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ECONOMICS OF GOOD AGRONOMIC PRACTICES ADOPTION BY RICE FARMERS IN VALUE CHAIN DEVELOPMENT PROGRAMME, ANAMBRA STATE, NIGERIA

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ABSTRACT

The study was on the economics of good agronomic practices adopted by rice farmers in the value chain development programme, Anambra State, Nigeria. The specific objectives focused primarily on the extent of good agronomic practice (GAP) adoption, cost and returns from GAP rice production, resource use efficiency and challenges of GAP adoption in the study area. Data were collected through a well-structured questionnaire from a cross-section of 337 (representing 91% of the approved sample size) rice farmers randomly selected by multi-stage sampling procedures. A combination of analytical techniques was used to operationalize the models. The study established that farmers did not adopt any technology disseminated at a pre-planting stage of rice farming, but adopted timely planting, bund making for water management and weed and/ or pest control in the planting stage of the technologies, while winnowing and proper storage of paddy had been successfully adopted at the post-planting stage. Evidently, about 50% of the technologies disseminated in the study area are under trial or consideration stage. From the profitability analysis, the study revealed a 59% return on investment for every 1 USD invested. However, the project implementers need to reduce the cost of fertilizer and labour, these could be achieved through increasing beneficiaries' budget on fertilizer by 12.4% and over 100% for labour through mechanization to justify the estimation of resource allocation efficiency which reported inefficiency for all the plating inputs. The study equally identified some factors militating against the adoption of GAP which were rotated into four components named institutional, socioeconomic, and economic and management factors. These four factors: institutional (24.5%), socioeconomic (10.9%), economic (10.5%) and management (9.5%) accounted for 55.4% of the challenges to GAP adoption. The study, therefore, concludes that GAP has not been fully adopted by farmers, this is because one-time use of technology does not guarantee its adoption. However, efforts should be prioritized by the appropriate authorities to tackle the identified challenges since the gain in rice production is worthwhile.

Key words: rice farmers, adoption, good agronomic practice, value chain development

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INTRODUCTION

Rice is one of the fastest-growing commodities in Nigeria's food basket with the likelihood of continued growth [1, 2]. Eating a cup of rice (65gram net weight) supplies one with 53 grams of carbs which translates to 23.6% of daily carbohydrates required and 10.6% of the daily energy required from 2000 calories [3]. The demand for rice has been increasing more rapidly in Nigeria compared to other West African countries. This rapid increase in rice demand is largely due to rapid population growth, increased urbanization and people's preference for the product.

It has been observed that Nigeria's annual rice demand has grown since 2018 by 7.8%, while supply has grown by a contrasting rate of 5.5% leaving a deficit demand-supply gap of 2.3% [4, 5]. This reveals that Nigeria is yet to attain self-sufficiency in rice production and supply.

The demand and supply gap in Nigeria's rice production sub-sector has been a source of concern to scholars and policymakers who have notably related some of these empirical issues causing the deviation to low productivity, inefficiency in resource allocation, little or no access to improved variety and production in the hand of smallholder out-growers who rely heavily on traditional technology [6, 7].

Other researchers in their study have equally maintained a similar opinion that the reason for this huge gap remains the farmer's inability to adopt the best technological practice in agriculture resulting from a low level of income, high cost of inputs and poor access to irrigation facilities, pest and diseases that reduce yield and high cost of labour [8]. Recently, the increased crises between herders and farmers, as well as other insurgency and agitation from many groups in Nigeria have widened the line of demand-supply deficit [6].

Having identified some empirical issues disrupting the attainment of self-sufficiency in Nigeria's rice sector, the Federal Government of Nigeria and the International Fund for Agricultural Development Project (IFAD) adopted some strategic programs to address production challenges. Some of the challenges include low productivity, a paucity of opportunity for value addition, inadequate access to inputs and productive assets, inadequate research and extension, scarcity of funds and credit, insufficient market and rural infrastructures, post-harvest handling and inadequate access to improved seeds among others through the establishment of Value Chain Development Programme (VCDP) on rice and cassava commodity [9].

