African Journal of Rural Development, Vol. 2(2): April- June 2017: pp.225-233 ISSN 2415-2838

Assessment of profitability and efficiency of cassava production among government and non-government assisted farmers association in Osun State, Nigeria

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ABSTRACT
This study compared profitability and efficiency of cassava production among government and non-government assisted farmers association in Osun State, Nigeria. Data were collected using a multistage sampling procedure and analyzed with the aid of descriptive statistics, stochastic frontier and budgetary analyses. The results showed that members of government-assisted farmers' associations had better access (100%) to credit (e.g. production credit) compared to their counterparts (35.8%) who were not members of government-assisted farmers' associations. Average yield (2,370.15 kg/ha) and farm revenue (₦514, 600.00) were higher among cassava farmers that were members of government-assisted farmers' associations and significantly different from those that were non-members. Results further revealed that members of government-assisted farmers' association were more efficient (72.4%) than farmers that were non-members in the associations in the study area. Socioeconomic factors such as age of the farmers, access to extension service and membership in government-assisted farmers' associations were the major factors determining farm level efficiency among the cassava farmers. On average, the profitability ratio (Return on Investment-ROI) for members of government-assisted farmers' association was ₦2.32 per naira invested and ₦1.16 per naira invested for farmers who were not members. The study concluded that cassava farmers that belonged to government-assisted association were more efficient and were making more profit than their counterparts who did not belong to government-assisted associations. Therefore, it is recommended that government should take steps to ensure that these advantages are extended to all farmers in order to significantly increase cassava production, agricultural GDP, food security and equity.

Key words: Cassava production, Government-Assisted Farmers' Associations, smallholder farmers, Osun State

RÉSUMÉ
Cette étude a comparé la rentabilité et l'efficacité de la production de manioc par les associations gouvernementales et non gouvernementales d'agriculteurs au Nigeria. Les données ont été collectées en utilisant une procédure d'échantillonnage multi-étapes et ensuite analysées. Les résultats ont montré que les membres des associations d'agriculteurs assistés par le gouvernement avaient un meilleur accès (100%) au crédit (par exemple, le crédit de production) par rapport à leurs homologues (35,8%) qui n'étaient pas membres d'associations d'agriculteurs assistés. Le rendement moyen (2,370,15 kg / ha) et les revenus agricoles (₦ 514, 600,00) étaient plus élevés chez les agriculteurs membres des associations assistés par le gouvernement et étaient significativement différents de ceux de l'autre groupe. Les résultats ont également révélé que les membres d'association des agriculteurs assistés par le gouvernement étaient plus efficaces (72,4%). Les facteurs socioéconomiques tels que l'âge, l'accès au service de vulgarisation et l'adhésion aux associations d'agriculteurs assistés par le gouvernement ont été les principaux déterminants de le niveau d'efficacité agricole. En moyenne, le ratio de rentabilité (retour sur investissement) pour les membres de l'association des agriculteurs assistés par le gouvernement était de 2,32 par naira investi et de 1,16 pour le second groupe. L'étude a conclu que les agriculteurs appartenant à une association assistée par le gouvernement étaient plus efficaces et gagnaient plus que leurs homologues des associations non-assistées. Par conséquent, il est recommandé que le gouvernement prenne des mesures pour que ces avantages soient étendus à tous les agriculteurs afin d'augmenter de manière significative la production de manioc, le PIB agricole, la sécurité alimentaire et l'équité.

