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Towards Sustainable Agricultural Growth in India: The role of banking credit and capital formation

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Abstract
The current literature has thoroughly examined the impact of financial development on enhancing agricultural productivity. But empirical studies are deficient in the effect of banking credits and capital formation on agricultural GDP in India. This study addresses this gap by examining the relationship between financial development, capital formation, and agriculture in the Indian economies from 1991 to 2021, focusing on agricultural growth. Our findings indicate that an increase in capital formation, lending interest rate, domestic credit to the private sector, and renewable energy consumption significantly enhances the long-term agricultural GDP by 0.081 %, 0.07%, 0.115%, and 0.35 %, respectively. Broad money has a negative impact on agricultural GDP. Broad money increased by 1% of agricultural GDP, leading to a decrease of 0.23%. This study highlights the importance of financial resources and agricultural inputs in ensuring food security and advocates for the revaluation of credit systems to alleviate potential negative impacts. These findings offer significant insights. Recommendations for policymakers seeking to enhance Agricultural growth in India.

Keywords: Agricultural growth, banking credit, capital formation, Johanson cointegration, VECM

Introduction

Agriculture is essential to India's economy, serving as a key source of livelihood for its population. Agriculture has been the backbone of India's economy for centuries, contributing significantly to employment, food security, and GDP growth. Despite rapid industrialization and the expansion of the service sector, agriculture remains a dominant force, supporting nearly 58% of India's population (FAO, 2022) and contributing approximately 18.3% of the nation's gross domestic product (GDP) (Ministry of Agriculture & Farmers Welfare, 2023). The agricultural sector is a key driver of sustainable development in many countries, as it contributes directly or indirectly to various United Nations Sustainable Development Goals. However, in order to rejuvenate and modernize production processes, this sector requires increasing financial investments Ozdemir, (2024).Consequently, the optimal distribution of financial resources must prioritise investments in agriculture and rural development, including improved access to financial services for small-scale farmers, Fan et al. (2023) The implementation of sustainable agricultural practices is contingent upon the availability of financial resources, Gregory et al. (2005). Effective food system operations also depend on an awareness of the advantages of various financing methods. With the use of cutting-edge technologies, precision agriculture holds great promise for enhancing sustainable farming methods. A synergistic impact could be produced by combining agricultural technology developments with financial development, increasing agricultural production (Gebbers, 2010; Stafford, 2000; Zhang et al., 2000). The relationship among financial factors, such as financial credit, broad money, banking credit, and precision agriculture, is critically significant. Farmers can enhance their agricultural practices using new ways if they have adequate finance (Lai et al. 2017; Raifu & Aminu, 2019). A boost in agricultural productivity can yield greater food production on reduced acreage, which is essential for food security. Policymakers may enhance global food security by formulating effective policies grounded in research on how various systems might augment profitability across the whole agriculture and food sector. These strategies encompass, but are not restricted to, the following: the implementation of risk management tools to mitigate the impact of CC and other unforeseen challenges on agricultural output and food availability, the expansion of financial resources for small-scale farmers, and the investment in agriculture and rural development (Farooq et al. 2023; Hu et al., 2021). However, agriculture often suffers from inadequate funding as a result of government prioritisation of other sectors or inefficient expenditure. Additionally, because they believe agriculture to be riskier and more costly than other industries, entrepreneurs may be reluctant to invest in it. However, the food and agricultural industries require far more money.

The ability of financial organisations to lend money is given a boost when there is an increase in broad money. The occurrence of this circumstance results in an increase in the quantity of credit that is available, which, in theory, makes credit more accessible to the general public. Converting liquidity into credit for the economy increases access to resources for individuals and businesses to finance projects. Because of this, an increase in the supply of wide money often results in an increase in the availability of credit, which in turn makes it more accessible. In times of market volatility, having a greater number of loan choices might provide additional financial assistance and protect against unforeseen events Narayanan (2016). For farmers and agricultural enterprises to be able to plan for future output and maintain supply conditions, it is essential for them to have timely access to financial materials.For instance, if farmers have access sufficient finance alternatives like microcredits, intelligent input subsidies, and guarantee funds , they will be able to modernise their operations and maintain their competitiveness in the agricultural market which exists today (Agbodji & Johnson, 2021; Farooq et al., 2023). The adoption of renewable energy technology can reduce the environmental impact of agriculture and improve food security over time Chopra et al. (2022). Ultimately, given that alterations in rural demographics may profoundly influence agricultural production with considerable significance for agricultural practices.

