



PRODUCTION INPUTS ALLOCATION AND PERFORMANCE BENCHMARK OF RICE FARMS IN ANAMBRA STATE, NIGERIA

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ABSTRACT

The study analyzed the production input allocation and the performance benchmark of rice farms in Anambra State, Nigeria. Efforts at improving farm management and production notwithstanding, more is yet to be achieved in that regard in Anambra State and Nigeria at large. Past studies concentrated on areas like profitability, resources and production efficiency with little or no focus on benchmarking the production and the pattern of input mix. To achieve the broad objective, four (4) specific objectives were outlined thus: (i) categorized production input patterns based on farm performance and based on expenses (iii) determined a performance standard/ benchmark from the category after identifying the existing standard, (iii) identified the diverse effect of production inputs cost on rice farm output for different production levels, and (v) identify the causal factors of difference in farm performance in the study area. A multi-staged sampling technique was employed in the selection of 120 farms. The study utilized primary data generated by the researcher using structured and pretested questionnaire. Descriptive statistics, net farm income, quantile regression and ANOVA were used for the analysis of the primary data gotten through the administration of a structured questionnaire. The 120 farms were grouped as top performers (40), average performers (40) and below average performers (40). The top performing farms had an average net farm income of ₦340,305 while the average farms and below average farms had ₦207,567 and ₦92,258, respectively. The benchmark standard for rice farms in Anambra State was ₦390, 500. The basic effects of the cost variables on the farm performance as identified with the quantile regression was that the higher the net farm income, the better the opportunities available to increase performance. The major causal factor of differences in farm outcome were, financial constraints, managerial ability, level of input utilization at the farm level, size of farm, high cost of inputs, pests and diseases, and seasonal variation or climate change. The ANOVA result showed that mean expenditures was not significantly different. The study therefore, recommended that cost management and better production instructions should be taken seriously by the extension agents and government should subsidize agricultural inputs for farmers.

Keywords: Allocation, Farm output, Performance benchmark, Production inputs, Rice.

INTRODUCTION

The estimates prepared for the Coalition for African Rice Development (CARD), noted that Nigeria has a total of 79 million hectares of cultivatable land. However, about 1.8 million hectares is currently used for rice production out of the 4.6 million hectares suitable for that purpose (National Rice Development Strategy [NRDS], 2020). This is an improvement to about 25 million hectares of land which was actually attributed to the cultivation of various food crops in 2019, of which 6.37% was cultivated to rice alone (Erenstein *et al.*, 2004). Increase in population growth and foreign exchange spending weighed the economy down to



the need for economic restructuring. The consideration of agriculture as Nigeria's first economic opportunity becomes imperative given the major part it plays in industry and employment (Ibrahim *et al.*, 2018).

One of the main grain products of Nigeria is rice (*Oryza Spp.*). Over the decades, rice has occupied a prominent position as a strategic crop for food security and economic development of nations of the world (Chukwu *et al.*, 2016). The President of Rice Farmers Association of Nigeria (RIFAN) known as Goronyo stated that annual rice production in Nigeria has grown from 5.5 million tons in 2015 to 5.8 million tons in 2017 (Ladapo *et al.*, 2020; Obianefo *et al.*, 2020) and that the consumption rate now is 7.9 million tonnes while the production rate has increased to 5.8 tons per annum. This is an improvement on the 2.21 million tons, milled product as at 2020 when annual rice demand was estimated at 5 million tones (NRDS, 2020). Obianefo *et al.* (2020) also remarked that the annual rice demand growth rate in Nigeria is 7.8% and the supply growth rate is 5.5% leaving a deficit demand-supply gap of 2.3%. Thus, the future challenge for the country's rice industry is to satisfy the country's projected growing demand (Osuafor & Ude, 2021).

Attaining a suitable resource allocation structure usually revolves around the farm manager. At the onset of a particular farming season, the manager of a farm gathers resources together and determines how much is meant for what in anticipation of a favourable harvest. His pattern of input allocation will have to depend on his experience in farming, his personality and openness, his knowledge and intuition, the scale of production (Nuthall, 2019). Adherence to the budget is desired but it is subject to change as uncertainties arise. Khan *et al.* (2019) opined that the measurement of efficiency is imperative to make effectual the management decision of resource allocation and put together different kinds of policies for the improvement of rice production.

