CAPITAL ACCUMULATION IN AGRICULTURE AND AGRICULTURAL OUTPUT GROWTH IN NIGERIA: 1993-2024

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ABSTRACT: This study investigates the relative effects of capital accumulation in agriculture and agricultural output growth in Nigeria using annual time-series data covering the period 1993–2024. The specific objectives were to examine the factors which influence capital accumulation in the agricultural sector in Nigeria, measure the relative effects of capital accumulation and financial inclusion on the growth of agricultural output in Nigeria. Robust regression techniques with heteroskedasticity and autocorrelation consistent (HAC/Newey–West) standard errors were employed, while standardized coefficients were used to assess the relative importance of the explanatory variables. Diagnostic tests confirm the reliability of the estimated models: the Breusch–Pagan test shows no evidence of heteroskedasticity ($LM = 3.0433$, $p = 0.5506$), the Jarque–Bera test confirms normality of residuals ($JB = 0.4083$, $p = 0.8153$), and the Breusch–Godfrey test indicates no serial correlation ($LM = 0.1254$, $p = 0.9392$), supported by a Durbin–Watson statistic of 1.7357. Variance Inflation Factor results further suggest acceptable multicollinearity levels. The results indicate that growth in net

national savings (g_NNS) has the strongest positive association with agricultural output growth, being statistically significant in Model 2 ($\beta = 0.0230$, $p = 0.010$) and recording the highest standardized coefficient in Model 1 ($\beta = 0.373$). Human capital formation growth (g_HCF) shows a positive but weaker effect. In contrast, gross fixed capital formation growth (g_GFCF) and financial inclusion (FII) exhibit negative and statistically insignificant relationships with agricultural output. Overall, the findings suggest that domestic savings and human capital formation are more effective drivers of agricultural growth in Nigeria than aggregate investment and broad financial inclusion measures. The study recommends rural savings schemes, increased investment in farmer education, and addressing structural bottlenecks in Agricultural Financing.

Keywords: *Agricultural output, Capital accumulation, financial inclusion, Net national savings, Human capital, Nigeria*

INTRODUCTION

Agriculture has long served as the backbone of Nigeria's economy, predating the oil boom and continuing to underpin livelihoods, especially in rural areas. It encompasses diverse activities such as crop cultivation, livestock production, poultry farming, fisheries, and forestry, ensuring food security, supplying raw materials for agro-industries, generating employment, and aiding poverty reduction and economic diversification (Ojo, Mustapha, & Ismaila, 2022). Despite its pivotal role, the sector faces persistent challenges in achieving sustained output growth, necessitating enhanced capital accumulation—the mobilization of financial and physical resources for productive investments like irrigation, improved seedlings, and precision tools (Umaru & Inusa, 2022).

From 2015 to 2024, government initiatives aimed at bolstering financial inclusion and capital formation intensified. The establishment of the Development Bank of Nigeria (DBN) in 2017 provided wholesale funding to microfinance institutions for agricultural MSMEs (DBN, 2023). Recapitalization of entities like NAIC and NIRSAL expanded agricultural risk underwriting, with NAIC insuring over ₦1.01 trillion in investments by 2023 (NAIC, 2023). The Anchor Borrowers' Programme

(ABP), launched in 2015, linked smallholders to value chains, boosting productivity and capital investment (Osabohien, Okorie, & Afolabi, 2023). International efforts, including the African Development Bank's $2.2 billion for Agro-Industrial Processing Zones (AfDB, 2024) and Saudi Arabia's $1.2 billion in Olam Agri Holdings (Adigun, 2024), further catalyzed inflows.

Financial inclusion, by enabling access to credit, savings, and insurance, is crucial for capital accumulation and agricultural output growth, measured via agricultural GDP changes (Nduka & Nwankwo, 2023). It fosters technology adoption and risk mitigation, driving efficiency and income growth (Babajide, 2020; Demirgüç-Kunt *et al*., 2018). However, Nigeria grapples with severe financial exclusion, with 38.6% of the population (about 75.6 million) lacking formal services, disproportionately affecting rural farmers (EFInA, 2020; Demirgüç-Kunt *et al*,. 2020; Demirgüç-Kunt *et al*., 2022). Rural-urban disparities exacerbate this, limiting capital deployment and productivity (Uduji & Okolo-Obasi, 2023; CBN, 2023). Barriers include low financial literacy (over 60% of farmers affected; Adesanya & Olajide, 2021), reliance on informal lenders with exorbitant rates (Okezie & Offor, 2022; Ukwuaba *et al*., 2021), and chronic underfunding—agriculture received just 1.67% to 6.16% of commercial bank loans from 2000 to 2022 (CBN, 2022). This restricts mechanization, technology adoption, and value addition, perpetuating low yields, food insecurity, and import dependence (Effiom & Etim, 2020; Okeke & Mbah, 2021; Omodara *et al*., 2022; World Bank, 2022).

