Human Capital Development and Agricultural Productivity in Nigeria

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Abstract
This paper examined the effect of human capital development on agricultural productivity in Nigeria, with further emphasis on quality education as they affect agricultural productivity. A longitudinal survey from 1988 to 2023 was carried out with regression analysis carried out using the auto regressive distributive lag (ARDL), auto correction check, heteroscedasticity and granger causality test to evaluate and assess the relationship between human capital development and agricultural productivity. Findings from this study revealed the existence of a negative significant relationship between human capital development and agricultural productivity. The study advised government to invest efficiently in human capital development especially, the agricultural extension workers for an increased agricultural productivity. Government was also advised to establish more agricultural fund-based and research centers are well funded.

Keywords*: Agriculture; agricultural productivity; human capital indicators,* heteroscedasticity.

1. Introduction

Classical economists have defined property, manpower and physical resources as three main economic growth drivers. In the 1960s, mainstream economists such as Schultz (1961) and Becker (1964) presented the idea of human property. They contend that the availability of a skilled population, qualified and balanced workers, allows orthodox factors to be used efficiently. Mincer (1974) followed them, offering a concise approach for measuring employment. Nevertheless, the argument that any expenditure in schooling has lengthy-term economic and social effects, both for the person and for community as a whole, dates back, if not farther, to Adam Smith. In sub-Saharan Africa, agriculture accounts for about a third of GDP and hires about two-thirds of the workforce. Therefore, agricultural productivity growth is a key element in endorsing widespread income growth. Moreover, growth in this sector has been sluggish for the continent as a whole in recent years; according to the World Bank, agricultural growth for the continent averaged only 1.8 percent per year from 1980 to 1991.
The real improvement of this growth rate is a concern for governments and international organizations alike. Investment in intellectual resources generates an economic benefit for people by rising both the job levels and labor profits. In relation to the advantages gained by people, innovation in intellectual resources will be valuable to the community overall. In

general, the cumulative economic effect of the global growth rate would be discernible, but it is challenging to validate and measure in reality. The agricultural sector plays an important role in the African context. It employs over 65% of the workforce available. But its Gross Domestic Product (GDP) contribution remains very low; it is 36 percent (World Bank, 2014). Governments and international organizations now direly need to make agriculture a means of reducing poverty and reducing hunger in Africa. However, a broad consensus seems to emerge between the different actors in order to achieve this: a high level of human capital is a necessary condition to increase productivity in agriculture (Ogunjobi et al, 2021).

In addition, Popoola et al (2019) noted that in economies where the proportion of agriculture contribution to gross domestic product (GDP) continues to grow, agricultural output may have an effect on overall economic development via a diversified and implicit connection of human resources. Enhancing the multiplier of human capital density will directly lead to productivity increases at the farm level, promoting the migration cycle by reducing costs and enhancing the consumption of dietary oil, which in effect facilitates efficiency. Nigeria reportedly has 75% of its fertile land, but just 40% of it is harvested. This means that there is a lot of scope for the county to concentrate on. This discusses the sustainability and agriculture portion of their program, as well as the emphasis on jobs for everyone. Moreover, in order to step ahead, the nation must improve the low profitability of existing agricultural enterprises, participate in competitiveness within the agricultural sector, establish national policies and raise financing (Ajayi & Ogunjobi, 2016).

Despite the concerted efforts by the government to improve Nigeria's agricultural productivity, the performance of the sectors remains weak compared to demand and supply big expansion efforts. Several agricultural development programs (ADPs) have been introduced, but the desired results have yet to be developed by the agricultural sector. One explanation for Nigeria's inequality, high rates of deprivation and rapid growth is that technological know-how and expertise typically come from international physical infrastructure, which is still ineffective for Nigeria's complex and varying continued growth needs.

While various authors (Ndour (2017); Ogunjobi et al (2021); Fashina et al (2018); and Popoola et al, (2019) focused on the colossal role of human capital on the transformation of less developed economies, this research aims to focus on the development of human capital in the agricultural sector, with emphasis on education and healthcare services. To this end, this research is aimed at investigating the relationship between human capital and agricultural productivity in Nigeria. In ensuring this, the long run association and the direction of causality between human capital development and agricultural productivity would be examined.

2. Objectives of the Study

i. To examine the long run relationship between human capital development and agricultural productivity in Nigeria.
ii. To investigate the causality between human capital development and agricultural value added per worker.