It is in the place of decision making those choices of the inputs to be used are made, followed by cost attachments depending on the scale of production and the input's importance. According to Stapenhurst (2020) and Ray *et al.* (2015), a usual way to improve cost-effective performance among farms is to benchmark the relative performance against the performance of leading farms in the industry. This is achieved by comparing the average of the best performing farms to the particular farm in question. A good manager then follows it up either to improve decisions about his inputs or find out why his farm's performance is not optimal. By identifying expense structures and the capital distribution of the top managers, inferences can help lower performing managers make expenditure adjustments to assist in improving profitability (Shockley *et al.*, 2016). Industry figures or standard benchmarks are often available in advanced countries, but are in most cases lacking in developing countries. Given that farm and site-specific characteristics outside the control of the farmer influence performance economically, environmentally and socially, the availability and accessibility of farm-specific benchmarks which guides the use of recommended practices and targets are needed to improve performance (Pope and Asseldonk, 2015). Simply put, benchmarking means comparison of a farm with best farms having similar enterprises and outlining methods for improvement. Having the farms split (relative to the net farm income) into three groups of top performers, average performers and low performers will help show the expenditure pattern for best farms and what leads to farm success.

The analysis of the management of farm business helps one to understand how one's business is performing and considers ways to improve the profitability of the business (Alford *et al.*, 2017). Farm analysis helps one to examine ways to look at the combination of physical and financial inputs to improve farm profitability and liquidity. In this period of threat from economic recession, farm business performance needs to be appraised and subsequently



compared to other farm businesses within the industry. Only then can a manager know if he is truly in business or at the mercy of competitors. Increased productivity can be achieved through an efficient input mix and benchmarking of individual farms in Nigeria. Hence, the specific objectives of the study were to:

- i. categorize production input patterns based on farm performance and expenses;
- ii. determine the performance benchmark from the category after identifying the existing standard;
- iii. identify diverse effect of production inputs cost on rice farm output for different production level; and
- iv. identify causal factors of differences in farm performance.

MATERIALS AND METHODS

The Study Area

This study was conducted in Anambra State of Nigeria. The State is located in the Southeast Geo-Political Zone of Nigeria and was established on the 27th of August, 1991. It covers an area of 4,416sq km and has a population of 4,182,000 people (National Population Commission [NPC], 2006). All rice farms in the state made up the population of the study.

Sampling Procedure

The sample frame was a list of rice farm managers gotten from Anambra ADP while the sample farms were drawn in a three-stage sampling process. The first stage involved the purposive selection of Aguata and Anambra agricultural zones because they have more rice farms than the others (Obiekwe & Ugwumba, 2016). In the second stage, two local government areas (LGAs) were randomly selected from each zone, giving a total of four LGAs. In the third stage, two communities were randomly selected from each of the four LGAs, giving a total of 8 communities. In the fourth stage, 15 rice farms were randomly selected from the 8 communities, making a total of a hundred and 20 rice farms. This study utilized primary data. Descriptive statistics such as mean, percentages and frequency distribution tables were used to achieve objectives i and ii. Objective iii was realized using net farm income analysis. Quantile regression was used to analyze objective iv. The null hypothesis was tested with Analysis of Variance test.

Model Specification:

Quantile regression is a type of regression analysis that estimates conditional median and other quantiles instead of the mean as the case in Ordinary Least Squares (OLS) regression. It focuses on the interrelationship between a dependent variable and its explanatory variables for a given quantile (Chidmi *et al.*, 2019). Its mathematical representation is given by:

Let (Y) be the real valued random variable with cumulative distribution function

$$F_Y(y) = P(Y \leq y) \quad \dots(1)$$

The τ th quantile of Y is given by $Q_Y(\tau) = F_Y^{-1}(\tau) = \inf\{y : F_Y(y) \geq \tau\} \dots(2)$

where;

$\tau \in [0,1]$.

The equation can be simplified thus; $y(q\tau) = \tau \quad \dots(3)$

where;

q_τ is the τ th quantile of the random variable Y.

Presenting the formula with regressors takes the form of ordinary least square regression model as:

$$Y_i = F(\text{land, labour, seed and fertilizer}) + u_i \quad \dots(4)$$



where;

Y_i =rice farm output (Kilogram)

Land is the farm size under production whether owned, leased, bought or shared (measured in Hectare). Labour is human labour used including family, hired and permanent labour. (Man day); seed is rice seedlings planted (Kilogram) and fertilizer includes natural and synthetic fertilizers and all agro chemicals used (Kilogram); and ui is the stochastic component of the farm yield for farmer i .

