MEDIATION EFFECT OF ADOPTING GOOD AGRONOMIC PRACTICES ON RICE PRODUCTIVITY IN ANAMBRA STATE, NIGERIA.

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ABSTRACT
The study on mediation effect of adopting good agronomic practices on rice productivity in Anambra State, Nigeria sort to ascertain the extent of good agronomic practice adoption, identify the variables that influence rice productivity and the mediation effect of good agronomic practice adoption. The study used a well-structured questionnaire and face to face interview to elicit information from randomly selected 384 rice farmers. After the data sorting and filtering, only 337 was found valid and used for the analysis. A combination of descriptive statistics and structural equation modelling were used to achieve the study objectives. Finding shows that of all the 26 items of good agronomic practice chosen, 10 (land selection, seed selection from certified Agro-dealer, timely fertilizer application, use of Smart weather reader, spot fertilizer application, weeding/pest control, appropriate Agro-chemical application, packing, bagging in jute bag, and proper storage) have been successfully adopted. Also, the cluster mean of 4.05 is an indication that the farmers agreed that being innovative, technical, responsive, scientific and economic were the variables that influence productivity. Furthermore, the hypothesis that good agronomic practices adoption mediates rice productivity was accepted and validated based on innovative, technical, responsive and scientific variables influencing rice productivity in the area

Keywords: Good agronomic practice adoption, mediation, structural equation modeling, productivity.

1. INTRODUCTION

The agricultural sector is an important economic sector in Nigerian economy sub-divided into four sub-sectors (crop production, fisheries, animal production and forestry) capable of employing over 70% of the country s population especially in the rural areas (Obianefo *et al.*, 2019). This agricultural sector is undergoing a series of reformation that will help to bring about food security and stabilization in the country; confirmation to this is the recent border closure by the Nigerian government aimed at spurring farmers especially rice farmers to increase production, equally force the consumers to demand more domestic food products. This paper dwells more on crop production subsector with special interest on rice (*Oryza sativa*) as an important crop in the nation s food basket. Rice has occupied a prominent position as a strategic crop for food security and economic development of many nations of the world (Chukwu *et al*, 2016).

Rice is one of the fastest-growing food commodities in Nigeria with a likelihood of continued growth, its increase in demand is associated with the rapid population growth, urbanization and consumer s preference for rice as convenience food (Akande, 2003; USDA, 2014; Onugu *et al.,* 2018) but it is the main cereal crop seriously affected by climatic factors (Md. Abu, *et al.,* 2017) in Anambra state and Nigeria in general. Rice production in Nigeria is mainly in the hand of small-scale rice growers cultivating about 0.5 to 3 hectares, these small-scale farmers supply about 80% of rice produced in Nigeria (IRRI, 2013). In an attempt to increase rice production in Nigeria, the federal government loaned out ₦43 billion through Anchor Borrowers Programme of the Federal Ministry of Agriculture and Rural Development (FMARD) to 293,000 rice farmers in the year 2017 which in turn produced rice that was sold at ₦193 billion (Ogbeh, 2018). This noble gesture of the federal government increased paddy output from 5 million metric tons (MT) in 2015 to 17 million MT in 2018. The effort is aimed at increasing the international potential of the rice out growers in the country.

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%. Hence many authors noted that Nigeria is yet to attain self-sufficiency in rice production (Nkwazema, 2016). Corroborating with Nkwazema (2016) Foyeku (2019) reported that the annual rice demand in the year 2018 was 7 million MT while only 56% of this demand was produced in Nigeria with the deficit (44%) been imported from the other countries. On the other hand, Anambra State Government leveraged on some Federal Government of Nigeria agricultural intervention special funds like IFAD assisted Value Chain Development Programme, Agricultural Transformation Agenda Special Programme I (ATAPS-1), FADAMA III

additional financing among other programs to increase the State rice annual production and supply from 90,000 MT to 210,000 MT against the 320,000 MT demanded as at year ending 2017 (Mbanefo, 2018). Thus, deficit supply still exists.

Many research evidence confirmed that some of the problems hindering Nigeria from meeting local demand were low productivity, inefficiency in resource allocation, little or no access to improved variety, and production in the hand of small-scale out-growers who rely heavily on traditional technology. Also, report from International Fund for Agricultural Development (IFAD) noted that the major problems of rice production in Nigeria were low productivity, a paucity of opportunity on value addition, inadequate access to inputs and productive assets, inadequate research and extension, scarcity of fund and credit, insufficient market and rural infrastructures, post-harvest handling, and improved seeds. Thus, concerted efforts of both government and non-governmental agencies are needed to surmount these problems in developing the agricultural sectors in Nigeria (IFAD, 2014). Corroboratively, recent research by Oluwadamilola suggested that the reasons for the demand-supply gap were a low level of income, high cost of inputs, poor access to irrigation facilities, pest and diseases that reduce yield, and high cost of labour (Oluwadamilola, 2018). These, therefore, suggest that the knowledge of efficiency in production is required to increase rice productivity given the limited resources available to the farmers (Wategire and Ike, 2015).