Literature Review

The empirical factors influencing agricultural production are diverse and may differ by region and crop type. Yadav & Goyari (2024), the study investigate the impact of financial development on agricultural productivity in India coming from 1980 to 2020. Agriculture productivity, capital creation, financial development, GDP per capita, rural population, arable land, and trade openness all have long-term equilibrium relationships, according to the ARDL cointegration test. The empirical factors influencing agricultural production are diverse and may differ by region and crop type. The projected long-run elasticities from all three methodologies, together with the short-run elasticities of ARDL, have consistently indicated that the elasticity of financial development is greater (1.55% and 1.40%, respectively) in elucidating the crop production of India. Md. Qamruzzaman (2024), this study focuse on the correlation between gross capital formation, financial development, renewable energy consumption and FDI. Using the NARDL and CS-ARDL to identify a robust statistical substantial relation, both short-term and long-term, among the gross capital formation, financial development, renewable energy consumption and FDI. Kumari & Garg (2023), this study analyses the immediate and enduring impact of bank loans on the growth of the agriculture industry. The ARDL Bound test was conducted utilising secondary data from 1990 to 2019 to examine the relationship among the variables. The research revealed that, over the long term, inflation, interest rate, and credit positively influence agricultural development. Conversely, in the short term, credit and inflation significantly affect agricultural development, while interest rates do not have a significant impact. Agbodji & Johnson (2021) the study nalyse the impact of credit on sorghum, maize and paddy rice productivity. The findings indicate that credit exerts a favourable and considerable influence on production. This general outcome fluctuates based on the category of credit, however. In-kind credit positively and significantly influences maize and sorghum productivity, although has no meaningful effect on paddy rice output. The effects of cash credit on productivity are negative for maize, favourable for sorghum, and insignificant for paddy rice. Raj Kharel et al. (2024) The results, obtained from extensive econometric analyses incorporating cointegration tests and vector error correction models, provide substantial insights into Nepal's economic performance and financial system. Findings demonstrate that Private Sector Credit significantly contributes to economic growth, with around 40.07% of the prior year's discrepancy affected by the long-term elasticity of independent variables. Dnyaneshwar Vishnu Gore Assistant Professor & Neeta Dnyandeo Shinde (2014) This study aims to uncover the factors and limitations affecting private capital and formation in Indian agriculture, and examines the influence of capital formation on agricultural and broader economic growth in India. This is an analytical study. This research relies on secondary data. Data is gathered from government-related documents and plan documents. Accelerated agricultural investment is necessary to meet the 12th five-year plan's goal of "Faster, Sustainable, and More Inclusive Growth."Farooq et al. (2023), this study determines to examine the long-term relationship among Pakistani agricultural growth and financial inclusion from 1960 to 2018. The evaluation is conducted using the dynamic ordinary least squares (DOLS) method, the Johansen co-integration test and the autoregressive distributed lag (ARDL) approach,. The findings indicate that, in Pakistan, broad money and cultivated area had a favourable effect on agricultural growth in both the short and long term, but domestic credit had a considerably negative effect. Pruntseva et al. (2024) according to the study, there is a significant indirect correlation between the incidence of undernourishment and metrics like "credit to agriculture," "agriculture value added share of GDP," and "agriculture share of government expenditure." The government, OECD, FAO, and other authorities may use the research's findings as a foundation to develop and implement policies and initiatives that will boost agricultural production and guarantee food security. Dwivedi et al. (n.d.) The proportion of agriculture in GDP has consistently decreased from 18.6 percent in 2004-05 to 14.6 percent in 2009-10 (at 2004-05 prices). The diminishing proportion of the agriculture sector in GDP is a hallmark of all developing countries. The gross capital formation (GCF) in the agricultural sector as a percentage of GDP has exhibited an upward trend, rising from 15.8 percent in 2005-06 to 21.3 percent in 2008-09. We aim to use the econometric analysis to uncover the long-run relationships among the Agricultural GDP and related to banking credit and capital formation variables. This study's novel contribution lie in analysing the impact of banking credit, broad money and capital formation on Agricultural GDP. This provides insight for sustainable policy decisions, sustainable agricultural growth, and economic development in India.

Material and Method

The current research utilises annual data encompassing India over the period 1991 to 2021. To study the linkage among the Agricultural GDP in terms of agricultural value added, gross capital formation, the lending interest rate, broad money, domestic credit to the private sector, and renewable energy consumption. The World Development Indicators provided the time series data (WDI 2023). The long-term association between variables is characterised by cointegration. Since the 1990s, cointegration has been used to examine the link between time series variables. The Johnson cointegration test and Vector Error Correction Model (VECM) were used to determine the Agricultural GDP.

Table 1 provides a description of and details for the studied dependent and independent variables.