Despite extensive literature on financial inclusion or capital accumulation's roles (Babajide, 2020; Effiom & Etim, 2020; Sethy & Goyari, 2023), a key research gap lies in their integrated effects on sector-wide productivity. Prior studies focus on isolated aspects like credit impacts on small enterprises, overlooking structural barriers such as underfunding, literacy gaps, and informal lending (CBN, 2022; ACCA, 2020; FATE Foundation, 2020; Ojo & Adebayo, 2020). Few provide longitudinal, macro-level analyses over 1993–2024, despite reforms yielding rural inclusion below 35% (World Bank, 2022). This study addresses this void by examining factors influencing agricultural capital accumulation and measuring the

relative effects of capital accumulation and financial inclusion on output growth in Nigeria from 1993 to 2024.

By addressing this critical gap, the study aims to analyze financial inclusion, capital accumulation in agriculture and agricultural output growth in Nigeria from 1990 to 2024. Against this backdrop, the study addressed the following research these problems using the following objectives.

i. examine the factors which influence capital accumulation in the agricultural sector in Nigeria;

ii. measure the relative effects of capital accumulation and financial inclusion on the growth of agricultural output in Nigeria.

MATERIAL AND METHODS

The study was conducted in Nigeria. Nigeria is a country located in West Africa, between latitudes 4° and 14° N, and longitudes 3° and 15° E. It covers a total land area of approximately 923,768 square kilometres, a North-South length of about 1450 km and a West-East breadth of about 800 km. Its total boundary is 4047 km, while the coastline is 853 km and a population estimate of over 200 million people, making it the most populous country in Africa (National Population Commission, NPC, 2021). It shares borders with Benin to the west, Chad and Cameroon to the east, and Niger to the north. Its southern coastline is along the Gulf of Guinea in the Atlantic Ocean. It comprises 36 states, and the Federal Capital Territory is located in Abuja. Nigeria is located in the tropics, which is characterized by high temperatures, high humidity and intense heat. Its rainfall ranges between 2000 and 3000 mm. Nigeria encompasses (6) major agro-ecological zones (Onyeiwu *et al*., 2021).

Nigeria, often referred to as the "Giant of Africa," has a vast land area of 923,768 km² and an estimated population exceeding 200 million (Onyeiwu *et al*, 2021). As an agrarian nation with extensive arable land, the country is well-positioned to harness its agricultural potential for economic transformation. The data for the study are basically time series data (secondary data) covering 1993 to 2024 years. The choice of this period was to determine the effort of Nigerian policies in driving financial

inclusion and capital accumulation of farmers in the country. The data were collected from Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), National Financial Inclusion Revised Strategy and Federal Ministry of Agriculture annual issues. Data were also obtained from other multiple credible sources, including the IMF Financial Access Survey (FAS), the World Bank Global Findex Database and the EFInA Access to Financial Services in Nigeria (A2F) Survey.

The data included aggregate agricultural output, capital accumulation proxied by Gross Fixed Capital Formation and Human Capital Formation. The data collected for the study were analysed in line with the specific objectives of the study. Objectives I and II were realized using the multiple regression analysis model. The model is specified as follows;

$$FII_{it} = \beta0 + \beta_1 AGDP_{it} + \beta_2 NNS_{it} + \beta_3 GFCF_{it} + \beta_4 HCF_{it} + \text{AFDI}_{it} + \text{INFL}_{it} + \text{INTR}_{it} + \mu_{i+\lambda_t} + \varepsilon_i \; \text{---}(1)$$

Where:

i = Country

t = time

μi = y fixed effects λt = time fixed effects

FIt = Financial Inclusion Index in year t

AGDPt= Agricultural Gross Domestic Product (N'$)

$NNSt$ = Net national savings (% of GNI)

$GFCFt$= Gross fixed capital formation (N'$)

$HCFt$= Human capital formation (proxy: Education Index)

INTR = Real interest rate (%)