Productivity has remained a very complex concept and most difficult to interpret in the agricultural sector (Azil, 2008; Sule and Yusuf, 2019). This is largely due to the diversity of capital being utilized in agricultural production. These, therefore suggest that the use of each factor of production should not depend solely on its availability. Long before now, many scholars have defined agricultural productivity as the ratio of the index of local agricultural output to the index of total input used in the farm production (Shafi, 1984; Sule and Yusuf, 2019). Others equally viewed agricultural productivity as the output per unit of input; the art of securing an increase in output from the same input or getting the same output from smaller input (Pandit, 1965; Sule and Yusuf, 2019), this is the premise on which the study is seating. To increase agricultural productivity in Nigeria especially among rice farmers, intensive training on rice cultivation to effectively enhance the adoption of new technologies and other agronomic practices including improved variety, site selection, and land preparation, fertilizer use and improved agronomic practices such as nursery, transplanting, germination test, good spacing, urea deep placement becomes necessary (De Graft-Johnson, *et al.*, 2014; Kijima, *et al*., 2012). Sadly, these improved rice cultivation technologies are not widely adopted partly because of weak public extension system (Nakano, *et al*., 2014). Thus, good agronomic practices is an efficient and eco-friendly tool for sustainable management of plant under changing climate scenario that is targeted at improving agricultural productivity (Singh, *et al*., 2012).

A number of empirical reviews exist in the area of adoption of good agronomic practices (GAP) in different agricultural commodities which have proven beyond doubt that GAP increases agricultural productivity (Fernandez-Cornejo, Mishra, Nehring, and Gregory, 2007; Mignouna, *et al*. (2011); Keelan, *et al.* (2014), but not much to the best of my knowledge considered the mediation effect of GAP on rice productivity using path analysis.

An intermediate variable called the mediator that helps explain how or why an independent variable influences an outcome is what is considered as mediation. It is often a great interest to identify and study the mechanisms by which an intervention variable achieves its effect (MacKinnon, Fairchild, 2009; Douglas, *et al.*, 2013). Regards to this study, the mediator remains the GAP intermediating the significant exogenous variables for the study (innovative, technical, responsive mindset, scientific and economic factors) that influence rice productivity in Anambra State. With this in mind, it will guide the researcher to provide an empirical answer to the following research questions;

i. What is the extent of adoption of good agronomic practice among rice farmers in the area?
ii. To what extent do innovative, technical, responsive, and scientific and economics variables influence rice productivity in the area?
iii. Does the adoption of good agronomic practices mediate productivity?
iv. To what extent does the adoption of good agronomic practices mediate individual variables to productivity?

Objectives

The main objective of this study is to investigate the mediation effect of good agronomic practice adoption on rice productivity in Anambra State, Nigeria. Specifically, the study tends to;

i. find out the extent of adoption of good agronomic practices among rice farmers,
ii. identify the Innovative, technical, responsive, scientific and economics variables that influence rice productivity in the area,
iii. estimate the mediation effect on the adoption of good agronomic practices on productivity, and

iv. ascertain the extent of mediation of good agronomic practices on individual variables.

Hypotheses

The study had five researchable hypotheses which are;

1. Good agronomic practices do not mediate an innovative influence on productivity.
2. Good agronomic practices do not mediate technical influence on productivity.
3. Good agronomic practices do not mediate a responsive mindset influence on productivity.
4. Good agronomic practices do not mediate scientific influence on productivity.
5. Good agronomic practices do not mediate economic influence on productivity.

2. RESEARCH METHODOLOGY

Study Area

Anambra state is located in the south-eastern part of Nigeria and comprises of 21 Local Government Areas (Aguata, Awka North, Awka South, Anambra East, Anambra West, Anaocha, Ayamelum, Dunukofia, Ekwusigo, Idemili North, Idemili South, Ihiala, Njikoka, Nnewi North, Nnewi South, Ogbaru, Onitsha North, Onitsha South, Orumba North, Orumba South and Oyi). The State is sub-divided into four agricultural zones (Onitsha, Anambra, Awka and Aguata) to aid planning and rural development. The State is bounded with Delta State to the West, Imo State and Rivers State to the South, Enugu State to the East, and Kogi State to the North. The indigenous ethnic groups in Anambra state comprised of 98% Igbo and 2% Igala mainly living in the north-western part of the State. Anambra State is situated between Latitudes 5° 32^{I} and 6°45^{I} N and Longitude 6°43^{I} and 7° 22^{I} E respectively. The State has an estimated land area of 4,865sqkm. The last official census reported that 4177828 people are living in Anambra State (NPC, 2006).

Sampling Procedure and Method of Data Collection

A multi-stage sampling technique was employed in the study, the first stage involved a random selection of two (2) Local Government Areas (LGAs) out from the four (4) Agricultural Zones in the State. Stage two involved a random selection of two (2) communities each from the two LGAs. Stage three (3) involved a random selection of three (3) villages to make it a total of forty-eight villages from where 8 rice farmers were randomly selected for the study. Thus, the total sample size was 384.