Net Farm Income Analysis

Net farm income refers to the return (both monetary and non-monetary) to farm operators for their labour, management and capital, after all production expenses have been paid (that is, gross farm income minus production expenses). It is a measure of profitability ascertained through the information from farm level data and was used as the dependent variable. Profitability means the difference between the worth of a product and the production expenditure of the product. Net farm income was obtained thus:

$$NFIA = TR - TC \quad \dots(5)$$

$$TR = P.Q$$

$$TC = TFC + TVC$$

where;

NFIA = Net farm income analysis

TR = Total revenue

TC = Total cost

P = Unit price of output

Q = Total quantity produced

TFC = Total fixed cost

TVC = Total variable cost

Test of Hypothesis

Analysis of variance (ANOVA) is a test performed to find out if survey results are significant. In other words, it helps you to figure out if you need to reject the null hypothesis or accept the alternative hypothesis. ANOVA gets the differences by comparing the means of each group which for this study becomes the independent variables of cost.

The model for one-way Analysis of variance is given by; $F = \frac{SSB}{SSW} \left(\frac{n-k}{k-1} \right) \quad \dots(6)$

where;

SSB =sum of squares between the group

SSW = sum of squares within the group

n = number of means to be compared

k = constant

n-k = degree of freedom for the SSB

k-1= degree of freedom for the SSW

Rejection rule: Reject null hypothesis if the f-value for the treatment is greater than the significance level or if the p-value is less than the significance level.

RESULTS AND DISCUSSION

Categorization of Farms

Rice farms in the study area were categorized based on their input and output variables so as to analyze the cost patterns. To better determine the cost decisions of the various farm managers with respect to their effect on farm outcome, four independent variables of land, fertilizer, seed and labour were outlined. It was then placed side by side with net farm income



which is the dependent variable. With the net farm income arranged in ascending order, the total farms were divided into three groups of top performers, average performers and below average performers. The summary of these groups of farms is presented in Table 1.

Table 1: Summary of the Top Performing Farms by Farm Performance

Variables	Number observation	Mean	Std. Dev.	Min.	Max.
Net farm income					
Top performing farms					
Cost of land	40	15253	7918.32	2500	25000
Cost of fertilizer	40	47636.25	12002.15	18600	78200
Cost of seed	40	20036	5680.71	8040	36000
Cost of labour	40	161744.4	30839.81	104453	234309
Middle performing farms					
Net farm income	40	207567.3	28818.57	155000	255000
Cost of land	40	13975	9003.53	2000	33500
Cost of fertilizer	40	46132.76	12020.75	5250	73600
Cost of seed	40	17572	4587.51	7500	26000
Cost of labour	40	172207.6	46153.76	103000	281400
Low performing farms					
Net farm income	40	92,258.38	47,139.02	1,800	151,000
Cost of land	40	15,003.75	8,549.59	2,000	30,000
Cost of fertilizer	40	47,051.64	13,691.51	11,125	90,500
Cost of seed	40	15,779.75	4,820.15	6,250	26,000
Cost of labour	40	169,739	42,569.07	94,625	263,000

Source: Field Survey (2020)

The maximum net farm income from the Table 2 is ₦643, 000 while the minimum for the top performers is ₦255, 000. The first 40 observations had a mean net farm income of ₦340,305 and a standard deviation of 86030. The minimum cost of land (₦2500) was 10% of the maximum (₦25,000). The highest standard deviation was derived from the net farm income while the least was from the cost of seed. The average incomes for the three groups followed the expected high, medium and low pattern but the standard deviation for the average performers was the lowest followed by that of the low performers.

Table 2: Summary of Net Farm Income among the Groups

Variable	Groups	Sum (₦)	Mean	Std. Dev.	Minimum	Maximum
Net Farm Income	Top Performers	13612215	340305.38	86030.21	255000	643000
	Average Performers	8302692	207567.3	28818.57	155000	255000
	Low performers	3690335	92258.38	47139.02	1800	151000

Source: Field Survey (2020)

The second aspect of the categorization was based on the expenditures. The four cost variables further grouped into three had their sum, mean, standard deviation, minimum and maximum presented in Table 3. Worthy of note is the fact that high-income earners had the highest average expenditures in all cost categories while the low-income earners had the lowest. The average income earners had the lowest standard deviation in all cost categories except for the cost of land where the low-income earners had the least. This is almost in line with the findings of Osborne (2019) who found that that the middle-income group had the



smallest standard deviation in every cost category. The top performers had the highest standard deviation in the cost of seed and land alone. The highest standard deviation for fertilizer cost was from low performers and that of land was from average performers.

