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Relative profit efficiency of Anchor Borrowers Programme (ABP) beneficiary and non-beneficiary rice farmers in Kebbi State, Nigeria

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Profit efficiency refers to the extent at which a firm makes not only profit but its ability to maximize profit. A comparative analysis was conducted to evaluate the profit efficiency of Anchor Borrowers Programme (ABP) beneficiary and non-beneficiary rice farmers in Kebbi State, Nigeria. Multistage sampling technique was used to select 499 ABP beneficiary and non-beneficiary rice farmers each giving a sample size of 998. A well-structured questionnaires were administered in order to collect data. Data collected were analyzed using Stochastic Frontier Profit Function Model. The results revealed that farm efficiency index varied from one farmer to another and ranged from 0.44 to 0.99, with a mean of 0.94 for the beneficiary farmers, while for non-beneficiary farmers, the maximum efficiency was 0.90 with 0.11 minimum efficiency and a mean of 0.74 The results revealed that the two categories of farmers were not efficient in maximizing profit, however, ABP beneficiary rice farmers were more profit efficient than the non-beneficiary rice farmers. This suggests that ABP has improved the profit efficiency of the beneficiary rice farmers. It is recommended that since ABP enhances the profit efficiency of the beneficiary rice farmers, policies should be tailored towards inclusion of other farmers to benefit from ABP intervention in Nigeria.

Key words: Profit efficiency, Anchor Borrowers Programme (ABP), beneficiary rice farmers.

INTRODUCTION

Rice is a staple food for about 2.6 billion people in the world. It is the most important staple food for a large number of the world human population. It is the second highest worldwide production after maize (FAOSTAT, 2017). Consequent upon maize crops been grown for the purposes other than human consumption; rice is said to be the most important grain with regard to human nutrition and calorie intake (Usman, 2011). Rice provides more than one fifth of the calorie consumed worldwide by human species, though relatively lower in protein compared to other cereals, it contains a better balance of amino acids (Oyewole and Ebukiba, 2010).

Nigeria is the leading consumer and largest producer of rice in Africa and simultaneously one of the largest rice

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importers in the world. Rice being an important food security crop, is an essential cash crop generating more income for Nigerian farmers than any other cash crop in the country. In 2008, Nigeria produced approximately 2 million metric tonnes of milled rice and imported roughly 3 million metric tonnes, including the estimated 800,000 metric tonnes that is suspected to enter the country illegally on an annual basis (NBS, 2007). According to Usman (2011), over the past several decades rice has established itself as a preferred staple food in Nigeria. For the purpose of ceremonial occasions, rice has grown in importance as a component of Nigerian diets. An average Nigerian consumes about 24.8 kg of rice per year, representing 9% of the total calories intake (FAO, 2001). The increased consumption of rice has led to its demand far exceeding supply except policy measures are put in place to improve production.

The program thrust of the ABP is provision of farm inputs in kind and cash (for farm labour) to small holder farmers (SHF) to boost production of these commodities, stabilize inputs supply to agro processors and address the country's negative balance of payments on food. At harvest, the SHF supplies his/her produce to the agro-processor (Anchor) who pays the cash equivalent to the farmer's account. The programme evolved from consultations with stakeholders comprising Federal Ministry of Agriculture and Rural Development, State Governors, millers of agricultural produce, and smallholder farmers to boost agricultural production and non-oil exports in the face of unpredictable crude oil prices and its resultant effect on the revenue profile of Nigeria (Central Bank of Nigeria (CBN), 2016). In order to boost agricultural output, provide food security and reduce importation of Agricultural commodities particularly those Nigeria has a comparative advantage to produce, the CBN established the ABP. The Programme which is intended to create a linkage between anchor companies involved in processing and the SHFs of the required major agricultural commodities.