3. METHOD OF DATA ANALYSIS

A combination of statistical techniques was employed to operationalize the research objectives. The study utilized both descriptive statistics and path analysis. Objective one and two were achieved with the help of a mean threshold from 5 points Likert scale. Before objective three and four were attended to, the data were subjected to series data treatment (normality, communality, reliability, data adequacy, and discriminant test) using principal factor analysis and Cronbach s alpha, thus, objective three was achieved with the help of path analysis. While the extent of mediation (objective four) was verified with the Hair, *et al.,* (2014) VAF model.

Model Specification

A). the mean threshold from 5 point Likert scale was estimated as follows:

$$\bar{X} = \frac{1+2+3+4+5}{5} = 3.0$$

Where:

$\bar{X}$ = Mean threshold ($\geq$ 3.0 is accepted range)
1 = Awareness stage
2 = Interested stage
3 = Evaluation stage
4 = Trial stage
5 = Adopted stage for the objective one and

1 = strongly disagree to 5 = strongly agree in objective two

B). Principal factor analysis (PFA) for objective two is equally defined by:

$X_{ij} = \delta_{i1}F_{i1} + \delta_{i2}F_{i2} + \delta_{jm}F_{ik} + e_{ij}$

Where:

X_{ij} = observation on variables
X_j = the ith sample number
F_iK = score on kth number of factors (K = 1, 2, 3 m)
F_1-F_m = common factors
e_{ij} = the value on the residual variable
E_j = the ith sample number
j_i .. j_m = factor loading (regression weight).

The associated assumption will be applied accordingly while the suitable number of factors will subjectively be selected based on varimax rotated factor matrix obtained using SPSS version 23.0 software.

C). the path analysis model for objective three according to Douglas *et al.,* (2013) is estimated as:

$Z_i = \beta_i + \beta_{xz}X_i + \varepsilon_{zi}$

$Y_i = Y^*_0 + Y^*_{zy}Z_i + Y_{xy}X_i + \varepsilon_{yi}$

The error terms are uncorrelated (ε_{zi}, ε_{yi}). The two structural equations are linked together to influence outcome simultaneously unlike two independent standard regression equation. The direct effect is the path from independent variables to the outcome variable while controlling for the mediation ($\beta_{xz}X_i$) (Clogg, *et al.,* 1992; Douglas *et al*., 2013). Y_{xy} is the direct effect, while the total effect is the sum of β_{xz} + Y_{xy}. Thus, we start by estimating a reduced regression result without mediation: $Y_i = Y^*_0 + Y^*_{xy}X_i + \varepsilon^*_{yi}$ (Imai, *et al.,* 2010).

D). Hair *et al*. (2013) extent of mediation was estimated as:

$$VAF = \frac{a * b}{(a * b) + c}$$

Where:
VAF = Variance accounted for
a = coefficient between an independent variable (IV) and the mediator
b = coefficient between the mediator and dependent variable (DV)
c = indirect effect coefficient between IV and DV
They therefore affirmed that when: VAF > 20% ≤ 80% partial mediation is supported, VAF > 80% full mediation is supported and VAF < 20% no mediation is supported.

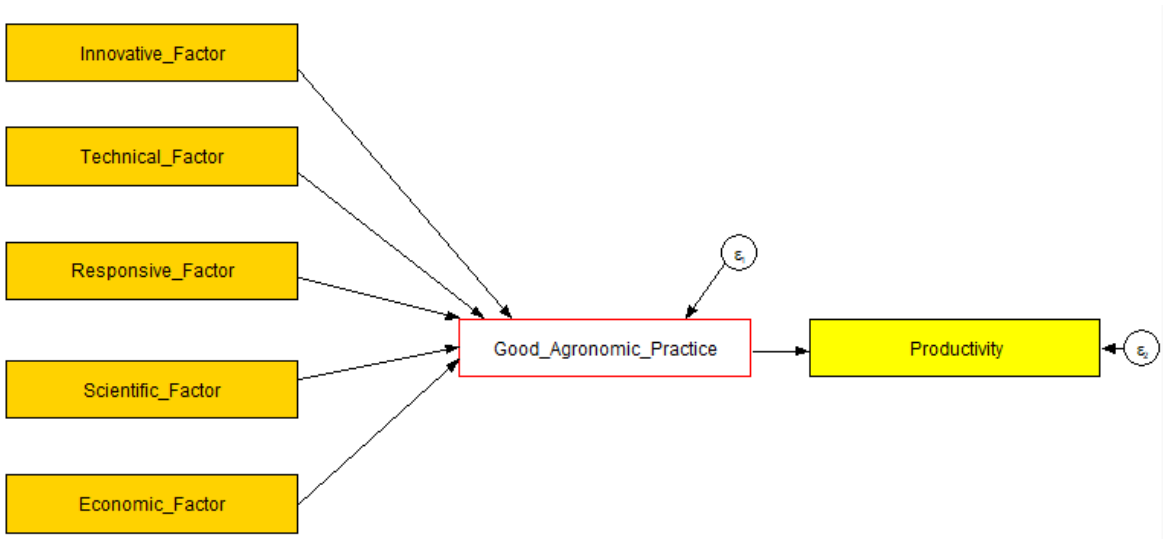

Figure 1: a Path model of the mediation effect on rice productivity

4. RESULTS AND DISCUSSIONS

Objective one: Extent of Good Agronomic Practice Adoption by Rice Farmers in Anambra State, Nigeria