Table 3: Summary of Cost of Land, Fertilizer, Seed and Labour

Variable	Groups	Sum (₦)	Mean	Std. Dev.	Min.	Max.
Cost of Land	Top performers	960,120	24,003	3,245.08	20,000	33,500
	Average performers	622,000	15,550	3,734.45	6,000	20,000
	Low performers	187,150	4,678.75	907.16	2,000	6,000
Cost of Fertilizer	Top performers	2,315,100	57,877.5	8,622.32	52,000	90,500
	Average performers	1,949,131	48,728.28	2,451.32	44,600	51,000
	Low performers	1,368,595	34,214.88	10,235.99	5,250	43,350
Cost of Seed	Top performers	903,900	22,597.5	4,056.81	2,000	36,000
	Average performers	748,500	18,712.5	1,340.34	16,000	20,000
	Low performers	483,110	12,077.75	3,101.41	6,250	16,000
Cost of Labour	Top performers	8,505,797	212,644.93	30,634.70	178,000	281,400
	Average performers	6,526,025	163,150.63	10,121.53	147,000	177,750
	Low performers	5,115,817	127,895.43	13,994.37	94,625	146,100

Source: Field Survey, 2020.

Summary of Patterns in Percentages

In Table 4, more than half of the total net farm income (53%) and the total cost of land (54%) were attributed to the top performers. This showed that high income managers know how to invest in quality and fertile lands that will give them better returns.

Table 4: Summary of Patterns in Percentages

Variables	Total in Naira	Top Farms in %	Medium Farms in %	Low Farms in %	Total in %
Net Farm Income	25605242	53	32	15	100
Cost of land	1769270	54	35	11	100
Cost of fertilizer	5632826	41	35	24	100
Cost of seed	2135510	42	35	23	100
Cost of labour	20147639	42	32	26	100

Source: Field Survey, 2020.

Farm Performance Standard or Benchmark

Farm benchmark or farm performance standard is an available standard of farm performance in an area against which other farms can compare outcomes to aid proper decision and improvement motive. This standard is gotten from the average of the best or top performing farms in the area and is expected to spur the spirit of competition in other producers to be one of the best or better than the best. This study utilized the best 20 farms from the top performers. Their net farm income was added and the average gotten to be a standard for rice farms in the study. This standard is subject to change periodically like annually or quarterly as the case may be. The sum of the net farm income for the first 20 best farms in monetary terms is ₦7,809,487. The mean standard benchmark is then ₦390,474.35 which is approximately ₦390,500. For 2020 production year, any rice farm in Anambra State generating ₦390,500 and above in one hectare of farm land as the net farm income would be regarded as a good business venture.



While other farms below the mark should aim at improving their production and management techniques. This is presented in Table 5.

Table 5: Farm Performance Standard or Benchmark

Variables	Farm Performance Standard or Benchmark
Net Farm Income for 20 best farms	7,809,487.00
Mean standard benchmark	390,474.35

Source: Field Survey, 2020

Quantile Regression: The varied effects of the cost variables on the farm outcome

The cost variables invariably have an effect on the farm outcome which for this study is represented as the net farm income. Quantile regression just like other regression techniques will show the effect of the independent variables on the dependent variable. But unlike the other regressands, quantile regression has the capacity to show the different effects of the explanatory variables at different points along the distribution of the explained variable. This study divided the rice farms into three sub groups and we expected to get three different regression results for the three quantiles of 0.25, 0.50 and 0.75. The functional form of double log was used because it was of best fit. The summary is captured in Table 6.

