strata. In the second stage, a

local government area was randomly selected from each stratum. The last stage involves random selection of fifteen respondents from each local government area making a total of sixty snail farmers. The information collected was subjected to reliability test and due to outlier and inconsistency; the respondents were reduced to 53.

*Method of Data Collection-* The data in this research work are mainly primary data that are obtained by conducting interviews through well-structured questionnaire that covered information on the socio-economic characteristics of snail farmers in the study area, the management practices employed in snail production, the cost incurred on and return accrued to snail production, factors affecting snail production, problems encountered in snail farming, possible solutions for the problem and likely areas of improvement in snail production activity in the study area.

*Method of Data Analysis-* The analytical techniques employed include descriptive statistics, budgetary techniques and stepwise regression analysis. Descriptive Statistics such as frequency counts, percentage and mean was used to measure socio-economics characteristics of the respondents.

Budgetary techniques were used to determine the gross margin and net farm income obtained from snail production in the study.

$$GM = TR - TVC$$

$$NFI = GM - TFC$$

$$Profit = TR - TC$$

Where GM	=	Gross Margin
TR	=	Total revenue
TVC	=	Total Variable Cost
NFI	=	Net Farm Income
TFC	=	Total Fixed Cost
TC	=	Total Cost

Mean was used to compute the cost of the various inputs such as cost of land, feeds, equipment and labour employed, cost of water and cost of hatchlings used in the production process.

All equipment used were depreciated using straight line method of depreciation in order to guide against over valuation of the cost incurred in each production year.

Profitability ratio analysis such as Benefit Cost Ratio (BCR), Gross Revenue Ratio (GRR), Expense Structure Ratio (ESR)s and rate of Returns (ROR) was used to measure the profitability of the snail farms and also to ascertain that snail production is a worthwhile venture.

Stepwise regression analysis was used to analyze the relationship between the profit made by the snail farmers (₦) and the inputs used in snail production. The functional form used was Cobb-Douglas production function. The model for the regression analysis is given below:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, \mu)$$

Where

Y	=	Profit made by snail farmers (₦)
X <sub>1</sub>	=	Level of education (years)
X <sub>2</sub>	=	Years of experience
X <sub>3</sub>	=	Cost of Equipment (₦)
X <sub>4</sub>	=	Cost of Feed (₦)
X <sub>5</sub>	=	Family labour (Man days)
X <sub>6</sub>	=	Farm size (acre)
μ	=	Error term.

## RESULTS AND DISCUSSIONS

*Socioeconomic Characteristics of the Respondents-* The results of the socio-economic characteristics of the snail farmers such as gender, age, marital status, educational status, religion, social organization, years of experience, major

occupation and source of capital is presented in Table 1.

Table 1 shows that 73.6% of the snail farmers are male while 26.4% were female. This shows that snail farming is a male dominated venture in the study area. This study agrees with the findings by Raheem (2001) that majority of the snail farmers are males (76%). The Table also shows that about 38% of the respondents are in the age bracket 30-39 years with a mean age of 38 years. This implies that most of the snail farmers are in their active age group. The reason for this is that snail farming is a new business in the study area and as such older people are yet to be involved in the rearing of snail on commercial basis, rather they rear snail for family consumption and as a way of getting themselves busy. Majority of the snail farmers (75.5%) are married while 24.5% were single. This indicates that married people are more involved in snail farming in the study area probably to increase household income. This study is in line with findings by Yusuf (2002).

Majority (58.5%) of the snail farmers had tertiary education while just 3.8% had primary education. Education is vital to snail rearing especially in the area of record keeping and proper management. Also commercial snail rearing being new in agricultural production activity is seen to be embraced by the educated people. More than half (62.5%) of the respondents are Christians, 35.8% were Muslims while 1.9% were traditional worshippers. This implies that there is no religious prohibition against snail rearing due to nutritional, medicinal and economic importance of snail. About 79% of the respondents belong to social organization such as cooperative society, farmers' development union, farmers' congress and

community development associations. This implies that apart from snail rearing activities, they still have other activities they attend to and this is possible since snail rearing is not time consuming.

Data in Table 1 also reveals that 41.6% of the respondents have years of experience of between three to four with a mean years of experience of 5 years. This implies that more people are now going into snail production due to increase in the awareness on the importance attached to snail production. About 84.9% of the respondents practice snail farming on part-time basis while the remaining 15.1% practiced snail farming on full-time basis. This implies that snail farming does not deprive the respondents of the time for other productive activities. Of the part-time farmers, majority (60%) were civil servant, 26.7% were traders while 8.9% and 4.4% were students and contractors respectively. This implies that they are involved in snail rearing as a source of increasing household income and for household consumption.

The data in Table 1 also shows that 98.1% of the initial source of capital used in setting up a snailery in the study area is from personal savings while the remaining 1.9% is from relatives and friends. This finding also agrees with the findings of Raheem (2001) that 96% of the snail farmers used their personal saving as a source of initial capital.

Table 1: Socioeconomic characteristics of the respondents

<b>Social-economic Characteristics</b>	<b>Frequency</b>	<b>percentage</b>
<b>Gender</b>		
Male	39	73.6
Female	14	26.4
<b>Age</b>		
20-29	12	22.6
30-39	20	37.7
40-49	17	32.1
50-59	2	3.8
60 and above	2	3.8
<b>Marital Status</b>		
Single	13	24.5
Married	40	75.5
<b>Educational Status</b>		
No-formal Education	0	0
Primary Education	2	3.8
Secondary Education	20	37.7
NCE/OND	11	20.8
HND/University	20	37.7
<b>Religion</b>		
Christianity	33	62.3
Islam	19	35.8
Traditional	1	1.9
<b>Member of Social organization</b>		
Yes	42	79.2
No	11	20.8
<b>Years of experience</b>		
1-2	17	32.1
3-4	22	41.6
5-6	14	26.3
<b>Mode of Practising</b>		
Full-time	8	15.1
Part-time	45	84.9
<b>Major Occupation</b>		
Civil service	27	60.0
Trading	12	26.7
Student	4	8.9
Contracting	2	4.4
<b>Source of Capital</b>		
Personal saving	52	98.1
Relations and friends	1	1.9

**Source:** Field survey, 2007.

*Management Practice in Snail*

*Production-* The data in Table 2 shows that 98.1% of the breed reared is *Archachatina marginata*. This is due to the fact that it has more meat than other species and thus command higher price thereby giving more revenue to the snail farmer.

This study agrees with findings by Hamzat (2000) that *Archachatina marginata* is common in Nigeria and it is an excellent source of animal protein, having large body size and easy to manage. Majority of the farmers reared their snail in fenced pen (43.4%), followed by Drums or pots (32.15%) and the least is used tyres. This implies that fenced pens are the most preferred among the breeding location.

Farm record is very important in agricultural business because it shows the overall performance of that particular enterprise at any point in time. As a result of the importance of record keeping, data in Table 2 shows that greater number of the respondents (90.6%) keep record of their snail production activity, 26.4% of the feed consumed by the snails in the study area came from domestic waste, 22.6% came from green feed while 17% each came from green feed and compound ration and green feed and domestic waste. This implies that the cost of feeding and sustaining snails are minimal and affordable since snail is able to convert low quality feed such as green feed and domestic waste into high quality animal protein thereby reducing the cost of feeding.

The data in Table 2 also reveals that most of the farmers in the study area feed their snails once a day with a mean frequency of feeding being 1.06 which is approximately one. This implies that snails do not require much feed since it is able to convert low quality feed to high quality animal protein and meat. More than three quarters (83%) of the respondents used well water in their snailery. This implies that the farmer would not be spending much on water since a well can be dug in the snailery to ease management activity thereby reducing the cost of snail production in the long

run. The mean family labour used was found to be 24 mandays which implies that majority of the snail farmers are still practicing on a small scale.

Table 2. Management Practices

<b>Management Practices</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Breed of Snail</b>		
<i>Archachatina marginata</i> (Igbin apinnu)	52	98.1
<i>Achatina achatina</i> (Igbin ilako)	1	1.9
<b>Where Snail are Grown</b>		
Fenced pens	23	43.4
Drums or pots	17	32.1
Trench pens	8	15.1
Tyres	2	3.8
Others	3	5.7
<b>Record Keeping</b>		
Yes	48	90.6
No	5	9.4
<b>Feed consumed</b>		
(1) Green feed	12	22.6
(2) Compound Ratio	5	9.4
(3) Industrial by-product	0	0
(4) Domestic waste	14	26.4
(5) 1 $\alpha$ 2	9	17.0
(6) 1 $\alpha$ 4	9	17.0
(7) 2 $\alpha$ 3	2	3.8
(8) 2 $\alpha$ 4	2	3.8
<b>Frequency of feeding</b>		
1	51	96.2
2	1	1.9
3	1	1.9
<b>Source of Water</b>		
(1) Well	44	83.0
(2) Stream	1	1.9
(3) Water supply	6	11.3
(4) 1 $\alpha$ 3	1	1.9
(5) 2 $\alpha$ 3	1	1.9
<b>Family Labour used (Mandays)</b>		
1-20	26	49.1
21-40	18	33.9
41-60	7	13.2
61-80	1	1.9
81-100	1	1.9

Source: Field survey, 2007

*Gross Margin and Net Farm Income Analysis-* Snail farmers made profits from their production with gross margin of ₦27, 432.78k and Net farm income of ₦ 24, 089.03k per farming season. This shows that snail production in the study area is a profitable business.

Table 3. Gross Margin and Net Farm Income Analysis for one farming season

Items	Cost (₦)
<b>Total Revenue</b>	39,628.13
<i>Variable cost</i>	
<b>Hatchling cost</b>	11,628.66
<b>Feed cost</b>	338.49
<b>Water cost</b>	92.45
<b>Transport</b>	144.75
<b>Total Variable cost</b>	<b>12,204.35</b>
<b>Gross margin</b>	<b>27,423.78</b>
<i>Fixed cost</i>	
<b>Land</b>	547.17
<b>Cost of equipment</b>	2787.58
<b>Total fixed cost</b>	<b>3334.75</b>
<b>Net farm Income</b>	<b>24089.03</b>

Source: Field survey, 2007

The data in Table 4 shows that BCR is greater than one. Judging from investment decision criteria, this implies that snail farming is profitable. The gross revenue ratio was found to be 0.388, which implies that from every ₦1.00 returns to the snail industry, 38.8k is spent. The expense structure ratio was found to be 0.181, which also implies that 18.1% of the total cost of production is made up of fixed cost component, thus making the business worthwhile to invest in. Also, the rate of returns was found to be 1.574 which shows that for every one naira invested in snail production 157k is gained. From all these profitability ratios snail production is a profitability business in the study area.

Table 4: Profitability Ratio of the Snail

Ratios	Values
<b>Benefit Cost Ratio TR/TC</b>	2.574
<b>Gross Revenue Ratio TC/TC</b>	0.388
<b>Expense Structure Ratio FC/TC</b>	0.181
<b>Rate of Returns NR/TC</b>	1.574

Source: Field survey, 2007

*Regression Analysis-* Stepwise regression was carried out and the variables that have low contribution to the research work were excluded from the model. The Cobb-Douglass function was specified for the regression analysis. The model obtained is as shown in Table 5. The third model is chosen because of the number of significant variables,  $R^2$  and F-value.