The extent of adoption of good agronomic practices (GAP) is presented in Table 1.
GAP adoption by rice farmers was subjected to 5 Point Likert Scale to determine the mean threshold of adoption among rice farmers. The farmers were either aware (1), interested (2), evaluating (3), trying (4) or have adopted (5) GAP in the study area. Thus, the cluster mean of 3.74 (75%) shows that GAP has not been fully adopted by all but majorly in a trial stage of adoption in the area. Out of the twenty-eight (26) items of the extent of GAP adoption by rice farmers in the area, finding shows that the farmers have satisfactorily adopted land selection, seed selection from certified agro-dealer, timely fertilizer application, use of smart weather reader (SWR), spot fertilizer application, weeding/pest control, appropriate agro-chemical application, packing, bagging in jute bag, and proper storage. While, land preparation, direct seeding, timely planting, bund for water management, timely harvest, threshing, winnowing, and transporting are still at a trial stage. The farmers are now evaluating pre & post emergence spraying. Finally, seed germination testing and bird scaring equipment are on the awareness stage.

Table 1: Extent of good agronomic practice adoption by rice farmers

S/n.	Variable of Adoption	Mean Threshold	Std. Dev.	Percentage of Adoption (%)	Decision
	Pre-planting stage				
1	Land selection	4.73	0.45	94.6	Adopted
2	Land preparation	3.91	0.60	78.2	Trial stage
3	Seed selection from certified Agro-dealer	4.77	1.10	95.4	Adopted
4	Seed germination test	1.45	1.08	29.0	Awareness
	Planting stage				
5	Nursery establishment	1.91	1.10	38.2	Interested
6	Transplanting	2.55	1.70	51	Evaluation
7	Planting depth and space	3.16	1.39	63.2	
8	Direct seeding	4.20	1.15	84	Trail
9	Line planting	2.91	1.50	58.2	Evaluation
10	Timely planting	3.91	0.93	78.2	Trial
11	Timely fertilizer application	4.77	0.52	95.4	Adopted
12	Use of Smart weather reader	4.55	0.58	91	Adopted
13	Bund for water management	4.05	0.95	81	Trial
14	Spot fertilizer application	4.91	0.29	98.2	Adopted
15	Pre and post emergence spraying	3.15	0.82	63	Evaluation
16	Urea deep placement	2.03	1.11	40.6	Interested
17	Bird scaring equipment	1.27	0.68	25.4	Awareness
18	Weeding/pest control	4.55	0.94	91	Adopted
19	Appropriate Agro-chemical application	4.72	0.45	94.4	Adopted
20	Timely harvest	4.30	0.76	86	Trial
	Post-planting stage				
21	Threshing	4.36	0.57	87.2	Trial
22	Packing	4.59	0.65	91.8	Adopted
23	Winnowing	3.86	0.92	77.2	Trial
24	Bagging in jute bag	4.50	1.20	90	Adopted
25	Transporting	3.64	1.02	72.8	Trial
26	Proper storage	4.82	0.49	96.4	Adopted
	Cluster mean	**3.74**	**0.19**	**74.8**	**Trial Stage**

Source: Field Survey Data, 2020.

Objective two: Innovative, Technical, Responsive, Scientific and Economics variables that influence Rice Productivity.

The innovative, technical, responsive, scientific and economics variables that influence rice productivity is presented in Table 2.

The innovative, technical, responsive, scientific and economics variables that influence rice productivity in Anambra State was subjected to 5 Point Likert Scale to determine the mean threshold of influence. The farmers either strongly agreed to strongly disagree with the influence of the variables. Thus, the cluster mean of 4.05 shows that the farmers strongly agree to the influence of the variables on rice productivity in the area. Out of the five (5) items of influence, all had a mean threshold of 3.0.

Table 2: Innovative, technical, responsive, scientific and economics variables that influence rice productivity

Sn.	Variables	Mean	Std. Dev.	Decision
1	Innovative Factor	3.65	0.19	Agree
2	Technical Factors	4.11	0.80	Agree
3	Responsive to change	3.60	0.82	Agree
4	Scientific mindset	4.20	1.15	Agree
5	Economic factors	4.72	0.45	Agree
	Cluster mean	**4.05**	**0.68**	**Agree**

Source: Field Survey Data, 2020.