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This gap between domestic demand and supply of rice has left Nigeria highly dependent on rice importation. Efforts should be directed to promote national self-sufficiency in rice production through the intensification of farmers' need to adopt agricultural technologies. Due to farmers' reliance on traditional technologies like slow use of modern inputs, use of grains in place of improved seed, manual weeding and poor fertilizer usage, their output or rice yields range from 2 - 3 tons per hectare (tons/ha) against the potential yield of 4 - 7 tons/ha [10]. To close these gaps, the Value Chain Development Programme tries to promote good agronomic practices or improved technology adoption through Farmer Field Business School (FFBS) and Demonstration plots to disseminate extension messages to members of Farmer's Organizations (FOs) and to facilitate the adoption of innovative technologies that will drive self-sufficiency in rice production sub-sector [5].

Intensive training on rice cultivation can effectively enhance the adoption of new technologies including improved variety, site selection and land preparation, chemical fertilizer and improved agronomic practices such as nursery, transplanting, germination test, good spacing, urea deep placement and productivity of rice cultivation among others [11, 12]. However, these improved rice cultivation technologies are not widely adopted partly because of the weak public extension system [13]. These, however, make the introduction of good agronomic practices ideal to improve agricultural production. The good agronomic practice (GAP) in rice production is a technological package that is suitable for a particular farm environment aimed at helping farmers to improve their yield or productivity. Furthermore, GAP should be seen as a basket that contains many agricultural practices in which the farmers can choose the most suitable practices that fit into their immediate environment. These practices are not limited to improved cultivars, bunding, best rice planting procedures, weeding and nutrient management method, pest control, proper harvesting and post-harvest techniques.

Much research abounds in the area of agricultural technology adoption in different agricultural production [14, 15]; but none to the best of the researcher's knowledge, has been carried out on the economics of good agronomic practices by rice farmers in Anambra State value chain development programme. This Value Chain Programme is a counterpart agricultural programme of the IFAD and the Federal Ministry of Agriculture and Rural Development signed in 2014 and became operational in 2015 to support rice and cassava production in Nigeria. Initially, five (Anambra East and West, Ayamelum, Orumba North and Awka North) Local Government Areas in the State played a host community to the programme [5].

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Later on, in 2019, additional fund was secured by the programme implementation unit to include three more LGAs (Ogbaru, Ihiala, and Orumba South) based on principles of comparative advantage. The programme activities in these LGAs include farmers' organization strengthening, business development, 50% input support, 70% support for farm machinery, land development and construction (farm access road, market infrastructure and storage facilities) among others.

Since the programme is promoting rice value chain for food security and poverty reduction in rural areas, there is an urgent need to address these problems raised and to operationalize the study objectives which specifically tend to:

i. understand the extent of good agronomic practice (GAP) adoption by rice farmers,
ii. estimate the profitability of GAP rice farming,
iii. ascertain the resource allocation efficiency of GAP rice farmers, and
iv. examine the challenges to GAP rice farming in the programme.

MATERIALS AND METHODS

The study was conducted in Anambra State, Nigeria. The State is located in the south-eastern part of Nigeria and comprises 21 Local Government Areas (LGAs) subdivided into four agricultural zones [16]. A multi-stage sampling technique was employed to arrive at the right sample size for the study. In the first stage, the sample frame (5396) was obtained from the programme implementing units, and a Taro Yamane sample size determination adapted from Otabor and Obahiagbon [18] was used to calculate the sample size.

$$n = \frac{N}{1 + N(e)^2}$$

Where: N = total population, n = sample size, (e) = level of significance, 1 = constant. Note: (e) = 0.05.

$$n = \frac{5396}{1 + 5396(0.05)^2} = \frac{5396}{1 + 5396(0.0025)} = 372 \text{ farmers}$$

In the second stage, the researcher(s) adopted the stratum formula to allocate the sample strata as used by Ekwere and Edem [19].

$$i_{th} = \frac{n_i * n}{N}$$

Where: n = total sample size, n_i = number of farmers in each location, N = total population of the farmer in the study, i_{th} = strata allocation (See table 1).
Finally, seven villages make up a rice cluster in VCDP and every village must have at least three rice farmers' cooperatives from which farmers were randomly selected.