The result of the analysis shows that years of education ( $X_1$ ); years of experience ( $X_2$ ) and farm size ( $X_6$ ) are significant factors influencing the profit made by the snail farmers in the study area. These variables are significant at various levels of significance indicated. This implies that farmers with more years of experience tend to earn more profit in snail production than farmers with less years of experience. Also, profit increases with increase in farm size and years of education.

The  $R^2$  for the estimated regression showed that about 25% of the total variation in the profit made by the snail farmers was explained by the explanatory variables while the remaining 75% unexplained was due to the variables not included in the model is the error term.

The F-value of 5.466 is statistically significant at 5% level of significance. This implies that all the variables ( $X_1$ ,  $X_2$ , and  $X_6$ ) significantly influence the profit made by the snail farmers.

Table 5: Stepwise Regression Analysis

Model	Coefficient	Standard error	t-ratio	R <sup>2</sup>	F
1. (Constant)	3.752	0.289	13.105***	0.107	6.113**
L <sub>N</sub> X <sub>1</sub>	0.167	0.068	2.472**		
2. (Constant)	3.341	0.352	9.485***		
L <sub>N</sub> X <sub>1</sub>	0.184	0.066	2.779***	0.177	5.374***
L <sub>N</sub> X <sub>2</sub>	0.292	0.124	2.061		
3. (Constant)	2.364	0.560	4.222***		
L <sub>N</sub> X <sub>1</sub>	0.181	0.064	2.835***	0.251	5.466**
L <sub>N</sub> X <sub>2</sub>	0.408	0.146	2.786***		
L <sub>N</sub> X <sub>6</sub>	0.753	0.343	2.197**		

\*\*\* - Significant at 1% level of Significance

\*\* - Significant at 5% level of significance

*Problems Encountered in Snail Production-* The major problems faced by the snail farmers in the study area are Predators such as rats, lizard, snake, frog, bird, ants, termites and cockroaches (43.4%), theft (18.9%), lack of finance (13.2%), lack of space (9.4%) and inexperience (3.8%). This implies that the major problem faced by the snail farmers in the study area is that of predators (Table 6).

Table 6: Distribution of the respondents according to problems encountered in snail production

Problems	Frequency	Percentage
No Problem	6	11.3
Lack of Finance	7	13.2
Lack of Space	5	9.4
Theft	10	18.9
Predators	23	43.4
Inexperience	2	3.8
Total	53	100

Source: Field survey, 2007

### CONCLUSION AND RECOMMENDATION

Based on the major findings of this research, the following conclusions were drawn. Snail farming is a profitable venture if carried out with adequate management and the right type of breed; Snail farming can be handled as a part-time business because it is not time consuming; A large number of feed consumed by the snails come from domestic waste and green feed which made the

cost of feeding to be low; Profit made in snail production is being influenced by years of education, years of experience and farm size; and the main problems of snail production is predators.

In view of this, this study therefore recommends that; more people should venture into snail production and the already involved farmers should enlarge their production; farmers should take great care by avoiding or removing of all materials that can cause harms to the snails; and due to snail's profitability and its low capital investment nature, it is recommended for farmers without substantial capital, unemployed and those aspiring to augment their income.

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## Economic Evaluation of Cultural Control of *Tithonia diversifolia* (Hemsl. A Gray) in South Western Nigeria

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**Abstract:** Field experiments were conducted during the rainy season of 1999 and 2000 at the Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso, Nigeria to assess the economics of the control of *Tithonia diversifolia* by mulching in Okra production. There were five treatments namely; plastic mulch, grass mulch, wood shavings mulch, Hoe weeded and an unweeded and unmulched plots which constituted the control treatments. The experimental design was the Randomised complete block while partial budgeting was the instrument of economic analysis. Weed control method significantly affected Okra fruit yield ( $P=0.05$ ) with highest resulting from plastic mulch followed by hoe weeding, grass mulch, wood shavings and unweeded control in that order. The economic profitability of the control methods measured by the net change in profit was in the order; hoe weeding (N263,630) > Panicum mulch (N253,950) > plastic mulch (N201,000) > wood shavings (N195,000). The established long term effect of grass mulch as it affects soil fertility and sustainability however makes grass mulch better than the other control methods.

**Key words:** Economic, partial budgeting, mulching, tithonia control, okra

### INTRODUCTION

The significance of weed in agriculture especially in crop production is both positive and negative. However, as crop producers, man is often quick to highlight crop losses due to weeds resulting from competition, allelopathy, adulteration of farm produce and inflation of cost of production among others (Akobundu, 1987 and Lavabre, 1991). Therefore, for a profitable crop production, the bulk of labour requirement goes into weed control. The estimated total labour for weed control as a percentage of the total labour requirement for production including harvesting have been put at 36% and 37% respectively for maize and sorghum (Akobundu, 1987). For fruits and vegetables, Usoroh (1995) reported that weeding alone accounted for between 30-45% of

the total cost of production in Nigeria. The frequency and hence the total cost of weeding had been linked to weed type and crop concerned (Olabode *et al.*, 1999 and Akobundu, 1987). Higher frequency and total cost of weeding is required for aggressive weeds such as *Tithonia diversifolia* (Olabode *et al.*, 1999) and *Amaranthus hybridus* (Chivinge and Schweppenhauser, 1995) compared with less aggressive weeds such as *Acalypha segetalis* (Ogunyemi *et al.*, 2001). Similarly, the cost of weed control is directly related to the weed control method(s) adopted and frequency of weeding required (Akobundu, 1987).

The effectiveness of mulching as a weed control method had been reported (Akobundu, 1987). However, Opara-Nadi (1993) reported differences in the weed control efficiencies of

different mulch types. *Tithonia diversifolia* (Hemsl.) A. Gray, member of the family Asteraceae and native to Mexico and Central America (Carter, 1978) has become a problem in Nigeria. Though the route of introduction of this weed into Nigeria is unknown, it has become a significant agronomic and economic factor to optimum arable crop production especially in the southern guinea savanna zone (LordBanjou, 1991). A major fruit vegetable in this region is okra which is grown for its nutritive fruits and leaves. Due to the slow juvenile development of okra, early and repeated hoe weeding is usually adopted to reduce the competitive effects of *Tithonia* on the crop. Repeated hoeing with the attendant accumulation of labour cost eventually reduces farmers' net income.

The objective of this study therefore is to evaluate the economics of the control of *Tithonia* by mulching in okra production in comparison with the traditional control method of hoe weeding.

## MATERIALS AND METHODS

Field experiments were carried out at the Ladoke Akintola University of Technology, Ogbomosho Teaching and Research farm in southwestern Nigeria. The experiments were sited on a *Tithonia* infested field (Akobundu, 1991) during the rainy seasons of 1999 and 2000. The soil characteristic and climatic data for the experimental site are presented in Figure 1 and Table 1.

Table 1: Soil physico-chemical properties of the experimental site

Properties	1999	2000
pH (H <sub>2</sub> O)	6.00	6.30
Organic Carbon (%)	1.90	1.60
Total N (%)	0.26	0.18
Available P (ppm)	4.93	5.98
Exchangeable K (Meq/100g)	0.42	0.38
Sand (%)	87.00	88.00
Silt (%)	9.00	10.00
Clay (%)	4.00	2.00

Source: Department of Agronomy, Ladoke Akintola University of Technology, Ogbomosho.

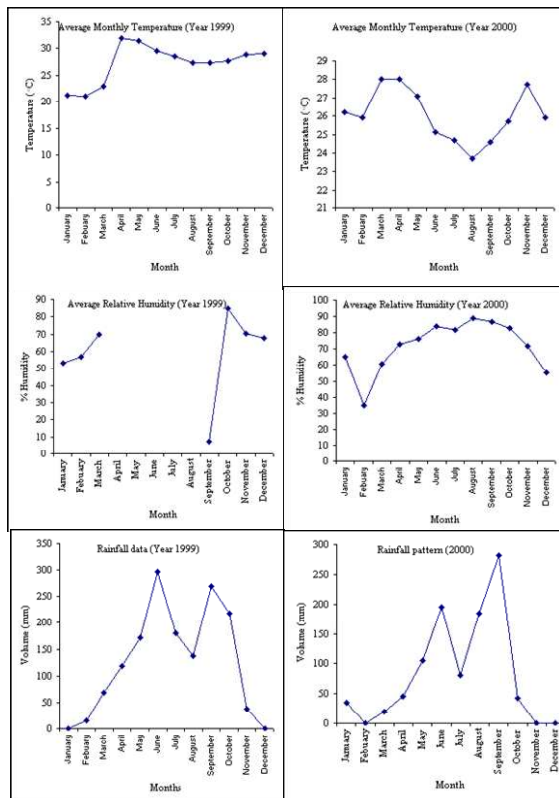


Fig1: Weather records of the study area for year 1999 and 2000

The site was manually cleared, tilled and levelled before laying out plots. The experimental design was a randomized complete block (RCB) with four replications. There were five treatments namely: plastic, grass, wood shavings mulching, hand hoeing and no weeding + no mulching. Each treatment plot size was 3 m x 3 m and the block size was 19 m x 3 m. each treatment plot and block plot were separated by an alley of 1m respectively, such that the total experimental plot size was 19 m x 15 m.

The plastic mulch 0.25m thick black-grey polythene sheet was obtained from the International Institute of Tropical Agricultural (IITA) and the grass mulch was sourced from slashing of *Panicum maximum* collected from adjacent fallow areas. The wood shavings from *Tectonia grandis* were collected from a local

sawmill in Ogbomosho. The mulches were applied to rain fed soils. The plastic mulch was laid with the grey side up and plantings made through holes at marked points. Both the grass and wood shavings were laid to a thickness of 3cm. The grass mulch was augmented at four weeks after the first application due to rapid decomposition. Weeding was done twice as hoe was used for weeding plots thereby receiving two weeding exercises at 2 and 4 weeks after planting (WAP); while the weedy plot was maintained leaving the plot unweeded from planting. Seeds of Okra V. 35 characterised with large alternative cordate leaves with 3 to 5 smooth edged lobes and short pods used for trial were obtained from the National Horticultural Research Institute (NIHORT) Ibadan, Nigeria. Plantings were done on 10th of May and 20th of May respectively for 1999 and year 2000 trials.

Cypertex, an insecticide containing 100mg/ml of cypermethrin was applied weekly to protect the crop from *Podagrica* sp attack (from the second WAP to fruiting). Data were collected for dry matter yield of Tithonia by oven drying (at 80°C for 48 hours) weeds collected from three randomly placed 0.25cm<sup>2</sup> quadrats and weighing on a Metler balance.

Okra fruit yield was estimated from cumulative fresh weight, per plant of okra harvested at 5 days interval. Data means were compared using Duncan's multiple range test (DMRT). The instrument of economic analysis was partial budgeting as described by Ronald (1986).

## RESULTS

The dry matter yield of Tithonia was significantly affected by mulch types (Table 2). The highest weed dry matter yield apart from the

unweeded control occurred on plots mulched with panicum while plastic mulched plots had the least. The order of weed control was plastic mulch> wood shavings mulch> hoe weeding> panicum mulch.

