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GENDER DIFFERENTIALS IN EFFICIENCY OF ADOPTION OF CASSAVA PRODUCTION TECHNOLOGIES AMONG FARMERS IN ANAMBRA STATE, NIGERIA: ADDITIVE MULTIPLICATIVE DUMMY VARIABLE APPROACH

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ABSTRACT
This study was designed to estimate and compare the technical efficiencies of male and female adopters and non-adopters of cassava production technologies in Anambra State, Nigeria. A multi-Stage random sampling technique was used for the sample selection. Primary data collected from a sample of 120 farmers consist of 60 males and 60 females. Data were analyzed by descriptive statistics (mean, frequency and percentage) and additive multiplicative dummy variable approach. The results for the male farmers indicated that technical efficiency coefficient for farm size and quantity of herbicide were positive and significant at 10% and 5% level respectively and capital, farm size dummy and herbicide dummy at 1%, level each. For the female farmers, the coefficient for farm size and capital were positive and significant at 5% levels each and fertilizer quantity at 1% level. Farm size dummy was negative and significant at 5% level. The findings indicate that male adopters were more technicaly efficient than their female counterparts. Advocating policies aimed at increasing the cassava production efficiency of female farmers that use improved cassava production technologies is made in order to improve their standard of living.

Keywords: Gender, Technical Efficiency, Adoption and Improved Cassava

Introduction

Nigeria was known for the production of yam and other crops before the introduction of cassava (*Manihot esculenta)* to Africa by the Portuguese during the late 16th century (Nweke, 1994).The crop is fast replacing other crops including yam in food economy because of its readiness to adapt to different environmental conditions, farming systems and socioeconomic conditions of Africa (Nweke, 1996a). The crop has the ability to provide a stable food security in any Nation due to its flexibility in terms of planting, harvesting strategies and relative tolerance to poor soil and pests and diseases problems (Government of Ghana, 1996). According to Onyemauwa (2010), cassava has the potential to increase farm incomes, reduce rural and urban poverty and help close the food gap of any Nation. As a cash crop, cassava generates cash income for the largest number of households, in comparison with other staples (Obisesan, 2012). Reports have shown that a higher proportion of cassava farmers, in Nigeria get a higher income from its production than they get from most other major staple (Ezeibe *et al.*, 2015). It is clear that in cassava growing areas, where the most important source of cash income is food crops, cassava is the most important food crop generating cash income. Partnership Initiative in the Niger Delta (2011) confirmed that Nigeria can earn about 5 billion US dollar per annum from cassava and its by-products, thereby regarded as means for job creation and economic development. Sanni *et, al*. (2005) observed that the potential of the crop is large because of its ability to offer the cheap source of food calories (a minimum of about 2400 calories per person per day) and the highest yield per unit area. Cassava production in Africa is used almost exclusively for consumption as food. About 95 percent of the total cassava production

after accounting for waste was used as food in Africa in the late 1990s. The increase in the total cassava consumption in Africa is due to a significant increase in per capita consumption in country like Nigeria where it is produced as food crop for urban consumption (FAO, 1995). The availability of the crop in a convenient food form, such as *gari* played a major role in the increase in the per capita cassava consumption in Nigeria (FAO, 1995). Globally, similarly, the traditional use of cassava is changing from primarily human consumption to processed products such as starch, flour, and ethanol (Partnership Initiative in the Niger Delta, 2011). Studies have shown that cassava has the potential to also industrialize Nigeria more than any other food crop if potentially utilized. Cassava was traditionally among the crops grown by males in Nigeria not until recent time when the female involvement started increasing due to the impact of the crop to economic development of Nigeria (Ewebiyi and Arimi, 2013). The Collaborative Study of Cassava in Africa (COSCA) studies found that both men and women make significant contributions of their labour to the cassava industry in most of the COSCA countries. Men and women were found to specialize in different tasks (Carter and Jones, 1989) which may range from land preparation to harvesting. Therefore, this study compared the technical efficiency of male and female cassava farmers in southeast Nigeria.