The questionnaire was designed in three sections. Section A was designed to collect data about the extent of adoption of the good agronomic practices disseminated to the farmers. The questions were collected in 5-point Likert scale where 1 = aware, 2 = interest, 3 = evaluation, 4 = trial and 5 = adopted. Section B was designed to collect data about rice production inputs measured at different measurement scales as appropriate to particular inputs and sale revenue measured in USD. Equally, section C was designed to collect data about the constraints to the adoption of good agronomic practices. The questions were collected in 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree.

DATA ANALYSIS

The study used a combination of analytical tools like descriptive, budgetary method, multiple regression analysis and principal factor analysis (PFA) to operationalize the objectives. Objective one (understand the extent of good agronomic practice (GAP) adoption by rice farmers) was achieved with a mean score on a 5-point Likert scale; the choice of this tool rested on the fact that there are five stages of agronomic practice adoption which need to be represented in the analysis. Objective two (estimate the profitability of GAP rice farming) was achieved with a budgetary method; this technique was adopted as the best tool for partial budgeting in the study. The resource allocation efficiency of the farmers was estimated from multiple regression analyses that operationalized the production function of rice farmers. However, objective three (ascertain the resource allocation efficiency of GAP rice farmers) was descriptively calculated from the lead equation. Again, the Principal Factor Analysis model was used to operationalize objective four (examine the challenges to GAP rice farming in the programme). The model was adopted to rotate the peculiar challenges into common factors with associated regression weight, this helps the farm manager to allocate scarce resources in dealing with the identified issues.

The explicit regression model for the study was defined as:
$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \varepsilon_i$$

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Where: Y is the observed rice yield (kg/ha), X_1 is rice seed (kg/ha), X_2 is fertilizer (kg/ha), X_3 is urea (kg/ha), X_4 is cultivatable land (ha), X_5 is labour (man-day), X_6 is agrochemical (lit/ha), β_0 is constant, $\beta_1 - \beta_6$ is the parameter to be estimated, and ε_i is the stochastic error term.

The allocative efficiency formula adopted from [20] is defined as:

$$r = \frac{MVP}{MFC}$$

$$MVP = MPP * P_y$$

The desired percentage of MVP of individual resources required for maximum allocation (r = 1) adopted in [21] was defined as:

$$D = 1 - \frac{MFC}{MVP} * \frac{100}{1} \text{ or } 1 - 1/r$$

Where: r = allocative efficiency, MVP = marginal value product, MPP = marginal physical product, P_y is revenue from rice sales, MFC = marginal factor cost (mean price of unit input cost in an open market economy), D = percentage of desired resource values. Note that; when: r = 1 implies efficient utilization of resources, r < 1 implies overutilization and r > 1 implies underutilization of resources [22].

The factors militating against the adoption of GAP by rice farmers in the Value Chain Development Programme adopted a principal factor analysis (PFA) to select the least number of factors that accounted for the common variance explained on the set of the variables in the study. By the rule of thumb, to proceed with PFA analysis, the benchmark for Kaiser-Meyer-Olkin Measure (KMO) is 0.7, alpha reliability is 0.7, total variance explained is 53% and that non-negative definite (determinant) must be greater than zero [16]. The principal factor analysis (PFA) model was defined as:

$$Z_i = \delta_{i0} + \delta_{i1}F_1 + \delta_{i2}F_2 + \dots \delta_{im}F_m + \varepsilon_i$$

Where Zi is the observed challenges, δi0 is the vector of means, δi1 - δim is the factor loading (regression weight), F1-Fm is the vector of factors, ei is the vector of residual variables or unobserved stochastic error term with zero mean and finite variance [23].

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RESULTS AND DISCUSSION

The Extent of Good Agronomic Practices Adoption in Anambra State Value Chain Development Programme

The extent to which rice farmers in the programme adopted good agronomic practices (GAP) is presented in Table 2. The findings showed that at the pre-planting stage, none of the technology was adopted (see table 2). At the planting stage, only timely planting, bund for water management and weeding/pest control were successfully adopted. Again, at the post-planting stage, only winnowing and proper storage of paddy was successfully adopted. Out of twenty-six (26) GAP technologies, only five were adopted by the farmers. These adopted technologies are similar to those found in Nenna in the role of extension in technology adoption [24].