For many years, Nigeria has been grappling with food insecurity and its attendant consequences leading to hunger, massive importation, and social disorders among others. In order to overcome the challenges posed by food insecurity so many agricultural programs were introduced with the sole aim of boosting food production, and stemming the tide of food insecurity and also leverage on Agricultural financing which is a key challenge in Agriculture, led to the setting up of ABP in order to boost the production of certain Agricultural commodities such as Rice, Maize, Sugarcane, Wheat among others.

Despite the prospects that greeted the launch of the ABP, with the hope that the program targets to alleviate poverty, increase income by enhancing the profit of the beneficiary farmers, an empirical study of the profit efficiency of the beneficiary farmers has not been documented in Kebbi State, Nigeria. This study hopes to provide information that would be useful to policy makers by serving as a guide on the success or otherwise of the ABP. It is against this backdrop that this study hopes to investigate the following questions.

Whether ABP beneficiary rice farmers maximize their profit?
What are the determinants of profit efficiency among ABP beneficiary rice farmers?

Conceptual framework

The conceptual framework for the study is based on the concept of technical efficiency of resource utilization and the concept of production by Coelli et al. (1998). Production is the transformation of a given set of inputs to produce output. In the light of rice production, farmers are required to combine certain measure of inputs such as rice, seed, land, labour, fertilizer agrochemicals and capital in order to produce paddy rice in which they sell so as to make profit. Given that for paddy rice to be produced that the farmers can be viewed have maximized profit, it requires that the resources be combined or appropriated in a definite proportion. Technical efficiency is the ability of the farmer to produce a given level of output using least amount of physical inputs. It signifiers a peak level of performance that uses the least amount of inputs to achieve higher amount of output, optimality is therefore required in deciding the level of inputs that are to be mixed.

Figure 1 depicts the concept of possible production set that is the set of all resources (inputs)-output combination that are feasible. If the obtained outlet lies along the frontier (the points from OF) the farm is technically efficient indicating the efficient subset of feasible production set. But if it lies below the frontier (point A), it means that it is technically inefficient because it could increase output towards the level associated with point B. without increasing input. Whereas points B and C represents efficient points.

The socioeconomic and institutional variables are expected to influence a farmer's profit efficiency. These factors includes marital status, age, educational level, household size, farming experience, cooperativeness seed variety, planting technology, income level among others.

Consequent upon the design of ABP targeted to provide incentives both in cash and in kind to the beneficiary rice farmers, the intervention from ABP was anticipated to influence the profitability and profit efficiency of the beneficiary rice farmers.

In the context of frontier literature, DD in Figure 2 represents profit frontier of farms in the industry (the best practice firm in the industry with the given technology. EE is the average response function (profit function) that does not take into account the farm specific inefficiencies. All farms that fall below DD are not attaining optimal profit given the prevailing input and output prices in the product

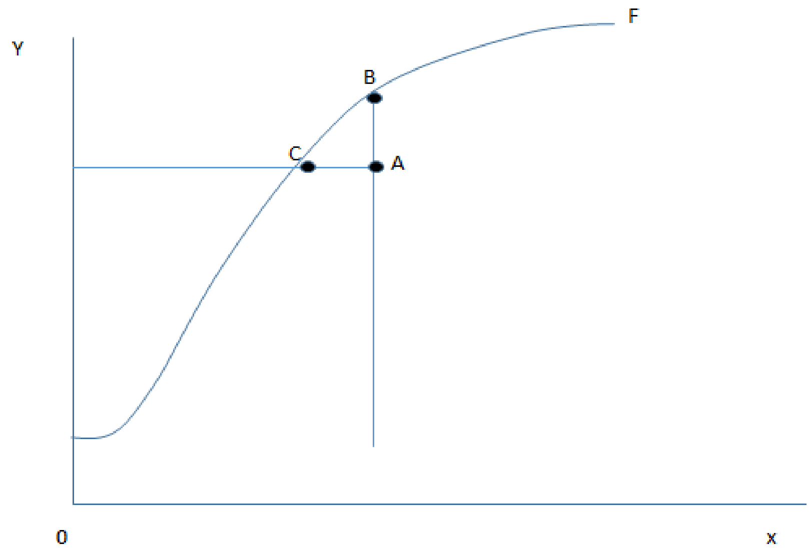

Figure 1. Production frontiers and technical efficiency.
Source: Coelli et al. (1998).