Mots-clés: Production de manioc, associations d'agriculteurs assistées par le gouvernement, petits agriculteurs et État d'Osun

Received: 27 May 2016
Accepted: 16 February 2017
Published: 30 June 2017

INTRODUCTION

Nigeria has consistently maintained its position as the world's largest producer of cassava, accounting for 18% and 35% of the total cassava output in the world and in Africa, respectively. The global production trend put the country's annual production figure at about 38 million tonnes in 2010 (FAOSTAT, 2013). Cassava ranks highly as a major staple food crop particularly for the low income earners and resource poor farmers in the developing economies of Sub- Saharan Africa particularly in Nigeria, serving as the major daily calorie intake for over 50 million people in the country (Ehilebo and Okon, 2009). The growing interest by many people in cassava related activities will likely contribute significantly to the economic outcomes and livelihood of both men and women (Adebayo, 2010). With low cost of production and improved varieties, cassava has a high potential to reduce poverty among the smallholder farm households in Nigeria but also to contribute immensely to the country's Gross Domestic Product (GDP) (Osun *et al.,* 2014). Of great importance also is the internal demand for cassava, and the government directive on the use of cassava flour has raised the demand for cassava products in Nigeria. The continuous high demand for cassava could guarantee price stability and improved household income among smallholder cassava farmers (Cassava Action Plan, 2012).

Despite the potential of cassava in addressing the increasing food demand of the growing population in Nigeria as well as its diverse uses, studies (IITA, 2011; Ogunleye *et al.,* 2014) have shown that the yield from and profit accruing to cassava farming among the smallholder farmers in Nigeria remained abysmally low. One of the major constraints to increased productivity and profitability among smallholder cassava farmers is the absence of appropriate policies, programmes and local institutions that could help to mobilize production resources, induce and encourage the adoption of improved technologies, and guarantee secured markets for their products (ICA, 2010; NSSP, 2011). Smallholder farmers are characterized by low income and low resource utilization thereby finding it difficult to pull their resources together in order to increase cassava productivity and generate more income (Bastelaer, 2000).

However, studies (Durlauf and Fafchamps, 2005; Hayami, 2009; Ishise and Sawada, 2009; Imandoust, 2011) have argued that access to productive resources can be facilitated through social networks and collective actions. Consequently, membership of farmers' associations and networks could present a strong and viable economic alternative because it could offer an efficient machinery for the smallholder famers through the provision of capital asset (Paal and Wiseman, 2011). Farmers' associations and networks create social capital which has been defined as networks of social relations and norms which govern interactions among individuals, households and communities, and provide access to productive resources (Coleman, 1988). This network is often structured through the creation of associations and group networks which could help members pull resources together in other to enjoy economies of scale, access volume discount, source inputs in appropriate packaging for their clients and extending trade in microcredit to their members. These interactions have measurable benefits to the participating individual farmers, and could lead, directly or indirectly, to a higher level of productivity (Adepoju *et al.,* 2012; Awerije, 2014).

According to International Cooperative Alliance (ICA, 2010), farmers' associations and group networks could improve the rural income by increasing agricultural productivity, improving the management of common resources, making rural trading more profitable, and energizing farmer federations and associations. It could also lead to increased access to inputs such as fertilizers, seeds, agrochemicals, farm equipment, among others (Coulter *et al.,* 2000; Davis, 2008) as with case of cassava farmers in Osun State where the state government assisted the farmers' associations through the lunching of 'Osun Rural Enterprise and Agricultural Programme (O-REAP) in 2011. The State government in its bid to achieve some of the development objectives using agriculture as a driver, established the O-REAP programme to help participating farmers mobilize production resources. This programme provided input resources (such as improved varieties, fertilizer supply, finance, among others), infrastructural development (resuscitation of farm settlement facilities) and training for participating farmers (IITA, 2015). The purpose of this initiative was to induce and encourage cassava farmers to adopt improved technologies, and increase cassava

productivity by organizing the farmers into different farmers' associations (OSUN, 2016). The assumption was that participation in the programme could help to improve cassava productivity and increase farm income in a number of ways. These include: raising the general price level for products marketed through the association or lowering the price level for supplies purchased, reducing per-unit handling or processing costs by assembling large volumes, among others (Imandoust, 2011).

