COMPARATIVE ANALYSIS OF RESOURCE USE EFFICIENCY AMONG ARABLE CROP COOPERATIVE AND NON-COOPERATIVE FARMERS IN AN AGRICULTURAL ZONE

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Abstract: The study was conducted in Enugu east agricultural zone of Enugu State, Nigeria. The study analysed and compared technical and allocative efficiencies of arable crop cooperative and non-cooperative farmers in the study area and estimated their return to scale. Purposive and multistage random sampling procedures were used to select the respondents. Data were collected through primary source. The collected data were analysed with Cobb-Douglas stochastic frontier production function. The result of the study showed that out of the inputs used by the farmers more resources (planting materials, labour and herbicides) contributed significantly to the output and efficiency of cooperative farmers than Non-co-operators which only one (fertilizer) positively influenced the efficiency of the farmers. Also findings from inefficient model indicated that more variables (age and educational level) enhanced cooperative farmers technically efficient than non-cooperative members who had only one (extension contact) that positively influenced their technically efficient. The findings indicated that the mean technical efficiency of cooperative and non-cooperative farmers were 0.81 and 0.71. This implied that the two groups underutilized their available resources which indicate that none of the groups allocatively maximized their resources and therefore, did not maximize production. The findings of the study therefore, indicated that members of the cooperatives were found to be more technically efficient than Non-co-operators. The policy implication is that farmers should be encouraged to form more cooperative societies because the association enhances their productivity and improves their efficiency in resource use.

Keywords: Cooperative societies, arable crop farmers, technical, allocative efficiencies

Introduction

Agriculture is the pivot of economic growth and development mostly in developing countries of the world. Nigeria being one of the developing countries, agriculture contributes significantly to the economy among which is the provision of food for the teeming population for domestic use as well as for export (Oji-Okoro, 2011). The major food provided to the populace is mainly from arable crops. Most Nigerians use arable crops as their staple food. These crops are grown across every geopolitical zone of the country. Arable crops are plants grown for food either for people or livestock or other products. They are replanted after each harvest. Arable crops mostly grown in Nigeria are cassava, yam, maize, vegetables, rice, cocoyam etc. (www.teara.govt.nz). These crops are equally grown in the South east part of Nigeria. The crops are produced through sole, mixed, or intercrop in the south east part of Nigeria. Mostly smallholder farmers are the producers of these crops. According to Akpan *et al*. (2012) smallholder farmers are those resource poor farmers that cultivate the following crops either as sole, or mixed cropping; cassava, maize, fluted pumpkin, okra, water leaf, pepper, green (Amaranthusspp) and yam. The resource poor farmers are sometime referred to as peasant farmers (Directorate of Cooperative and Enterprise Development, 2012). Also according to Awoke and Okorji (2004) and Eze (2007), smallholder farmers are those farmers who produce on small scale, not involved in commercial agriculture but produce on subsistence level, and cultivate less than five hectares of land annually on the average. FAOSTAT (2012) maintained that agriculture in Nigeria is predominantly on a smallholder basis and about 90% of farm holdings are less than two hectares in size. These farmers constitute about 80% of Nigerian farming population (Awoke and Okorji, 2004; Akpan *et al*., 2012). Not only that the smallholder farmers have small holdings, they are characterised by lack of knowledge of improved farm practices, use of primitive tools, lack of capital, low income, poor access to markets, lack of improved planting materials and production inputs (Ibezim *et al*., 2010). Most often these smallholder farmers operate as individuals. These individual farmers are usually too small to acquire and use labour and machinery efficiently and reduce cost and also too small to produce efficiently because of lack of specialization – doing little of everything but nothing too well (Agbo, 2010). Their major problem is then how to produce enough food to feed the Nigerian teeming population bearing in mind the numerous militating factors and low productivity due to inefficiency in resource use.

One of the ways of solving these problems which has found great favour and success in most parts of the world is through the means of agricultural cooperatives (Arua, 1991). Evidence abound that cooperatives and other informal groups can help farmers and growers improve their productivity by increasing their technical and allocative efficiencies (Virendra *et al*., 2015). In production, cooperative's efficiency can be increased and costs reduced through sharing technical expertise, machinery, equipment and manpower (Agbo, 2010). Also cost of inputs can be reduced through cooperatives by buying seeds, fertilizers, fuel, pesticides, herbicides etc in bulk and distribute to their members accordingly. Like any other type of productivity unit cooperatives are organisations which engage in deliberate and meaningful employment of resources for the benefit of members. They are veritable avenues to economic salvation through increased productivity (Nweze, 1997).