INFL = Inflation rate (%)

εt= Error term

To test for co-integration in order to know the disequilibrium error, equation (1) is rewritten as:

et = FII - $\square_0$ - $\square_1$AGDP - $\square_2$NNS - $\square_3$GFCF -$\square_4$HCF - $\square_5$INTR - $\square_\square$INTR – $\square_7$INFL - - -(2)

The presence of co-integration was tested using the Johansen or Engle and Granger (1987) single test approach. The order of integration of the estimated residual, et, is tested, and if there is a co-integrating regression, then the disequilibrium errors in equation (2) form a stationary time series, and have a zero mean, the et should be stationary, I(0) with E(et) = 0. The long-run equilibrium may be rarely observed, but there is a tendency to move towards equilibrium.

Thus, the Error Correction Model was used to represent the long-run (static) and short-run (dynamic) relationships between FII and other variables. Accordingly, Error Correction Model (ECM) is suitable to estimate the effect of determinant variables on FII. The greater the coefficient of the parameter, the higher the speed of adjustment of the model from short runs to long run. Considering our base equation (1), the ECM model is specified as follows:

$$\square fiiL \square \alpha_0 + \alpha_1 + \square AGDP_{t-1} + \square_2 + \square NNS_{t-1} + \alpha_3 + \square GFCF_{t-1} + \alpha_4 + \square HCF_{t-1} + \alpha_5 + \square AFDI_{t-1} + \alpha_6 + \square INFL_t + \alpha_6 + \square INTR_{t-1} + \delta ECM (-1) - \square\square\varepsilon t \quad - - - (3)$$

Where εt is the error term, ECM (-1) is the error correction term, captures the long run impact. The short run effects are captured through the individual coefficients of the differed terms (α) while the coefficient of the ECM variable contains information about whether the past values of variables affect the current values. The size and statistical significance of the coefficient of the ECM measure the tendency of each variable to return to the equilibrium. A significant coefficient implies that past equilibrium errors play a role in determining the current outcomes.

The capital accumulation model is specified as follows;

CAP = f (AGRP, NNS, HCF, GFCF, MCAFD, FDI, DIF, MCAFD, CMD) - - - Equ. (3.5)

Where;

Where;

CAP = Capital accumulation in agriculture, proxied by gross fixed capital formation in agriculture (₦, constant prices),

AGRP = Agricultural output (Mt) NNS = =Net National Savings

HCF = Human Capital Formation

MCAFD = Credit flows into small-scale farming or agribusiness AFDI = Inflows into agriculture

DIF = Domestic private investment in productive assets

CMD = Stock market capitalization

RESULTS AND DISCUSSIONS

DETERMINANTS OF CAPTIAL ACCUMULATION

Unit Root Test

The unit root test was employed to examine the stationarity properties of the five variables used in the study. Specifically, the Augmented Dickey–Fuller (ADF) test was applied to each series to determine the presence of unit roots. The results of the ADF unit root tests are presented in Table 1.

Table 1.: Unit Root Output (Augmented Dickey-Fuller)

| Variable | At Level | | | At First Difference | | | |
	ADF T-statistics	1%	5%	ADF statistics	1%	5%	Order of integration
AGDP	-1.517	-3.605	-2.936	-9.358***	-3.605	-2.936	1(1)
NNS	0.392	-3.887	-3.052	-6.037***	-3.621	-2.938	I (1)
GDP	-2.857	-3.605	-2.936	-4.855***	-3.605	-2.936	1(1)

MCAFD	0.256	-3.809	-3.021	-4.476***	-3.689	-2.946	1(1)
DIF	0.244	-3.788	-3.012	-7.034***	-3.610	-2.943	I (1)
AFDI	0.392	-3.887	-3.052	-6.037***	-3.621	-2.939	1(1)
CMD	0.245	-3.788	-3.012	-7.035***	-3.610	-2.943	1(1)
CAP	-1.383	-3.812	-3.030	-7.129 ***	-3.627	-2.972	1(1)

Source: Researcher's extraction from the unit root tests results using ADF methods. Note: *** represent statistically significant at 1% level. These tests were for the constant and trend in regression

Table 1 presents a summary of the Augmented Dickey–Fuller (ADF) unit root test results conducted to examine the stationarity properties and predictability of the variables included in the model. The tests were carried out at both levels and first differences.