A study by (Lawal *et al.,* 2009) showed that the level of social capital was low in many parts of Nigeria as a result of lack of cooperative spirit and/or inadequate resources for the existing farmers' association to fully optimize its potentials especially among the smallholder farmers who dominate the rural population. These constraints were attributed to complexities which included the socioeconomic (such as age of farmers, education status, size of farms, household size, etc) and institutional factors (government interventions, Non-governmental Organizations (NGOs), among others (NSSP, 2011).

An important empirical question is whether government initiative to support farmers' associations actually influenced the productivity and profitability of cassava production in the study area. Although governments (in many Sub-Saharan African countries) have committed themselves to spending up to 10% of their budget on agriculture under the Comprehensive African Agricultural Development Program (CAADP) agreement (Action aid, 2014), the situation in Nigeria revealed that less than 2% of the annual budget had been committed to agriculture in the last decade (FRN, 2015). Literature and empirical evidence concerning the roles of governments on farmers' associations and the corresponding effects on farmers' productivity and profitability among smallholder farmers in Osun State, Nigeria are limited (Adebiyi *et al.,* 2013; Akinbamowo, 2013). Therefore, the aim of this study was to compare the farm level productivity and profitability among farmers belonging to farmers associations with government interventions and those that were not supported by the government. The study hypothesized that membership of government-assisted farmers' association impacted positively on productivity and profitability of smallholder cassava farmers in the study area.

METHODOLOGY

Multistage sampling procedure was employed. The first stage involves purposive selection of Osun State in the southwestern Nigeria. The second stage involved the stratification of the Local Government Areas (LGAs) in the State into two based on O-REAP participation: participating LGAs and non-participating LGAs. The third stage involved the selection of one LGA from each stratum- (Ayedaade LGA) within the OREAP participating LGAs and the other (Irewole LGA) from non-participating LGAs. The two LGAs were carefully selected with maximum distance to avoid diffusion and spillover effects. At the fourth stage, a probability proportionate sampling selection of farmers' associations in each LGA (depending on their numbers) was carried out. Hence, the number of farmers' association that was chosen was a function of the number of farmers' associations available in each LGA. The proportionality factor used in the selection of farmers' association was defined as:

$$Xi = n/N*10 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Xi = number of farmers' associations to be sampled from a LGA, n = number of farmers' associations in the particular LGA, N = sum total number of farmers' associations in the two LGAs. In all, 100 farmers were selected and interviewed for this study. The survey questionnaire captured information on the socioeconomic characteristics of the respondents, such as age, gender, household size, education, extension contact, credit access, land tenure, distance to nearest market and farming experience. It also solicited information on technical factors such as labour, seed, fertilizer, pesticides and farm size. Information on cassava output was captured using the survey questionnaire

The Stochastic Frontier. The production frontier has undergone a substantial development in recent years. The earliest works on production frontiers, developed by Farrell (1957), Farrell and Fieldhouse (1962) and Afriat (1972), assumed these to be deterministic (Schmidt and Lovell, 1978). Deterministic frontiers attribute all deviations from the frontiers to inefficiency. Aigner and Chu (1968) and Seitz (1971) argued that the parameters of deterministic frontiers were estimated with a mathematical programming technique (which is non-statistical). Seitz (1971) also indicated that the one-sided disturbance term of the deterministic

frontier explicitly assumes some particular form that violates the regularity of conditions for the application of maximum likelihood. Therefore, the estimation of deterministic frontiers is not completely straightforward. This issue motivated Timmer (1971) to develop a probabilistic frontier.