Data treatment for structural equation modelling

The data collected from the respondents were subjected under a series of test for internal consistency. The study produced a Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value of 0.789 (Appendix 1; Table a). Based on the rule of thumb, a KMO value from 0.7 to 1 shows the adequacy of data collected for the analysis. Normality of the dataset was also checked with Skewness and communality Table (Appendix 1; Table b and c), none of the variables had a skewness value of -2 to 2 and communalities value less than 0.5 otherwise would have been deleted. The data equally had a positive Eigen-values which helped the researcher to achieve 66.6% total variance explained adequate enough to further the study. Furthermore, a Cronbach s alpha test of reliability was used to check for the internal consistency of the data collected, therefore, Cronbach s alpha value of 0.792 (Appendix; Table e) shows that the data collected was reliable. The researcher used a Promax[a] extraction method (Appendix 1; Table f) for the discriminant analysis to ensure none of the variables loaded in more than one construct otherwise called factors to aid structural convergence.

Objective three: Structural Equation Modeling (SEM)

The aim of the study which was to estimate the mediating effect of good agronomic practice (GAP) adoption on rice farmer s productivity in Anambra State, Nigeria was achieved with STATA 14.0 software. The researcher conceived rice productivity as an increase in output as a result of the adoption of GAP using the same level of factor inputs. The direct relationship between the independent variables (IV) (innovative, technical, responsive, scientific and economic factors) and the mediator (GAP adoption) was checked first before proceeding for the mediation effect. Thus, the first structural path is presented in figure 2, while the relationship between the mediator and the outcome variable (productivity) is presented in figure 3.

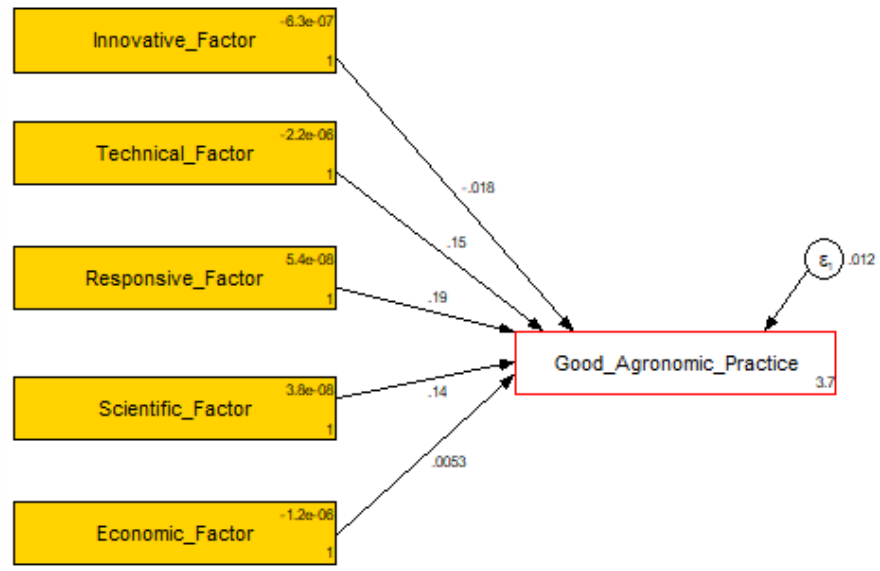

Figure 2: The Research SEM model on the independent variable (IV) and the mediator variable (M)

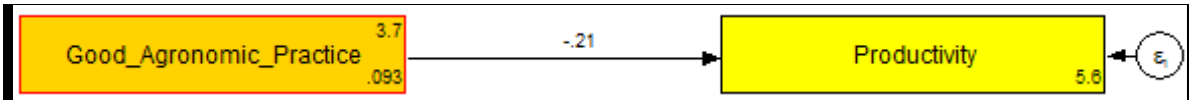

Figure 3: The Research SEM model on the mediator variable (M) and the dependent variable (DV)

Relationship between IV and Mediator

The relationship between the independent variables and the first dependent variable (mediator) is presented in Table 3, while, the relationship between the mediator and the outcome (second dependent variable) is presented in Table 4. Both Table 3 and 4 is saturated and had a Chi^2 value of 0.00 which is well below the 0.05 significant level hence conclude that the

model is a good fit. Furthermore, The structural coefficient (0.0181015) of innovative influence was negative and significant at 1% level of probability. This implies that an increase in the number of rice farmers that are less innovative by 1% will reduce adoption of good agronomic practice (GAP) by 1.81% in Anambra State, Nigeria.

The structural coefficient (0.1537486) of technical influence was positive and significant at 1% level of probability. This implies that an increase in the number of rice farmers that are technically minded by 1% will increase the adoption of good agronomic practice (GAP) by 15.37% in Anambra State, Nigeria. The structural coefficient (0.1943428) of responsive influence was positive and significant at 1% level of probability. This implies that an increase in the number of rice farmers that are responsive to change by 1% will increase the adoption of good agronomic practice (GAP) by 19.43% in Anambra State, Nigeria.

