DOI https://doi.org/10.18551/rjoas.2018-03.18

INFLUENCE OF AGRICULTURAL TECHNOLOGY UTILIZATION ON TECHNICAL EFFICIENCY OF COWPEA FARMERS IN NIGERIA: EVIDENCE FROM PARAMETRIC ANALYSIS

Coker A.A.A.*, Ibrahim F.D., Ibeziako U.N.
Department of Agricultural Economics and Extension Technology,
Federal University of Technology, Minna, Niger State, Nigeria
*E-mail: ayodejicoker@futminna.edu.ng

ABSTRACT

This study examined the influence of agricultural technology utilization on the technical efficiency of cowpea farmers in Niger State, Nigeria. Data were sourced through the use of structured questionnaire administered to 286 respondents. Descriptive statistics, technology utilization index and stochastic frontier analysis models were used for the data analysis. The results revealed that 37.76% of the farmers operated on a low technology utilization range, while 22.38 and 39.86% operated on a moderate and high technology utilization range respectively. Agricultural technology utilization by cowpea farmers showed an inverse relationship with technical efficiency at 1% significant level. The distribution of technical efficiency levels for cowpea farmers indicated that technical efficiency indices ranged from 44% to 96%, with a mean efficiency score of 79%. Major challenges hindering farmers' technology utilization and technical efficiency were lack of credit (83.22%), low income (74.83%), risk of new technology (64.69%), complexity of technology (60.84%), little knowledge of equipment use (57.34%) and use of hired labour (53.15%). The study recommended increased extension support by the Niger State Agricultural and Mechanization Agency directed at cowpea farmers towards ensuring optimal and appropriate utilisation of agricultural technologies such as fertilizers and improved seeds, with the view to enhancing the technical efficiency of cowpea farmers.

KEY WORDS

Technology utilization, technical efficiency, cowpea, farmers.

In-spite contributing 23.1% of the Gross Domestic Product (GDP) of Nigeria's economy (Federal Ministry of Budget and National Planning, 2017) the agriculture sector is still underdeveloped and unexplored. This may partly not be unconnected with low technology absorption, sub-optimal production efficiency and low productivity, under-utilisation of available natural resources, the non-inclusive and non-transformative nature of growth witnessed within the sector. The sector is also currently dominated by the crop sub-sector, which accounts for about 85% of the sector, covering, cash and arable crops, including cowpea. Cowpea is a tropical annual herbaceous legume grown majorly in Nigeria and it provides income and employment opportunities for most people in the rural communities of the country. Nigeria is the largest producer of cowpea in the world, as it produces an estimated 2.17 million tons annually (Food and Agriculture Organization, 2014).

However, cowpea efficiency in Nigeria has been sub-optimal, with producers' technical efficiencies below the frontier in most parts of the country (Sofoluwe and Kareem, 2011; Egbetokun and Ajijola, 2008; Abba, 2016 and Abdui, Makama and Mika 'il, 2013). This development may not be unconnected to numerous factors, including low agricultural technology uptake. For instance, the Federal Ministry of Agriculture and Rural Development (2011) revealed that average fertilizer use in Nigeria is just 13kg/hectare compared to a World average of 100kg/hectare and 150kg/hectare for Asia, while only 5% could access improved seeds compared to 25% in East Africa and 60 % in Asia. In a related development, Nigeria could only record 10 tractors per 100 hectares compared to Indonesia with 241tractors per 100 hectare.

Agricultural technology utilization refers to the adoption of new agricultural innovations for the increased and efficient improvement of a crop or farming process. Consequently, the importance of agricultural technology utilization cannot be overemphasized. Logically, farmers with poor allocation and low utilization of production technologies may not expect improved level of productivity or output. This thus confirms the linkage between technology utilisation and efficiency. According to Piya *et al.* (2012), this link can be related to the production decisions of the households when they produce either for subsistence or for profit motive. For instance, a subsistent farmer who is satisfied with providing for the family may not bother to utilize a technology or improve on their level of efficiency, while a commercial farmer who is producing on a large scale and whose aim is to increase output as well as outwit competitors will do everything possible to utilize technologies and enhance efficiency level. Numerous promising agricultural technologies which have the potentials to increase the productivity and livelihood of faming households have been churned out by Research Institutes in Nigeria and across the globe. However, the potentials of these technologies depend among others on the capacities of individual farm households to utilize them efficiently. This study therefore identified the types and technologies utilised by cowpea farmers in the study area, determined the level of technology utilisation and ascertained the influence of the technologies utilised on cowpea farmers' technical efficiency.