It is in respect of these functions that Federal Government of Nigeria as part of food policy measures intensified the campaign for the formation of cooperatives and other forms of community development associations (Federal Ministry of National Planning, 1981; Koinyan, 1991). Nwobu (1998) noted that in the mid-nineties, many cooperatives were formed among which were 40,000 agricultural cooperative societies that were formed as instrument of change and agricultural transformation. In addition to this effort, government in the past made several efforts to improve the agricultural productivity and efficiency of rural farmers through the establishment of many agricultural programmes such as

National Accelerated Food Production Programme (NAFPP), Agricultural Development Programme (ADP), Root and Tuber Expansion Programme (RTEP), Fadama Programmes etc. Some of these programmes were implemented through farmers' cooperative societies with the aim to raise farmers' efficiency and increase their productivity so as to make the country self-sufficient in food production. Resources were channelled into these agricultural programmes through these cooperatives yet the impact on arable crop production which is mostly the staple food for Nigerians was not quite commensurate to the effort of the government. It is doubtful if the operations of these groups were efficient in the distribution of the resources for efficient production. The performance of the cooperatives in Nigeria was consistently adjudged to be poor (Idachaba, 1991; Ojo, 1991, Cooperative Federation of Nigeria, 1996). This is because there still exists the gap between food production and demand. The increasing deficit in the food production is evidenced by the present global food crisis (Ibezim et al, 2010). One of the major issues to this regard is that most of the members of the cooperatives are still smallholder framers who are characterised by low levels of productivity, individually they cultivate small portions of land, use low levels of other resources in their farming activities. The outcome is low efficiency in the use of resources and low output (Okoh, 2016). Yields are low as a result of inefficient production techniques manifested in technical and allocative inefficiencies, over reliance on household resources, labour intensive agricultural technology and rapidly declining soil productivity (Tanko, 2003; Likita, 2005).

It is widely held that efficiency is Heartbeat of agricultural production. This is because efficient farms make use of existing resources and produce their output at the lowest cost. For these reasons, efficiency has remained an important subject especially in developing countries where majority of the farmers are resource poor (Earfan-Ali and Smad, 2013). It is a very important factor of productivity growth especially in developing agriculture where resources are meagre.

Efficiency of resource use is the relative performance in transforming given inputs into output (Coelli, 1994; Umo, 2005). There are three types of efficiency, technical, allocative and economic efficiencies (Olayide and Heady, 1982). Technical efficiency is the ability of a firm to produce a given level of output with minimum quantity of inputs under a given level technology (Olayide and Heady, 1982). According to Idiong (2005), it is a measure of firm's success in producing maximum output from a given set of input. Technical efficiency is the attainment of production goal without wastage (Amaza and Olayemi, 2001). It is also described as the ratio of output to input and the greater the ratio, the more the magnitude of technical efficiency (Oluwatusin, 2011, Simonyan *et al*., 2012). According to Simonyan *et al*. (2012) and Girei *et al*. (2014), a production process may be technically inefficiency if it fails to produce maximum output from a given bundle of inputs and is therefore operating beneath its stochastic production frontier. Allocative efficiency is the ability to produce at a given level of output using the cost minimizing input ratio (Okorji, 2013). It is a measure of the degree of resources in achieving the best combination of different inputs in producing a specific level of output considering the relative prices of those inputs. Allocative efficiency includes cost minimization; revenue maximization and profit maximization (Rios and Shively, 2005). Resources are said to be efficiently allocated when the value of marginal product of each resource equals its price (Nsikak-Abasi *et al*., 2013; Girei *et al*. 2013; Girei *et al*., 2014; Ohen *et al*., 2014). Economic efficiency is the product of technical and allocative efficiencies (Olayide and Heady, 1982). It is the ability of a farmer to maximize profit (Adetunji, 1998). Economic efficiency is said to have occurred when a firm chooses resource and enterprise in such a way as to attain economic optimum (Ume *et al*., 2016).