Table 6: OLS and Quantile regression analysis of the three groups of farms

Variable	OLS	Q(.25)	Q(.50)	Q(.75)
Cost of land	0.07 (0.60)	0.06 (0.65)	0.18 (0.01)***	0.15 (0.00)***
Cost of fertilizer	-0.52 (0.04)**	-0.49 (0.09)*	-0.21 (0.07)*	-0.14 (0.08)*
Cost of seed	0.84 (0.01)***	1.03 (0.01)***	0.70 (0.00)***	0.44 (0.00)***
N	120	120	120	120

Note: Probability value in parentheses *p < 0.10, **p < 0.05, ***p < 0.01

Source: Field Survey, 2020

The low farms, medium farms and high-income farms were represented by 0.25, 0.50 and 0.75 quantiles, respectively. The ordinary least square regression result will be compared to the quantile regression results for better clarification as to the choice of the model. The significance level for this study is 0.05 with a corresponding confidence level of 95%. If the probability value is less than 0.05, we conclude that a significant difference does exist. Ordinary least square estimates states that Anambra State farmers could only improve their net earnings per hectare if they increase the cost of seed. The estimate of about 0.84 per additional Naira increase in the cost of seed is made by the model. The cost of fertilizer and the cost of labour would negatively increase with a positive increase in the net farm income. But this suggestion is not favourable for the different groups of farms. The low performing farms are only expected to channel their resource increase to the purchase of seed. This shows that a lot of the low performing managers neglect the importance of quality seeds or allow a lot of land under sparse seed plants.

The middle-income managers are expected to increase their land and seed expenditures in order to increase their farm performance. Increasing land expenses does not necessarily mean purchasing more lands, but taking note of quality and fertile lands which in most cases are costlier. Up to 70% per increase in farm outcome and 18% increase will be accounted for by the increase in seed and land, respectively. The requirement for top managers is quite different. Increasing expenditures on labour would cause a negative effect (0.48) on net farm income for the 75th quantile. While increasing all other expenditures will positively increase



farm performance. From the tables, poor-performing managers have only one significant expense outlet for increasing net farm income. Middle performing managers have two while top performers have three. Costs of fertilizer and seed are all negatively significant with varying degrees of significance level while only cost of seed is in all positively significant for both OLS and quantile regressions. The difference is that cost of fertilizer is significant at 5% level while it is only significant at 10% level for the quantiles. Another difference is that while the OLS model predicts a 99% negative effect in labour increase, the negative effects for the quantile model are all below 50%.

Causal Factors of Differences in Farm Income

The result of the analysis is presented in Table 7. From a pool of the farmers' perception of the constraints they face, the factors limiting farms' optimum rice output and quality thereby causing differences in farm outcome in the area includes; water availability, level of inputs utilization at the farm level, mixing of different seed varieties, unavailability of lowland rice production ecology, lack of extension workers' visits, variety and quality of crops available, none adoption of new technology, belonging to an association/ cooperative, size of the farm, financial constraints and managerial ability. From the result, only water availability and belonging to a cooperative were rejected by the farmers while others were accepted in varying degrees.

Table 7: Causal Factors of Farm Outcome Differences

Causal Factors	Mean	SD	Decision
Water availability	2.43	0.60	Rejected
Level of inputs utilization at the farm level	3.10	0.83	Accepted
Mixing of different seed varieties	2.64	0.56	Accepted
Unavailability of lowland rice production ecology	2.60	0.70	Accepted
Lack of extension workers visits	2.50	0.67	Accepted
Variety and quality of new technology	2.63	0.63	Accepted
None adoption of new technology	2.79	0.73	Accepted
Belonging to an association / cooperative	2.28	0.50	Rejected
Size of the farm	3.11	0.78	Accepted
Financial constraints	3.88	0.33	Accepted
Managerial ability	3.24	0.72	Accepted
Decision rule: ≥ 2.5 = Accept. < 2.5 = Reject			
Other Causal Factors	Frequency	Percentages	
High cost of agrochemical	2	2.70	
Seasonal variation or climate change like flooding	10	13.51	
High cost of inputs/labour	30	40.54	
Pest and diseases	22	29.73	
Herdsmen	1	1.35	
Insufficient modern tools like tractor	9	12.16	
Total	74	100.0	

Source: Field Survey, 2020

The benchmark of 2.5 was obtained which guided the decision to accept or reject a factor. In clear terms, any factor with mean point greater than or equal to 2.5 was accepted while otherwise is rejected. The farm managers were of the opinion that financial constraint is the major factor that causes differences in farm output. The place of finances in every farming enterprise cannot be denied. Managerial ability was the second factor to be accepted. In as



much as this ability is part of the inert ability of an individual, it plays an important role in any business management. The managers also attributed the limitation to the size of the farm and the level of input utilization at the farm level. Size of the farm can be linked to financial constraints since more money can lead to more expanse of land, while the level of input utilization can be linked to managerial ability which is the focus of this study. A good manager should know how to mix the inputs for optimum yields and sales. Since this is one of the main limiting factors, more is needed in the area of management training for our farmers. This agrees with that of Adetimehin *et al.* (2018) that rice farmers do not have adequate knowledge for the efficient management of their farms.