Theories of Technology Utilisation and Efficiency. Agricultural technological utilisation is hinged on theoretical approaches supporting the understanding of the psychology of users' acceptance and use of technologies. Key among these theories are the theories of reasoned action, technology acceptance model, planned behaviour, the combined theory of planned behaviour and technology acceptance and acceptance and use of technology theory. The theory of reasoned action states that an individual's behaviour is determined by one's intention to perform the behaviour, and this intention is influenced jointly by the individual's attitude and subjective norm. On the other hand, the theory of acceptance stipulates that acceptance of any technology is determined by the perceived usefulness and perceived ease of use, while, the theory of planned behaviour is an extension of the reasoned action, given the inclusion of perceived behavioral control as a factor which influence human intention (Dillon and Morris, 1996). Thus, perceived behavioral control is determined by the availability of skills, resources and opportunity to achieve outcomes. The theory of acceptance and use of technologies is based on users' intentions and information system. The theory is based on four constructs, namely; performance expectancy, effort expectancy, social influence and facilitating conditions. The first three are direct determinants of usage intention and behavior and the fourth is a direct determinant of user behavior.

Evidence from literature suggests that Debreu (1951), Koopmans (1951) and Farrell (1957) pioneered the work on efficiency. The novel contributions of Farrell led to the decomposition of efficiency into technical, allocative and economic efficiencies. According to Farrell, technical efficiency relates to the capacity to attain maximum level of output from a given level of inputs. Allocative efficiency relates to the ability to use inputs in optimal proportion at unique prices and available level of technology. Economic efficiency on the other hand is a product of the technical and allocative efficiencies and relates to the concept productivity, performance, quality and profit. Also, the trend in efficiency estimation has gone from double to single model estimation, using either the parametric and or the non-parametric approaches. However, recent insight defined efficiency in terms of optimal resource allocation (Norton, Alwang and Masters, 2015). This study therefore focuses on technical efficiency of cowpea farmers using the parametric estimation.

Relationship between Technology Utilization and Efficiency. According to Ibeziako (2017), agricultural growth depends not just on technology utilization, but also on the level of efficiency. Ali *et al.* (1989) also established that farmers find themselves in disequilibrium because of continuously generated new technology and the difference in input and output prices. According to the source, farmers' cope-up strategy to these disequilibria differs with each other and thus, may result into different levels of efficiency. Ibeziako (2017) further noted that production locations and scale of operations of technologies have correlations with efficiency.

METHODS OF RESEARCH

The study was carried out in Niger State, situated in the Guinea Savannah vegetation zone of Nigeria. It is located within Latitudes 8^0 11' N and 11 ^{0} 20'N and Longitudes 4^0 30 'E and 7^0 20'E. Niger is bordered to the north by Zamfara State, to the northwest by Kebbi State, to the south by Kogi State, to southwest by Kwara State; while Kaduna State and Federal Capital Territory borders the State to northwest and southwest respectively. The State also shares a common international boundary with the Republic of Benin at Babanna in Borgu Local Government Area (LGA). Niger State consists of twenty five Local Government Areas (LGAs) grouped into three administrative Zones, with the zones having 8, 8 and 9 LGAs respectively. This study was conducted in Zones 1 and 3 of Niger State. Agriculture is predominant in the state, with cowpea, rice, yam, sugar cane, maize and millet, being the major crops grown.

Sampling Procedure and Sample Size. A multi-stage sampling technique was used in selecting respondents for this study. The first stage was a purposive selection of Zones 1 and 3 out the three zones (1, 2 and 3) in the State given preponderance of cowpea farmers Niger State Agricultural Mechanization and Development Agency (NAMDA), (2016). The second stage was a selection of two LGAs from each of the two zones selected. The third stage entailed a random selection of two villages from each of the selected LGA, giving a total of eight villages. In the fourth stage, sampling of farm households in each village was determined proportionately. Sample selection was based on the cowpea farmers' frame using the Yamane sample section model at 5 percent precision level.