Several approaches which fall under the two broad groups of parametric and non-parametric methods have been used in empirical studies of farm efficiency. The frontier is concerned with the concept of maximal in which the function sets a limit to the range of possible observations (Forsund *et al*., 1980). Thus it is possible to observe points below the production frontier for firms producing less than maximum possible output but some points can lie above the production frontier given the technology and deviation from the frontier, and this is regarded as inefficient.

Frontier studies are classified according to method of estimation. Coelli (1994) grouped these methods into broad categories – parametric and non-parametric methods. The parametric method can be deterministic programming and stochastic frontier. These two forms of parametric are called Data Envelopment Analysis (DEA) (Effiong, 2005; Forsund, 1980). The stochastic frontier analysis and the DEA are most commonly used methods. Both methods estimate the efficiency frontier and constitute the firm's technical, cost and profit efficiency relative to it.

The use of deterministic approach is affected by noise and measurement error (Forsund, 1980), while stochastic frontier is generally preferred because of its stochastic (Okorji, 2013). The major features of the stochastic production frontier is that the disturbance term is composite error consisting of two components, one symmetric, the other one sided component. The symmetric component captures the random effects due to measurement error, statistical noise and other influence and assumed to be normally distributed. The one sided components, μ_i captures randomness under the control of the firm. It gives the deviation from the frontier distributed to inefficiency. It is assumed to be either half normally distributed or exponentially distributed.

Stochastic frontier production function was independently proposed by Forsund, 1980; Effiong, 2005; Egonu, 2006). It is represented as specified below:

$$Yi = f(X_i, \beta) \exp(Vi - \mu_i), \ i = 1, 2, \ldots N, \quad \ldots\ldots (1)$$

Where: Yi = Output of ith farmer, X_1 = Quantity of inputs used by the farmer, β_0 = Vector of unknown parameter to be estimated, f = the appropriate functional form (such as Cobb-Douglass and translog), Vi = Assumed to be factors beyond the farmer's control such as weather, diseases etc, μ_i = Error due to technical inefficiency (Coelli, 1994).

Allocative Efficiency: Allocative efficiency is the kind which takes unity price of inputs into consideration. It is the choice of input level which is consistence with the relative price. In other words, a firm is said to be efficient in allocation of resources if it is capable of equating the marginal value product (MVP) of the input to its price; it is referred to as pricing efficiency (Onubuogu, 2013).

It was noted that resources were channelled to cooperatives to raise food production and improve agricultural production in Nigeria, but it appears that the resources were not efficiently utilized by the cooperative societies considering the gap between food supply and demand in the country (Idachaba, 1991; Ojo, 1991; Cooperative Federation of Nigeria, 1996; Ibezim *et al*., 2010). Therefore, having channelled and expended much resources into cooperative societies, it becomes necessary to analyse and compare the resource use efficiency of members and non-members of arable crop cooperatives in Enugu east agricultural zone of Enugu State with a view to determine and compare the technical and allocative efficiencies of the two categories of arable crop farmers and estimate their return to scale.

Materials and Method

Study area

The study was conducted in Enugu East Agricultural Zone of Enugu State, Nigeria. Enugu east agricultural zone is one of the six agricultural zones of Enugu State. The zone is made up of three Local Government Areas (LGAs) namely; Enugu North, Enugu East and Isi-Uzo LGAs. The zone is located at latitudes $6^{0}28^{/}$ E and 6^{0} $31^{/}$ E and longitudes $7^{0}31^{/}$ N and 7^{0} $47^{/}$ N with a population of 672,356 and area of 1,366 km^2 (NPC, 2006). There are two distinct seasons in the zone in a year, namely: dry season which starts in the month of November and ends in March and rainy season with duration of April – October. The annual rainfall in the area is between 1500mm and 2000mm while the mean annual temperature is 32^{0C}. The major occupation of the people of the selected LGAs in the zone is farming which is practiced at the small scale level especially the arable farming. The zone is richly endowed with fertile land suitable for the growth of arable crops such as cassava, yam, maize, rice, vegetables etc. Intercrop of arable crops is the main cropping system in the zone. The people rear livestock such as goat, sheep and poultry.