Methodology

Study Area

This study was conducted in Anambra State of Nigeria, which comprises of 21 Local Government Areas (LGAs). The State is divided into four Agricultural zones and is lied within the 6º13' and 7º 9' North and longitudes 7º49' and 7º57' East (Nfor, 2006). The area lies mainly on plains under 200m above sea level (ASADEP, 2003). Farming is the predominant occupation of the rural inhabitants. The main crops in the State are roots, tubers, cereals and tree crops. Cassava is a crop that grows and thrives in almost all the agro-ecological zones of the LGAs in the State (PIND, 2011). It is produced either as a sole crop or intercropped with maize, melon, or vegetables. The State has comparative resource advantage in the production of cassava (ASADEP, 2003): available markets for the sale of products from the crops (ASADEP, 2003).

Sample Selection

A multi-stage sampling technique was used in choosing the samples. Anambra, Aguata and Awka Zones were purposefully selected for the study because they are the major Zones known for crop production in the State (ASADEP, 2003). From the selected zones, one block was randomly selected from each of the Zones. Two circles were selected from each of the block. Furthermore, one village was randomly selected from each of the circle and finally 20 respondents (that is 10 male and 10 female) were randomly selected from each of the village. Hence, a total of 120 cassava farmers were selected for the study.

Data Collection

Preliminary visits were carried out to Anambra agricultural Zone and study locations before the commencement of the actual data collection. The visit was an aid for the familiarization of the researchers with the study locations, village heads, resident agricultural extension agents, key informants and field guides. Data were collected using structured questionnaire and interview schedule. A rapid appraisal of questionnaire was undertaken by the extension agents and other enumerators. Four enumerators and one extension agent were used for the data collection. The questionnaire and interview schedule were pre-tested in Aguleri (because it is closer to the Zonal office) to standardize them and to give the enumerators and extension agent adequate orientation. Data collection covered the socio-economic characteristics of the farmers, labour, farm size, herbicides quantities, capital, production technologies, fertilizer quantities and input costs.

Data Analysis

Descriptive statistics such as mean, frequency, and percentages was used to estimate the socio-economic characteristics of the respondents while additive multiplicative dummy variable approach suggested by Gujarati (1970) and Maddala (1988), which has been used widely by researchers (Onyenweaku, 1994; Nwaru, 2003; Iheke, 2006; Nwaru and Iheke, 2010;) was used to estimate and compare the technical efficiency of male and female cassava farmers. The model was specified following Onyenweaku, (1994) and Nwaru and Iheke, (2010) thus;

$\ln Y = \ln Ao + \beta oD + A_1 \ln X_1 + \beta_1 D \ln X_1 + A_2 \ln X_2 + \beta_2 D \ln X_2 + A_3 \ln X_3 + \beta_3 D \ln X_3 + A_4 \ln X_4 + \beta_4 D \ln X_4 + A_5 \ln X_5 + \beta_5 D \ln X_5 + ei$

Y i= the value of cassava output in tone (t);

In = the natural Logarithm,

Ao = the intercept or constant term;

Bo = the coefficient of the intercept shift dummy or neutral technical efficiency parameter

D = the dummy variable which takes the value of unity for adopters and zero for non-adopters;

X_1 = size of farmland (ha);

X_2 = labour in man-days (mds);

X_3 = quantity of herbicide in litre (L);

X_4 = quantity of fertilizer in kilogramme (kg);

X_5 = capital assets (depreciation charges on farm machinery, interest on loan and rent on land) (N)

X_1D, X_2D, X_3D, X_4D, X_5D, = slope shift dummies for X variables.

A_1, A_2, A_3, A_4, and A_5 = coefficients of the X_1, X_2, X_3, X_4 and X_5 variables respectively

ei = stochastic error term assumed to satisfy all the assumptions of the model.