Table 2: Effect of mulch type *Tithonia diversifolia* biomass on Okra plot at flowering in the two seasons (1999 and 2000).

Weed Control Method	Weed Biomass {dry weight (g/m <sup>2</sup> )} within Okra plot.	
	1999	2000
Plastic mulch	28.4e	0.00d
Panicum mulch	98.5b	104.0b
Wood shaving mulch	87.7c	90.5b
Hoe weeding	62.5d	57.6c
Weedy plot	263.0a	220.4a

Values with the same letter for each year along the significant different at 5% level of probability by Duncan Multiple Range Test (DMRT).

The yield of okra was significantly (P<0.05) affected by weed control methods in the two years (Table 3). Okra fruit yield followed the trend plastic mulch> hoe weeding> panicum mulch> wood shaving> unweeded plot. The economic implications of the various weed control methods are presented in Tables (4 -7). The economic profitability of the control methods measured by the net change in profit was in the order; hoe weeding (N263,630.40)> panicum mulch (N253,950.40> plastic mulch (N201,110.40)> wood shaving (N195,150.40).

Table 3. Effect of mulch type on Okra yield and yield parameters in the two seasons (1999 and 2000)

Weed Control Method	Number of Fruit/plant	Weight of Fruit/plant (g)	Estimated Fruit Yield (Kg/ha)
<b>1999</b>			
Plastic mulch	12.11a	173.41a	11560.55a
Panicum mulch	8.67b	99.73bc	6648.60b
Wood shaving mulch	4.54c	77.20c	5146.62c
Hoe weeding	7.85bc	104.00b	6933.26b
Weedy plot	0.00d	0.00d	0.00d
<b>2000</b>			
Plastic mulch	10.12a	190.67a	12711.00a
Panicum mulch	6.33b	101.38b	6759.00b
Wood shaving mulch	6.00b	81.85c	5456.00c
Hoe weeding	5.78b	102.29b	6820.00b
Weedy plot	1.56c	28.38d	868.00d

Values with the same letter for each year along the significant different at 5% level of probability by Duncan Multiple Range Test (DMRT).

Substituting panicum mulch for hoe weeding led to an additional cost of N251, 800 as against an additional income of only N185,080 (Table 5). By replacing hoe weeding with wood shaving mulch, there was a 33% reduction in the cost of production. However, apart from no accruing extra income, the total income fell by 26% (N71,480) (Table 6). Panicum mulch reduced cost of production by 31% and total income by

only 4% (N11,360) (Table 7) when substituted for hoe weeding.

Table 4: Farm income statement per hectare of Okra

Control Plot: Hoe Weeding		N.	K
<b>a) Income</b>			
Yield: 6,933.26 Kg @	N	277,330.40	
40.00/Kg			
<b>b) Variable Cost</b>			
Land Preparation: 6 *MDL,			
Weeding: 10 MDL,			
Spraying (for Insect Control): 3 MDL, Harvesting: 5 MDL,			
Transportation: 2 MDL			
<b>Total MDL and Cost for field</b>		7,800.00	
<b>=26 @ # 300.00/MDL</b>			
Cost of Hoe:8 hoes @ #150.00 each		1,200.00	
Seed: 4 Kg @ #350.00/Kg		1,200.00	
Cypertex: 3 Litres @ #850.00		2,550.00	
Sub -Total		12,950.00	
<b>c) Overhead Cost</b>			
Rent on Land 1ha @ #750.00		750.00	
<b>d) Total Cost of Production/ha:-</b>		<b>13,700.00</b>	
<b>b + c</b>			
Gross Margin/ha:-	a – b	<b>264,380.40</b>	
Net Profit :-	a – d	<b>263,630.40</b>	

\*MDL = Mandays labour.

Table 5: Partial Budgeting for Okra production with Plastic Mulch  
Proposed Change: Plastic Mulch

Additional Cost:		Additional Income:		
	N	K	N.	K
10,000m <sup>2</sup> plastic mulch @ #25/m <sup>2</sup>		250,000.		
Fixing of the plastic mulch - 4 MDL @ #300.00/MDL		1,200.		
Cost of Harvesting: 2 MDL @ #300.00/MDL		1,200.		
Sub Total		<b>251,800. 00</b>		
<b>Reduced Income</b>		<b>Nil</b>		
Additional Cost + reduced income		<b>251,800. 00</b>		
<b>Additional Income:</b>				
Yield increase over the Control plot = (11,560 – 6,933) kg = 4,627 Kg @ #40.00/Kg = <b>185,080.00</b>				
<b>Reduced Cost</b>				
10 MDL of weeding @ #300.00/MDL = 3,000.00				
Cost of 8 hoes @ #150.00 each = 1,200.00				
Sub Total <b>4,200.00</b>				
Additional Income + Reduced Cost = 185,080 + 4,200 = <b>189,280</b>				
Net change in profit = # (189,280 – 251,800) = - # <b>62,520.00</b>				

\*MDL = Mandays labour.

Table 6: Partial Budgeting for Okra production with shaving mulch  
Proposed Change: Wood shaving Mulch

<p><i>Additional Cost:</i></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"></th> <th style="text-align: right;">N. K</th> </tr> </thead> <tbody> <tr> <td>Cost of packing and Transportation</td> <td style="text-align: right;">300. 00</td> </tr> <tr> <td>Cost of mulch application -</td> <td></td> </tr> <tr> <td>4 MDL @ #300.00 /MDL</td> <td style="text-align: right;">1,200. 00</td> </tr> <tr> <td style="text-align: right;">Sub Total</td> <td style="text-align: right;"><b>1,500. 00</b></td> </tr> </tbody> </table> <p><i>Reduced Income</i></p> <p>Yield reduction below the control (6,933 – 5,146)Kg = 1,787.00 Kg @ #40.00/Kg = 71,480.00</p> <p><b>Additional Cost + reduced income 72,980.00</b></p> <p>Net change in profit = # (4,200 – 72,980) = - #<b>68,480.00</b></p>		N. K	Cost of packing and Transportation	300. 00	Cost of mulch application -		4 MDL @ #300.00 /MDL	1,200. 00	Sub Total	<b>1,500. 00</b>	<p><i>Additional Income:</i></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"></th> <th style="text-align: right;">#. k</th> </tr> </thead> <tbody> <tr> <td><i>Reduced Cost</i></td> <td></td> </tr> <tr> <td>10 MDL of weeding @ #300.00/MDL</td> <td></td> </tr> <tr> <td style="text-align: right;">=</td> <td style="text-align: right;">3,000.00</td> </tr> <tr> <td>Cost of 8 hoes @ #150.00 each</td> <td></td> </tr> <tr> <td style="text-align: right;">=</td> <td style="text-align: right;">1,200.00</td> </tr> <tr> <td>Cost of harvesting: 1 MDL</td> <td style="text-align: right;">300.00</td> </tr> <tr> <td style="text-align: right;">Sub Total</td> <td style="text-align: right;"><b>4,500.00</b></td> </tr> </tbody> </table>		#. k	<i>Reduced Cost</i>		10 MDL of weeding @ #300.00/MDL		=	3,000.00	Cost of 8 hoes @ #150.00 each		=	1,200.00	Cost of harvesting: 1 MDL	300.00	Sub Total	<b>4,500.00</b>
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\*MDL = Mandays labour.

Table 7: Partial Budgeting for Okra production with Panicum mulch  
Proposed Change: Panicum mulch

<p><i>Additional Cost:</i></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"></th> <th style="text-align: right;">#. k</th> </tr> </thead> <tbody> <tr> <td>Cost of cutting and packing</td> <td></td> </tr> <tr> <td>5 MDL @ #300.00 /MDL</td> <td style="text-align: right;">1,500 00</td> </tr> <tr> <td>Cost of mulch application -</td> <td></td> </tr> <tr> <td>3 MDL @ #300.00 /MDL</td> <td style="text-align: right;">900. 00</td> </tr> <tr> <td style="text-align: right;">Sub Total</td> <td style="text-align: right;"><b>2,400. 00</b></td> </tr> </tbody> </table> <p><i>Reduced Income</i></p> <p>Yield reduction below the control (6,933 – 6649)Kg = 584 Kg @ #40.00/Kg = 11,360.00</p> <p><b>Additional Cost + reduced income 13, 760.00</b></p> <p>Net change in profit = # (4,200 – 13, 760) = - #<b>9,560.00</b></p>		#. k	Cost of cutting and packing		5 MDL @ #300.00 /MDL	1,500 00	Cost of mulch application -		3 MDL @ #300.00 /MDL	900. 00	Sub Total	<b>2,400. 00</b>	<p><i>Additional Income:</i> Nil</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"></th> <th style="text-align: right;">#. k</th> </tr> </thead> <tbody> <tr> <td><i>Reduced Cost</i></td> <td></td> </tr> <tr> <td>10 MDL of weeding @ #300.00/MDL</td> <td></td> </tr> <tr> <td style="text-align: right;">=</td> <td style="text-align: right;">3,000.00</td> </tr> <tr> <td>Cost of 8 hoes @ #150.00 each</td> <td></td> </tr> <tr> <td style="text-align: right;">=</td> <td style="text-align: right;">1,200.00</td> </tr> <tr> <td style="text-align: right;">Sub Total</td> <td style="text-align: right;"><b>4,200.00</b></td> </tr> </tbody> </table> <p>Additional Income – Reduced Cost = 4,200.00</p>		#. k	<i>Reduced Cost</i>		10 MDL of weeding @ #300.00/MDL		=	3,000.00	Cost of 8 hoes @ #150.00 each		=	1,200.00	Sub Total	<b>4,200.00</b>
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\*MDL = Mandays labour.

## DISCUSSION

The performance of various control methods conforms to the pattern earlier reported by Stapleton (1990). The variation in Okra yield from the different plots is attributable to the effectiveness of the control methods except for wood shavings mulch. Reduced yield under wood shavings in spite of good weed control had been reported (Opara-Nadi, 1993, Adetunji 1990) as being the resultant of a number of factors ranging from Nitrogen (N) immobilization to phytotoxicity of some wood materials to seedlings.

Mulching brought about a change in the cost of production compared with hoe weeding. The high increase in the cost of production under plastic was due largely to the cost of plastic material. Panicum and wood shavings mulches reduced the cost due to no cost of purchase. Though there was a significantly higher yield of Okra under plastic, the additional income from the increase could not offset the additional cost and hence a reduced net income. Apart from a reduced cost of production, the yield under panicum mulch was similar to those of hoe weeding (Table 3) and

thus a similar net income. The gains from reduced cost of production under wood shavings mulch could however not offset the loss in income due to depressed yield which could have resulted from release of phytotoxins into the soil (Opara-Nadi, 1993). This study had shown that plastic mulching in okra production is better left for experimental purposes rather than commercial production.