3. Literature Review

This literature review on Ndour (2017) investigates the relationship between human capital and agricultural production in Nigeria, especially on how education, skills, and health increase farm output and efficiency. The researcher examined the effect of human capital on agricultural productivity in Senegal, with their research particularly focusing on education, training of

farmers on their efficiency on productivity. Their research employed the stochastic frontier model and simple Tobit in investigating 183 local farmers. Their findings revealed a significant positive relationship exist between human capital and productivity. They further recommended the improvement of human capital training and education by government so as to make the farmers more efficient. Luh (2017) investigated the effect of education on agricultural productivity in East Asian economies. In carrying out this research, secondary data was employed while the regression model (OLS) was adopted for the processing of the data. The result of the findings revealed that, there was a significant positive relationship between education and productivity growth. Although, it was noted that the effect of education varies from one economy to another depending on the level of technological development, the role of technology through education was felt positively in the region where education was taken seriously. The study therefore recommended policy on human capital investment in agricultural sector.

Mahmood et al. (2017) in a contribution to literature appraised the effect of human capital development on food security in the Punjab Province, Pakistan. Their research was specifically aimed at examining the direction of relationships between literacy rate of farmers and food security. Research data were collected from the Punjab Development Statistical center and analysis was carried out with the aid of correlation. Findings of this research revealed the existence of a negative association between literacy rate and food security. Osinowo and Sanusi (2018) investigated the drivers of agricultural productivity in an agricultural-based economy. Their research further examined the factors that influence agricultural productivity between 1980-2014 using panel data, while data analysis was carried out using the Impulse Respond Function (IRF) and the Panel Least Square (PLS) regression technique. Their findings revealed the absence of human capital development as an instigating factor of agricultural productivity, instead other factors like an expanded irrigation system and adequate farm machinery were identified as drivers of agricultural productivity. Human capital, particularly in the form of education, has been shown to considerably improve agricultural output.

Gideon et al (2018) highlight the importance of agricultural extension services and its impacts on farmers' productivity in Northern Ghana. Cross sectional data from 200 household farmers were used, while regression analysis was employed to process the data. The result of the findings showed that extension professionals assist farmers in expanding their understanding of contemporary farming techniques, pest management, and post-harvest handling. This improved understanding leads to better crop management and higher yields. Obayelu et al. (2019) made use of primary data to examine the impact of education on technology adoption among smallholder farmers in Nigeria. Primary data, with the use of questionnaire was adopted as data collecting tool while regression method was used to process the data. The result of the analyzes showed that education has a substantial influence on farmers' ability to accept modern agricultural technologies. Educated farmers are better able to grasp and use new techniques like improved crops, fertilizers, and mechanized tools, resulting in enhanced productivity. This connection is critical since Nigeria's agricultural sector relies primarily on smallholder farmers, who require training and education to boost their output.

Salisu (2020) examined the moderating effect of non-governmental organization (NGO) on education and agricultural output in Kastina State, Nigeria. Primary data was adopted with a total number of 400 questionnaire distributed to farmers. Equation modelling was used as data analysis, the result showed that farmers with higher education levels are more likely to adopt enhanced farming technologies and management methods. This results in increased yields and

more efficient use of resources, including land and labour. Furthermore, rural extension programs that improve farmers' knowledge and access to modern agricultural techniques are crucial to achieving productivity increase in Nigeria.

In his contribution to agricultural development in Nigeria between 1981 and 2017, James (2021) identified the relationship among the human capital, national security and agricultural sector growth. Data were sourced from the World Bank Statistical Bulletins, the Central Bank and the Bureau of Statistic of Nigeria while auto-regressive distributed lag (ARDL) model was adopted to estimate the relationship among the different variables used. The result of the estimate showed that there was no relationship among various variables used. The findings revealed that life expectancy play a major role on agricultural productivity in Nigeria. The study therefore recommended an improved health care services as well as extending the health insurance scheme to the farmers. Isegholu (2021) studied the effect of health status on labour productivity in Nigeria between 2000 and 2018. He made use of vector auto-regression and granger causality for its analysis. Variables like malaria cases was used as proxy to health status, while the macroeconomic variables include secondary school enrolment rate and gross fixed capital formation. The result of the finding showed that secondary school enrolment rate, and life expectancy rate have no significant effect on labour productivity. The researcher therefore advised government to put in place policies that would combat Malaria in Nigeria, also Secondary school Curriculum should be reviewed to include skills and training as well as to improve the life expectancy rate. smallholder farmers, who require training and education to boost their output.