Variable	Measurement	Sources
AGDP	Agricultural, forestry, and fishing value added (% of GDP)	WDI
GCF	Gross capital formation (% of GDP)	WDI
Interest rate	Lending interest rate	WDI
Broad money	Broad money (% GD)	WDI
Domestic credit	Domestic credit to private sector (% of GDP)	WDI
REC	Renewable energy consumption (% of total final energy consumption)	WDI

Model Specification

To evaluate the link between the agricultural GDP

$$AGDP_t = \beta_0 + \beta_1 GCF_t + \beta_2 LIRt + \beta_3 BM_t + \beta_4 DCP_t + \beta_5 RECt + \varepsilon_t \quad \text{eq. 1}$$

Where, t= periods, AGDP = Agricultural, forestry, and fishing, value added (% of GDP), GCF is gross capital formation (% of GDP), IR is the lending interest rate (% of GDP), BM is the broad money (% of GDP), DCP is the domestic credit to private sector (% of GDP), and REC is the renewable energy consumption (% of total final energy consumption), and εt is error term. Moreover, these variables have been used in previous studies (Chandio et al., 2024; Chopra et al., 2022; Dwivedi et al., n.d.; Farooq et al., 2023; Raifu & Aminu, 2019)

Johansen (1991), The Johansen co-integration test counts the number of co-integrating relationships (long-term equilibrium relationships) between a group of time series variables that are not stationary. The examination is performed utilising two statistical measures. Trace statistic and max-eigenvalue statistic.

$$\text{Trace Statistic} = -T\sum_{i=r+1}^{k} \ln(1-\lambda_i) \quad \text{eq.2}$$

$$\text{Max} - \text{eignvalue} = -T\ln\left(1-\hat{\lambda}_{r+1}\right) \quad \text{eq. 3}$$

T is the sample size

$\lambda_1, \lambda_2, ..., \lambda\_k$ are the ordered eigenvalues ($\lambda_1 > \lambda_2 > ... > \lambda\_k$)

r is the number of cointegrating relationships under the null hypothesis

Tests from r = 0 to r = k–1

Results and discussion

Outcome of unit root examination

This research uses the Phillips-Perron test to examine the stationarity of the variables. The, presented in table 2 indicate that none of the variables are stationary at their level form (I(0)). However, after applying the first difference (I(1)), all variables achieve stationarity. This conclusion is supported by the PP test statistics, which are higher than the 5% significance level's critical values.

Table 2. Unit root analysis

Variable	Philips Pherron			
	Level	Prob	First Diff	Prob
Intercept				
AGDP	-2.4363	0.1408	-6.1228	0.0000
GCF	-1.7251	0.4089	-7.5120	0.0000
LI	-2.1827	0.2163	-6.7011	0.0000
BM	-0.9666	0.7521	-4.8318	0.0005
DC	-0.8983	0.7748	-4.9499	0.0004
REC	-1.1636	0.6767	-3.8114	0.0073
Intercept & Trends				
AGDP	-0.4166	0.9821	-7.6140	0.0000
GCF	-0.7813	0.2818	-7.7540	0.0000
LI	-0.2764	-3.4058	-8.8625	0.0000
BM	-1.4789	0.8145	-4.7344	0.0037
DC	-1.1417	0.9496	-4.8456	0.0028
REC	-0.9496	0.9364	-3.8988	0.0252

Source Author's calculation using Eviwes

Table 3 presents the six cointegration vectors along with their trace and. If the trace value is greater than its critical value, it means reject H0, which shows there is strong evidence for the long-run relationships among the model's variables. Table 4 also presents six cointegration vectors along with their max-eigen statistic. If the max-eigenvalue is greater than its critical value. It means there is strong evidence for the long-run relation among the variables.

Table 3. Johansen co-integration test using the trace statistics

Lags interval: 1 to 2

Eigenvalue	Trace Statistic	5 Percent	Prob***	Hypothesized no. of CE(s)
0.992964	319.2539	103.8473	0.0000	None*
0.889420	180.4656	76.97277	0.0000	At most 1*
0.808994	118.8091	54.07904	0.0000	At most 2*
0.759796	72.45648	35.19275	0.0000	At most 3*
0.492010	32.52102	20.26184	0.0006	At most 4*
0.383793	13.55682	9.164546	0.0070	At most 5*

Table 4. Johansen co-integration test using the max-eigen statistic

Eigenvalue	Max-eigen statistics	5 percent critical value	Prob**	Hypothesized no. of CE(S)
0.992964	138.7883	40.95680	0.0000	None*
0.889420	61.65653	34.80587	0.0000	At most 1*
0.808994	46.35260	28.58808	0.0001	At most 2*
0.759796	39.93546	22.29962	0.0001	At most 3*
0.492010	18.96420	15.89210	0.0159	At most 4*
0.383793	13.55682	9.164546	0.0070	At most 5*

Sources: Author calculations

Table 5. The long-run coefficient

Co-integration eq:	Coint Eq1
AGDP (-1)	1.000000
GCF (-1)	-0.081041
	(0.01110)
	[-7.29842]
LIR (-1)	-0.070106
	(0.03357)
	[-2.08826]
BM (-1)	0.228975
	(0.01030)
	[-22.2200]
DCP (-1)	-0.115438
	(0.01372)
	[-8.41548]
REC (-1)	-0.355829
	(0.01795)
	[-19.8179]
C	-11.85990