Profitability of GAP Rice farming in Anambra Value Chain Development Programme

The profit from GAP rice production is presented in Table 3. The result revealed that the mean Paddy output was 4.81 tons (4813 kg/ha) against the 4.5 tons/ha reported by the International Institute of Tropical Agriculture in 2017 [10]. Within a space of three years, adoption of GAP saw 6.4% increase in paddy productivity from the standard recommendation.

Also, the project baseline reported in 2015 noted that the average rice productivity before the project commenced in 2015 was 2.6 tons/ha. This, therefore, implied that the project has delivered an extra 2.21 tons/ha due to its active extension service delivery. Again, in favour of GAP, paddy productivity increased by 45.9% in four years, indicating that the adoption of GAP is a gainful exercise to all farmers since it will increase their income status. This means that the gain in GAP adoption commiserates its benefit to farmer's income.

The mean farm size was 2.42 ha, while the total variable cost (VC) was 1,867.17 USD, and the average total fixed cost (TFC) was 413.86 USD. The Gross Margin (GM) which is the profit before tax that is just enough to pay for the operational expenses in the short run was 1,767.40 USD. Equally, the net gain for the total of 2.42 ha which is the profit after the total cost has been deducted is just enough to pay for all the costs incurred in the business, in the long run, was 1,353.54 USD (559.32 USD/ha). The return on investment (ROI) showed that GAP rice production will return 59% profit for every 1 USD invested in the sector.

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Production Function of GAP Rice Farmers in Anambra State Value Chain Development Programme

The result of the multiple regression analysis done to ascertain the lead equation that will help to estimate the resource allocation efficiency among GAP rice farmers is presented in Table 4.

The coefficient of multiple determinant (R^2) value of 0.974 indicated that 97.4% of the variation in rice yield was explained by the joint action of the predicting variables (inputs), while the remaining 2.6% unexplained resulted from external noise or error beyond the control of the farmers. The F-statistics was highly significant at 1% level of significance, which implies a good fit model and that the predictors influenced rice output in the study.

The coefficient of seed (14.814), farm size (4174.883), and labour (10.939) was positive and significant at 1% level of probability, this implies that a marginal increase in the supply of these factors (improved rice seed, cultivable land, and labour) used would increase rice productivity by 14.8136 kg/ha (seed), 4174.883 kg/ha (farm size) and 10.939 kg/ha (labour) respectively. Increasing the farm size by 1 ha would increase output by approximately 4.2 tonnes which is just 0.3 tons/ha below the International Institute of Tropical Agriculture recommendation in 2017 [10]. This result is in agreement with Olufemi and Ayodele [25] on the economic analysis of irrigated rice farming in Kano state. Again, in absence of mechanization, GAP adoption is labour intensive which justifies the high labour demand in the study area. Its application by one would increase rice output by 10.939 kg/ha.

The coefficient of N.P.K (15.15.15) fertilizer (25.876) used was positive and significant at 5% level of probability, implying that a marginal increase in the volume of fertilizer adopted and used would increase rice output by 25.876 kg/ha. This is only possible when applied properly and at the appropriate time. The finding is in agreement with Olufemi and Ayodele whose report noted that fertilizer has a significant and positive relationship with rice production [25]. Furthermore, the coefficient of urea (59.027) was negative and significant at 5% level of probability, which implied that a marginal increase in urea application would reduce rice output by 59.0274 kg/ha in the area. Urea should be applied two weeks after N.P.K fertilization. When urea is not used at the right time and proportion, it becomes toxic to the yield. Thus, rice farmers practicing GAP are advised to use urea deep placement (UDP). On the other hand, urea contains 46% Nitrogen for plant vegetation and should be applied immediately after planting, though, soil testing

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must be conducted to ensure the soil needs such amount of nitrogen being introduced [26].