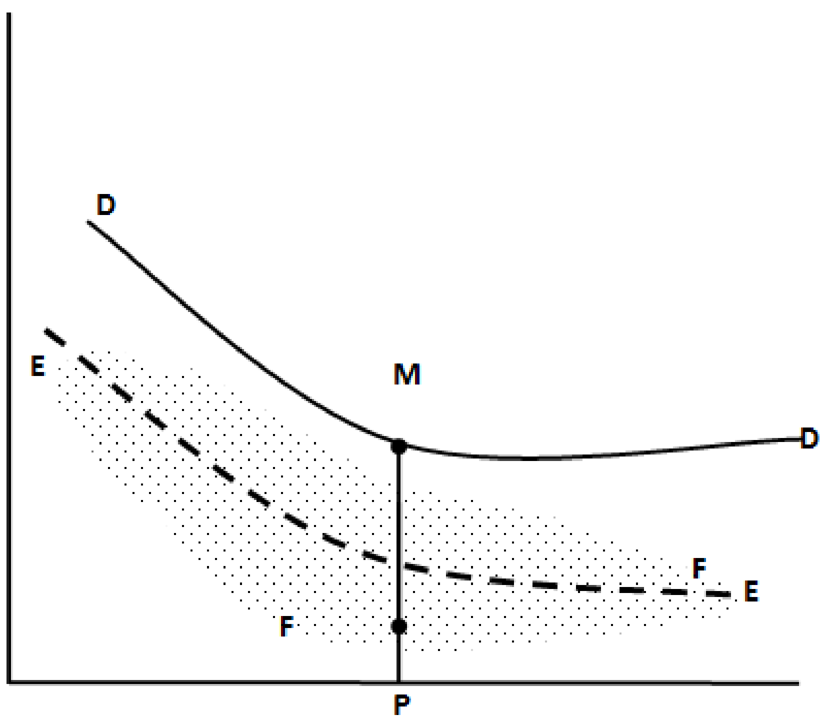

Figure 2. Frontier MLE Stochastic Profit Functions. Normalized input price given fixed price given fixed resources P_1/Zj.
Source: Ali and Flinn (1989).

and the input markets. They are producing at allocatively inefficient point F in relation to M in Figure 2. Profit inefficiency is defined as profit loss of not operating on the frontier. In Figure 1, a firm operating at F, is not efficient and its profit inefficiency is measured as FP/MP (Ali and Flinn, 1989; Sadoulet and De Janvry, 1995).