The results reported in Table 1 indicate that none of the variables was stationary at levels, as the absolute values of the ADF test statistics were less than the corresponding MacKinnon critical values at the 1% and 5% significance levels. Consequently, the null hypothesis of a unit root could not be rejected at levels.

To address this, each variable was transformed into its first difference and re-tested for stationarity. The ADF test results at first difference reveal that all variables became stationary, with the absolute values of the test statistics exceeding the critical values at the 1% significance level. This provides sufficient evidence to reject the null hypothesis of non-stationarity.

In summary, the unit root test results confirm that all variables used in the study are stationary at first difference and are therefore integrated of order one, I(1). This implies that shocks to the series are temporary and dissipate over time, returning the variables to their long-run equilibrium paths.

Given that all the variables are integrated of the same order, I(1), this satisfies the necessary condition for conducting a co-integration analysis. Accordingly, a co-integration test was undertaken to determine the existence of a long-run equilibrium relationship among the variables.

Where co-integration is established, two models are estimated for each equation: (i) an Ordinary Least Squares (OLS) model based on the level data, which captures the long-run equilibrium relationship among the variables; and (ii) an Error Correction Model (ECM), which explains the short-run dynamics and the speed of adjustment toward long-run equilibrium.

Prior to the Johansen co-integration test, a lag length selection procedure was conducted to determine the optimal lag structure for the model. The results of the lag order selection test are presented in Table 2.

Table 2: Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	213.6500	NA	9.69e-15	-9.565115	-9.237450	-9.444282
1	487.2393	32.6529*	5.95e-19	-19.31346*	-16.36447*	-18.22596*
2	547.6468	73.05088	9.62e-19	-19.14636	-13.57605	-17.09220
3	626.3708	65.90847	1.28e-18	-19.83120*	-11.63957	-16.81038

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The optimum lag length on the selection of lag order criteria using sequential modifier LR test statistic (LR), Final Prediction Error (FPE), Schwarz Information Criterion and HQ: (SC), Hannan-Quinn information criterion (HQ) and Akaike Information Criterion (AIC) respectively d "1". Lag of 1 was appropriate since the lag order selection result fell on one. Therefore, LR: sequential modified LR test statistic each was test at 5% level of significance, FPE: Final Prediction Error, AIC:

Akaike Information Criterion, SC: Schwarz Information Criterion and HQ: Hannan-Quinn information criterion all confirmed that three period lag is most appropriate for the analysis.

With this optimal lag length, the Johansen procedure was carried out to ascertain if any co-integration (long-run) relationship exists among the variables of interest both the maximum Eigen value and Trace statistic were reported in the result as shown in Table 2. The null hypothesis of no co-integrating relationship was tested against an alternative hypothesis that there was at least 1 co-integrating vector for maximum Eigen value and trace statistic respectively. The null hypothesis of no con-integrating vector was rejected and the alternative hypothesis of co-integrating vector accepted. Hence in estimating the error correction model, we utilized a lag length of 1. Therefore, the results of the Johansen co-integrating test based on the optimal lag length chosen by the lag selection criteria were presented in Table 3

Trend assumption: Linear deterministic trend

Series: AGDP, GFCF, MCAFD, NNS, DIF, AFDI, CMD

Lags interval (in first differences): 1 to 2

Table 3: Johansen Co-integration Test
Unrestricted co-integration Rank Test (Trace)

Hypothesized No of CE(s)	Eigen Value	Trace Statistic	0.05 Critical Value	Probability **
None *	0.663	86.574	69.819	0.000
At most 1 *	0.473	50.634	47.856	0.027
At most 2	0.400	29.509	29.797	0.054
At most 3	0.284	12.665	15.495	0.128
At most 4	0.048	1.623	3.842	0.203

Trace test specifies 2 co-integrating equations at the 0.05 level

* denotes rejection of the hypothesis at 5% significant level

**MackKinnon-Haug-Michelis (1999) p-values

Table 4 Unrestricted Cointegration Rank Test (Maximum Eigen value)

Hypothesized No of CE(s)	Eigen Value	Trace Statistic	0.05 Critical Value	Probability **
None *	0.981	35.940	33.877	0.028
At most 1	0.849	21.125	27.584	0.269
At most 2	0.247	16.844	21.132	0.180
At most 3	0.124	11.042	14.265	0.152
At most 4	0.048	1.623	3.842	0.203

Maximum Eigen value test indicates 1 co-integrating equations at the 0.05 level

* denotes rejection of the hypothesis at 5% significant level

**MackKinnon-Haug-Michelis (1999) p-values

The Johansen co-integration test was employed to examine the existence of a long-run equilibrium relationship among the variables. The trace statistic was used to test the null hypothesis of no co-integration $(r=0)(r = 0)(r=0)$ against the alternative of one or more co-integrating vectors $(r>0)(r > 0)(r>0)$. The trace test results indicate that the null hypothesis of no co-integration was rejected at the 5% significance level, as the trace statistics for both "none" and "at most one" exceeded their respective critical values. This suggests the presence of two co-integrating equations among the variables, based on the MacKinnon–Haug–Michelis (1999) p-values.