Sampling procedure

Both purposive and multistage random sampling techniques were used for the study. Purposive was used to select the two LGAs (Enugu East and Isi-Uzo LGAs) that were used for the study because Enugu North LGA is the main capital city of Enugu State which is predominately an urban area. Also purposive sampling was used to select only the arable cooperative societies. For multistage random sampling, firstly, three communities were randomly selected from each of the two selected LGA making it 6 communities. Secondly from the 6 communities chosen, 3 villages were randomly selected from each community given a total of 18 villages. Then from each village, one arable crop cooperative society was chosen making it 18 cooperatives for the study. Finally from each of the chosen cooperative, 10 members of the group were randomly selected, giving a total of 180 co-operators. Also from the villages selected where the cooperatives were chosen, 10 non-members of cooperatives were randomly selected making it 180 non-cooperative members. Therefore, a total of 360 respondents were used, 180 co-operators and 180 non-co-operators. Enugu State ADP enumerators in the selected LGAs assisted the researchers in the identification of the cooperatives and administration of questionnaires to the respondents.

Data collection and analysis

Relevant data were collected through primary source with well design and administered of questionnaires. Also oral interview was equally used.

Data collected were analysed with Cobb-Douglas Stochastic Frontier model to compare the technical and allocative efficiencies as well as the return to scale of the arable crop cooperative and non-cooperative farmers. The technical efficiency and inefficiency of the respondents were estimated with the use of Maximum Likelihood Stochastic Frontier Production Function. The technical efficiency was analysed using Cobb-Douglas functional form of the stochastic frontier production function because Cobb-Douglas has advantages over other functional forms and is widely used in frontier production study in most developing agriculture (Coelli, 1994; Effiong and Idiong, 2004; and Onyenweaku and Effiong, 2006). The Cobb-Douglas frontier production is specified thus: $Yi = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + Vi - \mu_i$ ………… (2)

Where: subscript i indicates ith farmer in the sample, ln = natural logarithm, Yi = output of the farmer, X_1 = farm size (Ha), X_2 = planting materials (Kg), X_3 = fertilizer (Kg), X_4 = labour (Man days), X_5 = herbicides (Lt), X_6 = pesticides, β_0 = constant, Vi = random variation in production due to factors outside the farmers control e.g. weather, disease, natural disaster etc, Ui = technical inefficiency predicted by the model. Determinants of technical inefficiency (Ui) were achieved by using the following model:

$Ui = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7 + ei$……………………… (3).

Where: Ui = technical inefficiency of the ith farmer, Z_1 = age of the ith farmer (Yr), Z_2= household size (Number), Z_3 = educational level (Yr), Z_4 = farming experience (Yr), Z_5 = sex (male = 1, female = 0), Z_6 = extension contact (Number), α_0 = constant, $\alpha_1 - \alpha_7$ = unknown parameters. The stochastic frontier production function of the members and non-members of the cooperatives of the Cobb-Douglass is assumed to be technical efficiency of a farm firm ranging from 0 to 1. Maximum efficiency in production has a value of 1.0. Lower values represents less than maximum efficiency in the production.

In order to realise the allocative efficiency of the arable crop cooperative and non-cooperative members, the resources used were determined on the ratio of Marginal Value Product (MVP) and Marginal Factor Cost (MFC), **where:**

Ei = MVP/MFC ……………………… (4)

Ei = Allocative efficiency ratio of the ith input

MVP = Marginal Value Product of the ith output

MFC = Marginal Factor Cost of the ith input

The values of MVP and MFC were estimated as follows:

MVP = MPP.Py

MFC = Pxi

Where: MPP = Marginal Physical Product, Py = Unit price of output, Pxi = Unit price of input (Okon, 2005).

The rule provides that when Ei = 1, there is efficiency of resource use; Ei> 1indicates underutilization of resource, while Ei< 1 shows overutilization of a resource.

The return to scale (R) was realised with the summation of elasticity of individual resources used. The rule also provides R = 1 indicates constant return to scale, R > 1 shows increasing return to scale while R <1 depicts decreasing return to scale.