If the coefficient of the dummy variable, D (in the additive form) is significant, it indicates a difference in the technical efficiency of the farmer groups. If it is positive, this implies that the production function for the farmers group denoted as unity has larger intercept term denoting a higher level of technical efficiency than the group denoted as zero and vice versa. If Bo = 0 and all Bi (i = 1, 2, 3, 4, and 5) = 0, then the two farmer groups are represented by the same production function. If Bi = 0 but $B0 \neq 0$, the two groups of farmers face neutral production function. If at least one $Bi \neq 0$, the two groups of farmers are facing factor biased or non-neutral production function (Onyenweaku, 1994).

Results and Discussion

The results in Table1 show the socio-economic characteristics of the respondents. The results revealed that the mean age of male farmers was 49 years while female farmers were 48years. This implies that the farmers were within their active age and therefore they will adopt any technology or intervention that would gear towards improving their cassava production system. This is because new technology in agriculture requires physically able men and women and the finding is consistent with that of Rathmen, *et al.*, (2002). Table 1 also shows that 38.33% of male farmers attained primary school education while 43.33% of female farmers attained secondary school education. The implication is that female farmers are more literate than their male counterparts and therefore would be better-off to cope with cassava production technologies introduced to them than the male. Education predisposes farmers to be innovative and puts them in a better position to cope with the challenges of the adoption of new technologies introduced to them (Adewuyi, *et al*., 2013). Furthermore, the findings revealed that male farmers had mean farming experience of 20 years while female farmers had 23 years. This implies that female farmers had more cassava farming experience than their male counterparts in the area and therefore would tend to adopt innovations in cassava than men. The mean farm size for male farmers was 1.8ha while female farmers had 1.2ha. The results showed that arable land was more available to male farmers than their female counterparts. This could be that male farmers had more access to farm land than female farmers due to gender steorotypes regarding land and access by women. This is in consistent with FAO, (2010) which reported that globally women scarcely own land due to norms and custom. The result is also an indication that farmers in South-east of Nigeria were mainly small scale farmers who perhaps engage on subsistence farming method. This agrees with Onyebinama, (2004) who noted that farmers with less than 5 ha of farm land are small holder farmers.

Table1: Distribution of respondents according to socio-economic characteristics

Variable	Male		Female	
Age (Years)	Frequency	Percentage	Frequency	Percentage
18-35	9	15.00	6	10.00
36-53	28	46.67	30	50.00
54-71	23	38.33	18	30.00
72-89	0	0	6	10.00
Mean	49		48	
Educational Status				
Primary School	23	38.33	20	33.33
Secondary School	22	36.67	26	43.33
Tertiary	10	16.67	8	13.33
None	5	8.33	6	10.00
Farming Exp (yrs)				
1-10	15	25.00	7	11.67
11-20	28	46.67	20	33.33
21-30	12	20.00	18	30.00
31-40	4	6.00	14	23.33
41-50	1	1.67	1	1.67
Mean	20		23	
Farm Size (ha)				
0.1-2.0	42	70.00	55	91.67
2.1-4.0	15	25.00	5	8.30
4.1-5.0	3	5.00	0	0
Mean	1.8		1.2	

Source: Field survey, 2015

Technical Efficiency of Male and Female Cassava Farmers

Table 2 shows the relative technical efficiency of male and female adopters and non-adopters of improved cassava production technologies. Coefficient of determination (R^2) was 0.7861 implying that 78.61% of the variation in output of cassava produced by male farmers was accounted for by the independent variables. The F-ratio was significant at 1%, indicating an overall significance level of the estimation. This means that the data fitted the model and the independent variables are important explanatory factors of the variation in cassava adoption.