However, Panicum mulch could be adopted for commercial purposes. Apart from the economic aspect, grass mulch (organic) had been recommended for improved soils productivity and sustainability (Obatolu and Agboola, 1993) as against the tendency of hoe weeding to expose the soil to agents of erosion and destroy the structure of the soil. High carbon/nitrogen ration requiring longer period of degradation does not make wood shavings beneficial for yield improvement in a short duration crop like okra

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## Return to scale and determinants of farm level technical inefficiency among small scale yam based farmers in Niger state, Nigeria: implications for food security

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**Abstract:** The study examined the implication of resource productivity and farm level technical inefficiency in yam production on food security in Niger state, Nigeria. Data used for the study were obtained using structured questionnaire administered to 100 randomly selected yam based farmers from Edati and Munyan Local Government Areas of the state. Stochastic frontier production function was used to represent the production frontier of the small scale yam based farms.

The result showed the return to scale of 1.686 indicating an increasing return to scale and that small scale yam production in the area was in stage I of the production function. The study also showed that the levels of technical efficiency ranged from 31.72% to 95.10% with mean of 75.64% which suggests that average yam output falls 24.46% short of the maximum possible level. From the results obtained, although farmers were generally relatively efficient, they still have room to increase the efficiency in their farming activities as about 24 percent efficiency gap from optimum (100%) remains yet to be attained by all farmers. Therefore, in the short run there is room for increase in technical efficiencies on yam based farms in the study area. The result further showed that, farmers' educational level, years of farming experience and access to extension service significantly influenced the farmers' efficiency positively. It is recommended that relevant policies that would enhance the technical skill of the farmers and access to extension services should be evolved by the stakeholders.

**Keywords:** Yam production, return to scale, technical inefficiency, stochastic frontier production function

### INTRODUCTION

The Agricultural sector has always been an important component of Nigerian economy. The sector is almost entirely dominated by small scale resource poor farmers living in the rural areas, with farm holdings of 1-2 hectares, which are usually scattered over a wide area. According to Olayide *et al* (1981), about 75% of Nigeria's land is under arable cultivation with land-human ratio of 58

persons per square kilometre in south western Nigeria. This shows that the average sizes of farmlands are very small. The production practices of small-scale farmers are synonymous with their production characteristics such as subsistence level of production, low hectare due to tenurial rights, poor access to credit and other production inputs as well as poor managerial ability and enterprise combination based on ecological considerations,

available resources, taste and preferences of farm families.

Yam is widely consumed especially in West Africa. As a food crop, the place of yam in the diet of the people in West Africa and in Nigeria in particular cannot be overemphasized. Babaleye, (2003) observes that yam contributes more than 200 dietary calories per capita daily for more than 150 million people in West Africa while serving as an important source of income to the people. Yam is a preferred food and a food security crop in some sub-Saharan African countries (IITA, 1998). Babaleye (2003) reported that in many yam producing areas in Nigeria, yam is food and food is yam. Unlike cassava, sweet potato and aroids, one can store yam tubers for periods of up to 4 or even 6 months at ambient temperatures. This characteristic contributes to the sustaining of food supply, especially in the difficult period at the start of the wet season. Olawoye (1994) opined that food security existed when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

*Root and tuber crops especially yam*-FAO, (1987) emphasized that tuber crop e.g. yam has some inherent characteristics, which make it attractive, especially to smallholder farmers in Nigeria. First, it is rich in carbohydrates especially starch and consequently has a multiplicity of end uses. Secondly, it is available all the year round making it preferable to other more seasonal crops such as grains, peas and beans, and other crops for food security. According to Akoroda and Hahn (1995), the production of yam in Nigeria is grossly inadequate and cannot meet the ever-increasing demand for it under present level of input use. In

order to meet this level of demand and even surpass it, there is need to assess the level of inefficiency and its determinants in yam production. This study in the light of this intends to measure the magnitude of gain that could be obtained to improve farmers' performance by examining the return to scale and determinants of technical inefficiency of yam production in Niger State, Nigeria. Therefore, a stochastic frontier modelling is developed to simultaneously estimate resource productivity and determinants of technical inefficiency in yam production

#### ***The Conceptual Framework***

Farrell, (1957) distinguishes between technical and allocative efficiency through the use of a frontier production and cost function respectively. He defined technical efficiency (TE) as the ability of a firm to produce a given level output with a minimum quantity of inputs under certain technology and allocative efficiency (AE) as ability of a firm to choose optimal input levels for a given factor prices. In Farrell's Framework, economic efficiency (EE) is an overall performance measure and is equal to the product of TE and AE (that is  $EE = TE \times AE$ ).

However, over the years, Farrell's methodology has been applied widely, while undergoing many refinements and improvements. Such improvement is the development of stochastic frontier model that enables one to measure firm level efficiency using maximum likelihood estimate. The Stochastic frontier model incorporates a composed error structure with a two sided symmetry and one sided component. The one sided component reflects inefficiency while two sided component capture random effects outside the control of production unit including

measurement errors and other statistical noise typically of empirical relationship.

In this study, Battese and Coelli (1995) model was used which builds hypothesized efficiency determinants into the inefficiency error component so that one can identify focal points for action to bring efficiency to higher levels.

The general form of the model is expressed as:

$$Q_i = \beta_0 + \beta_1 X_i + (V_i - U_i) \dots \dots \dots (1)$$

Where

$Q_i$  is the production (on the logarithm of the production) of the  $i^{th}$  firm;

$X_i$  is a vector of (transformations of the) input quantities of the  $i^{th}$  firm;

$\beta$  is a vector of unknown parameters;

The  $V_i$  are random variables which are assumed to be iid  $(N, \delta^2 v)$  and independent of the  $U_i$  which are non-negative random variables which are assumed to account for technical inefficiency in production and are often assumed to be iid  $(0, \delta^2 u)$ .

It is further assumed that the average level of technical inefficiency, measured by the mode of the truncated normal distribution (i.e.  $U_i$ ) is a function of factors believed to affect technical inefficiency as shown below:

$$U_i = \delta_0 + \delta_1 Z_i \dots \dots \dots (2)$$

Where

$Z_i$  is a column vector of hypothesized efficiency determinants and  $\delta_0$  and  $\delta_1$  are unknown parameters to be estimated. It is clear that if  $U_i$  does not exist in equation (1) or  $U_i = \delta_0^2 = 0$ , the stochastic frontier production function reduces

to a traditional production function. In that case, the observed units are equally efficient and residual output is solely explained by unsystematic influences. The distributional parameters,  $U_i$  and  $\delta U^2$  are hence inefficiency indicators, the former indicating the average level of technical inefficiency and the latter the dispersion of the inefficiency level across observational units.

Given functional and distributional assumptions, the values of unknown coefficients in equations (1) and (2), i.e  $\beta_0, \beta_1, \delta_0, \delta u^2$  and  $\delta v^2$  can be obtained jointly using the maximum likelihood method (MLE). An estimated value of technical efficiency for each observation can then be calculated as

$$TE_i = \exp (-U_i).$$

The unobservable value of V may be obtained from its conditional expectation given the observation value of  $(V_i - U_i)$  (Yao and Liu, 1998).

**METHODOLOGY**

*Study Area-* The study was conducted in Niger State of Nigeria. The state is located within latitudes 8° – 10° north and longitudes 3° – 8° east of the prime meridian with land area of 76,363 square kilometers and a population of 4,082,558 people (Wikipedia, 2008). The state is agrarian and well suited for production of arable crops such as cowpea, yam, cassava and maize because of favourable climatic conditions. The annual rainfall is between 1100mm – 1600mm with average monthly temperature ranging from 23°C and 37°C (NSADP, 1994). The vegetation consists mainly of short grasses, shrubs and scattered trees.

*Sampling Techniques-* The data mainly from primary sources were collected from two Local Government Areas (LGAs) which were purposively selected because of prevalence of the

crop in the area using multistage sampling technique. The LGAs are Edati and Munyan LGAs. The second stage involved a simple random selection of 50 farmers from each of the two LGAs, thus, making 100 respondents. The data were collected with the use of structured questionnaire designed in line with the objectives of the study.

*Empirical Models-* The stochastic frontier production function is expressed as follows:

$$\ln Y_i = \beta_0 + \sum \beta_j \ln X_{ij} + V_i - U_i$$

Where

Ln = Natural logarithm;

The explicit form of the Cobb-Douglas functional form is written thus:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + V_i - U_i$$

Where  $Y_i$ ,  $X_1$ ,  $X_2$ ,  $X_3$ ,  $X_4$  and  $X_5$  are as defined earlier. The  $V_i$ 's are assumed to be independent and identically distributed (iid) normal random errors having zero mean and unknown variance.  $U_i$ 's are non-negative random variables called technical inefficiency of production of the respondent farmers which are assumed to be independent of the  $V_i$ 's such that  $U_i$ 's are the non-negative truncation (at zero) at the normal distribution with mean  $\mu$  and variance  $\sigma^2$

$$\mu = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i}$$

$Z_1$ ,  $Z_2$ ,  $Z_3$ ,  $Z_4$  and  $Z_5$  are the age, household size, level of education, years of farming experience and access to extension agents (number of contact) of the  $i^{\text{th}}$  farmers respectively and the  $\beta$ s and  $\delta$ s are known scalar parameters to be estimated.

The variables like age, household size, level of education, years of farming experience and access to extension agents were included in the model for

$I = i^{\text{th}}$  sampled smallholder farm;

$Y$  = Value of farm output from farm  $I$ ;

$X_s$  = input variables in the model, and

$X_1$  = Farm Size (in hectares);

$X_2$  = Labour (in man-day);

$X_3$  = Fertiliser (kg);

$X_4$  = Herbicide (litres);

$X_5$  = Quantity of Seed (kg)

$\beta_3$  = Input coefficients for the resources used in production;

$U_i$  = Farmer specific characteristics related to production efficiency;

$V_i$  = Statistically disturbance term.

the technical inefficiency effects to include positive effects of farmers' characteristics on the efficiency of production.

The technical efficiency of the farmers is expressed as:

$$TE_i = \exp(-U_i)$$

*Return to Scale:* This is the measure of farm's success in producing maximum output from a given set of inputs. The elasticity of production ( $Ep$ ) and return to scale (RTS) was estimated using the formula

$$\sum^k Epx_i = RTS$$

## RESULTS AND DISCUSSION

*Production Analysis:* The summary statistics of the variables for the frontier estimation is presented in Table 1. They include the sample mean and the standard deviation for each of the variables. The mean of 3.29 tons of yam per annum

was obtained from the data analysis with a standard deviation of 1.97.

Analysis of the inputs also revealed an average farm size of 1.93ha per farmer an indication that the study covered small scale family managed farm units. The average labour of 74.42 man- day showed that yam farmers relied heavily on human labour to do most of the farming operations. The analysis of other input variables showed the mean values of 228.69kg, 6.90litres and 224.98kg for fertiliser, agrochemical and seed yam respectively. All these findings exemplify the

nature of subsistence farming which dominates agricultural production in Nigeria.

Variables representing the demographic characteristics of the sampled farmers employed in the analysis of the determinant of technical inefficiency include age of the farmers, household size, educational level of the farmers, years of experience and number of extension contacts. The average age of the farmers, household size, year of schooling, years of experience and number of extension contact were 42.92, 4.16, 5.27, 15.70 and 2.29 respectively, meaning that the farmers were relatively young and with no formal education.