Results and Discussion

Maximum likelihood estimates of the Cobb-Douglas frontier production

The result of the maximum likelihood estimate of the Cobb-Douglas frontier production for members and non-members of the cooperatives is shown in Table 1. The result shows that for cooperatives, planting material was the most important resource in the arable crop production as this was positively signed and significant at 1% level with coefficient of 0.479. This implies that an increase in the use of planting material will bring about an increase in the output of the arable crop and technical efficiency of the farmers. The result agrees with the findings of Tashikalma (2011) who noted that agricultural productivity can be increased through planting materials. Other inputs that were positively signed and significant at 1% level were labour and herbicides. The result indicates that these inputs were directly related to output and had positive influence on the output of this group's crops. For labour, this could be that as a group, their labour contribution was high enough to exert positive influence on the farmers' output. This result is in tandem with the findings of Okeke and Emaziye (2017). The result shows the importance of labour in farming particularly in developing countries where mechanization is commonly used in commercial farms (Earfas Ali and Samad, 2013). The significance of the herbicides could be that the group increased the use of herbicides in the weed control instead of using manual labour to weed or clear bushes. From the result, it shows that planting material, labour and herbicides contributed significantly to the technical efficiency of the cooperative farmers. Fertilizer was found to be inversely related to output but not significant. This result agrees with the findings of Taphe *et al*. (2016) who found that contribution of fertilizer to output was not significant. For the Non-co-operators, except for pesticides with a negative coefficient of -0.109, all other resources – farm size, planting material, fertilizer, labour and herbicides gave positive coefficient of 0.396, 0.249, 0.069, 0.368 and 0.025, respectively. From the results of the Non-co-operators, fertilizer was the only input that contributed significantly to the technical efficiency of the non-members of the cooperatives.

The result of the inefficiency model for both cooperative and non-cooperative arable cooperative farmers is shown in Table1 too. The result from inefficiency model showed that signs of the estimated coefficients in the model have implication on the technical efficiency of the members and non-members of the cooperatives. The signs of the coefficients are interpreted in the opposite direction such that a negative sign implies that the variable input enhances technical efficiency and vice versa (Egbodion and Aguelle, 2017). The result from the Table shows that for the cooperative members, age, household size, educational level, and extension contact were negatively signed. This shows correct sign and conformation to *a priori* expectation. Out of these variables, only age and education were significant at 1 and 5% levels, respectively. The negative coefficient of household size and extension contact among cooperative farmers implied that these farmers may be productive but not significant. The negative coefficient and significance of age and educational level implied that the cooperative members were productive and the two resources increase the technical efficiency of the farmers. The possible explanation is that farmers with formal education are more likely to be more technically efficient compared with the uneducated ones and also age connotes with level of maturity which suggests that matured farmers could use their resources efficiently in order to increase the productivity of their enterprises. For the non-cooperative farmers, age, household size, and extension contact were correctly signed and also conform to *a priori* expectation. Out of this, only extension contact was significant at 5% level. The significance of extension contact implies that farmers who are in contact with extension staff tend to be more technically efficient in resource use. This finding agrees with Amaza and Tashikalma (2003), Amos *et al.* (2004), Amaza and Maurice (2005).

From the overall result as shown in Table 1 on the technical efficiency and the associated inefficient factors, the result showed that out of the inputs used by the farmers more resources (planting material, labour and herbicides) contributed significantly to the output and efficiency of cooperative farmers than non-cooperative farmers in which only one (fertilizer) exerted positive influence in the efficiency of the farmers. Also in the inefficiency factors, more variables (age and educational level) tended to make cooperative farmers technically efficient than non-cooperative members who had only one (extension contact) that positively influenced their technically efficient. This result shows that the members of the cooperatives achieved more and therefore seemed to be more technically efficient that non-cooperative farmers in the use of resources available to them.