Resource Allocation Efficiency of GAP Rice Farmers in Anambra State Value Chain Development Programme

The calculation of resource allocation efficiency of GAP rice farmers is presented in table 5. The study revealed that farmers under-utilized improved rice seed, urea, farmland and agrochemicals. This suggests that the farm managers should reduce the money budgeted for the inputs or reduce the quantity allocated to seed by 74.8%, urea by 90.5%, farmland by 100.0%, and agrochemical by 99.8%. They however, over-utilized N.P.K fertilizer and labour, these suggest that farm managers should increase the money budgeted for the input or increase the quantity allocated to fertilizer by 12.4% and labour by over 100%. Labour was under-budgeted by the farmers probably because the programme supports with 50% labour cost, this labour support often comes late and in return affects farmers' operations. This has proven that farmers should plan for their labour outside the programme support, but if it eventually arrives early, it would then serve as a bonus. These findings have validated the assertion of the Federal Ministry of Agriculture and Rural Development which noted that rice farmers are inefficient in the use of resources available [27].

Factors Militating against the adoption of GAP by Rice Farmers in Anambra State Value Chain Development Programme

The results of the factors militating the adoption of GAP is presented in Table 6, these factors were rotated into four components named institutional, socioeconomic, economic and management factors. This rotation pattern and naming are similar to the ones found in studies by Mignouna *et al.* and Keelan *et al.* [14, 15]. The 55.4% total variance of factors explained was accounted for by institutional (24.5%), socioeconomic (10.9%), economic (10.5%), and management (9.5%) factor militating against the adoption of GAP.

Furthermore, the variables that constitute the institutional factors with their construct effect size include training and/ or capacity building (0.931), extension services (0.850), learning route or social networking (0.528), and difficulty of machine operation (0.386). Socioeconomic factors include farm size for mechanization (0.769), bad road network (0.725), low level of education (0.623), household size to supply cheap labour (0.543), and inadequate access to credit (0.483). The variables under this factor aligned with those found in Mignouna *et al.*, Keelan *et al.*, and Genius *et al.* [14, 15, 28].

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Also, those that constitute the economic factors include net gain (0.847), inadequate access to off-farm income (0.747), and unavailability of demanded input (0.585). Finally, those that constitute management factors are environmental hazards (0.778), the generic nature of farm machines causes compatibility issues (0.661) and late arrival or disbursement of farm inputs (0.387). These variables corroborate those found in [29, 30].

CONCLUSION

The study analyzed the benefit of adopting good agronomic practices by rice farmers participating in the Anambra State Value Chain Development Programme. The results established that most of the practices disseminated to the farmers were being tried. This implied that the majority of farmers did not adopt the technologies disseminated. Seen that several of these technologies are at the evaluation stage of adoption, it is imperative that extension agents should move faster to capture the farmer's minds convincingly to improve food production and sustainability of the production in the study area. From the above information, it is clear that extension services need to be intensified to improve the productivity of farmers through GAP adoption by promoting the right attitude among natural resource managers.

The study clearly revealed that the little technologies adopted (bund for water management, weeding/pest control, winnowing, and proper storage) saw an upsurge or increase in the farmers' profit. Their profitability index grows by 59% in the study. The study through the resource allocation efficiency estimation found that farmers were using improved rice seed, urea and agrochemical in a wasteful manner. However, extension agents should move faster to teach the farmers the right way of using agricultural inputs in a more resourceful manner because one-time use of technology does not necessarily mean its adoption.

Furthermore, farmers in Anambra State can contribute more to food security, as well as catalyze economic growth when they are motivated to adopt good agronomic practices. An important gain to the farmers is that effective use or adoption of GAP would enhance farmers' productive potentials, increase their income and sustainable livelihood, reduce poverty and ensure aggregate food security in Nigeria. Suggestively, the study reiterates the need for the Value Chain Development Programme implementers to intensify their effort to educate the farmers on the best ways to use and manage scarce resources to optimize rice yield. However, the fact that the project subsidized production inputs should not be the reason to become wasteful in resource allocation. Rice heavily depends on

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nitrogen base fertilizer (urea) which was 90.5% under-utilized in the study. Thus, the extension agents in the programme should sensitize the farmers on the best way to apply urea through urea deep placement (UDP) to avoid waste.