Table 2: Estimated Production Function for Male and Female Cassava Farmers

		Male		Female	
Variable	**Parameter**	**Co-efficient**	**t-value**	**Co- efficient**	**t-Value**
Intercept	a_0	-3.2574	-2.1882*	1.2075	0.3622
Farm size	a_1	0.1526	1.6605*	0.4599	2.5969**
Labour	a_2	-0.1769	-0.5133	-0.4184	-0.7248
Quantity of Herbicide	a_3	0.3037	2.4472**	0.1311	0.8338
Quantity of Fertilizer	a_4	-0.0196	-0.1310	0.3982	3.4717***
Capital	a_5	0.5729	4.5468***	0.3113	2.6359**
Intercept dummy(D)	b_0	-0.0827	-0.0323	-4.5326	-0.8477
Farm size (D)	b_1	0.0883	6.3071***	-0.5709	-2.3123**
Labour (D)	b_2	0.1622	0.2719	0.5516	0.5365
Herbicide(D)	b_3	0.0449	2.9933**	0.0255	0.1182
Fertilizer (D)	b_4	0.004	0.0191	0.1713	0.5469
Capital (D)	b_5	-0.0165	-0.0903	0.1642	0.7515

Source: 2015 Field Survey

Note: * = 10% level of significant, ** = 5% level of significant, and * = 1% level of significant**

The results show that farmland, herbicide and capital were positive and significant at 10%, 5% and 1% respectively. The implication is that the increase in farmland, herbicide quantity and capital input would result to increase in technical efficiency of male adopters of improved cassava

production technologies. This agrees with the finding of (Adewuyi, *et al*., 2013) who reported that an increase in farm size and agrochemicals increases the technical efficiency of cassava farmers in Ogun State. The intercept dummy was negative and statistically not significant implying that there is no difference in technical efficiency between the male adopters and non-adopters of improved cassava production technologies. This agrees with Nwaru and Iheke, (2010). The slope dummies for farmland, and herbicides were positive and statistically significant at 1%, and 5% respectively. The implication is that there is difference in the slope shift coefficients of these resources. This implies that the adopters and non-adopters are characterized by non neutral production function. That is adopters had higher level use intensity for these resources than the non-adopters. This agrees with the findings of Nwaru and Iheke, (2010).

The results for the female farmers show that the co-efficient of determination was 0.6803 indicating that 68.03% of variation in output of cassava produced by female cassava farmers was accounted for by independent variables. The F-ratio was significant at 1%, indicating an overall significance level of the estimation. The results show that farmland, fertilizer and capital were positive and significant at 5% level each. The implication is that, the increase in these resources (farmland, fertilizer and capital) would result to an increase in technical efficiency of female adopters of improved cassava production technologies and it agrees with the result of Adewuyi, *et al*., (2013). The intercept dummy was not significant, implying that no technology shift existed between the female adopters and non-adopters of improved cassava production technologies. The slope dummy for farmland was negative and significant at 5% indicating a lower level of use intensity for this resource by female adopters. This is an indication that women have no control over land for agriculture. This is in consistent with FAO, (2010) which noted that globally women scarcely own land due to norms and custom.

Conclusion

The gender and technical efficiency of adopters and non-adopters of improved cassava production technologies was designed to compare the technical efficiency of male and female improved cassava production technology adopters and non-adopters. The result of technical efficiency of male adopters and non-adopters of improved cassava production technologies shows that farmland, herbicide quantity, and capital were positive and significant at 10%, 5% and 1% respectively while the slope dummies for farmland and herbicides quantity were positive and significant at 1% level each. On the other hands, the female results indicated that farmland and capital were positive and significant at 5% level each while fertilizer quantity was positive and significant at 1% level. The slope dummy for farmland was negative and significant at 5% level. The result is an indication that male adopters were more technicaly efficient than their female counterparts. The results therefore call for policies aimed at equitable distribution of farm inputs between male and female farmers. The land reform act 1978 should be re-enacted to give women access to land for farming. There should be need for good farm road (feeder road) network system for movement of farm produce from farm to market.

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