Technical efficiency of the arable crop cooperative and non-cooperative farmers

The range of technical efficiencies of cooperative and non-cooperative arable crop farmers in the study area is shown in Table 2. The Table shows that 45% of the cooperative farmers had technical efficiency of 0.41-0.81. The farmers' specific indices of technical efficiencies varied widely between the two groups ranging between 0.41 and 1.00 for cooperative farmers and 0.44 and 0.99 for the non-cooperative farmers. The cooperative farmers had wide range of technical efficiency with minimum of 0.43 and maximum of 0.98 while the variation among Non-co-operators was wider with minimum technical efficiency 0.41 and maximum of 1.00. The mean technical efficiency of members of cooperatives was 0.81 while that of non-cooperative members was 0.79. The technical efficiencies of 0.81 for cooperative members and 0.79 for non-cooperative members imply that on the average, the cooperative members were able to achieve about 81% of optimum output from the set of inputs and technology available for them while non-members of cooperative achieved 79% of the same optimum output with the existing inputs and technology. Therefore the output of arable crops among the cooperative group could be increased by 19% while that of the Non-co-operators could likewise be increased by 21%. The findings from the study indicated that arable crop cooperative farmers were more technically efficient than the non-members of the cooperatives.

Table 1: Maximum likelihood estimate of parameters of the Cobb-Douglas frontier production function for arable crop cooperative and non-cooperative farmers

Variables	Cooperative Farmers			Non-cooperative Farmers	
	Parameters	Coefficient	t-ratio	Coefficients	t-ratio
Constant	β_0	-0.1641	-3.175***	-1.879	-0.724
Farm size	β_1	0.131	1.541	0.396	1.124
Planting materials	β_2	0.379	3.107***	0.249	0.891
Fertilizer	β_3	-0.073	-1.282	0.069	3.190***
Labour	β_4	0.435	3.475***	0.368	0.388
Herbicides	β_5	0.081	2.805***	0.025	0.158
Pesticides	β_6	0.175	1.003	-0.109	-0.106
Inefficiency Factors					
Constant	Z0	1.163	2.896***	-0.518	-0.098
Age	Z_1	-0.019	-6.008***	-0.105	-0.051
Household size	Z_2	-0.005	-0.079	-0.185	-0.070
Educational level	Z_3	-0.019	-2.281**	0.005	0.501
Farming experience	Z4	0.109	0.717	0.095	0.679
Sex	Z5	0.871	2.416**	0.591	0.522
Extension contact	Z6	-0.040	-0.137	-0.564	-2.114**
Sigma-squared	δ^2	0.568	3.147	0.227	0.715
Gamma	Υ	0.707	0.514	0.556	0.542
Log likelihood ratio		3.810	4.176		
LR test		20.170	3.864		

(**), (***) Significant at 5 and 1%
Source: Field Survey, 2017

Table 2: Frequency distribution of technical efficiency range between cooperative and non-cooperative farmers

Range of Technical Efficiency	Cooperative farmers		Non-Cooperative farmers	
	Frequency	Percentage	Frequency	Percentage
0.00 - 0.30	0	00	0	0.00
0.31-0.40	0	00	0	0.00
0.41-0.50	22	12.2	21	11.7
0.51-0.60	29	16.1	27	15.0
0.61-070	32	17.7	29	16.1
0.71-0.80	29	16.1	29	16.1
0.81-0.90	23	12.8	32	17.7
0.91-1.0	45	25.0	42	23.3
Total	**180**	**100.0**	**180**	**100**
Mean	0.81		0.79	
Maximum	0.98		1.00	
Minimum	0.43		0.41	

Source: Field Survey, 2017

Allocative efficiency of the arable crop cooperative and non-cooperative farmers

The allocative efficiency of the cooperative farmers is presented in Table 3a. The Table depicts that the factor inputs of farm size, planting material, labour, fertilizer, herbicides and pesticides gave an MVP/MFC ratio of 3.56, 1.96, 2.40, 8.30, 5.20 and 35.95 respectively. This indicates input underutilization among the resources used by this group. This implies that the cooperative farmers could not achieve allocative efficiency in the six resources used and therefore failed to maximize profit. Profit could be maximized by the cooperative members by increasing the resource utilization of the farm size, planting materials, labour, fertilizer, herbicides and pesticides by 356%, 196%, 240%, 830%, 520% and 3595% respectively. The result conforms to the findings Awoniyi and Omonona (2007) who observed that farmers were generally inefficient in allocation of resource in production of food crop in their respective study areas.