Table 1. Summary Statistics of the Variables in Stochastic Frontier Model

<b>Variables</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Mean</b>	<b>Standard Deviation</b>
Output (tons)	0.48	9.96	3.29	1.97
Farm Size (ha)	0.50	5.20	1.93	0.10
Labour (Man-days)	25.00	102.00	74.42	1.66
Fertiliser (kg)	2.00	650.00	228.69	20.67
Agrochemical (Litres)	2.00	14.00	6.90	0.29
Seed yam(kg)	45.00	650.00	224.98	9.26
Age (years)	25.00	65.00	42.92	9.42
Household Size	0.00	11.00	4.16	2.20
Education Level (years)	0.00	13.00	5.27	3.90
Years of Experience	2.00	47.00	15.70	9.45
Number of Extension Contact	0.00	4.00	2.29	0.67

Source: Field Survey, 2008

The stochastic frontier production function estimates of small scale yam based farmers in Niger State are presented in Table 2. The Table showed that the coefficients of labour, herbicide and agrochemical had the expected positive signs which indicated that a unit increase in these inputs will lead to increase in the gross output of yam. These variables were statistically significant at 1% and 5% levels of probability. The coefficients of land and fertiliser are negative. The estimated elasticities of mean output with respect to labour, agrochemical and seed yam inputs were 0.371, 0.977, and 0.365 respectively. This means that for 1% increase in man-day of labour, the output will increase by 0.371%. One percent

increase in the amount of agrochemical applied and seed yam planted also increased yam output by 0.977% and 0.365% respectively. However, a 1% increase in land and fertiliser used decreased yam output by 0.01% and 0.017% respectively.

#### *Determinants of Technical Inefficiency*

Table 2 shows the result for the regression analysis of the determinants of technical inefficiency in small scale yam based production in Niger State. The estimated coefficients of the inefficiency function provide some explanations for the relative efficiency levels among individuals' farms. Since the dependent variable of the inefficiency function represents the mode of inefficiency, a positive sign of an estimated

parameter implies that the associated variable has a negative effect on efficiency and a negative sign indicates the reverse. The negative coefficients for education, farming experience and extension contacts imply that educated farmers, the farmers with high farming experience and extension contacts in small scale yam production were more technically efficient meaning that as the level of education, years of farming experience and access to extension services increased in the study area, the technical inefficiency of the farmers decreases. Also, negative coefficient for age and household

size implied that the farmers' level of technical inefficiency increased with increased in age and household size.

The sigma square is 0.4954 and statistically significant at 1 percent. This indicates a good fit and the correctness of the specified distributed assumption of the composite error term. The gamma ( $\gamma$ ) ratio of 0.9394 which is significant at 1% level implied that about 93.94 percent variation in the output of yam-based farmers was due to differences in their technical efficiencies

Table 2: Maximum Likelihood Estimates of Parameters of the Cobb-Douglas Frontier Function for Small Scale Yam based Farmers in Niger State.

Variables	Parameters	Coefficients	t-ratio
<b>General Model</b>			
Constant	$\beta_0$	6.089	9.161***
Farm Size (ha) ( $X_1$ )	$\beta_1$	-0.010	-0.190 <sup>NS</sup>
Labour (Man-days) ( $X_2$ )	$\beta_2$	0.371	3.069***
Fertiliser (kg) ( $X_3$ )	$\beta_3$	-0.017	-0.921 <sup>NS</sup>
Agrochemical (Litres) ( $X_4$ )	$\beta_4$	0.977	7.285***
Seed yam (Kg) ( $X_5$ )	$\beta_5$	0.365	2.018**
<b>Inefficiency Functions</b>			
Constant	$\delta_0$	-0.730	-0.314 <sup>NS</sup>
Age (years)	$\delta_1$	0.010	0.458 <sup>NS</sup>
Household Size	$\delta_2$	0.021	0.356 <sup>NS</sup>
Education Level (years)	$\delta_3$	-0.007	-9.403***
Farming Experience (years)	$\delta_4$	-0.013	-13.432**
Extension Contact	$\delta_5$	-0.495	-4.032***
<b>Diagnosis Statistics</b>			
Sigma-square $\delta^2$		0.4954	8.320***
Gamma $\gamma$		0.9394	11.767***
Log likelihood function		-23.67	
LR Test		87.53	

Source: Computed from MLE Results

\* = Significant at 10% level; \*\* = Significant at 5% level; \*\*\* = Significant at 1% level.

NS = Not significant

*Elasticity of production inputs and returns to scale:* The input elasticities of production are shown in Table 3. The summation of the elasticities of 1.686 obtained indicated an increasing return to scale and that small scale yam production in the area was in stage I of the production function.

Table 3: Estimated elasticity of factor inputs and return to scale

Variables	Coefficients (Elasticity of production)
Farm Size ( $X_1$ )	-0.010
Labour ( $X_2$ )	0.371
Fertiliser ( $X_3$ )	-0.017
Agrochemical ( $X_4$ )	0.977
Seed yam ( $X_5$ )	0.365
<b>Return to Scale</b>	<b>1.686</b>

Source: Field survey, 2008



*Test of Hypotheses and Diagnostic Statistics*

The result of the generalized likelihood ratio which is defined by the chi square distribution is presented in Table 4. The null hypothesis in the Table is  $H_0: \gamma = 0$ , which specifies that the

inefficiency effects in the stochastic frontier production are not stochastic. The null hypothesis is rejected. This implies that the traditional response function (OLS) is not an adequate representation of the data.

Table 4: Generalized likelihood ratio test of hypothesis for parameters of the stochastic production frontier for small scale yam production in Niger State.

Null Hypothesis	Log likelihood	No. of Restrictions	$\chi^2$ Statistics	Critical value	Decision
$H_0: \gamma = 0$	-23.67	7	87.53	14.07	Rejected

Source: Computed from MLE Results

*Technical Efficiency Estimates of the Farmers*

The technical efficiency indices were derived from the MLE results of the stochastic production function, using computer programme FRONTIER 4.1. The indices in Table 5 showed that the technical efficiency of the sampled farmers was less than one (less than 100%), implying that all the yam farmers in the study area were producing below the maximum efficiency frontier. Some farmers demonstrated a range of technical efficiency of 0.9510 (95.10%) while the worst farmer had a technical efficiency of 0.3172 (31.72%). The mean technical efficiency is 0.7564 (75.64%), implying that on the average, farmers in the study area were able to obtain a little over 75percent of potential yam output from a given mix of production inputs. From the results obtained, although farmers were generally relatively efficient, they still have room to increase the efficiency in their farming activities as about 24.36 percent efficiency gap from optimum (100%) was yet to be attained by all farmers.

Table 5: Distribution of Technical Efficiency Indices among Yam Farmers in the Study Area

Efficiency Class Index	Frequency	Percentage
0.00 - 0.10	0.00	0.00
0.11 - 0.20	0.00	0.00
0.21 - 0.30	0.00	0.00
0.31 - 0.40	2.00	2.00
0.41 - 0.50	7.00	7.00
0.51 - 0.60	11.00	11.00
0.61 - 0.70	7.00	7.00
0.71 - 0.80	22.00	22.00
0.81 - 0.90	41.00	41.00
0.91 - 1.00	10.00	10.00
Total	100.00	100.00
Mean	0.7564	
Maximum value	0.9510	
Minimum value	0.3172	

Source: Computed from MLE Results

**SUMMARY AND CONCLUSION**

This empirical study is on return to scale and determinants of farm level technical inefficiency among small scale yam based farmers in Niger state, Nigeria: Implications for food security. A Cobb-Douglas production frontier was estimated by maximum likelihood estimation method to obtain ML estimates and inefficiency determinants. The MLE results revealed that TE of small scale yam farmers varied due to the presence of technical inefficiency effects in yam production. Labour, agrochemical and seed yam were found to be the significant production factors which

accounted for changes in the output of yam in the study area. The distribution of the technical efficiency indices revealed that most of the farmers were technically efficient with mean TE index of 0.7564 (about 73% of the farmers had technical efficiency above 70%). The results of the inefficiency model showed that the years of education, farming experience and number of extension contacts significantly increased the farmers' technical efficiency.

This study showed that small scale yam based farmers were not fully technically efficient and therefore there is allowance of efficiency improvement by addressing some important policy variables that could negatively and positively influence farmers' levels of technical efficiency in the area.

#### **POLICY IMPLICATION AND RECOMMENDATIONS**

The implication of the study therefore, is that the level of efficiency among small-scale yam producers in Nigeria could be increased by 24.36 percent through better utilisation of available resources, given the current state of technology.

In view of current global effort in achieving the Millennium Development Goals (MDGs), Nigerian Government as part of this effort should embark on a food policy measure that will strategically ensure that yam farmers follow appropriate farm practices/recommendations in the course of technology adoption. In view of this, a more realistic package that will increase the ratio of the number of farmer to extension contact should be pursued and encouraged as a vital step towards sustainable agricultural production in the country. It was shown that education (years of schooling)

had a positive correlation with technical efficiency and therefore farmers should be encouraged to improve their levels of education by registering in Adult/Continuing Education Centres in the area.

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## **Towards assuring households' food security in rural Nigeria: Have cooperatives got any place?**

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**Abstract:** The place of cooperatives in the lives of rural households in Nigeria as is the case in many developing countries of the world can not be overemphasized. This is attributable to the fact that cooperative has been used as a veritable strategy to meeting income and production shortfalls especially among farming households. Again, cooperative provides an easy and well-accessible source of credit to meeting households' obligations with little or no collateral requirements and the stringent conditions often attached to loan acquisition from the formal financial institutions. The results presented here rely on data collected from a random sample of 292 respondents in Ekiti State, Nigeria using well-structured questionnaire. Data were analysed using descriptive statistics, dietary diversity index measures and probit model. Analysis of results indicates that mean age of respondents is 53 years with average household size of 8. Respondents' distribution by gender reveals that there are more male-headed households than female-headed households with about 37 percent and 52 percent of the former and the latter having no formal education respectively. However, respondents' distribution by food security status revealed that there are more food-insecure male-headed households than female-headed households. This is attributable to the fact that in many of the female-headed households, incomes are usually pooled to meet households' needs. Moreover, the results of the probit analysis employed reveals that respondents belonging to cooperatives are more food-secured than those not belonging to cooperatives. Other determinants of food security status among respondents in the study area include age, marital status, gender, educational level, household size and income. While the coefficient of education is positively related to respondents' food security status that of household size is negatively related to it. In other words, the higher the educational level of respondents, the more food secured they are. It is therefore recommended that investment in human capital development should be intensified and that cooperative activities should be encouraged and assisted especially at their formative stages since this can serve as a hub to meeting the Millennium Development Goals (MDGs) of a well-informed society, reducing poverty by half and ending hunger.