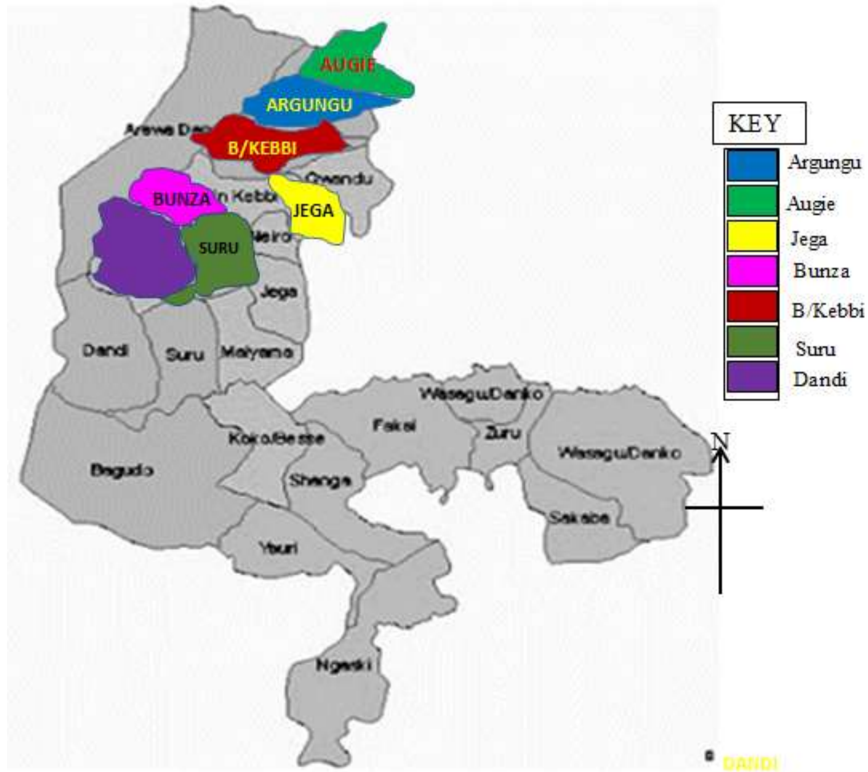

Figure 3. Map of Kebbi State showing the study area (Local Government Areas).

MATERIALS AND METHODS

Study area

The study was carried out in Kebbi State (Figure 3). The choice of Kebbi State was because that is where the ABP was first launched in Nigeria. The State is in north-western Nigeria, occupying a land area of about 36,229 km^2 Projecting the population of the State as at 2018 based on 2006 census at the growth rate of 2.38% reveals a total population of about 4.938,006 people. The state lies between latitudes 10° 05[1] and 13° 27[1]N of the equator and between longitudes 3° 35[1] and 6° 03[1]E of the Greenwich. This area is characteristic of Sudan savannah sub-ecological zone with distinct wet and dry seasons. Soils are ferruginous on sandy parent materials evolving from sedentary weathering of sandstones.

Over two-third of the population are engaged in agricultural production, mainly arable crop alongside cash crops with animal husbandry. The main crops cultivated include sorghum, millet, maize, cowpea, sweet potato, rice, vegetables and fruits. Cash crops grown here include soybeans, wheat, ginger, sugarcane, tobacco and gum-arabic.

Sampling procedure and sample size

To achieve the objective of the study, a multistage sampling method was adopted for the study. First, the purposive selection of 7 local government areas (LGA) with the highest concentration of Anchor Borrowers Programme beneficiary farmers in the state. The LGAs are Suru, Brinin-Kebbi, Bunza, Argungu, Augie, Dandi and Jega). Secondly, purposive selection of two villages/communities with the highest number of (ABP) beneficiary farmers from the 7 local government areas giving a total of 14 villages/communities. Thirdly, from each of the 14 villages/communities all together 499 beneficiary and non-beneficiary rice farmers each were proportionately selected randomly thus, giving a sample size of 998 rice farmers for the study (Table 1).

Data collection

Data on the socio-economic characteristics of both ABP beneficiary and non-beneficiary rice farmers, inputs and output such as farm inputs (fertilizer, seed, agrochemicals), labour, rice output and their various costs and the problems involved in accessing ABP intervention among beneficiary in the state were collected.

Stochastic frontier profit function and cost models

The Cobb-Douglas stochastic frontier profit function model was used to examine the profit efficiency and the determinants of profit efficiency for both ABP beneficiary and non-beneficiary rice farmers. The stochastic frontier profit function is the double log (Cobb-Douglass functional form) which is specified explicitly as follows:

$$\ln \pi = \beta_0 + \beta_1 \ln P_1 + \beta_2 \ln P_2 + \beta_3 \ln P_3 + \beta_4 \ln P_4 + \beta_5 \ln P_5 + \beta_6 \ln P_6 + \beta_7 \ln p_{7+} \beta_8 \ln \beta_8 + V_i + U_i \quad (1)$$

where π =normalized profit (₦) defined as gross revenue less variable cost, divided by price of output, P_1= normalized price of seed (₦) computed as total expenditure on seed divided by price of output, P_2= normalized wage of labour (₦) as total expenditure on

Table 1. Sampling frame and the sample size of ABP beneficiary farmers in the state.