The structural coefficient (0.1377478) of scientific influence was positive and significant at 1% level of probability. This implies that an increase in the number of rice farmers that are scientifically minded by 1% will increase the adoption of good agronomic practice (GAP) by 13.77% in Anambra State, Nigeria. The structural coefficient (0.0052617) of economic influence was positive and not significant at either 1% or 5% level of probability. Thus, we conclude that economic influence has no effect on the adoption of good agronomic practice (GAP) in the study area. This was not expected by *a priori* expectation.

Equally, the direct relationship between good agronomic practice and rice productivity had a coefficient value of 0.2145296 which was negative and significant at 5% level of probability. The implication is that an increase in the number of rice farmers that do not adopt GAP by 5% will reduce rice productivity by 21.45% in Anambra State, Nigeria. This finding was highly expected based on *a priori* expectation as many scholars have proven that good agronomic practice increase agricultural productivity (Fernandez-Cornejo, *et al*., 2007; Mignouna, *et al*., 2011; Keelan, *et al.*, 2014).

Table 3: the Relationship between IV and Mediator

```
Structural equation model                       Number of obs     =        337
Estimation method  = ml
Log likelihood     = -2126.1253
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	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
Good_Agronomic_Practice <-						
Innovative_Factor	-.0181015	.0060616	-2.99	0.003	-.029982	-.006221
Technical_Factor	.1537486	.0060616	25.36	0.000	.1418681	.1656291
Responsive_Factor	.1943428	.0060616	32.06	0.000	.1824623	.2062233
Scientific_Factor	.1377478	.0060616	22.72	0.000	.1258673	.1496283
Economic_Factor	.0052617	.0060616	0.87	0.385	-.0066188	.0171422
_cons	3.661692	.0060526	604.98	0.000	3.649829	3.673555
var(e.Good_Agronomic_Practice)	.0123456	.0009511			.0106155	.0143578

```
LR test of model vs. saturated: chi2(0)   =      0.00, Prob > chi2 =      .
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Table 4: Relationship between Mediator and DV

Structural equation model Number of obs = 337
Estimation method = ml
Log likelihood = -328.76078

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
Productivity <-						
Good_Agronomic_Practice	-.2145296	.0911244	-2.35	0.019	-.3931301	-.0359291
_cons	5.598301	.3348227	16.72	0.000	4.94206	6.254541
var(e.Productivity)	.2598076	.0200148			.2233972	.3021523

LR test of model vs. saturated: chi2(0) = 0.00, Prob > chi2 = .

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Objective four: Mediation Analysis

MacKinnon *et al.* (2000) noted that mediation variables are intervening factors between the independent and dependent variables. This work is concerned with mediating effect adoption of good agronomic practices (GAP) on rice productivity in Anambra State, Nigeria. The procedure for testing mediation are: to establish the necessary individual relationship that has a significant effect and to establish a first model of direct effect and a second model of indirect effect (Hair and Anderson, 2010). This means that the independent variables must have a significant relationship with the mediator (first dependent variable).