Similarly, the maximum eigenvalue test supports the existence of a long-run relationship. The null hypothesis of no co-integration $(r=0)(r = 0)(r=0)$ was rejected at the 5% level, indicating the presence of one co-integrating vector. Although the trace test identified two co-integrating equations while the maximum eigenvalue test identified one, both tests consistently confirm the existence of co-integration among the variables.

The evidence from both the trace and maximum eigenvalue statistics, therefore, establishes a stable long-run relationship among the variables. As noted by Gujarati (2004), the presence of at least one co-integrating vector implies a long-run equilibrium. Consistent with Engle and Granger (1987), when variables are integrated of order one, I(1), and co-integrated, short-run dynamics should be modelled using an error correction mechanism.

Accordingly, an Error Correction Model (ECM) was estimated to capture both the short-run adjustments and the speed at which deviations from long-run equilibrium are corrected. The inclusion of the error correction term ensures that short-run disequilibria are gradually eliminated, reinforcing the existence of both short-run interactions and long-run equilibrium relationships among the variables. The co-integrating equations were normalized to obtain long-run parameter estimates, confirming that the variables share a stable long-run economic relationship.

SHORT-Run Determinants of Capital Accumulation In Agriculture, Proxied by Gross Fixed Capital Formation in Nigeria

The short-run determinants of capital accumulation in agriculture are presented in Table 5.

Table 5: Short-run determinants of Capital accumulation in Nigeria (1993-2024)

Variable	Coef.	Std. error	Z	P>|z|
Constant	6.078	8.496	0.715	0.479
D[LogAGDP(-1)]	0.142	0.065	2.18**	0.256
D[LogGDP(-1)]	0.452	0.132	3.421***	0.001
D[LogMCAFD(-1)	0.170	0.076	2.234**	0.030
D[LogNNS(-1)]	0.123	0.078	1.567	0.210
DLog [DIF(-1)]	0.346	0.116	2.987***	0.004
D[LogAFDI(-1)]	-0.002	0.044	-0.960	0.345
D[LogCMD(-1)]	0.041	0.194	1.33	0.121
ECM(-1)	-0.672	0.215	-3.124***	0.000
R^2	0.772			
F statistic	231.86***			
DW stat	1.988			

Source: CBN STATISTICAL Bulletin, 2024

The estimated Error Correction Model (ECM) demonstrates a strong overall fit and sound diagnostic properties. The coefficient of determination R^2 of 0.772 indicates that approximately 77.2% of the variation in capital accumulation is explained by the explanatory variables included in the model, while the remaining variation is attributable to factors outside the model. The Durbin–Watson statistic of 1.988 confirms the absence of serial correlation, while the F-statistic (231.86; p < 0.01) indicates that the model is jointly significant.

The error correction term is negative and statistically significant at the 1% level (−0.672), confirming the existence of a stable long-run relationship among the variables. This coefficient implies a rapid speed of adjustment, with about 67% of short-run deviations from long-run equilibrium corrected within one year, consistent with the ARDL framework proposed by Pesaran *et al*. (2001).

In the short run, agricultural GDP exerts a positive and significant effect on capital accumulation, indicating that increases in agricultural output immediately enhance reinvestment capacity and capital formation. Gross Domestic Product also shows a positive and highly significant impact, suggesting that overall economic expansion has an immediate effect on capital accumulation. Credit flows to small-scale farming similarly exhibit a positive and significant short-run effect, highlighting the role of financial access in facilitating investment and capital formation.

Net national savings, although positively signed, does not exert a statistically significant short-run effect on capital accumulation, suggesting that the savings–investment nexus operates more strongly in the long run. In contrast, domestic private investment displays a positive and significant short-run relationship with capital accumulation, underscoring its critical role in driving investment and economic growth.