**Key words:** Cooperatives, Food security, MDGs, Rural households, Ekiti State

### **INTRODUCTION**

Developing countries across the globe have continued to grapple with a number of problems ranging from poverty, widening inequality, food insecurity, environmental hazards to insecurity of lives and properties just to mention

a few. Worse still, a number of measures put in place to cushion the effects of these problems by national governments of these countries have yielded little or no appreciable results. The resultant effect of these anomalies is manifested in the generally low level of well-being among the

inhabitants of these countries. However, participation in cooperatives activities has been described as a veritable way of reducing the impact of poverty on rural households. This is attributable to the fact that formal financial institutions (banks) have kept credit out of the reach of poor people (Osuntogun, 1975; Steel and Webster, 1989). Due to the dearth of banking services in rural areas, the Rural Banking Scheme was introduced in 1977 and Commercial Banks were required under it to open rural branches. A total of 776 rural branches were opened by commercial banks in three phases, which expired in 1989 (Balogun and Otu, 1991). These were complemented by the establishment of People's Bank of Nigeria (PBN) in 1989 and the private sector corollary of PBN is Community Banks (CBs) in 1990. The PBN and CBs were required to eliminate the problems of collateral lending, high interest rates, promotion of adequate spatial distribution of rural bank branches and to inculcate banking habits in rural areas. Though there was a significant improvement in banking services during these periods but the economic recession experienced in Nigeria in the late eighties and the resultant distress in the banking sector arouse increased interest in credit cooperatives. Thus, the loans from credit cooperatives were considered as a viable alternative to those from these formal financial institutions (Osayamwen, 1995).

Cooperatives therefore are people-based and value-based economic enterprises, founded upon well-defined ethics and principles, which include "concern for community". This dual (social + economic) character is unique to cooperatives, which makes them the ideal and in fact, the only vehicle to ensure equitable distribution. They have

the flexibility to fit into any political system while reinforcing national commitments for equity, democracy and good governance. Cooperatives are the only means to bring the poorest segments of society into an organisational fold as legally recognised entities, providing opportunities for employment and better income along with the needed support services (Prakash, 1999). Cooperatives are community-based, rooted in democracy, flexible, and have participatory involvement, which makes them well suited for community development (Gertler, 2001; Brown, 1997; Fields and Sigurdson, 1972; Craig, 1993). Co-operatives can provide locally needed services, employment, circulate money locally and contribute to a sense of community or social cohesion (Quarter, 1992). Often-marginalized segments of communities have the opportunity to be represented in co-operatives, where in many other organizations they are left out (Fairbairn, 1995; Bruce 2000). Co-operatives can also be seen as an agent for the process of community development. Essentially, all co-operatives are a form of community economic development. As Ketilson *et al.* (1992) states that, "the process of developing and sustaining a co-operative involves the processes of developing and promoting community spirit, identity and social organization".

The conclusion is that cooperatives and similar member-owned businesses are an extremely flexible form that can be adapted successfully to solve a variety of economic problems. However, their successful application requires a great deal of promotional effort, attention to detail, and investment in human capital. A key conclusion of the study is that self-help organisations by the poor is a pre-condition for successful anti-poverty work

and that cooperatives can play an important role in this struggle. The conclusions are that the development of cooperatives and similar self-help organisations is a vital aspect of participatory development, and that without some form of self-organisation by the poor wider development would not be sustainable. The poor must be involved in the ownership of the development process, through their own local, democratically controlled economic organisations. If the cooperative form did not exist, it would have to be invented (Johnston, 2003). It is in view of the foregoing that this paper explores the role played by cooperatives in ensuring households' food security in rural Nigeria.

## LITERATURE REVIEW

### Linking Food Security with the Informal Financial Sector

Food security is defined as access by all people, at all times to sufficient food for an active and healthy life and includes at a minimum the ready availability of nutritionally adequate and safe foods, and an assured ability to acquire acceptable foods in socially acceptable ways (FAO, 1997; Sarah, 2003). Access to adequate food is a necessary but not a sufficient condition for a healthy life; a number of other factors, such as the health and sanitation environment and household or public capacity to care for vulnerable members of the society, also come into play (von Braun *et al*, 1992). The inability of the poor to have access to needed food can be attributed to low income and food production. Food insecurity on the other hand connotes a temporary shortfall of adequate food for a proper diet (transitory food insecurity) as well as

a long term food shortage called chronic food insecurity.

Rural and urban households cope with transitory food insecurity by diversifying their source of income through selling assets, or by resorting to informal financial credits, savings and insurance markets. The informal financial sector now acts as the place of solace for the rural poor to augment their consumption needs and meet other basic necessities of life. For the attainment of food security in Nigeria, there is therefore no gainsaying the prime position of the informal financial sector in ensuring consumption smoothing all year round for the rural and urban poor. In achieving this, farmers operating on small scale and having scattered farms needs to be brought together and properly organised to take advantage of group actions as this will make them to be better equipped to take advantage of credit access from the informal sources. Again, government must play an active role through assisting the informal lenders either through education or creating an enabling environment for competition. Proper organization of the informal financial sector will reduce the pressure on the formal sectors like banks and other specialized institution.

Credit acquisition from the formal financial institutions poses some specific problem for the poor whether rural or urban. The poor have little or no collateral to offer. Savings and credit amounts and instalments are very small, raising transaction costs per unit (Zeller *et al*, 1997). The informal financial sector has been and will for a long time remain the last hope for credit acquisition for inhabitants of developing countries. This is because of the ease of obtaining loan from this source and the less arduous and formal

procedures involved in processing this loan and the collateral requirements. Informal financial sector in Nigeria is comprised mainly of village money lenders, agricultural produce merchants, friends, business associates and other sources of credit acquisition available to rural and urban dwellers apart from the organised/specialized formal financial sources.

The informal financial sector provides important savings, credit, insurance, and social security services to the poor. However, the weakness of this sector appear to be the lack of medium-and long-term loans for production and technology adoption and the lack of monetary savings options with real returns. Moreover, informal arrangements are often restricted to the community or district levels, and therefore may be seriously limited in their ability to pool covariate risks across regions and to mobilize capital and allocate it to different regions and economic sectors. Also, the high interest rate charged on loan obtained from the informal sector discourages investment in agriculture. This directly or indirectly impacts on the attainment of food security in most of these developing countries. On the part of the borrower, the risk of non-repayment of loan is very high because of the familiarity involved and this further limits the amount of loan disbursed from these sources. Informal financial sector has very important roles to play towards the attainment of food security. This is due to the fact that increased agricultural production (a precursor to food security) is only achievable when there is availability of credit to enhance increased production from subsistence agriculture to large scale agriculture. These and many more underscore

the important role that cooperatives play in ensuring food security.

## METHODOLOGY

*Study Area-* This research work was conducted in Ekiti State, Nigeria. Ekiti State is one of the six states constituting the southwestern region of Nigeria. Although some parts of the region are fairly urbanized, the greater majority of the population still lives in rural areas. The State is situated entirely within the tropics. Ekiti State is chosen as the study area because of its prominent agricultural activities being the primary occupation of the inhabitants of the study area.

*Data Sources and Sampling Technique-* Primary data were collected through the aid of well-structured questionnaire. A multistage random sampling was employed in the study to select the respondents. Based on the division of the state into three senatorial districts; Ekiti North, Ekiti Central and Ekiti South, three Local Government Areas (LGAs) were selected from each district. This made a total of 9 LGAs out of the 16 LGAs in the state. 12 rural communities were later selected with at least one from each of the LGA based on probability proportionate to size and a total of 300 copies of questionnaire were administered out of which only 292 were used for the analysis.

*Methods of Data Analysis-* A number of statistical tools were employed in this study. These include; descriptive statistics, dietary diversity measures and probit model.

*Descriptive Statistics-* This was employed to summarize the socioeconomic characteristics of households in the study area. Tables, means, and frequencies were used to summarize the data obtained.



*Dietary Diversity Measures* - This measure was employed to categorise respondents into food secure and non-food secure group (Ruel, 2002; Hoddinott and Yohannes, 2002). In the survey, a number of food consumed by the respondents were identified. A food secure benchmark of 0.5 was determined based on how respondents are. In all, 15 common food items (with three food items belonging to each of the five classes of food) and water (as the 16<sup>th</sup> food item) were used and respondents with a benchmark  $\geq 0.5$  classified as food secure (1) while those with a benchmark  $< 0.5$  were classified as food insecure (0).

*Probit Model* - This was employed to ascertain the relationship between respondents' food security status and their membership of cooperatives. Other households' socioeconomic variables were also included as regressors in the model. The dependent variable (Y) takes the value '1' for food secure and '0' otherwise.

The explicit form of the model is specified as:

The probit model (Gujarati, 1995) used was of the

$$\text{form: } \Pr (Y_i = 1) = F (X_i \beta )$$

Where,  $Y_i$  = Food security status (1 or 0)

$X_1$  -Age (years)

$X_2$  -Marital Status (married = 1, unmarried = 0)

$X_3$  -Educational Status (years)

$X_4$  -Household Size

$X_5$  -Gender (Male = 1, Female = 0)

$X_6$  -Membership of Cooperatives (Yes =1, No = 0)

$X_7$  -Primary Occupation (Farming =1, Non-farming =0)

$X_8$  -Income (Naira)

$\beta_1 - \beta_8$  = Coefficients

$\epsilon_i$  = Error term

## RESULTS AND DISCUSSION

*Socioeconomic Characteristics of Respondents*- This involves a descriptive analysis of the various socioeconomic characteristics of respondents. Among the several features presented and discussed are: age, gender, marital status, household size, educational level, primary occupation and level of income.

*Age of Respondents*- As indicated in Table 1, the percentage of respondents with ages less than 30 is 2 percent. Those with age between 31 and 40 years are 10.3 percent, while those with age between 41 and 50 are 29.1 percent. Respondents with age between 51 and 60 years are 34.9 percent and those with age above 60 years are 23.6 percent. Thus, average age of the respondents is 53 years indicating that majority of the respondents are fairly old.

Table 1. Distribution of Respondents by Age

Age	Frequency	Percentage
5-30	6	2.1
31-40	30	10.3
41-50	85	29.1
51-60	102	34.9
> 60	69	23.6
<b>Total</b>	<b>292</b>	<b>100</b>

Source: Field survey data, 2007

*Marital Status of Respondents*- Distribution of respondents by marital status as shown in Table 2 below indicates that over two-third (62.7 percent) of them are married 19.5 percent are single, 7.5 percent divorced and 10.3 percent widowed. This shows that most of the respondents in the study area are married.

Table 2. Distribution of Respondents by Marital Status

Marital Status	Frequency	Percentage
Married	183	62.7
Single	57	19.5
Divorced	22	7.5
Widowed	30	10.3
<b>Total</b>	<b>292</b>	<b>100</b>

Source: Field survey data, 2007

*Educational Background of Respondents-*

As revealed in Table 3, about one-third (36.6 percent) of the respondents are educated up to tertiary level. Those with primary and secondary education are 17.5 and 26.7 percents respectively. However those having no formal education are 19.2 percent. In general, respondents in the study area are fairly educated and one wonders while this does not reflect as such in the food security status and earning potential of the respondents.

Table 3. Distribution of Respondents by Educational Background

Educational Level	Frequency	Percentage
No formal education	56	19.2
Primary education	51	17.5
Secondary education	78	26.7
Tertiary education	107	36.6
<b>Total</b>	<b>292</b>	<b>100</b>

Source: Field survey data, 2007

*Household Size of Respondents-*

Household size of respondents (Table 4) were grouped into those between 1-3, 4-6, 7-9, 10-12 and more than 12. The distribution shows that 14.4 percent have sizes ranging between 1-3, 27.8 percent are in the range of 4-6, 45.5 percent are in the range of 7-9, 6.8 percent within 10-12 and about 5.5 percent of the respondents have their size more than 12 members. Average household size of respondents is 8 indicating a fairly large size.