Other causal factors suggested by the farm managers in their order of importance include, high cost of inputs/labour suggested by 30 managers. This has been a problem for agriculture in developing nations and Nigeria is not left out. The second is pest and diseases with the frequency of 22. Seasonal variation or climate change like flooding is a new factor that exists because of ozone layer depletion. Insufficient modern tools like tractor are the next with the frequency of 9. High cost of agro chemicals and finally herdsmen attack are the least of the factors. The study by Khapayi and Celliers (2016) outlined among other factors, the lack of implements, poor management skills and low education as limiting factors. Amene (2017) also added financial factor and infrastructural factor. This result is in line with the findings of Keszthelyi (2018) and Chukwu *et al.* (2016) who noted that farm size has been found to influence the cost-effective performances of farms.

Test of Hypothesis

The null hypothesis that guided the work is- there are no significant differences in the mean values of input expenditures for different production level. This was tested using the analysis of variance (ANOVA) technique and the result presented in Table 8 showed that it is insignificant.

Table 8: Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	184610032	2	92305016.2	0.05	0.9525
Within groups	2.2162e+11	117	1.8942e+09		
Total	2.2180e+11	119	1.8639e+09		
Bartlett's test for equal variances: chi2(2) = 6.3043 Prob>chi2 = 0.043					
Source: Field Survey, 2020					

The result showed that the calculated F value is 0.05. This value is equal to the significance value of 0.05 making us to accept the null that there is no significant difference between the average expenditures for the groups of farms. This Analysis of variance was applied in a study to show variations of rice production variables. Here, some of the rice variables were slightly significant while some were negatively significant (Oladimeji, 2017).

CONCLUSION AND RECOMMENDATIONS

The study focused on input cost patterns and how they affect or influence the performance of farms. Quantile regression was employed instead of ordinary least square method because of the different groups of farms which require particular recommendations instead of general. The varied results from the two models also point to the conclusion that quantile regression is a better model to study farm performance. This study finds that poor-performing managers have only one significant expense outlet for increasing net farm income.



This shows lack of knowledge on basic farm principles which points to the need for more impacting extension service. There is still room for improvement for the middle and even the high performing managers to grow to the best and better than the best rice farm managers. Based on the results of this study, the following recommendations are given to serve as reference points for further research and future strategies at promoting rice production increase in Nigeria. This would come under two sub headings; recommendations for further action and recommendations for further research.

- i. Research has shown that the concept of benchmarking which is relatively new and unexplored is a widely unknown term among the farmers and even the extension agents. Efforts should be made to create the awareness for proper enlightenment and application.
- ii. Financial constraints and high cost of inputs should be tackled by the government through the provision of subsidies for farmers.
- iii. Climate change can be mitigated by the government through climate change adaptive reforms while pest and diseases should be handled through resistant varieties.
- iv. Managerial ability is under the purview of the extension agents. Our managers need training in order to increase efficiency so better extension service should be promoted.