Long-Run Determinants of Capital Accumulation in Agriculture

The estimated regression results of the response of capital accumulation to changes in the selected independent variables in Nigeria are presented in Table 6.

Table 6: Long-run determinants of capital accumulation in Nigeria (1993 – 2024)

Variable	Coef.	Std.err	Z	P>|z|
Constant				
LogAGDP	0.314	0.116	2.706***	0.006
LogGDP	0.428	0.133	3.214***	0.001
LogMCAFD	0.153	0.053	2.871***	0.019
LogNNS	0.196	0.048	4.122***	0.011
LogDIF	0.287	0.093	3.074***	0.007
LogAFDI	-0.071	-0.049	1.453	0.215
LogCMD	0.118	0.063	1.864*	0.066

Source: CBN Statistical Bulletin, 2024

The long-run estimates presented in Table 6 reveal that agricultural gross domestic product (AGDP) exerts a positive and statistically significant effect on capital accumulation in Nigeria. The elasticity of AGDP (0.314), which is less than unity, indicates that a 1% increase in agricultural output leads to a 0.31% increase in capital accumulation, suggesting moderate but sustained reinvestment effects from agricultural expansion.

Overall economic performance, captured by GDP, shows a strong and significant positive relationship with capital accumulation. The estimated elasticity (0.428) implies that growth in aggregate output substantially enhances long-run capital formation, reflecting the role of macroeconomic expansion in driving investment in productive assets.

Credit flows to small-scale farming and agribusiness also have a positive and significant long-run impact on capital accumulation, underscoring the importance of financial access in supporting sustained investment and capital deepening within the agricultural sector. Similarly, net national savings exhibits a positive and highly significant effect, confirming that higher savings translate into increased investment and capital stock accumulation in the long run.

In contrast, agricultural foreign direct investment shows a negative but statistically insignificant relationship with capital accumulation, suggesting that foreign inflows into agriculture have not contributed meaningfully to long-run capital formation, possibly due to their limited scale and weak linkage with domestic production systems.

Domestic private investment emerges as a key driver of capital accumulation, with a positive and significant coefficient, highlighting the dominant role of locally driven investment in sustaining long-run capital growth. Stock market capitalization, while positively signed, exerts only a weak long-run influence on capital accumulation, indicating limited integration between Nigeria's capital market and the agricultural sector.

RELATIVE EFFECTS OF CAPITAL ACCUMULATION AND FINANCIAL INCLUSION ON THE GROWTH OF AGRICULTURAL OUTPUT IN NIGERIA, 1993 - 2024

Results of the relative effects of capital accumulation and financial inclusion on the growth of agricultural output in Nigeria are presented in Table 7.

Table 7: Model 1 (OLS HAC):

Variable	Coef.	Std.Err (HAC)	Z	P>|z|
Const	3.1005	2.3442	1.323	0.186
g_GFCF	-0.2291	0.1794	-1.278	0.201
FII	-2.0746	2.9294	-0.708	0.479
g_HCF	0.0205	0.0126	1.628	0.103
g_NNS	0.0215	0.0116	1.854	0.064

Explanatory variables: g_GFCF (growth in gross fixed capital formation), FII (financial inclusion index), g_HCF (growth in human-capital formation), g_NNS (growth in net national savings)

Table 8: Model 2 (using change in FII):

Variable	Coef.	Std.Err (HAC)	T	P>|t|
Const	1.9989	0.6547	3.053	0.002
g_GFCF	-0.1472	0.1705	-0.863	0.388
dFII	-11.6269	9.8318	-1.183	0.237
g_HCF	0.0217	0.0144	1.513	0.130
g_NNS	0.0230	0.0089	2.591	0.010

dFII= change in FII Standardized Coefficients (Relative Effects)

Standardized coefficients allow comparison of the relative importance of predictors. Below are standardized coefficients (Model 1):

Table 9: standardized coefficients (Model 1):