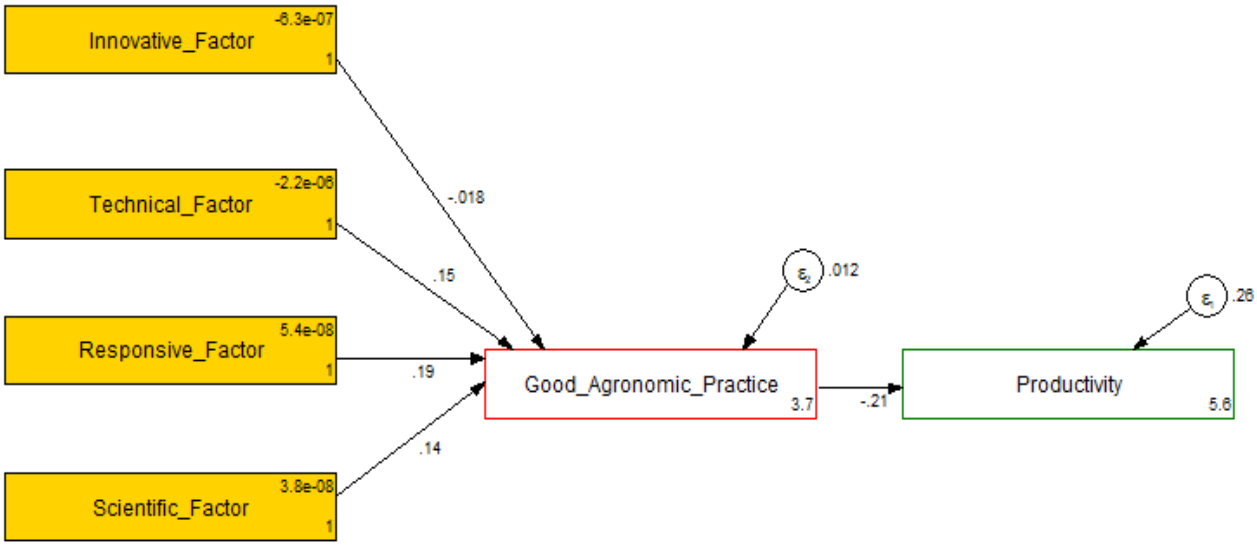

Figure 4: SEM model for mediation analysis

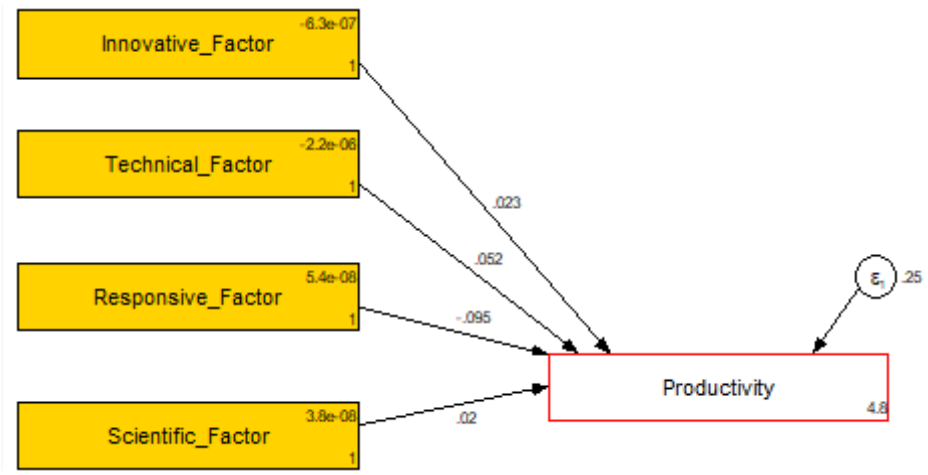

Figure 5: SEM model relationship between IV and DV

The significant relationship between the IV and the mediator have been established, therefore, the economic influence was dropped for the mediation analysis. Based on the direct relationship analysis between the IV and DV, only responsive factor had a direct effect (0.095347) on rice productivity at a 1% level of probability in Anambra State. Thus, justifying the need for the mediation analysis to be conducted in order to validate the study main objective. Furthermore, the SEM result of the mediation effect (indirect effect) shown in Figure 4 shows that all the four variables had a significant relationship with GAP, hence, mediation effect was accepted and validated for all innovative, technical, responsive and scientific influence.

Indirect effect of innovative influence (β = -0.018105 and z = 2.98) is significant at 1% level of probability. Thus, good agronomic practice adoption mediates the significant effect of innovative influence on rice productivity in Anambra State, Nigeria is fully validated and accepted. Indirect effect of technical influence (β = 0.1537486 and z = 25.34) is significant at 1% level of probability. Thus, good agronomic practice adoption mediates the significant effect of technical influence on rice productivity in Anambra State, Nigeria is fully validated and accepted. Indirect effect of responsive influence (β = 0.1943428 and z = 32.03) is significant at 1% level of probability. Thus, good agronomic practice adoption mediates the significant effect of responsive influence on rice productivity in Anambra State, Nigeria is fully validated and accepted. Indirect effect of scientific influence (β = 0.1377478 and z = 22.70) is significant at 1% level of probability. Thus, good agronomic practice adoption mediates the significant effect of scientific influence on rice productivity in Anambra State, Nigeria is fully validated and accepted. Since the relationships between the IV and the DV remained unchanged immediately the mediator was introduced, mediation was not supported. The next step is to ascertain the extent of mediation and validate the indirect effect of good agronomic adoption on productivity in Anambra State, Nigeria.

Table 5: Mediation analysis model

Structural equation model Number of obs = 337
Estimation method = ml
Log likelihood = -1899.8957

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
Good_Agronomic_Practice <-						
Innovative_Factor	-.0181015	.0060684	-2.98	0.003	-.0299953	-.0062077
Technical_Factor	.1537486	.0060684	25.34	0.000	.1418548	.1656424
Responsive_Factor	.1943428	.0060684	32.03	0.000	.182449	.2062365
Scientific_Factor	.1377478	.0060684	22.70	0.000	.1258541	.1496416
_cons	3.661692	.0060594	604.30	0.000	3.649816	3.673568
Productivity <-						
Good_Agronomic_Practice	-.2145296	.0911244	-2.35	0.019	-.3931301	-.0359291
_cons	5.598301	.3348227	16.72	0.000	4.94206	6.254541
var(e.Good_Agronomic_Practice)	.0123732	.0009532			.0106392	.0143899
var(e.Productivity)	.2598076	.0200148			.2233972	.3021523

LR test of model vs. saturated: chi2(4) = 26.01, Prob > chi2 = 0.0000

Table 6: Relationship between IV and DV

Structural equation model Number of obs = 337
Estimation method = ml
Log likelihood = -2156.29

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Structural						
Productivity <-						
Innovative_Factor	.0231223	.027356	0.85	0.398	-.0304945	.076739
Technical_Factor	.0515679	.027356	1.89	0.059	-.0020488	.1051847
Responsive_Factor	-.0953471	.027356	-3.49	0.000	-.1489638	-.0417304
Scientific_Factor	.0196852	.027356	0.72	0.472	-.0339315	.0733019
_cons	4.81276	.0273154	176.19	0.000	4.759223	4.866297
var(e.Productivity)	.2514456	.0193706			.2162071	.2924275

LR test of model vs. saturated: chi2(0) = 0.00, Prob > chi2 = .
.