However, since a probabilistic frontier is a deterministic frontier computed from a subset of the original sample using a mathematical programming technique, it remains non-statistical, which makes hypothesis-testing difficult. Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977) attempted to address the problems associated with deterministic and probabilistic production frontiers by introducing a stochastic production frontier. The stochastic production frontier decomposes the disturbance term into measurement error and inefficiency effect. The parameters in the stochastic frontiers are estimated with the maximum likelihood approach. The present study adopted the stochastic frontier approach developed by Aigner (1977) and Meeusen and Van den Broeck (1977). The production frontier of the cassava farms was modeled following a general stochastic frontier model:

$R_i=f(x_{ij};\beta)e^{(\emptyset_i-\eta_i)}, u_i=\emptyset_i-\eta_i$ *and* $i=1,2,3,N;j=1,2,\ldots J$ ……(2)

Where R_i denotes the output of the ith farm, (x_{ij}) represents a vector of inputs, and β is a vector of the unknown parameters to be estimated. Equation (2) is a nonlinear function that is linearised (2) by taking the natural logarithm of both sides and manipulating the relevant terms to give (3), which is a Cobb-Douglas production frontier, i.e.,

$$lnRi=\alpha+\sum_{j=1}^{J}\beta_j\, lnx_{ij}+\emptyset_i-\eta_i, u_i=\emptyset_i-\eta_i \quad \text{.....(3)}$$

Where $\emptyset_i$ is the systematic random error that accounts for measurement error and other factors that are not under the control of the farm household, and η_i denotes the asymmetric non-negative random error component that measures technical inefficiency effects. The systematic random error variable is assumed to be independently and normally distributed with zero mean and variance σ^2 (Coelli, 1995). The non-negative variable, η_i, is assumed to be independently and normally distributed truncations (at zero from below) of the N ($0,\sigma^2$) distributed (Coelli, 1995). Moreover $\emptyset_i$ and η_i are assumed to be independent of each other and also independent of the input x_{ij}. The variance parameters of the model are parameterized as in (4):

$$\sigma^2=\sigma_{\emptyset}^2+\sigma_n^2, \gamma=\frac{\sigma_n^2}{\sigma_{\emptyset}^2} \text{ and } o\le\gamma\le 1 \quad \text{..... (4)}$$

The technical efficiency of a farm, denoted by TE_i, can be estimated as:

$$TE_i=\frac{R_i}{R_i^*}=\frac{f(x_i;\beta)\,e^{(\emptyset_i-n_i)}}{f(x_i;\beta)\,e^{(\emptyset_i)}}=e^{-i} \quad \text{..... (5)}$$

Profitability Analysis Model. We hypothesized that the relationship between profit, revenue and cost was as follows:

GM = TR - TVC……(6)

Where: GM, TR, and TVC are Profit/gross margin, total revenue and total variable costs, respectively.

Budgeting technique. The budgeting technique was used to estimate the costs and returns to cassava production among the smallholder farmers. Information on total cost (TC) (comprising total fixed cost (TFC) and total variable cost (TVC)), and total revenue (TR) (product of quantity of cassava produced (kg) and unit price (₦/kg)) was estimated following the model stated below:

TC = TFC + TVC…… (7)

TR = P x Q …….. (8)

The gross profit (GP) and the gross margin (GM) were computed using equations (9) and (10):

GP = TR – TC……..……(9)

The GM was used to compute profit/gain to each farmer from the difference between the gross income earned (TR) and the total variable cost (TVC) incurred as:

GM = TR – TVC……...……..… (10)

Profitability analysis. The profitability of the cassava enterprise was calculated using Rate of Returns on Investment (ROI) as follows:

ROI = GM / TVC……..... (11)

This was used to determine the profit/GM per naira (Nigerian currency; 1U$ = 349.99 at the time of the study) invested in cassava farming.

RESULTS AND DISCUSSION

Socioeconomic characteristics of cassava farmers. The socioeconomic characteristics of the cassava farmers listed in Table 1 showed that average age of cassava farmers that were members of government-assisted farmers' associations and cassava farmers that were not