Agwu et al (2023) used the OLS statistical analysis to study the effect of human capital development on agricultural productivity in Nigeria between 1981 and 2022. The authors specifically looked into the impact of investment in education and healthcare services on agricultural output. In their findings, expenditure in education, labour force contribution and life expectancy at birth have positive and significant relationship with agricultural output while healthcare expenditure and illiteracy have non-significant negative relationship with agricultural outputs over the years under examination. The study implored governments to improve in funding healthcare services and the education sectors. Also, Olaoye et al (2023) examined the effect of training on the extension workers by the Federal Ministry of Agriculture in a training at Ogun State ADP Headquarters, Abeokuta. Data was collected from the forty extension personnel involved in the training. Descriptive and inferential analytical techniques were used to analyze the data. Their result showed that 95% of the extension workers gained positively in the training. Also, 85% of the workers called for more such training because of the extensive knowledge acquired in the training, The study therefore recommended time – to-time training by the ministry.

Going through the literature, researchers focus their studies on either the effects of education or health status on agricultural productivity, but in this study, we made use of human capital index, which encompasses education, health services and training.

4. Methodology

4.1 Theoretical Framework

In examining the effect of human capital development on agricultural productivity in Nigeria, this research adopted the human capital theory developed in the 1960s by Theodore Schultz. This theory states that human capital development via formal education is very essential for enhancing workers' productivity and efficiency, leading to economic growth and development

at the long run. This theory further emphasized the need for succession of economic knowledge, innovations, and affordable inventions (Babalola, 2003). This theory has also proven useful for some researchers (Almendarez, 2011; Tan, 2014; and Holden, 2016).

4.2 Model Specification

The research model adopted, attempts to examine the relationship between human capital and agricultural productivity in Nigeria. The models capture agricultural output, macroeconomic variables are stated below with the independent variables as interest rate, government recurrent expenditure on the agricultural sector, human capital development index and agricultural machinery: tractors. While the dependent variable is agricultural value added per worker; the model is expressed as:

$AVAPW = \alpha_0 + \alpha_1 AGMT + \alpha_2 GREA + \alpha_3 INT + \alpha_4 HDI + U.$

Express in log linear form.

$\text{Log } AVAPW = \log\alpha_0 + \log\alpha_1 AGMT + \log\alpha_2 GREA + \log\alpha_3 INT + \log\alpha_4 HDI + \mu_t$

Where;

AVAPW = Agricultural Value added per worker
INT = Interest Rate
GREA = Government recurrent expenditure on the agricultural sector
HDI = Human Capital Development Indicator
AGMT = Agricultural Machinery Tractor
α = Intercept
α1-9 = Slope Coefficients
μt = Stochastic Variables

4.3 'A Priori' Expectation

In the Complex process of examining the relationship between human capital and agricultural productivity. The A priori expectation is vital for indicating the expected signs of the parameters. They are;

INT Interest Rate. $\frac{dAVAPW}{dINT} > 0$ positive relationship

HDI Human capital Development Index: $\frac{dAVAPW}{dHDI} > 0$ positive relationship

AGMT Agricultural Machinery Tractors: $\frac{dAVAPW}{dAGMT} > 0$positive relationship

GREA Government Real Expenditure on Agriculture: $\frac{dAVAPW}{dGREA} > 0$ positive relationship

$\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5 > 0$

4.4 Model Estimation Technique

This was analyzed using the E-view edition of Econometric tools. The results were assigned to a stationary test using the Augmented Dickey Fuller Test (ADF). The co-integration test was used to know the long-run relationship between variables in the model. If a co-integrating vector exists, the co-integration procedure for Johansen and Juselius (1990) cannot be applied. It is therefore imperative to evaluate the Autoregressive Distributed Lag (ARDL) method suggested by Pesaran and Shin (1995) and Pesaran et al (1996b), irrespective of whether the relevant parameters are I (0), I (1) or both. In analytics and econometrics, the distributed lag model is a technique for time series data in which the regression formula is used to estimate the present values of the explanatory variables depending on the existing values of the

explanatory variable and the slowed values of that explanatory variable (past timeframe). The long-term association between the fundamental considerations is established by the F-Measurement (forest test). Through this approach, the long-term partnership of the agreement is assumed to be set up until the F-Measurement approaches the specific band of confidence. It has three benefits over other recent and current forms of co-integration. The first is that ARDL does not require the entire component of the analysis to be implemented in the same order. The second benefit is that the ARDL method is much more effective in the case of low and limited sample sizes. The third advantage is that we obtain unbiased long-term model estimates by applying the ARDL technique (Harris and Sollis 2003). The ARDL model used in this study is therefore stated:

$$D(AVAPW_t)=\alpha_{01}+\beta_{11}AVAPW_{t-1}+\beta_{21}INT_{t-1}+\beta_{31}HDI_{t-1}+\beta_{41}AGMT_{t-1}+\beta_{51}GREA_{t-1}+\sum_{i=1}^{p}\alpha_{1i}D(INT_{t-1})+\sum_{i=1}^{q}\alpha_{2i}D(HDI_{t-1})+\sum_{i=1}^{p}\alpha_{3i}D(AGMT_{t-1})+\sum_{i=1}^{p}\alpha_{4i}D(GREA_{t-1}) \quad (1)$$

The first step in the method of the ARDL limits is to approximate the coefficients by the ordinary least square (OLS). Estimate of calculations, check for the presence of a long-term relationship between variables. It is achieved by performing an F check to assess the mutual importance of the parameters of the stalled variable point. i.e.H_0:β_1I=β_2i= β_3i=β_4i=β_5i=β_6i= β_7i =0 against the alternativeH_1: β_1i ≠β_2i ≠β_3i≠ β_4i ≠β_5i≠ β_6i≠ β_7i≠0.

It is necessary to evaluate two sets of essential values with a specific degree of significance. The first level is determined on the presumption that all variables used in the ARDL model are in order zero, while the second level is measured on the presumption that the variables are in order one. The null hypothesis of no co-integration is denied if the F-statistic value approaches the maximum sensitive limit value and acknowledged if the F-statistic value does not surpass the lower limit value. Therefore, the co-integration evaluation is unclear.

5. Presentation of Results

Table 1. Unit Root Test Result using augmented dickey-fuller (ADF) Procedure

Variable	Trend specification	Lag Length	Critical values at 1%	Critical values at 5%	Critical values at 10%	ADF stat at levels	ADF stat at 1st diff	Order of integration
AVAPW	Trend and Intercept	2	-4.243644	-3.544284	-3.204699	-5.891251***	-6.601479***	I (0)
HDI	Trend and Intercept	2	-4.252879	-3.548490	-3.207094	-1.144651	-5.440297***	I (1)
INT	Trend and Intercept	2	-4.243644	-3.544284	-3.204699	-7.187788***	-9.146401	I (0)
AGMT	Trend and Intercept	2	-4.252879	-3.548490	-3.207094	-2.026875	-5.553775***	I (1)
GREA	Trend and Intercept	2	-4.243644	-3.544284	-3.204699	-5.411510***	-6.890508	I (0)

(*)(**)(***) indicates significance at 1%, 5%, 10% level respectively
Source: Authors' Computation

From the result presented in the table 1 above, agricultural value added per worker was integrated at levels with Interest rate and Government recurrent expenditure on agriculture while Human capital development Indicator and Agricultural machinery tractor is integrated at first difference. The unit root was done using two lags and Schwarz info criterion. With the test type of Augmented Dickey- Fuller. Therefore, the variables can be used to perform the time series analysis without turning out anomalous results.

5.2 Autoregressive Distributed Lag

The autoregressive distributed lag was used to test the long run relationship between the variables

Table 2. ARDL Bound Test

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	8.532798	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Author's computation

From table 2 above, the summary of the ARDL bound test shows the involvement of a long-between the parameters, the long-exists when the value of the F-is higher than the upper bound level at all levels of significance, and there is a long-between the variables. From the table f-stat is 8.532798 which is greater than the upper bound value of 3.52 which is shown in Table 3. which implies that there is a lengthy-term association between variables using AVAP as the dependent variable.

VARIABLES	COEFFICIENT	STANDARD ERROR	T- STATISTIC	PROB
HDI	-15393935	9603847.	-1.602893	0.1264
GREA	17257.06	5378.874	3.208304	0.0049
AGMT	1803.397	932.0686	1.934833	0.0689
INT	-628.1718	6586.014	-0.095380	0.9251

Source: Author's Computation.