Data collection and Analysis. The data for the study were generated through primary sources and were collected with the use of structured questionnaire designed in line with the research objectives. This was administered to the respondents with the assistance of trained enumerators. Descriptive statistics such as frequency, distribution tables, percentages and mean were used to identify the technologies utilized and identify the challenges hindering farmers' technology utilization. To determine the level of technology utilization in the study area, inference was drawn to derive the technology utilization index from the study of Mabe *et al.* (2012) as modified by Nakuja *et al.* (2012) on the adaptive capacities of farmers to climate change adaptation strategies and their effects on rice production in the Northern Region of Ghana. With respect to data collection on the model, respondents were asked to indicate their level of utilization of commonly used technologies available in the study area. The seven common technologies were improved land preparation, use of improved seed, pre-sowing, seed dressing, fertilizer application, agrochemical usage, utilization of improved planting method and post-harvest storage. These were scored as:

- Use of improved land preparation= 1; none-usage = 0;
- Use of improved seed =1; none-usage = 0;
- Use of Pre-sowing seed dressing = 1; none-usage= 0;
- Use of 2bags/ha 15kgN NPK(15:15:15) or 2bags/ha 30kg single superphosphate =2; use of 1 bag =1; none-usage= 0;
- Use of agrochemical = 1; none-usage = 0;
- Improved technology of planting on ridges or flat beds, recommended spacing based on variety and sowing 2 seeds/hole at 2.5 cm - 5 cm = 3, Partial utilization of improved planting method =1.5; none-usage =0
- Post-harvest storage using air tight containers, use of jute or polypropylene bags with polythene inner liners or triple bagging or the use of chemical =1; none-usage =0

The average level of technology utilization of an ith farmer to jth technology was then calculated as shown in equation (1):

$$\text{Average Technology Utilization Scale} = \frac{ILP_{ij} + ISV_{ij} + PS_{ij} + FA_{ij} + AP_{ij} + PM_{ij} + PH_{ij}}{N_A} \quad (2)$$

Where: ILPij = Improved land preparation technology; ISVij = Improved seed variety; PSij = Pre-sowing seed dressing; FAij = Fertilizer application; APij = Agrochemicals application; PMij = Planting method adopted; PHij = Post- harvest storage technology adopted; NA = Number of total recommended technologies.

From the above equation, the sum of technologies utilized divided by the number of total recommended technologies for each farmer was then calculated to derive the technology utilization index using equation (2).

$$\frac{\sum TU}{NA} \quad (2)$$

Where: $\sum TU$ = Sum of technologies utilized; NA = Number of total recommended technologies.

Based on the generated technology utilization index result, farmers were then categorized, as follows 0 < 0.33 - Low technology utilization level, 0.33 < 0.66 - Moderate technology utilisation level while a range of 0.66 ≤1.00 - High level of technology utilization. Modifying the ranking, table 1 summarizes how this was categorized for this study.

Table 1 – Level of technology utilization by respondents

Level of technology utilization	Range of technology utilization level
Low technology utilization	0 - 0.32
Moderate technology utilization	0.33- 0.65
High technology utilization	0.66 ≤ 1.00

Source: Modified from Mabe et al., (2012) and Nakuja et al., (2012).

The effect of technology utilization on cowpea farmers efficiencies were determined using the inefficiency function specified thus:

$$TE = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \ldots\ldots\ldots \delta_{23} Z_{22} \quad (3)$$

Where:

Z_1 = Household size (Number of persons in the HH);
Z_2=Gender of HH head (Male =1, Female =0);
Z_3 = Marital Status (Single Yes =1, No =0);
Z_4 = Marital Status (Married Yes =1, No =0);
Z_5 =Marital Status (Divorced Yes =1, No =0);
Z_6= Age of decision maker on technology utilization (Years);
Z_7= Gender of decision maker on technology utilization (Male =1, Female =0);
Z_8= Years of farming experience (Number of years);
Z_9=Educational level (Number of years spent in formal school);
Z_{10}=Farm size (Hectares);
Z_{11}= Employment (Number of those employed in the HH);
Z_{12} = Household Composition -Adult male (Number);
Z_{13} = Household Composition -Adult female (Number);
Z_{14} = Household Composition -Children (Number);
Z_{15} = Number of extension visits (Number);
Z_{16} = Membership of Cooperative society (Yes =1, No =0);
Z_{17} = Number of languages spoken (Number);
Z_{18} = House ownership (Male =1, Female =0);
Z_{19} = Income of Household Head (Naira);
Z_{20} = Access to Credit (Yes =1, No =0);
Z_{21} = Access to insurance (Yes =1, No =0);
Z_{22} = Technology Utilization (Index);
δ_0 = Constant;
δ_1 - δ_{22} = Coefficients to be estimated.