Table 7: Model fit test

```
. estat gof, stats(all)
```

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(4)	26.014	model vs. saturated
p > chi2	0.000	
chi2_bs(9)	710.695	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.128	Root mean squared error of approximation
90% CI, lower bound	0.084	
upper bound	0.177	
pclose	0.003	Probability RMSEA <= 0.05
Information criteria		
AIC	3817.791	Akaike's information criterion
BIC	3852.172	Bayesian information criterion
Baseline comparison		
CFI	0.969	Comparative fit index
TLI	0.929	Tucker-Lewis index
Size of residuals		
SRMR	0.042	Standardized root mean squared residual
CD	0.867	Coefficient of determination

The model overall goodness of fit was estimated. According to the rule of thumb, if the Chi^2 value is greater the probability value (Chi2 > P at 0.05) signifies a bad model. Equally, when the root mean squared error of approximation (RMSEA) value is less than 0.05 signifies a poor model fit. Hence from Table 7, the Chi^2 value of 26.014 is greater than p value at 0.05 signifying a good model fit. The RMSEA value of 0.128 is not closer to 1 which equally confirms the model fit. Thus, the mediation effect is fully validated.

Hypotheses: Extent of Mediation

Hair *et al.* (2014) formula for extent of mediation as estimated and defined previously is presented in Table 8. Thus, the extent good agronomic practice adoption mediated individual factors.

Table 8: Extent of mediation

variables (Influence)	(a*b)	(a*b)/a*b + c)	(a*b)/a*b + c)*100	Decision
Innovative	0.0039	0.0270	14.38	No mediation supported
Technical	0.0330	0.0846	39.01	Partial mediation supported
Responsive	0.0417	0.1370	30.42	Partial mediation supported
Scientific	0.0296	0.0492	60.02	Partial mediation supported

Source: Field Survey Data, 2020.

CONCLUSION

Measuring productivity in the agricultural sector remained a complex task unlike in other industrial sectors, known that all factor inputs being utilized are not measured on the same unit. There is a need to increase rice production output in Nigeria since the nation is yet to attain self-sufficiency in rice supply. It becomes necessary to develop a model or template for the adoption of good agronomic practices targeted at increasing output which farmers must comply with if they need to commercialize their enterprise and reduce import expenditure of the Government. Hence, on this premise, the researcher conceptualizes productivity as the change in farmer s output before they adopted

good agronomic practices and after adoption, while maintaining the same level of input use. A good number of farmers are wasteful in their use of agricultural scarce resources which in turn affect their efficiency and productivity.

The need to intensify training targeted at improving the farmer s skills especially in the area of being innovative, compliant with modern agri-tech and quick to respond to changes especially in the face of climate variability cannot be overemphasized. Summarily, the estimated mediation analysis on the adoption of good agronomic practices on rice productivity is also very important such that it will become easy for policymakers to identify the individual variable contribution to rice productivity been mediated by GAP adoption in Anambra State, Nigeria.

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Appendix

Table a: KMO and Bartlett's Test of adequacy

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.789
Bartlett's Test of Sphericity	Approx. Chi-Square	901.293
	df	15
	Sig.	.000

Table b: Normality test Statistics (n = 337)

	Innovative_Factor	Technical_Factor	Responsive_Factor	Scientific_Factor	Economic_Factor	GAP
Mean	3.92	4.30	4.88	4.72	4.05	3.6617
Median	4.00	4.00	5.00	5.00	4.00	3.5800
Skewness	.176	-.560	-1.854	-.990	-.676	.369
Std. Error of Skewness	.133	.133	.133	.133	.133	.133

Table c: Communalities test

Variable	Initial	Extraction
Innovative_Factor	1.000	.855
Technical_Factor	1.000	.652
Responsive_Factor	1.000	.744
Scientific_Factor	1.000	.532
Economic_Factor	1.000	.540
GAP	1.000	.871
Extraction Method: Principal Component Analysis.		

Table d: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	2.908	48.469	48.469	2.908	48.469	48.469	2.902
2	1.086	18.094	66.563	1.086	18.094	66.563	1.123
3	.911	15.180	81.743				
4	.727	12.114	93.857				
5	.229	3.811	97.669				
6	.140	2.331	100.000				

Extraction Method: Principal Component Analysis. a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table e: Reliability Statistics

Cronbach's Alpha	N of Items
.792	6

Table f: Pattern Matrix[a]

	Component	
	Factor 1	Factor 2
GAP	.937	
Innovative_Factor	.883	
Technical_Factor	.791	
Economic_Factor	.717	
Responsive_Factor		.860
Scientific_Factor		