R^2 = 0.958419 Adjusted R^2 = 0.928389

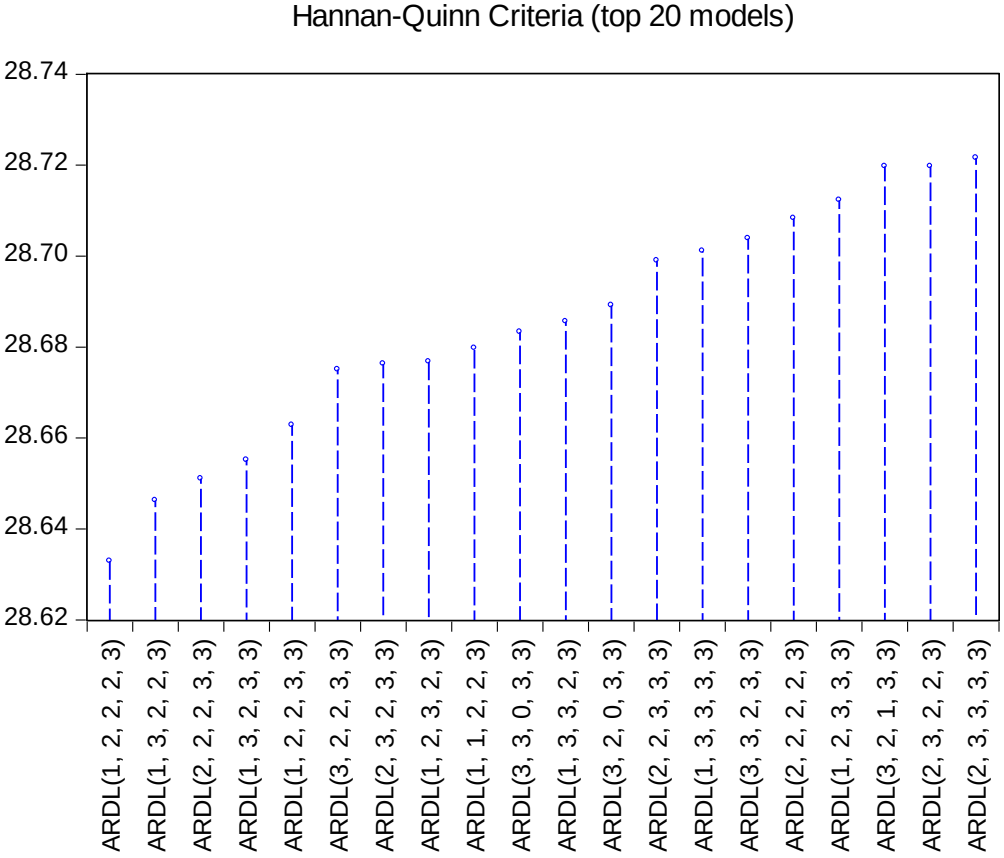
R2= 0.958419 and this implies that the independent variables combined describe approximately 95 percent of the variance in the dependent variable. Matched to R2= 0.928389. This is normally less than R^2 and takes into account the degree of freedom, indicates that, since incentivizing undesirable variables and taking into account the degree of freedom, the independent variable describes approximately 92.8% of the variance in the dependent variable.

Interpretation of Variables

- A unit change in HDI, other variables held constant, will on the average bring about a 15393935 decrease in AVAP
- A unit change in GREA, other variables held constant, will on the average bring about a 17257.06 increase in AVAP.

- A unit change in AGMT, other variables held constant, will on the average bring about an 1803.397 increase in AVAP.
- A unit change in INT, other variables held constant, will on the average bring about a 628.1718.

Fig 1. Model Selection Summary Result



Source: Author's computation.

Figure 1 above displays the 20 model outcomes of the ARDL, as a consequence of which ARDL (1,2,2,2,3) has the lowest Hannan-Quinn and ARDL (2,3,3,3) has the maximum Akaike Knowledge Criterion. The lower the HQC value of the product, the more suitable the concept is. ARDL is the most suitable model for this study (1,2,2,2,3).

5.4 Granger Causality

Table 4: Granger Causality Test Pairwise

Null Hypothesis:	Obs	F-Statistic	Prob.
HDI does not Granger Cause AVAP	34	0.36815	0.6952
AVAP does not Granger Cause HDI		0.08838	0.9157

Source: Author's computation

The result of the pairwise Granger causality test indicates that HDI and AVAP are not statistically significant because the probability is greater than 0.05. Hence, we accept the null

hypothesis that there is no causality running from human capital development and agricultural value added per worker and running from agricultural productivity and human capital in Nigeria. We then conclude that there is Independence causality running from human capital development in Nigeria.

The result of this causality test shows that human capital development cannot help to predict the behavior of agricultural productivity in Nigeria. The other results for the Granger causality are available in the appendix but an objective of this study concerns the causality between human capital development and agricultural productivity, hence it is only the causality between these two that is presented above.