There should be constant training and capacity building of farmers till the change advocated through adoption in rice production is achieved sustainably. The study is of the view that to guarantee the adoption of good agronomic practices for improved rice production, mechanization should be encouraged through subsidy by the government and non-governmental agencies supporting the programme. This mechanization should be location-specific as this will help the farmers to maintain and manage the equipment better.

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Conflict of interest
The author(s) have declared no conflict of interest.

Table 1: Sample representation of rice farmers in the 5 VCDP LGAs

Sn	Local Government Area	No of Farmers	Sample size
1	Ayamelum	2558	176
2	Awka North	1066	73
3	Anambra East	436	30
4	Anambra West	1027	71
5	Orumba North	309	21
	Total	5396	372

Source: Researcher's computation, December 2018

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Table 2: Extent of good agronomic practice adoption

SN.	Good agronomic practice adoption	Awareness	Interest	Evaluation	Trial	Adoption	Total score	Mean	Decision
A	Pre-planting stage								
1	Land selection	0	8	129	680	600	1417	4	Trial
2	Land preparation	0	40	285	636	315	1276	4	Trial
3	Seed selection from certified Agro-dealer	0	236	321	428	25	1010	3	Evaluation
4	Seed germination test	0	0	30	652	820	1502	4	Trial
B	Planting stage								
5	Nursery establishment	0	54	216	588	455	1313	4	Trial
6	Transplanting	0	4	246	804	260	1314	4	Trial
7	Planting depth and space	0	86	318	524	285	1213	4	Trial
8	Direct seeding	0	216	327	460	25	1028	3	Evaluation
9	Line planting	0	128	339	492	185	1144	3	Evaluation
10	Timely planting	0	0	0	116	1540	1656	5	Adopted
11	Timely fertilizer application	0	202	312	528	0	1042	3	Evaluation
12	Use of Smart weather reader	0	16	135	640	620	1411	4	Trial
13	Bund for water management	0	0	3	440	1130	1573	5	Adopted
14	Spot fertilizer application	0	28	249	608	440	1325	4	Trial
15	Pre and post emergence spraying	0	78	363	536	215	1192	4	Trial
16	Urea deep placement	0	2	126	664	640	1432	4	Trial
17	Bird scaring equipment	0	44	279	596	365	1284	4	Trial
18	Weeding/pest control	0	0	0	480	1085	1565	5	Adopted
19	Appropriate Agro-chemical application	0	114	366	480	190	1150	3	Evaluation
20	Timely harvest	0	128	342	512	155	1137	3	Evaluation
C	Post-planting stage								

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21	Threshing	0	40	177	628	505	1350	4	Trial
22	Packing	0	140	453	388	95	1076	3	Evaluation
23	Winnowing	0	0	3	556	985	1544	5	Adopted
24	Bagging in jute bag	0	224	153	696	0	1073	3	Evaluation
25	Transporting	0	0	36	628	840	1504	4	Trial
26	Proper storage	0	0	0	468	1100	1568	5	Adopted

Source: Field Survey Data, May 2019

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Table 3: Net returns of rice farmers in the Anambra State value chain development programme

Item	Quantity	Unit price (USD)	Amount/ha (USD)	Value/2.42ha (USD)
Revenue				
Sales of Paddy	4,813.35 kg/ha	0.312/kg	1,501.89/ha	3,634.57
Variable Inputs				
Land preparation	9.25 man-day	19.72	182.31	
Seed rice kg	125	0.86	107.97	
Fertilizer kg	525	0.40	210.55	
Urea kg	265	0.31	81.09	
Herbicide (Glyphosate) Liter	5.03	4.87	24.47	
Pesticide (Liter)	5.03	3.16	15.88	
Labour (man-day)	144	6.84	984.27	
Transportation			66.17	
Logistics	-	-	194.45	
Total Variable Cost				1,867.17
Fixed cost				
Rent on land per cycle	2.42ha	78.34	189.58	
Interest on loan	-	-	82.28	
Equipment depreciation			142.00	
Total Fixed Cost				413.86
Total Cost				2281.04
Gross Margin (GM)				1767.40
Net Return				1353.54
Net gain/ha				559.32
Net Return on Investment				0.59