RESULTS AND DISCUSSION

Technologies utilized by Respondents. The main technologies utilized by the respondents were improved land preparation technique, improved seed, pre-sowing, seed dressing, fertilizer application, agrochemical application, improved planting method and post-harvest storage. The results showed that only 47.90% of the respondents utilized improved land preparation technology. This implies that 52.10% either used family labour or hired labour for their land preparation. Most (73.78%) of the farmers did not plant improved seeds, 69.23% did not use the pre-sowing seed dressing technology and 59.79% did not apply fertilizer. The Federal Ministry of Agriculture and Rural Development (2011) established that the level of technology utilisation in Nigeria were far lower than global best practice. However, 64.34% of the respondents applied agrochemicals, 57.69% utilized improved planting method and 100% utilized the post-harvest storage technologies of either air tight containers, use of jute/polypropylene bags with polythene inner liners or triple bagging or the use of chemicals. The technologies utilized by the respondents are as shown in Table 2.

Table 2 – Technologies utilized by the respondents

TECHNOLOGIES UTILISED	FREQUENCY	PERCENTAGE
Improved Land Preparation technique		
Yes	137	47.90
No	149	52.10
Improved Seed		
Yes	75	26.22
No	211	73.78
Pre-Sowing seed dressing		
Yes	88	30.77
No	198	69.23
Fertilizer Application		
Recommended Level	27	9.44
Partial	88	30.77
None	171	59.79
Agrochemical Application		
Yes	184	64.34
No	102	35.66
Improved Planting Methods		
Recommended Level	165	57.69
Partial	120	41.96
None	1	0.35
Post harvest storage		
Yes	286	100
No	0	0

Source: Field survey, 2016.

Level of technology utilization. To ascertain the level of technology utilization by respondents, the range of technologies utilized were categorized into three, with a rating of 0 - 0.32 considered as low, 0.33 - 0.65 is considered moderate and 0.66 ≤ 1.00 is considered high. The results, as detailed in Table 3 shows that 39.86% of the farmers operated at high technology utilization level, 22.38% on moderate level, while 37.76% operated on low technology utilization level. The implication of the result is that 60.44% (sum of the low and moderate) which is a considerable percentage of the sampled population are either not utilizing the available technologies or are not utilizing them adequately. The respondent's level of technology utilization is as shown in table 3.

Table 3 – Distribution of respondents according to level of technology utilization

LEVEL OF TECHNOLOGY UTILIZATION	FREQUENCY	PERCENTAGE	REMARK
0 - 0.32	108	37.76	Low
0.33 - 0.65	64	22.38	Moderate
0.66 ≤ 1.00	114	39.86	High

Source: Computation from survey data, 2016.

Effect of Technology Utilization on Farmers' Efficiency. The estimated coefficients of the Stochastic Frontier Model as presented in Table 4 shows that the estimated sigma-square (σ^2) which was 0.19 was significant at 1% level of probability. The gamma estimate of 0.99 was significant at 1% level of probability. This shows that there was 99% variation in output resulting from technical inefficiencies of the farmers. The estimate of the parameters of the stochastic production frontier indicated that the coefficients of all the significant factors included in the efficiency function were positive, implying that increase in the use of any of the factors led to increase in technology utilization, all things being equal.

Specifically, the input with respect to farm size, hired labour, agrochemicals and seed were all positive and statistically significant at 1% level of probability implying that an increase of 1% in farm size, hired labour, agrochemicals and seed resulted in an increase in output by 0.753%, 0.013%, 0.049% and 0.043% respectively. This aligns with the studies of Bekele (2003), Boris *et al*, (1997), Nyagaka *et al*, (2010) and Agwu (2004) that these variables have a potential of increasing the farmers' output.