Table 5. Serial Correlation Lm Test

F-statistic	2.415516	Prob.F(2,70)	0.1211
Obs*R-squared	7.653200	Prob.chi-square (2)	0.0218

Source: Author's computation using E-views 9

Table 5 above demonstrates the Breuch-Godfrey sequence connection LM, arising from the probation. Chi-squared is 0.2209 which is larger than 0.005, so the null statement that there are no systematic differences between the variables should be acknowledged.

Table 6. Heteroscedasticity Test: ARCH

Heteroskedasticity Test: ARCH

F-statistic	0.672764	Prob. F(2,28)	0.5184
Obs*R-squared	1.421388	Prob. Chi-Square(2)	0.4913

Source: Author's computation

Table 6 above represents the Heteroscedasticity, from the result of prob. Chi-Square is 0.4913 which is greater than 0.05, therefore the null hypothesis that there is no heteroscedasticity between variables will be accepted.

5.4 Normality Test

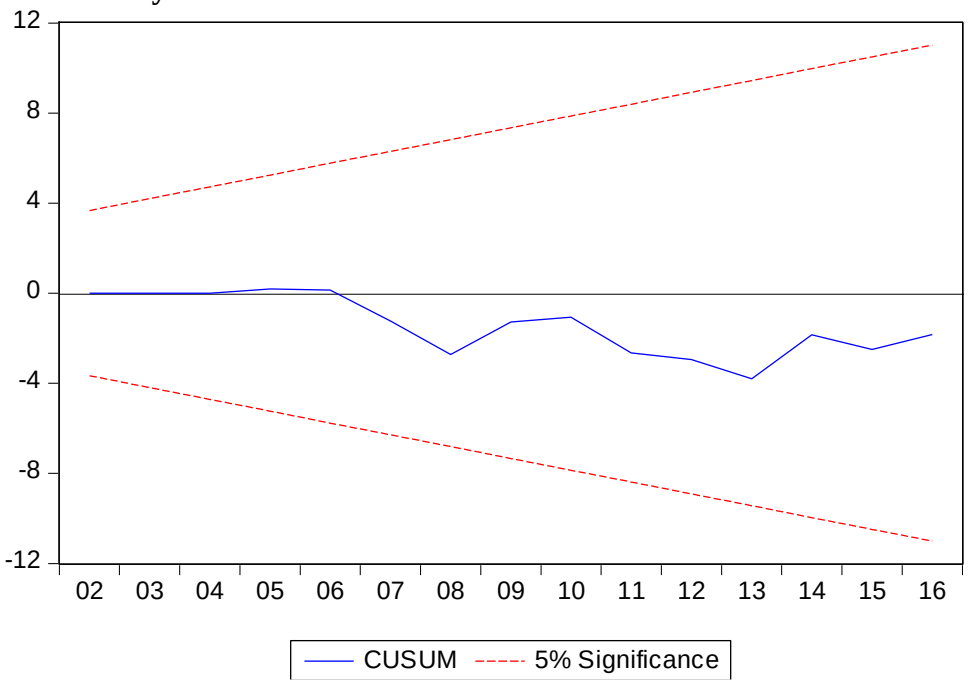
The test was carried out to check whether the error term follows a normal distribution. The Jacque-Bera (JB) test of normality was used. **DECISION RULE**: Reject the null hypothesis in absolute terms, if the probability of the Jacque-Bera is less than the level of significance, otherwise do not reject. **Table 7** Normality test result

Variable test	**Value**
Jacque-Bera	5.908733
Probability	0.052112

Source: Author's Computation

From the result presented in table 7, the probability of the Jacque-Bera which is greater than 0.05 chosen level of significance. Following the decision rule, we accept the null hypothesis. Hence, we conclude that the error term does not follow a normal distribution.

5.5 Stability Test



Source: Author's computation

From the graph above, the total sum of the recurrent residuals (CUSUM) check for the consistency of the specifications is used to determine the consistency of the specifications. Estimates indicate the consistency of the metric as the CUSUM plot sinks below the crucial boundary of the 5% significance point. As a consequence, the model passes the stability test at a 5% significance point.