REFERENCES

- Alford, A., Ashwood, A., Buesnel, D., Davies, L., Dowman, T. and Griffiths, C. (2017). *Dairycheck – Farm business management analysis* [Manual]. An initiative of the NSW Government and Dairy Industry. New South Wales, Australia.
- Adetimehin, O.D., Okunlola, J.O. and Owolabi, K.E. (2018). Utilization of agricultural information and knowledge for improved production of rice farmers in Ondo State, Nigeria. *Journal of Rural Social Sciences*, 33(1), 76-100.
- Amene, T.B. (2017). Assessment of factors affecting performance of agricultural cooperatives in wheat market: The case of GedebHasasa District, Ethiopia. *African Journal of Business Management*, 11(16), 393-414.
- Chidmi, B., Solis, D. and Cabrera, V.E. (2019). Analyzing the sources of technical efficiency among heterogenous dairy farms: A quantile regression approach. *African Journal of Agricultural Marketing*, 7(2), 001-007.
- Chukwu, V.A., Eze, A.V. and Osuafor, O.O. (2016). Socio-economic determinants of adoption of improved rice Production technologies among Rice Farmers in Ebonyi State Nigeria: A logit regression model approach. *Elixir Agriculture*, 94, 39900-39908.
- Erenstein, O., Lançon, F., Osiname, O. and Kebbeh, M. (2004). *The Nigerian rice economy in a competitive world: constraints, opportunities and strategic choices*. West Africa Rice Development Association (WARDA), Côte d'Ivoire.
- Ibrahim, A., Ayodele, A., Hakeem, M. and Adeniran, Y.A. (2018). Oil price shocks and Nigerian economic growth. *European Scientific Journal*, 10(19), 375-391.
- Keszthelyi, S. (2018). *The components of agricultural income development over the last decade in Hungary*. Pociolio 22, Innovations in farm level data. Dublin, Hungary: Research Institute of Agricultural Economics.
- Khan, A., Huda, A.F. and Alam, A. (2019). Farm household technical efficiency: A study on rice producers in selected area of Jamalpur district in Bangladesh. *European Journal of Social Science*, 14(2), 262-271.
- Khapayi, M. and Celliers, P.R. (2016). Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa. *S Afr. Jnl. Agric. Ext.* vol.44. Retrieved from <http://dx.doi.org/10.17159/2413-3221/2016/v44n1a374>.



- Ladapo, H. L., Aminu, F.O., Selesi, O.S. and Adelokun, I.A. (2020). Determinants of the effects of pesticide use on the health of rice farmers in Kwara State, Nigeria. *Journal of Research in Forestry, Wildlife and Environment*, 12(3), 198-205.
- National Rice Development Strategy [NRDS] (2020, May 29). A draft report prepared for the Coalition for African Rice Development (CARD). Federal Republic of Nigeria.
- Nuthall, P. L. (2019). Managerial ability: A review of its basis and potential improvement using psychological concepts. *Journal of Agricultural Economics*, 24(3), 247-262.
- Obianefo, C.A., Osuafor, O.O., Ezeano, C.I. and Anumudu, O.O. (2020). Mediation effect of adopting good agronomic practices on rice productivity in Anambra State, Nigeria. *International Journal of Agriculture and Rural Development*, 23(1), 4913-4926.
- Obiekwe, J. N. and Ugwumba, C.O.A. (2016). Encouraging the rice production enterprises for employment development and poverty reduction: The case of Anambra State, Nigeria. *Asian Academic Research Journal of Social Science and Humanities*, 3(6), 200-210.
- Oladimeji, Y.U. (2017). Food production trend in Nigeria and Malthus theory of population: empirical evidence from rice production. *Nigerian Journal of Agriculture, Food and Environment*, 13(1):126-132.
- Osborne, W. A. (2019). *Improving farm management decisions by analyzing production expenditure allocations and farm performance standing*. Master's thesis, The University of Kentucky. Retrieved from http://uknowledge.uky.edu/agecon_etds/20.
- Osuafor, O. O. and Ude, K.D. (2021). Valuation of rice farmers' preferences and willingness to pay for climate-smart agricultural technologies in Southeast Nigeria. *Asian Journal of Economic Modelling*, 9, 48-57.
- Poppe, K. and Asseldonk, M. (2015). Eip-Agri Focus Group Benchmarking of Farm Productivity and Sustainability Performance: How can farmers and advisers use benchmarking data and process to improve productivity and sustainability performance? Retrieved online 09/02/21 from https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_fg_benchmarking_starting_paper_2015.pdf
- Ray, S. C., Kumbhakar, S.C. and Dua, P. (2015). *Benchmarking for Performance Evaluation: A Production Frontier Approach*. New Delhi, India: Springer.
- Shockley, J.M., Osborne, W.A., Dillon, C.R. and Pierce, J.S. (2016). A two-tiered benchmarking analysis for cost management. *Journal of the ASFMRA* Retrieved from <https://higherlogicdownload.s3.amazonaws.com/ASFMRA/aeb240ec-5d8f-447f-80ff-3c90f13db621/UploadedImages/Journal/437-Shockley.pdf>.
- Stapenhurst, T. (2020). *The benchmarking book*. (1sted.) Oxford, United Kingdom: Routledge.