Table 4 – Effect technology utilization on respondents' technical efficiency

Variables	Parameter	Coefficient	Standard-error	t-ratio
Efficiency model				
Constant	δ0	7.669717	0.596637	12.85***
Farm size	δ1	0.753937	0.018543	40.66***
Fertilizer	δ2	0.001615	0.001688	0.96
Family labour	δ3	0.004146	0.002880	1.44
Hired labour	δ4	0.013527	0.001918	7.05***
Agrochemicals	δ5	0.049946	0.006792	7.35***
Capital inputs	δ6	0.148705	0.085850	1.73
Seed	δ7	0.043970	0.016770	2.62***
Inefficiency model				
Constant	δ0	2.391503	0.396236	6.04***
Household size	δ1	-0.024572	0.128653	-0.19
Gender of HH head	δ2	0.471671	0.183052	2.58**
Marital status – single	δ3	0.432319	0.100134	4.32***
Marital status – married	δ4	-0.316448	0.088266	-3.59***
Marital status – divorced	δ5	0.408890	0.101565	4.03***
Age of decision maker on technology utilization	δ6	-0.004401	0.004860	-0.91
Gender of decision maker on technology utilization	δ7	-0.736329	0.113748	-6.47***
Years of farming experience	δ8	0.005219	0.007013	0.74
Educational level	δ9	0.011691	0.006355	1.84*
Farm size	δ10	-0.149852	0.060949	-2.46**
Employment	δ11	-0.096400	0.025215	-3.82***
HH Composition – Adult male	δ12	-0.025457	0.131227	-0.19
HH Composition – Adult female	δ13	0.131568	0.131523	1.00
HH Composition – Children	δ14	0.050560	0.128153	0.39
Number of extension visits per production season	δ15	-0.190364	0.046078	-4.13***
Membership of Cooperative society	δ16	-0.087049	0.093143	-0.93
Number of languages spoken	δ17	-0.079570	0.050572	-1.57
House ownership	δ18	-0.654500	0.131643	-4.97***
Income of Household Head	δ19	-0.000016	0.000002	-9.62***
Access to Credit	δ20	-0.919833	0.144010	-6.39***
Access to insurance	δ21	-0.113649	0.125463	-0.91
Technology Utilization	δ22	0.459189	0.140217	3.27***
Sigma-squared	σ^2	0.191528	0.029841	6.42***
Gamma	Γ	0.996769	0.001083	920.13***

*Log likelihood function = 149.55944*** LR test of the one-sided error = 294.69447****

**** Significant at 1%, ** significant at 5%, * significant at 10% Source: Computation from survey data, 2016*

With respect to the inefficiency model, gender of household head, marital status, gender of decision maker on technology utilization, educational level, farm size, employment, number of extension visits per production season, house ownership, income of household head, access to credit and the level of technology utilization were the only variables that contributed significantly to the explanation of inefficiency measures.

Gender of household head was positive with coefficient of 0.471 which was statistically significant at 5% level of probability. The implication is that gender of household does not increase efficiency. Farm size was negative with coefficient of -0.149 which was also statistically significant at 5%. The implication is that farm size increase efficiency. This is in line with Boris *et al.* (1997) and Tanko *et al.* (2008) that reported that farm size has a significant influence on farmers' efficiency but in contrast with the study of Akinwumi *et al.* (1996) that reported that farm size has no influence on farmers' efficiencies. Educational level was positive and statistically significant at 10% with a coefficient of 0.011. This implies that educational level does not increase efficiency. This is not in agreement with the studies of Kimenye (2001), Mendola (2007) and Okoye *et al.* (2006) that reported that education promotes farmers' efficiency.

The coefficients of being single and divorce were positive with coefficients 0.432 and 0.408 respectively and significant at 1% level of probability while being married was negative with coefficient -0.316 and also significant at 1% level of probability. This implies that marriage increases efficiency. This may be as a result of the advantage of the joint-force of the married people in acquiring agricultural information and pulling funds together to utilize technologies as against the single and divorced farmers. Gender of decision maker on technology utilization, employment, number of extension visits, house ownership, income of household head and access to credit were negative with coefficients of -0.096, -0.190, -0.654, -0.000 and -0.919 respectively and were all statistically significant at 1% level of probability level. This implies that these variables increase efficiency. This agrees with the studies of Katungi (2006), Habtemariam (2004), Boris *et al.* (1997), Kidane (2001), Getahun (2004), Mbanasor *et al.* (2008), David (2005) and Okoye *et al.* (2006), which established that these variables promote farmers' efficiencies. Technology utilization was positive with coefficients 0.459 and was statistically significant at 1% level of probability, implying that technology utilization decreases efficiency. This could be as result of inadequate and wrong utilization of the technologies by the farmers, probably due to inadequate knowledge. The estimated coefficients of the Stochastic Frontier Model are presented in Table 4.