members were 47.5 and 44.4 years, respectively. This implied that average cassava farmers in the study area were neither too young nor too old but were in their active working age. The average years of schooling were 5.23 and 5.75 for members of government-assisted farmers' associations and non-members respectively. Average households in the area contained 7 and 6 members for cassava farmers that were members of government-assisted farmers' associations and non-members respectively. This indicated that average household regardless of whether they were members or non-members of government-assisted farmers' associations, had financial obligation to its members. The result also showed that members of government-assisted farmers' associations had better access to credit (e.g. production credit) compared to their counterpart who were not members of government-assisted farmers' associations because government, as part of the initiative, provided financial assistance to participating farmers. This implied that farmers who were members of government-assisted associations would be able to raise their level of investment in cassava production than others who were not members. The result further showed that on the average cassava farmers that were members of government-assisted farmers' associations had more access to farm land (2.4 ha) compared to those cassava farmers that were non-members (1.5 ha). Per hectare (ha) of average yield, farm revenue and other cost items were higher among cassava farmers that were members of government-assisted farmers' associations and significantly different from those that were non-members.

Farm level efficiency among cassava farmers. The farm level efficiency among the farmers in the study area followed the same trend with observed differences in the socioeconomic characteristics of cassava farmers that were members of government-assisted farmers' associations and cassava farmers that were not. The maximum likelihood estimates (MLEs) of the parametric stochastic frontier analysis (SFA) in Table 2 revealed that among O-REAP member famers, the independent variable (Xs) such as man-days of labour used and farm size were significant at 5%, but the coefficients of man-days of labour used was negative. This implied that farm size cultivated was a significant factor to the efficiency and hence farm productivity of cassava farmers. However, man-days of labour used and cost of chemical (fertilizer and pesticides) were significant to their efficiency level at 5%. In order to identify the factors that were responsible for inefficiencies among the two categories of cassava farmers, we considered the following inefficiency variables; age, farming experience, households' size, years of schooling, access to credit, membership of government-assisted farmers' association, extension contact, off-farm employment, and rent paid on land used. For cassava farmers in government-assisted association, membership and extension contact were significant and their mean technical efficiency value was 0.724. On the other hand, among non-participating farmers, inefficiency factors like age and membership of farmers' associations were significant and their mean technical efficiency value was 0.609. The difference in the mean technical efficiency among the two groups was significant ($p< 0.01$). This implied that farmers that participated in government-assisted association were more efficient (72%) than non-participating farmers (61%).

Profitability of cassava farmers. Costs and returns to cassava production shown in Table 3 indicated that the average total revenue, gross margin and profit realized per hectare of cassava by members of government-assisted association were ₦514,600.00, ₦359,522.33 and ₦358,422.33, respectively. Return on investment (ROI) showed that the amount realized by farmer on every one naira spent on production was ₦2.32. However, the total revenue realized by cassava farmers that were non-members of government-assisted association was ₦219,866.6; the gross margin was ₦118,331.670 while their profit was ₦117,681.17. Their ROI showed that every 1 naira invested returned ₦1.16. This implied that farmers that were members of government-assisted associations, who participated in various trainings and inputs provided through government intervention made more profit than farmers that were not members of such associations in the study area.

Table 1. Socioeconomic characteristics of the cassava famers

Variables	O-OREAP members (N=60)	Non-members(N=40)	T-test
Age (yrs)	43.75 (7.7)	46.94 (11.04)	1.25
Years of Schooling (yrs)	5.23 (2.66)	5.75 (3.02)	1.50
Household Size (#)	7.00 (2.3)	6.60 (2.78)	2.45**
Farming experience (yrs)	23.5 (9.17)	18.0 (11.07)	0.16
Farm size (ha)	2.4 (0.06)	1.5 (0.02)	3.98**
Married (%)	100	77.5	
Male (%)	88.3	77.5	
Access to credit (% Yes)	100	35.8	
Yield (kg/ha)	2370.15 (285.67)	1641.84 (142.22)	601.34**
Farm Revenue (₦/ha)	514600 (35890)	219867(1010.7)	16.86**

Note: () figures in parentheses are standard deviations, ** indicates significant at 1%.