Table 4: Distribution of Respondents by Household Size

Household Size	Frequency	Percentage
1-3	42	14.4
4-6	81	27.8
7-9	133	45.5
10-12	20	6.8
>12	16	5.5
<b>Total</b>	<b>292</b>	<b>100</b>

Source: Field survey data, 2007

*Primary Occupation of Respondents-*

Going by the distribution in Table 5, majority of the respondents are engaged in farming (35.6 percent). This is closely followed by those engaged by government (civil servants) with a percentage of 22.9 percent. Also a sizeable number of the respondents are self-employed (16.8 percent). In general, the distribution reveals the relative importance of farming as the main source of income for majority of the respondents in the study area.

Table 5: Distribution of respondents by primary occupation

Primary Occupation	Frequency	Percentage
Farming	104	35.6
Government Employment	67	22.9
Trading	35	12.0
Private Firm	37	12.7
Crafts and Artisan	49	16.8
<b>Total</b>	<b>292</b>	<b>100</b>

Source: Field survey data, 2007

*Membership of Cooperatives-*

Households' distribution by membership of cooperatives (Table 6) indicated that about 78 percent belong to one cooperative or the other while only about 22 percent do not belong to any cooperative. This is attributed to the understanding that people now have about easy accessibility to credit facility through cooperatives.

Table 6: Distribution of Respondents by Cooperative Membership

Membership of Cooperative	Frequency	Percentage
Yes	227	77.7
No	65	22.3
<b>Total</b>	<b>292</b>	<b>100</b>

Source: Field survey data, 2007

*Income Level of Respondents-*  
Respondents' distribution by income level (Table 7) shows that majority of the respondents (42.8 percent) earn between N5, 001 and N10, 000. Those earning above N20, 000 are 16.1 percent. The distribution generally show that over three-quarter of the respondents earn below N20, 000 a month. This is very low considering the current cost of living in the study area and this further

explains why majority are into one form of cooperative activity or the other.

Table 7: Distribution of Respondents by Income Level

Income Range (N)	Frequency	Percentage
≤ 5000	38	13.0
5, 001 - 10,000	125	42.8
10,001 - 15,000	53	18.2
15,001 - 20,000	29	9.9
> 20, 000	47	16.1
<b>Total</b>	<b>292</b>	<b>100</b>

Source: Field survey Data, 2007

*Food Security Status of Respondents-*  
Respondents' categorisation based on dietary diversity measures revealed that there are more male-headed respondents than female-headed respondents. However, there are more food insecure male-headed households than female-headed household as depicted in Table 8.

Table 8. Distribution of Respondents by Food Security Status

Gender	No of Respondents	No food secure	% food secure	No food insecure	% food insecure
Male	168	73	43.5	95	56.5
Female	124	88	71.0	36	29.0
<b>Total</b>	<b>292</b>	<b>161</b>		<b>131</b>	

Source: Field survey data, 2007

*Determinants of Food Security in the Study Area-* A number of variables were used as explanatory variables to explain the determinants of food security status of the respondents. This is shown in Table 9:

Table 9. Probit Results on Determinants of Food Security Status

Variables	Coefficients
constant	1.576 (20.690)
Age (X <sub>1</sub> )	0.271 (0.133)
Marital Status(X <sub>2</sub> )	4.987 (15.359)
Educational Status (X <sub>3</sub> )	12.637** (6.023)
Household Size (X <sub>4</sub> )	-3.080*** (0.906)
Gender (X <sub>5</sub> )	-0.437 (11.009)
Membership of Cooperative (X <sub>6</sub> )	4.176*** (1.976)
Primary Occupation (X <sub>7</sub> )	-3.900 (6.014)
Income (X <sub>8</sub> )	7.990 * (5.628)

Source: Computed from field survey data, 2007

\* = Coefficient significant at 10%

\*\* = Coefficient significant at 5%

\*\*\* = Coefficient significant at 1%

*Log likelihood = -26.3107, Number of Observations =292*  
*Figures in parenthesis are standard errors.*

The result in Table 9 revealed age, marital status, gender, educational level, household size, income and membership of cooperatives as major determinants of food security in the study area. The coefficient of age is positively related to food security indicating that food security status of respondent increases as their age increases. Also the coefficient of marital status is positive indicating that married respondents are more food secure than single, divorced or widowed respondents. This is attributable to the possibility of couples assisting each other to augment households' needs. Also, while the coefficient of education is positively related to respondents' food security status that of household size is negatively

related to it. In other words, the higher the educational level of respondents, the more food secured they are. Again, respondents with large household size are more prone to food insecurity than those with small size. This is because as household size increases, income per head decline and the less food secure the household becomes. Moreover, respondents belonging to cooperatives are more food-secured than those not belonging to cooperatives. This is as a result of the ease of those belonging to cooperatives having access to credit facility to meet households' needs.

#### **SUMMARY**

This study examined the role of cooperatives in ensuring households' food security in rural Nigeria. The study revealed that mean age of respondents is 53 years with a fairly large household size (average household size of 8 members). Respondents' distribution by gender showed that there are more male-headed households than their female-headed counterparts. However, there are more food-insecure male-headed households than female-headed households. Also, household's distribution by educational level indicates that majority of the respondents are educated up to tertiary level with only a few of them having no formal education. Meanwhile, respondents' categorisation by food security status using the dietary diversity measures revealed that there are more food insecure respondents than food secure respondents. The probit model reveals that respondents belonging to cooperatives are more food secure than those not belonging to cooperatives. Also, educated, small-sized and high income respondents are more food secure than

uneducated, large-sized and low income respondents.

#### **CONCLUSION AND RECOMMENDATIONS**

Going by the findings of this study, it is generally revealed that cooperatives play a very prominent and significant role towards ensuring food security in Ekiti State. This is attributable to the fact that those belonging to cooperatives being more food secure than those not belonging to any form of cooperative. Hence, it is recommended that:

- Cooperatives need to be properly guided and organised especially at their formative stages, having seen it as a veritable channel of meeting the needs of the poor majority in rural Human capital development through education should be made a priority having found that households with tertiary education are less prone to food insecurity.
- Public enlightenment on birth control and awareness on the need to have moderate household size should also be given urgent attention so as to curtail arbitrary population growth.

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## Using Nigeria Agricultural Cooperative and Rural Development Bank small holder direct loan scheme to increase agricultural production in rural Oyo State, Nigeria

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**Abstract:** Credit disbursement has been given priority by the Nigerian Agricultural Cooperative and Rural Development Bank. The study examined the use of NACRDB Small-holder Direct Loan Scheme to increase agricultural productivity in the rural areas of Oyo State, Nigeria. Systematic random sampling technique was used to select 130 beneficiaries and 130 non-beneficiaries for the study. The results of the study showed that beneficiaries have significantly higher mean yield index (1467), than non-beneficiaries (600). Also the income realized by the beneficiaries (N70,000 per annum) is higher than that of non-beneficiaries (N30,000 per annum). Generally, the beneficiary's access to credit has enabled them to make efficient use of improved farm inputs and labour than non-beneficiaries. It could be deduced that NACRDB small holder direct loan scheme is capable of transforming rural agriculture.

**Keywords:** Agricultural credit, loan scheme, agricultural production

### INTRODUCTION

Agriculture has been and is still the bedrock on which every successful and stable economy the world over is built. In Nigeria today, agriculture accounts for one third of the Gross Domestic Product (GDP) and employs about two third of the labour force (Oyeyinka, 2002).

The Nigerian Agricultural policy places the small scale farmers in central focus. This is because, the nation's agriculture has always been dominated by the small-scale farmers who represent a substantial proportion of the total population and produce about 90 – 95 percent of the total agricultural output in the country. Prior to

the advent of the oil boom era and that of money illusion in the economy, Nigeria was noted for her high production performance, in terms of food and cash crops as well as the supply of most industrial raw materials, which is the product of our small-scale farmers. For instance, the total agricultural output between 1986 and 1992 grew at the rate of 0.6 percent per year on the average. This is in contrast to the growth rate of 3.5 percent between 1981 and 1986 (World Bank, 1996). However, this important role agriculture has played in the Nigerian economy has declined tremendously. The decline has for a long time been blamed on the neglect of the rural sector, comprising mainly the



small-scale farmers by successive administration in the country. As the role of agriculture in the economy decline, food importation increase, thus leading to the depression of the locally produced food, which has decreased farmers, expected income that could have been used to improve their farm productivity (Okunmadewa, 2003). This phenomenon led farmers to produce for their household use only, and as such they did not have marketable surpluses, when there are surpluses, it is usually too meagre to contribute enough income for household consumption and social obligations as well as re-investment in the farm. Since their income is small, most of these farmers resort to borrowing in order to fulfill their household economic demand and social obligations. Inadequate credit provision and poor marketing systems have reduced agricultural productivity drastically to the extent that food importation has been on the increase in recent years. Since agriculture in Nigeria and most other developing countries is where small-scale farmer's producers predominate, several constraints and barriers, which appear insurmountable, limit the overall farming activities. If this is anything to go by, the destiny of the developing economy heavily rest on the shoulders of the small-scale farmers (Bolarinwa and Oyeyinka 2005).

Granting credit to peasant farmers for the cost they incurred on land preparation, weeding and harvesting operations and labour to increase the use of agricultural inputs will enable them most importantly to be able to adopt modern farming techniques, so as to increase their agricultural productivity. Farmer's access to credit will enable them use tractors, which will lead to increased output of higher quality, thereby resulting in

increased income and improved standard of living, which is imperative. Public policy in mobilizing financial resources for agricultural development has not been very effective for a number of reasons. First, there have been no consistent and effective policies to make private investment in agriculture more attractive due to persistently low productivity. While this has not induced the necessary industrial growth in the sector to create larger markets for farm output, it has also curtailed free flow of funds from the private sector.

As a result, the bulk of the investment in agriculture has been from state resources. The proportion of agricultural output in the GDP which was close to 60 percent during the 1960s stagnated below 30 percent for most of the 1970s, although, there has been a reversal of this negative trend since the National Economic Empowerment Development Strategy (NEEDS) was introduced in 2004. The achieved proportion is however, yet to meet its pre-1970 levels. This indicates sub optimal use of available finance in the sector. In reality real expenditure in agriculture always falls far short of budgetary allocation, which in itself at best often hovers around the recommended minimum of 25 percent of total budgetary allocation for a predominantly agriculture state such as Nigeria (Food and Agricultural Organization (FAO), 1975 cited in Oyeyinka, 2002)

For many years, the urge to foster agricultural growth and development, among other things, has often compelled government to intervene in the development of agriculture. Among the key areas of intervention include extension, input supply, marketing services and most importantly, credit disbursement. It is a general belief that the disbursement of credit is a

precondition for technology change and agricultural productivity. As such, the government of most developing countries has often fostered the growth of institutional financial market mainly to provide credit to the farmers on concessionary terms. Also credit disbursement to farmers has been given priority by the Nigeria Agricultural Cooperative and Rural Development Bank (NACRDB), Cooperative Societies and Commercial Banks.