Local government area	Sampling frame	Villages/Communities of the beneficiaries	Sample size
ARGUNGU	7,364	Argungu Gulma	74
AUGIE	5,421	Augie Bayawa	54
JEGA	3,020	Jega Basaura	30
BUNZA	8,446	Bunza Raha	84
BIRNIN KEBBI	10,909	Makera Zauro	109
SURU	11,549	Suru Dakin Gari	115
DANDI	3,347	Kamba Dole Kaina	33
Total	50,056		499

Source: Kebbi State Anchor Borrowers Office.

labour divided by price of output, P_3= normalized price of fertilizer (₦) as total expenditure on fertilizer divided by price of output, P_4= normalized price of Agrochemicals (₦) as total expenditure on Agrochemicals divided by price of output, P_5= Depreciation charges on Capital (farm implements) (₦), P_6= normalized price of land (₦) as total expenditure on land divided by price of output, P_7= normalized price of transportation (₦) as total expenditure on transportation divided by price of output, and P_8= normalized price of empty bags (₦) as total expenditure on empty bags divided by price of output

$V_i + U_i =$ Error term.

Inefficiency factors

Inefficiency in production and are often assumed to be independent of V_i such that U_i is the non-negative truncated (at zero).

U_i is defined as:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 + \delta_9 Z_9 + \delta_{10} Z_{10} + \delta_{11} Z_{11}$$

where U_i = Profit Inefficiency, Z_1 =Age (years), Z_2 = Gender (1 for male, 0 for otherwise), Z_3 = Marital status (1 for married, 0 for otherwise), Z_4= Educational level (years), Z_5 = Experience in rice farming (Years), Z_6 = House hold size (Number of members living in the family), Z_7= Membership of association (1 for yes, 0 for otherwise), Z_8= Amount of Credit accessed (Naira), Z_9= Planting technology (1 for broadcasting, 0 for otherwise), Z_{10}= Seed varieties (1 for improved, 0 for otherwise), Z_{11}= Extension contact (1 for contact with extension, 0 for otherwise), and $\delta_0 - \delta_{11}$ = Parameters estimated.

RESULTS AND DISCUSSION

Summary statistics

Results in Table 2 revealed the mean value of total revenue for beneficiary rice farmers as ₦296, 020.00 and ₦200, 763, 30 for non-beneficiary rice farmers per hectare. Comparing this value with the total cost of production (₦ 145,192.38 and ₦138, 468.93 for ABP beneficiary and non-beneficiary rice farmers respectively, shows that production of rice among the two category of farmers was profitable. However, beneficiary farmers realized more profit than the non-beneficiaries as for every ₦1.00 invested ₦2,04 was realized as investment turn over for the beneficiary rice farmers while for every ₦1.00 invested ₦1.45 was realized as investment turn over. This implies that ABP improves the profitability of the beneficiary farmers.

Estimates of the stochastic frontier profit function

Results in Table 3 indicate the sigma squired value of 0.0327 and 0.1469 for ABP beneficiary and non-beneficiary rice farmers respectively, and the variance ratio of 97.9% and 89.9% for the two categories of farmers and are significant at 5% level, respectively. This parameter estimate ascertains the goodness – of - fit and

Table 2. Summary statistics for ABP beneficiary and non-beneficiary rice farmers.

Variable (₦)	Mean ABP beneficiary (₦)	Mean non-beneficiary (₦)
Total Revenue	296,020.00	200,763.30
Total Variable Cost	134,204.60	125, 049.49
Total Fixed Cost	10,987.78	13,419.44
Total Cost	145,192.38	138,468.93
Net Farm Income	150,827.62	62,294.37
Rate of return on investment	2.04	1.45

Table 3. Maximum likelihood estimates of the stochastic frontier profit function.