Table 2.Efficiency of cassava farmers-Stochastic frontier production function

Variables	Parameters	O-REAP Member (N=60) Coefficient	Non-members(N=40) Coefficient	T-Value
Constant	β0	0.1296 (0.117)*	0.1182 (0.115)*	
lnX1	β1	-0.2814 (0.209)	0.693 (0.211)	
lnX2	β2	-0.1895 (0.229)*	-0.920 (0.266)*	
lnX3	β3	0.6980(0.570)*	0.607 (0.206)	
Inefficiency function				
Intercept	α 0	14.797 (-1.138)	0.208 (0.194)	
Age	α 1	0.746 (0.343)*	-0.108(0.157)	
Household size	α 2	0.162(0.238)	0.243 (0.144)	
Farming experience	α 3	-0.568 (0.193)	0.313 (0.053)	
Years of education	α 4	0.280 (0.065)	0.169 (0.039)	
Access to credit	α 5	-0.0126 (0.096)	-0.0079 (0.059)	
Government-assisted' association	α 6	-1.884 (0.932)*	0.00033 (0.062)	
Extension contact	α 7	0.916 (0.730)*	-0.4-E6 (0.15-E6)*	
Off-farm employment	α 8	0.3-E4 (0.2-E4)	0.0001 (-0.0001)	
Land Rent	α 9	-1.512 (2.012)	0.89-E6 (0.15-E5)	
Diagnosis statistics				
Sigma-square		0.820 (0.108)*	0.355 (0.185)	
Gamma		0.954 (0.634)*	0.999 (0.516)	
Average Technical Efficiency		0.724 (0.0056)	0. 609 (0.0015)	10.05**

Note: figures in parentheses are standard error, *, and ** indicate significant at 5%, and 1%

Table 3: Profitability of cassava farmers (per ha)

Variables	O-REAP Members (N=60) Coefficient	Non-members (N=40) Coefficient	T-test
Total revenue	514600.00(35890.94)	219866.67(14580.23)	5.88**
Variable cost			
Cost of planting	4379(680.00)	2667.5(1010.70)	
Cost of chemical	29670(6423.8)	22510(11109)	
Labour cost	117493(8711)	73142(9190)	
Cost of fertilizer	3528(1396)	910(544)	
Total Variable cost	155077.67(13121)	101535(16315)	2.55**
Gross Margin	359522.33	118331.67	
Fixed cost			
Land rent	933.3(447.12)	650.5(445.1)	
Cost machineries	166.7(136.9)	0.000(0.000)	
Total fixed cost	1100	650.5	
Total cost	156177.67	102185.00	
Net income	358429.33	117681.17	3.58**
ROI	2.32	1.16	3.08**

Note: figures in parentheses are standard error. ** indicates significant at 1%.

CONCLUSION AND RECOMMENDATION

The study analyzed the effects of government-assisted farmers' associations on profitability and efficiency of cassava production among smallholder farmers in Osun State, Nigeria. Findings from the study revealed that, on the average, cassava farmers belonging to government-assisted associations cultivated more cassava farm (in terms of farm size dedicated to cassava production), had better yield and increased income compared to other farmers. The study concluded that cassava members that belonged to government-assisted farmers' associations were more efficient and were making more profit than their counterpart who did not belong to government-assisted associations. The farm level efficiency also revealed that farmers in the study area could still improve on their level of productivity. Socioeconomic characteristics such as age of the farmers, access to extension service and membership of government-assisted farmers' associations were the major factor determining farm level efficiency among the cassava farmers in the study area. Following the findings of this study, we recommended that government at all level should take steps to ensure that these advantages (e.g. access to production credit, subsidized farm inputs, among others) are extended to all farmers in order to significantly increase cassava production, agricultural GDP, food security and equity. As a follow up on this study, future research work may want to explore the impact of subsidy and guaranteed markets on the productivity and profitability of cassava production in the study area.

STATEMENT OF NO CONFLICT OF INTEREST

We the authors of this paper hereby declare that there are no competing interests in this publication.

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