Both large and small-scale farmers in Nigeria have been enjoying the services of Nigeria Agricultural Cooperative and Rural Development Bank (NARDB), in terms of loan disbursement to help them increase their farm output, by enhancing productive efficiency. However, with the small-scale farmers, there does not seem to be any significant increase in their output. Many of them still produce at subsistence level with little or none left for the market. This situation defeats the ultimate goals of loan disbursement by agricultural credit institution, which is to ensure higher agricultural productivity.

The following research questions emanate from an analysis of the use of Nigeria Agricultural Cooperative and Rural Development Bank (NARDB) small holder direct loan scheme on farmers productivity in rural Oyo state, Nigeria.

- i. Is the level of production of beneficiaries, different from that of non-beneficiaries?
- ii. Do beneficiaries have higher income than non-beneficiaries?
- iii. Is the level of inputs used by beneficiaries different from that of non-beneficiaries?
- iv. Do beneficiaries have larger farm size than non-beneficiaries?

### **Objective of the Study**

The general objective of this study is to determine the effect of the use of Nigeria Agricultural Cooperative and Rural Development Bank (NARDB) smallholder direct loan scheme on farmer's productivity in rural Oyo State, Nigeria.

The specific Objectives are to:

- i. investigate the differences in the production level of beneficiaries and non-beneficiaries.
- ii. determine the net income of beneficiaries and non-beneficiaries.
- iii. compare the level of inputs used by beneficiaries and non-beneficiaries.
- iv. ascertain the effect of the use of credit on beneficiaries and non-beneficiaries, in terms of the size of farm acquired.

### **Hypotheses of the Study**

The following null hypotheses were tested;

- Ho<sub>1</sub>: There is no significant difference between the beneficiary's level of production and that of non-beneficiaries.
- Ho<sub>2</sub>: There is no significant difference between the farm income of beneficiaries and non-beneficiaries.
- Ho<sub>3</sub>: There is no significant difference between level of inputs used by the beneficiaries and non-beneficiaries.
- Ho<sub>4</sub>: There is no significant difference between the farm size of the beneficiaries and non-beneficiaries.

### **METHODOLOGY**

*Area of the Study-* The study was carried out in Fasola Community in Oyo West Local Government area of Oyo State. It is bounded in the North by Atiba Local Government, to the South by

Iseyin Local Government, to the West by Afijio Local Government and to the East by Oyo East Local Government areas of Oyo State. Ecologically, Oyo West local government lies in the Guinea Savannah. The major occupation of the people is farming, but there are few of them who engage in petty trading and artisan works.

Stratified and systematic random sampling techniques were adopted for the selection of the respondents. The lists of beneficiaries of the loan scheme were collected from the NACRDB, Oyo Zonal Office while the lists of non-beneficiaries farmers were supplied by the ADP in the study area. A systematic random sampling technique was used to select 10% of beneficiaries from NACRDB register and 10% of non-beneficiaries from the ADP register this gives a total of 130 beneficiaries and 130 non-beneficiaries that participated in study. Structured questionnaire and interview schedule were used for gathering the primary data. Data was analyzed using t-test.

*Impact Measurement-* The impact of NACRDB smallholder direct loan scheme was studied with the use of t-test in order to empirically establish if there is any difference between the performance of farmers who have access to credit and those who do not have access to the loan facility. This is justified on the basis that the differences between two means could be established with the use of t-test. Yield of maize which is a common crop for all farmers was used as a proxy variable for productivity. Income generated from their total agricultural enterprises was used as their income level. The ratio of adopted fertiliser compared with recommended was used as a proxy for adoption of improved

practices, while the farm sizes were actually measured.

## RESULTS AND DISCUSSIONS

*Smallholder Direct Loan Scheme (SHDLS) and Crop Production Level:* For this particular study, yield of maize was considered as a proxy for productivity at the farm level. Farmers in Fasola village are familiar with maize production as both sole crop and as a component in intercropping systems. Table 1 shows that, there is significant difference between the farm output (yield) of beneficiaries and non-beneficiaries in the study area. T-test is 33.04 and  $P = .000$  which is less than 0.05. The beneficiaries have a higher mean yield index of 1467, than non-beneficiaries (600). Generally, the productivity of the beneficiaries in terms of maize production is higher than non-beneficiaries. The implication of this is that credit disbursement had enhanced the productivity of the farmers in Fasola community. This finding supports the outcome of the study of Williams (1985), Balogun and Otu (1992) and Oyeyinka (2002) which showed that positive and significant relationship exists between agricultural credit and productivity.

*Smallholder Direct Loan Scheme (SHDLS) and Farmers Income:* Income made by farmers is also recorded in Table 1, increase in yield is desirable for farmers especially when it leads to increased income. Many intervention and development programmes increased yield without a corresponding increase in farmer's income. Access to credit facilities helped the farmers to translate their increase in yield to a higher significant increase in income. Table 1, indicates that, there is a significant difference between the total income of

beneficiaries and non-beneficiaries. The t-test is 31.3% and  $P = .000$  which is less than 0.05. The beneficiaries has a mean total income of about N70,000 per annum, while that of non-beneficiaries is about N30,000 per annum. The higher income accruing to the beneficiaries may be a consequence of the loan obtained from NACRDB smallholder direct loan scheme, which has enabled them to invest more on agriculture. This finding is supported by the outcome of the study of Zeller *et al* (1997) and Oyeyinka (2002) which found that improved access to credit enables households to invest in farm assets and therefore increase income levels of beneficiaries.

*Smallholder Direct Loan Scheme (SHDLS) and Use of Farm Inputs:* The use of inputs measured by taking a ratio of inputs used against inputs recommended. The input of reference in this case was fertiliser. Farmers in Fasola village had poor access to agro inputs, where they are available, the prices were unaffordable. These problems coupled with poor knowledge of how to use them were major disincentives to adoption of farm inputs. However, the influx of credit had influenced the farmers in the adoption of farm inputs. The analysis of the results indicates that the t-test is 2.7 and  $P = 0.04$  which is less than 0.05. Hence, the null hypothesis

was rejected and the alternative hypothesis was accepted, that there is significant difference between the beneficiaries and non-beneficiaries, in their adoption of farm inputs. The implication of this findings is that farmers access to credit, has enabled them to purchase improved inputs such as seeds, herbicides, insecticides and fertilisers which has enabled them to expand and improve on their farm productivity. This finding is in line with the position of Ewuola (1985) and Oyeyinka (2002) which stated that credit availability is capable of enabling the small scale farmers to adopt improved farming technologies.

*Smallholder Direct Loan Scheme (SHDLS) and Farm Size:* Data on farm size of beneficiaries and non-beneficiaries is also contained in Table 1, access to credit facilities significantly increased the farm holdings of beneficiaries, which is 17.16 hectare compared with that of non-beneficiaries which is 9.77 hectare.  $P = 0.000$  which is less than 0.05. This was probably due to the fact that beneficiaries' farmers increase their incomes and started to have some surplus which was ploughed into expanding their farm holdings. Like the use of external inputs, expansion of farm holdings is also an indicator of increased commercial outlook for subsistence-oriented farmers.

Table 1. Means of Variables and T-test Values of yield of maize, incomes, external inputs used and farm sizes of the beneficiaries and non-beneficiaries.

Variables	Mean Score of BF	Mean Score of NBF	Mean Differences	T-test Value	P	Decision
Yield per unit area	1,467.69	600.0	867.69	33.04	.000	Significant
Income	62,536.16	28,776.36	33,759.8	31.37	.000	Significant
Use of external inputs	54,923	45,839	9,084	2.07	0.40	Significant
Farm size	17.16	9.77	7.39	12.77	.000	Significant

Source: Field Survey, 2006

S = Significant at 0.05

\*NS = Not significant at 0.05

*Smallholder Direct Loan Scheme (SHDLS) and Source of Labour:* The major factor input for crop production practices were land, capital and labour. Labour in any production practices enterprises is often limiting. This becomes vital as a result of diversification of products and reduced emphasis on tractor usage. This is due to limitation of capital for farm labour, like other inputs; this therefore aligns this resource with capital requirements. Table 2 indicates that

farmer's access to credit enable 55.4 percent of the beneficiaries and 18.5 percent of non-beneficiaries to make use of tractors. Generally, the beneficiaries' accesses to credit enable them to make efficient use of hired labour more than the non-beneficiaries (60.0% > 41.5%). However, the non-beneficiaries are more efficient than the beneficiaries in the use of family labour (52.3% > 40.0%) and exchange labour (46.2% > 35.4%).

Table 2. Frequency Distribution of Respondents by Sources of Farm Labour

Sources of Farm Labour	Beneficiary N = 130		Non-Beneficiary N = 130	
	Frequency	Percentage	Frequency	Percentage
Hired labour	78	60.0	54	41.5
Family labour	52	40.0	68	52.3
Tractor	72	55.4	24	18.5
Animal traction	04	3.1	03	2.3
Self effort	82	63.1	72	55.4
Exchange labour	46	35.4	60	46.2

Source: Field Survey, 2006

\* Multiple Responses

*Smallholder Director Loan Scheme (SHDLS) and Reasons for Changes in Farm Output:* Table 3 indicates that 60.0 percent of the beneficiaries opined that changes in their farm output was due to their access to credit facilities, while 13.8 percent of the non-beneficiaries shared similar view. The bane of the low productivity of

the non-beneficiaries was due to their lack of access to credit facilities (53.8%), while (20.8%) of the beneficiaries shared the same opinion. Both the beneficiaries and non-beneficiaries who are of the opinion that other factors are the reason for changes in their farm output are (19.2%) and (32.3%) respectively.

Table 3. Frequency Distribution of Respondents by Reasons of changes in farm output n = 130

Response	Beneficiary N = 130		Non-Beneficiary N = 130	
	Frequency	Percentage	Frequency	Percentage
Access to credit	78	60.0	18	13.8
No access to credit	27	20.8	70	53.8
Other factors	25	19.2	42	32.2
Total	130	100.0	130	100.0

Source: Field Survey, 2006

## CONCLUSION AND RECOMMENDATIONS

The study assesses the use of NACRDB small-holder direct loan scheme to increase agricultural productivity in Fasola village, a rural community in Oyo State. It was observed that farmers' access to credit facilities rapidly increase

their output (productivity). The beneficiaries have a higher mean yield index of 1467kg, than non-beneficiaries of 600kg. Also, the beneficiaries' income, use of external inputs, and farm size are higher than that of non-beneficiaries. Generally beneficiaries' access to credit enable them to make

efficient used of hired labour more than the non-beneficiaries (60.0% > 41.5%). Also (60.0%) of the beneficiaries opined that their changes in farm output was due to their access to credit facilities, while (13.8%) of the non-beneficiaries shared similar view. It could be deduced therefore that the NACRDB smallholder direct loan scheme (SHDLS) have the capacity to transform rural agriculture is delivered and sustainable. They therefore hold the key to the agricultural revolution that can solve the problem of African agriculture.

### RECOMMENDATIONS

1. Loan should be disbursed to the beneficiaries with minimum delay, since respondents identified timely disbursement of loans as a way of effectively implementing the loan scheme.

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ISSN1596-9908