Variable	Beneficiary			Non-beneficiary		
	Coefficient	Standard error	t-ratio	Coefficient	Standard error	t-ratio
Constant (β_0)	12.08416***	0.0348	346.80	10.5374 ***	0.9988	10.55
Cost of Seed (X_1)	-.06129***	0.0037	-6.58	-0.2005	0.0200	-10.05
Cost of labour (X_2)	-.32549***	0.0071	-85.70	-0.8927***	0.1764	-5.06
Cost of fertilizer (X_3)	-.26833***	0.0077	-4.90	-0.0631***	0.0066	-9.60
Cost of agro chemicals (X_4)	-0.12715	0.0075	-7.06	-0.1437**	0.0568	-2.53
Cost of farm tools (X_5)	-.01720***	0.0038	-4.54	-0.0571***	0.0450	-7.27
Farm size(X_6)	-.09239***	0.0023	-7.06	-0.0486	0.0949	-0.51
Transportation cost(X_7)	-.08920***	0.0054	16.61	-0.0214	0.0021	-1.13
Cost of empty bag(X_8)	2.46796***	0.0086	288.35	1.9221***	1.7964	7.07
Diagnostic Statistics						
Sigma squared (σ^2)	0.0327***	0.0015	21.33	1.469	0.1614	9.1***
Gamma (γ)	0.9999***	0.0030	336.7	0.999	0.0027	372***
Log likelihood ratio test	845			133		

***Significant at 1%, **Significant at 5%.

the correctness of the specified distributional assumptions of the composite error term. The variance ratio/gamma(r = 0.979 and 0.899) for the two group of farmers signifies that the unexplained influences by the profit function are the major sources of the random errors indicating also that 97.9% and 89.9% of the variation in rice farming among the two categories of farmers is attributed to profit in inefficiency. This confirms the presence of the one sided error component in the model that makes the average function inadequate in representing the data.

For the ABP beneficiary farmers, the coefficient for seed cost, labour cost, fertilizer cost, Agrochemical cost, and cost of farm tools are negatively significant in determining profit efficiency at 1% level, respectively while transportation cost and cost of empty bags were positively significant at 1% level respectively. The implication of the negative coefficient is that increase in the price of these variables, would lead to a corresponding farmers' profit efficiency to decrease. This implied that increase in the cost of these variables with existing technology will reduce profit efficiency. For the non-beneficiary farmers, seed cost, labour cost, fertilizer cost, Agrochemicals cost and cost of farm tools were negatively significant in determining profit efficiency and cost of farm tools were positively significant at 1% level of probability. The significance of labour input could be due to the fact that it is an important factor of production. Farm production is subsistence and labour intensive. Merem et al. (2017) in their study among beneficiary and non-beneficiaries of developmental programme noted that labour is the second most import factor of production in rice production. The findings of this study are similar to that of Ogundari and Ojo (2005) who stated that labour and herbicides are the most important inputs contributing significantly to output.

Profit efficiency of rice farmers

The results in Table 4 reveal that profit efficiency ranged from 0.44 to 0.96, with a mean value of 0.94 for ABP beneficiary rice farmers while it ranged from 0.11 to 0.93 with a mean value of 0.86 for non-beneficiary rice farmers. Based on the mean efficiency estimate among beneficiary farmers, the average farmer requires 2.08%, that is, (1-(0.94/0.96) × 100) cost savings to attain the

Table 4. Frequency distribution of profit efficiency estimates.

Efficiency	Beneficiary	Non-Beneficiary
0.21-0.30	-	14
0.31-0.40	-	3
0.41-0.50	1	4
0.51-0.60	3	2
0.61-0.70	6	3
0.71-0.80	12	Nil
0.81-0.90	65	271
0.91-1.0	412	202
Total	499	499
Mean	0.94	0.86
Minimum	0.44	0.11
Maximum	0.96	0.93
t-value	10.14***	

Table 5. Determinants of profit efficiency among ABP beneficiary and non-beneficiary rice farmers.