6. Summary, Recommendation and Conclusion

The work is to examine the effects of human capital on agricultural production in Nigeria from 1988 to 2023. To this end, the regression analysis was used to evaluate the relationship between the variables and this research used several statistical methods such as auto-regressive distributed lag (ARDL), auto-correlation check, and heteroscedasticity evaluation to assess the relationship among the variables. From the result, human capital development index (HDI) which is a major indicator of human capital shows a negative and insignificant relationship with the dependent variable, agricultural value added per worker (AVAPW) i.e, an increase in human capital development will decrease agricultural productivity, but not significantly which indicated that human capital development has a negative impact on Agricultural productivity. To further investigate the effect of human capital on agricultural productivity, the degree of causality between these two variables were further examined with the aid of the granger causality test. With the application of this test, the direction of causality between these two variables were concluded to be independent. This meant that there was no causality from HDI to AVAPW, no causality from AVAPW to HDI and in both regressions, implying that human capital cannot help to predict the behavior of agricultural productivity in Nigeria. While the ARDL bounds test was used to test for the long run relationship between variables (human capital and agricultural productivity) used for this study. results showed that in the case of GREA and AGMT, there was an existence of a positive relationship with the dependent variable but only GREA was statistically significant, meaning that an increase in GREA and

AGMT would also increase AVAPW but only GREA out of the two will contribute to AVAPW significantly.

Therefore, focusing on human capital (HDI) and agricultural productivity. This study showed that Nigeria has not worked on its human capital, if the governments have put more efforts on the human capital development, the long run relationship between human capital and agricultural productivity would have been positive and significant. The analysis of the study also showed that the recent focus on agriculture is seen through the government's recurrent expenditure on agriculture and agricultural machinery (tractors). This is due to the positive relationship with agricultural value added per worker.

From the careful investigations of human capital and agricultural productivity, it is therefore important to proffer the following recommendations to the government.

1. Strong sustainable facilities in schools, improved Schools curriculum to produce more agricultural experts that will add to the potential increase in agricultural productivity and improve efficiency.

2.Governments should establish adequate and timely training for farmers on the need for effective and efficient food productivity

3.Government should establish more agricultural fund-based and research Centers that are well funded. This would give rise to much more investors in the agricultural sector.

References

Adama J.I; Asaleye J.A; Oye J.A and Ogunjobi J.O (2018) Agricultural Production in Rural Communities: Evidence from Nigeria. Journal of Environmental Management Tourism. Vol. ix, Issue 3

Adebayo, O., & Olagunju, K. (2021). Health and Agricultural Labor Productivity in Rural Nigeria. Agricultural Systems Journal.

Adegbite, D. A., & Ayoola, J. O. (2021). Social Capital and Agricultural Productivity: The Role of Farmer Cooperatives in Nigeria. African Journal of Agricultural and Resource Economics.

African Aggrey, N., Eliab, L., & Joseph, S. (2010). Human capital and labor productivity in East manufacturing firms. Current research journal of economic theory, 2(2), 48-54.

Ajayi S.A and Ogunjobi J.O (2016) Bank credit and Agricultural Development in Nigeria: An Assessment. EKSU Journal of the Management Scientists, Ekiti State University, Ado Ekiti. Vol. 1, No 2

Akinyemi, O. A., & Alege, P. O. (2018). Education and Agricultural Productivity in Nigeria. Journal of Development Economics.

Almendarez, L. (2011). Human capital theory: Implications for educational development in Belize and the Caribbean

Amassoma, D., & Nwosa, P. I. (2011). Investment in human capital and economic growth in Nigeria using a causality approach/investissement en capital humain et croissance economique au Nigeria grace a une approche de causalite. Canadian Social Science, 7(4), 114.

Babalola, H. (2003), "Economic growth and human development" Nsukka, University Press

Becker, G. (1964). Human Capital: A Theoretical and Empirical Analysis, with Special Reference

Fashina A.O; Asaleye A.J; Ogunjobi J.O and Adedoyin L.I (2018) Foreign Aid, Human Capital and Economic Growth Nexus: Evidence from Nigeria. Journal of International Studies. 10(1) 277 - 292

Fowowe Babajide (2020). The Effects of Financial Inclusion on Agricultural Productivity in Nigeria. Journal of Economics and Development. Vol.22, Issue 1. Pp 61-79.

Gideon Danson-Abbean; Dennis Sedem Ehlakpo and Robert Aldoo (2018) Agricultural extension and its effects on farm productivity and income: Insight from Northern Ghana. Agriculture and Food Security. Vol.7 pp 78-91

Holden, L., & Biddle, J. (2016). The Introduction of Human Capital Theory into Education Policy in the United States.

Iseghohi Judith Omon (2021) Health and Labour Productivity in Nigeria: A Macroeconomic Approach.