With regard to allocative efficiency for the non-members of arable crop co-operators, the result is presented in Table 3b. The result shows that factor inputs of farm size, planting materials, labour, fertilizer, herbicides and pesticides gave an MVP/MFC ratios of 12.95,13.93, 11.93, 11.87, 3.15, 9.14 and 55.61 respectively indicating input underutilization. The farmers also failed to achieve allocative efficiency in the use of the six resources and therefore did not maximize profit. This result also conform the findings of Ike and Inon (2006) as obtained in the result of members' cooperatives. The result then suggests that the Non-co-operators could equally increase the use of farm size, planting materials, labour, fertilizer, herbicides and pesticides by 1195%, 1295%, 1087%, 2150%, 8140%, 5461% respectively. The findings with respect to allocative efficiency showed that the groups underutilized the six resources available to them therefore, failed to maximize profit.

Table 3a: Allocative efficiency of cooperative farmers

Input	MVP (MPP.P)	MFC	Efficiency ratio	Deviation from optimality (1 – E)
Farm size	30,000	8,500	3.56	-2.66
Planting material	9,200	4,800	1.96	-0.96
Labour	9,600	4,000	2.40	-1.40
Fertilizer	16,600	2,000	8.30	-7.30
Herbicides	6,300	1,200	5.20	-4.20
Pesticide	39,000	1,100	35.95	-34.90

Source: Field Survey, 2017

Table 3b: Allocative Efficiency of Non-Cooperative Farmers

Input	MVP (MPP.P)	MFC	Efficiency ratio	Deviation from Optimality (1 – E)
Farm size	30,050.00	2320	12.95	-11.95
Planting material	18,806.21	1,350	13.93	-12.95
Labour	12,458.62	1,050	11.87	-10.87
Fertilizer	724.45	230	3.15	-2.15
Herbicides	502.73	55	9.14	-8.14
Pesticide	2,502.30	45	55.61	-54.61

Source: Field Survey, 2017

Table 4: Elasticity of factor inputs and return to scale of the cooperative and non-cooperative arable crop farmers

Variable	Cooperative Farmers	Non-Cooperative Farmers
	Elasticity	Elasticity
Farm size	0.131	0.396
Planting materials	0.379	0.249
Labour	0.435	0.368
Fertilizer	-0.073	0.069
Herbicides	0.081	0.025
Pesticides	0.175	-0.109
Total	**1.128**	**1.001**

Source: Field Survey, 2017

Return to scale of the cooperative and non-cooperative arable crop farmers

The result of elasticity of production of the two groups is shown in the Table 4. The result indicates that sum total of elasticity of the resources for cooperative and non-cooperative farmers were 1.128 and 1.001, respectively. The results indicate that the two groups are still in stage 1 of production function which is an uneconomic stage of production implying that the resources were under-utilized. This means that production by the two groups can still be expanded or increased by increasing their level of use of inputs.

Conclusion

The result of the study showed that out of the inputs used by the farmers more resources (planting material, labour and herbicides) contributed significantly to the output and efficiency of cooperative farmers than non-cooperative farmers in which only one (fertilizer) positively influenced the efficiency of the farmers. Also findings from inefficient model indicated that more variables (age and educational level) enhanced cooperative farmers' technically efficient than non-cooperative members who had only one (extension contact) that positively influenced their technically efficient. The mean technical efficiencies of cooperative and non-cooperative members were 0.81 and 0.79, respectively. The allocative efficiency ratios of the cooperative farmers were 3.56, 1.96, 2.40, 8.30, 5.20 and 35.95 for farm size, planting material, labour, fertilizer, herbicides and pesticides while that of Non-co-operators were 12.95, 13.93, 11.87, 3.15, 9.14 and 55.61 in the resources utilized by the farmers, respectively. This shows that the two groups underutilized the resources available to them. The return to scale for cooperative and non-cooperative members were 1.128 and 1.001 indicating that the two groups were operating in the stage 1 of production function. The forgoing result indicated that although none of the groups allocatively maximized the efficiency of their resources and did not have maximum production because they were in the stage one of production function, but the findings depict that members of cooperative societies were found to be more technically efficient in the use of the resources than non-members. The policy implication is that the three tier systems (Federal, State, and Local) of government should intensify more effort in encouraging farmers on formation of more cooperatives as this enhances the technical efficiency in resource use and productivity of farmers. This will ensure increase in food production and help to bridge the gap between food supply and demand in the country.

Conflict of Interest

Authors declare that there are no conflicts of interest.

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