The frequency distribution of technical efficiency levels for cowpea farmers in the study area is presented in Table 5. The mean technical efficiency was 0.791, which suggested that on the average, the observed output was 21% less than the optimum output. This implies that cowpea farmers in the study area were technically efficient (0.791) and were 21% less from the maximum possible level due to technical inefficiency. This can be improved on by utilizing best practices of existing technologies. The result indicates that technical efficiency indices range from 44% to 96% for the study area, with an average of 79%.

Table 5 – Technical efficiency distribution of Cowpea Farmers in Niger State

Technical Efficiency Score	Frequency	Percentage
0.31 – 0.40	47	16.43
0.41 – 0.50	1	0.35
0.51 – 0.60	11	3.85
0.61 – 0.70	31	10.84
0.71 – 0.80	15	5.24
0.81 – 0.90	38	13.29
0.91 – 1.00	143	50.00
Sample size	286	100.00
Minimum score	0.445	
Maximum score	0.9622	
Mean score	0.791	

Source: Computation from survey data, 2016io

Challenges hindering farmer's technology utilization and technical efficiency. The main challenges hindering cowpea farmers' technology utilization and technical efficiency were complexity of technology (60.84%), lack of credit (83.22%), low income (74.83%), use of hired labour (74.83%), risk of new technology (64.69%) and little knowledge of equipment use (57.34%) (Table 6). This is in agreement with the study of Feder *et al.* (1985) that reported constraint to credit as one of the barriers to technology utilization in developing countries and the study of Baidu-forson *et al.* (1995) which established that farmers' perception played a significant effect on their level of technology utilization.

Table 6 – Challenges hindering farmer's technology utilization and technical efficiency

CHALLENGES	FREQUENCY	PERCENTAGE
Risk of new technology	185	64.69
Complexity of technology	174	60.84
Doubts in Profitability	44	15.38
Lack of credit	238	83.22
Low income	214	74.83
Low accessibility	90	31.70
Language barrier	30	10.49
Insufficient training	50	17.48
Societal factors	65	22.73
Religious inclination	47	16.43
Cultural inclination	68	23.78
Little knowledge of equipment usage	164	57.34
Little or no experience in cowpea farming	77	26.92
Doubts in efficiency of equipment	113	39.51
Use of hired labour	152	53.15
Large size of land cultivated	128	44.76

Source: Computation from survey data, 2016.

CONCLUSION AND RECOMMENDATIONS

Arising from the outcome of the study, the study concluded that the level of technology utilisation among cowpea farmers in the study area was low and that utilization of agricultural technologies had a negative influence of cowpea farmers' efficiency. Consequently, the study recommended as follows:

- There is the need for increased extension support by the Niger State Agriculture and Mechanization Agency directed at cowpea farmers towards ensuring appropriate utilisation of agricultural technologies such as fertilizers, improved seeds;
- It has become imperative for NAMDA to facilitate access of cowpea farmers to agro-input sources in order to ensure optimal utilisation of these inputs.
- There is the need to shore of cowpea farmers' efficiency through continuous training and technical support on efficient production resource allocation.
- To further enhance efficiency on cowpea farmers, supportive credit policies should be made by the State Ministry of Agriculture to facilitate increased access to credit at interest rates favourable to the farmers.

REFERENCES

1. Abba, M.W. (2016). Economic Analysis of Cowpea Production in Nigeria. Russian Journal of Agricultural and Socio-economic Sciences, 1(13).
2. Abdui, Z., Makama, S.A. and Mika'il, K.T. (2015). Resource Use Efficiency in Small-Scale Cowpea Production System in Dawakin Kudu Local Government Area, Kano State, Nigeria. Journal of Agriculture and Sustainability. Vol. 8, No. 2, 69-82.
3. Akinwumi, A.A., & Djato, K. K. (1996). Farm Size Relative Efficiency and Agrarian Policy in Cote d'Ivoire: Profit Function Analysis of Rice Farms, Cote d'Ivoire. Agricultural Economics, 30-39.