James Kelechi Obima (2021). Capital Human Development, National Security and Agricultural Sector Growth in Nigeria. International Journal of Economics, Commerce and Management Vol ix, Issues 8. PP 90-103.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. Oxford Bulletin of Economics and statistics, 52(2), 169-210.

Liverpool-Tasie, L. S., Kuku, O., & Ajibola, A. (2011). Review of Literature on Agricultural Productivity, Social Capital, and Food Security in Nigeria. International Food Policy Research Institute (IFPRI).

Luh, Y. H. (2017). The Impact of Education on Agricultural Productivity: Evidence from East Asian Economies. International Journal of Food and Agricultural Economics (IJFAEC), 5(4), 11-24.

Mahmood, Z., Iftikhar, S., Saboor, A., Khan, A. U., & Khan, M. (2016). Agriculture land resources and food security nexus in Punjab, Pakistan: an empirical ascertainment. Food and Agricultural Immunology, 27(1), 52-71.

Mincer, J., & Polachek, S. (1974). Family investment in human capital: Earnings of women. Journal of Political Economy.

Nafukho, F., Hairston, N., & Brooks, K. (2004). Human capital theory: implications for human resource development. Human Resource Development International

Nnana O.O; Tangban E.E; Wilfred O and Okafor R.N (2023) The Impact of Human Capital Development on Agricultural Output in Nigeria. Wukari International Studies Journal.Vol.7(5).

Ndour, C. T. (2017). Effects of human capital on agricultural productivity in Senegal. World Scientific News, (64), 34-43.

Fowowe Babajide (2020). The Effects of Financial Inclusion on Agricultural Productivity in Nigeria. Journal of Economics and Development. Vol.22, Issue 1. Pp 61-79.

Obayelu, A. E., Adepoju, A. O., & Adegbola, A. J. (2019). Impact of Education on Technology Adoption Among Smallholder Farmers in Nigeria. Journal of Agricultural Economics

Obafemi, F.S; Ayodele, O; & Ebong, F. (2013). The Sources of Efficiency in the Nigerian Banking Industry. International Journal of Finance & Banking Studies (2147-4486), 2(4), 78-91.

Ogunjobi J.O, Ekiran J.O; and Adesanmi (2021) Human Capital Development, Employment and Economic Growth in Nigeria. International Journal of Economics, Business and Management Research. Vol.5, No 12. Pp247 – 258

Ogunniyi, A., Olagunju, K., Ogunniyi, S., & Yeboah, F. (2020). Human Capital, Health, and Agricultural Productivity in Nigeria. World Development Journal.

Oluwatobi, S. A., & Ogunrinola, I. O. (2011). Government expenditure on human capital development: Implications for economic growth in Nigeria. Journal of sustainable development, 4(3).

Okoli, C., Nwosu, C., & Ezeh, I. (2021). Human Capital and Agricultural Innovation Adoption in Nigeria. Journal of Agricultural Research.

Olaoye O.J; Ojebiyi W.G; Ankwe E.; and Akinniyi O.T. (2023) Effect of Traning of Extension Personnel in Selected Agricultural value chains in Ogun State, Nigeria. Ife Journal of Agriculture. Vol.35 No 1 pp 57-74

Oluwatobi, S. A., & Ogunrinola, I. O. (2011). Government expenditure on human capital development: Implications for economic growth in Nigeria. Journal of sustainable development, 4(3).

Osinowo, O. H; & Sanusi, R. A. (2018). Drivers of Agricultural Productivity in Agriculture-Based Economy.

Pesaran, M. H., Shin, Y., & Smith, R. J. (1996). Testing for the 'Existence of a Long-run Relationship' (No. 9622). Faculty of Economics, University of Cambridge.

Popoola O; Alege P.O; Gershon O; and Asaleye A.J (2018). Human Capital Channels and Productivity Growth: Evidence from Nigeria. Journal of Economics and Sociology. Vol 12, No 4. Pp 59-73

Salisu Ahmed (2020) The Relationship Between Education and Agricultural Productivity: The Moderating Effect of NGO. Universal Journal of Education Research.Vol.8 (3) pp 866-871

Schultz, T. W. (1961). Investment in human capital. American Economic Review.

Tan, E. (2014). Human capital theory: A holistic criticism. Review of Educational Research, 84(3), 411-445.

Timmer, C. P. (2002). Agriculture and Economic Development. In B. Gardner & G. Rausser (Eds.), Handbook of Agricultural Economics (vol. 2). Elsevier Science B.V.