Variable	ABP Beneficiary			Non-beneficiary		
	Coefficient	Standard Error	t-ratio	Coefficient	Standard Error	t-ratio
Constant	1.0604***	0.001368	-5.36	-0.7675***	0.000704	7.09
Gender	-0.0090***	0.000658	-3.68	-0.1393***	0.029388	-4.74
Marital status	0.0385***	0.00030	-7.82	-0.0588***	0.013674	4.30
Age	-0.0097***	0.00038	-6.24	-0.0091***	0.001449	-6.28
Educational level	-0.003***	0.00016	-7.82	0.0334***	0.007749	-4.31
Household size	-0.0049***	6.25005	7.42	-0.0060***	0.007749	-3.10
Farming experience	- 0.0085***	0.0000416	-2.42	-0.0042***	0.001935	-2.61
Cooperative	-0.0357***	0.000045	-8.88	0.0683***	0.001609	-3.27
Seed variety	-0.0091	0.13000	-3.07	-0.0165***	0.020887	-2.49
Planting technology	-0.0048***	0.00023	-2.74	-0.0415***	0.006627	-4.25
Income	-0.0028**	3.03E-05	-9.23	-0.0098***	0.003427	-2.86

***Significant at 1%, **Significant at 5%.

status of the most efficient beneficiary farmer and 7.5%, that is, (1-(0.86/0.99) × 100) to achieve the level of the most efficient non- beneficiary farmer. The least performing beneficiary farmer would need 54.2% cost savings and non-beneficiary farmer would need 88.2% to become the most efficient farmer

The difference in the profit efficiency of the two categories of farmers could be attributed to the ABP support granted to the beneficiaries in terms of seed, chemicals, cash, fertilizer, training etc. system of production, and difference in the quantity of input used by the two groups of farmers which offered them advantage over non-beneficiary rice farmers. Even though the fact that the profit efficiencies of all sampled farmers are less than 1 is an indication that no farmer reached the frontier of production. Thus, opportunity still exists for increasing farmers' productivity through increasing efficiency in the use of existing resources.

The estimated t-value of 10.14 was significant at 1% level indicating that there is significant difference in the profit efficiency of the two categories of farmers. Since the beneficiaries were expected to have more access to farm inputs, credit facilities, and extension advisory services from the ABP which could place them on production advantage over their colleagues who are not benefiting from the program. The result suggests that ABP beneficiaries are more prudent in maximizing profit compared with their counterparts.

Determinants of profit efficiency among ABP beneficiary and non-beneficiary rice farmers

The result in Table 5 for the beneficiary farmers indicates that the coefficients of gender, marital status, age, educational level, household size farming experience cooperativeness, seed variety planting technology and income are negative and statistically significant at 1% level of probability respectively. This tally with the apriori expectation. In a one- step stochastic frontier estimation, the parameter for a negative sign of a variable in the Z – vector implies that the corresponding variable would reduce profit inefficiency (or increase efficiency). In the case of non-beneficiary farmers the result is similar to that of the beneficiary farmers.

Conclusion

Results revealed that both ABP beneficiary and non-beneficiary rice farmers were not efficient in the use of existing resources, however, ABP beneficiary rice farmers are more profit efficient with a mean value of 0.94 compared with the non-beneficiary rice farmers having a mean profit efficiency estimate of 0.74. It is thus concluded that ABP enhances the profit efficiency of the beneficiary rice farmers. Result further revealed that ABP beneficiary rice farmers realized more profit than the non-beneficiary rice farmers suggesting that ABP is an intervention that should be advocated to reach all categories of farmers in Nigeria in order to boost profit and efficiency among farming households in Nigeria.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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