Source: Field Survey Data, 2019. 380 NGN = 1 USD

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Table 4: Production function of GAP rice farmers in Anambra State value chain development programme

Variable	Linear	Exponential	Semi-log	Double log
Intercept	-685.569 (-4.12)	-3004.051 (-0.47)	3.51969 (364.90)	3.3698 (26.43)
Seed (kg)	14.814 (3.56)***	6621.207 (2.32)**	0.000 (1.64)*	0.1594 (2.81)**
Fertilizer (kg)	25.876 (1.97)**	-7940.397 (-0.45)	0.001 (1.12)	0.0041 (0.01)
Urea (kg)	-59.027 (-2.28)**	-2567.809 (-0.15)	-0.001 (-1.13)	-0.1931 (-0.58)
Farm land (ha)	4174.883 (12.26)***	14266.392 (4.77)***	0.208 (10.52)***	0.875 (14.71)***
Labour (man-day)	10.939 (5.60)***	5640.560 (5.02)***	0.00069 (6.07)***	0.228 (10.21)***
Agrochemical (lt)	52.124 (0.93)	10823.400 (3.65)***	-0.01110 (-3.43)***	-0.005 (-0.09)
R^2	0.974	0.901	0.9363	0.971
F-value	2,073.35	499.18	808.81	1,858.69
Obs.	337			

Source: Computed from the Field Survey Data, 2019. Figures in parenthesis are t – ratios significant at 10% (*), 5% (**) and 1% (***)

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Table 5: Resource allocation efficiency of GAP rice farmers in Anambra State Value Chain Development Programme

Predictors A	Coefficient B	Value product C	Mean inputs D	MVP E = (B*C/D)	MFC F	r G = (E/F)	D% H	Decision I
Seed (kg)	14.8136	3,634.57	125.67	428.43	107.97	3.97	74.8	Underutilized
Fertilizer (kg)	25.8755	3,634.57	501.9	187.38	210.55	0.89	12.4	Over utilized
Urea (kg)	59.027	3,634.57	251.04	854.60	81.09	10.54	90.5	Underutilized
Farm land (ha)	4174.88	3,634.57	2.42	6,270,203.97	189.58	33,074.18	100.0	Underutilized
Labour (Man-day)	10.939	3,634.57	144	276.10	984.27	0.28	256.5	Over utilized
Agrochemicals (lt)	52.124	3,634.57	10.06	18,831.84	40.35	466.71	99.8	Underutilized

Source: Field Survey Data, 2019. r = 1 (efficient) and 1 > r > 1 (inefficient), marginal value product (MVP), marginal factor cost (MFC)

Table 6: Factors militating against the adoption of GAP by rice farmers in Anambra State VCDP

		Rotated Component pattern matrix			
Sn.	**Constraints**	Institutional	Socioeconomic	Economic	Management
1	Training and or capacity building	0.931			
2	Extension services	0.850			
3	Learning route or social networking	0.528			
4	Difficulty of machine operation	0.386			
5	Farm size for mechanization		0.769		
6	Bad road network		0.725		
7	Low level of education		0.623		
8	Household size to supply cheap labour		0.543		
9	Inadequate access to credit		0.483		
10	Net gain			0.847	
11	Inadequate access to off farm income			0.747	
12	Unavailability of demanded input			0.585	
13	Environmental hazard				0.778
14	Generic nature of farm machines causes compatibility issue				0.661
15	Late arrival or disbursement of farm input				0.387
		Diagnostic tools			
	Kaiser-Meyer-Olkin Measure (KMO)	0.703			
	Determinant	0.022			
	Factor 1 (Institutional)	24.52			
	Factor 2 (Socioeconomic)	10.88			
	Factor 3 (Economic)	10.54			
	Factor 4 (Management)	9.5			
	Total factor explained	55.44			
	Cronbach's alpha	0.710			

Source: Field Survey Data, 2019. Variables with factor loadings less than 0.30 were discarded

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