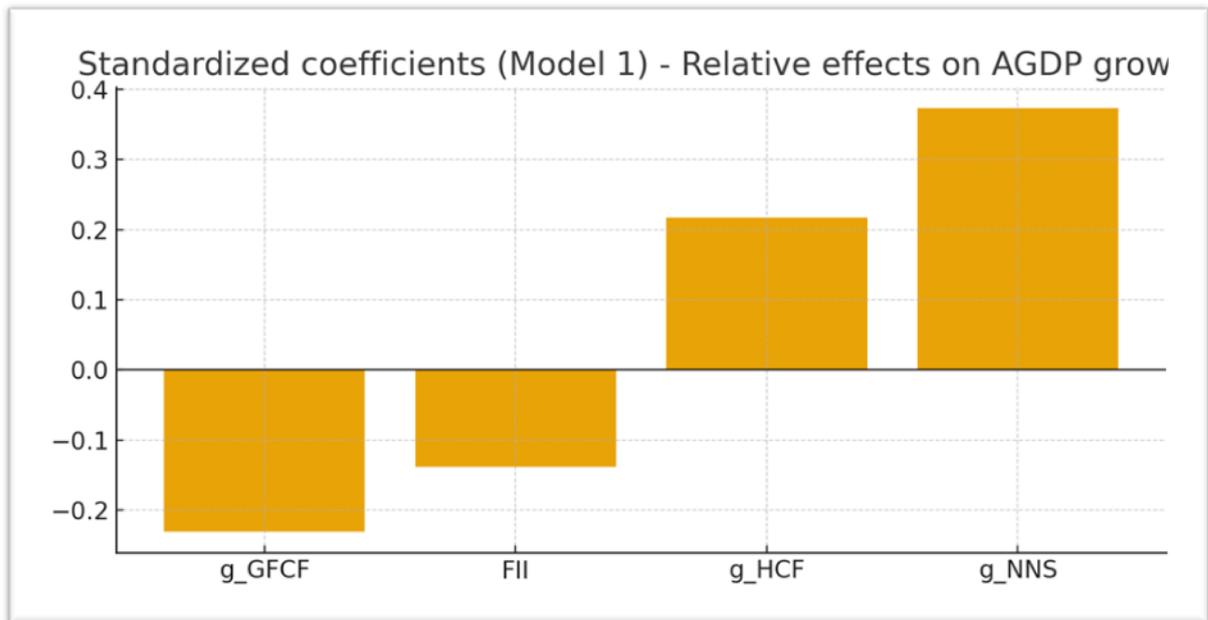| Variable	Standardized Coefficient
g_GFCF	-0.2305
FII	-0.1382
g_HCF	0.2173
g_NNS	0.3730

Figure 1: Standardized coefficients (beta coefficients) for Model 1 to compare relative importance.

Diagnostic tests indicate that the estimated models satisfy the classical regression assumptions. The Breusch–Pagan test shows no evidence of heteroskedasticity (LM = 3.0433, p = 0.5506), while the Jarque–Bera test confirms normality of the residuals (JB = 0.4083, p = 0.8153). The Breusch–Godfrey test reveals no serial correlation (LM = 0.1254, p = 0.9392), and the Durbin–Watson statistic of 1.7357 indicates the absence of first-order autocorrelation. Variance Inflation Factor (VIF) results suggest that multicollinearity is within acceptable limits. Heteroskedasticity and autocorrelation consistent (HAC/Newey–West) standard errors were employed to ensure robust statistical inference.

Relative Effects Results showed that the standardized coefficient estimates indicate that growth in net national savings (g_NNS) has the largest positive association with agricultural output growth. In Model 2, g_NNS is positive and statistically significant ($\beta = 0.0230$, p = 0.010), and it records the highest standardized coefficient in Model 1 ($\beta = 0.373$). Human capital formation growth (g_HCF) shows a positive but weaker effect. Gross fixed capital formation growth (g_GFCF) and financial inclusion (FII) display negative but statistically insignificant coefficients across the models. Overall, net national savings and human capital formation exhibit positive

effects on agricultural output growth, while gross capital formation and financial inclusion do not show statistically significant effects within the study period.

CONCLUSION

The empirical evidence from this study indicates that agricultural growth in Nigeria is driven more by domestic savings and human capital development than by aggregate capital accumulation or broad financial inclusion. Net national savings consistently emerged as the most influential factor, underscoring the importance of internal resource mobilization for sustaining agricultural production. Human capital formation also contributes positively, highlighting the role of skills, education, and knowledge dissemination in improving agricultural productivity. Conversely, the insignificant effects of gross fixed capital formation and financial inclusion suggest structural weaknesses in Nigeria's agricultural financing framework, including sectoral misallocation of investment, limited rural credit penetration, and inefficiencies in financial intermediation. Overall, the findings imply that macro-level investment and financial inclusion policies, when not specifically targeted at agriculture, may fail to generate meaningful productivity gains within the sector.

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