Sources: Author calculation using Eviews

Table 5 above demonstrates that all coefficients are highly statistically significant (absolute t-stats > 2), which means that GCF, LIR, BM, DCP, and REC all have statistically meaningful long-run effects on agricultural GDP. The negative coefficients for the GCF, LIR, DCP, and REC mean that these variables have a positive impact on agricultural GDP in the long run, while the positive coefficient means broad money hurts agricultural GDP in the long run. It reveals that Gross capital formation increased by 1% while agricultural GDP increased by 0.081 %. The lending interest rate increased by 1%, which leads to a 0.07% increase in agricultural GDP in the long run. If the broad money increased by 1%, then agricultural GDP would lead to a decrease in 0.23 %. Domestic credit to the private sector increased by 1%, and then the agricultural GDP increased by 0.115%. Renewable energy consumption increased by 1%, which led to agricultural GDP by 0.35 %.

Table 6. Vector error correction model

Error Correction	D(AGDP)	D(GCF)	D(LIR)	D(BM)	D(DCP)	D(RE
Coint Eq1	-0.153972	-3.279604	0.367666	-0.600350	-0.628863	-3.279604
	(0.34672)	(0.86069)	(0.44131)	(1.42850)	(0.74099)	(0.40306)
	[-0.44408]	[-3.81043]	[-0.83313]	[-0.42027]	[-0.84868]	[-1.41335]
D(AGDP(-2))	0.066426	1.730243	0.431654	0.986290	0.713402	-0.541240
	(0.36210)	(0.89887)	(0.46088)	(1.49186)	(0.77386)	(0.42093)
	[0.18345]	[1.92491]	[0.93658]	[0.66111]	[0.92188]	[1.28580]
D(AGDP(-2))	1.029347	0.624651	0.508160	-0.541369	-0.680751	0.001850
	(0.380290	(0.94402)	(0.4803)	(1.56680)	(0.81273)	(0.44208)
	[2.70676]	[0.66169]	[1.04984]	[-0.34552]	[0.83761]	[0.00418]
D(GCF(-1))	-0.032062	-1.154018	-0.001102	-0303033	0.393359	0.103661
	(0.10492)	(0.26045)	(0.13354)	(0.43227)	(0.22423)	(0.12197)
	[-0.30559]	[-4.43089]	[-0.00826]	[0.70103]	[1.75430]	[0.84991]
D(GCF(-2))	0.213744	-0.518610	0.004319	0.512751	0.137988	0.139186
	(0.09832)	(0.24407)	(0.12514)	(0.40509)	(0.21013)	(0.11430)
	[2.17395}	[-2.12484]	[0.03451]	[1.26578]	[0.65669]	[1.21776]
D(LIR(-1))	-0.019450	-1.135960	-0.075333	-0.317311	-0.171969	0.006825
	(0.16336)	(0.40553)	(0.20793)	(0.67306)	(0.34913)	(0.18991)
	[-0.11906]	[-2.80119]	[-0.36230]	[-0.47145]	[-0.49257]	[-0.03594]
D(LIR(-2))	0.194847	-1.955861	-0.385203	0.647659	0.075409	0.163445
	(0.17598)	(0.43685)	(0.22399)	(0.72504)	(0.37609)	(0.20457)
	[-0.11906]	[-4.47722]	[-1.71976]	[0.89327]	[0.06869]	[0.79895]
D(BM(-1))	-0.050674	0.695075	-0.217156	0.034283	-0.018505	-0.131428
	(0.12606)	(0.32293)	(0.16045)	(0.17789)	(0.26941)	(0.14655)
	[-0.40198]	[2.22115]	[1.35340]	[0.06601]	[-0.06869]	[-0.89684]
D(BM(2))	-0.068237	0.532806	0.007441	-0.198155	0.118209	-0.163027
	(0.13976)	(0.34694)	(0.17789)	(0.57582)	(0.29869)	(0.14655)
	[-0.48825]	[1.53574)	[-0.39576]	[-0.34413]	[-0.39576]	[-1.00344]
D(DCP(-1))	-0.218008	-0.775509	0.220608	-0.507782	-0.343304	0.043943
	(0.20548)	(0.51008)	(0.26153)	(0.84658)	(0.43914)	(0.23887)
	[-1.06098]	[-1.52038]	[0.84352]	[-0.59981]	[-0.78177]	[0.18396]
D(DCP(-2))	0.115673	-0.984774	-0.009698	0.259057	0.195765	0.268600
	(0.16473)	(0.40892)	(0.20967)	(0.67869)	(0.35205)	(0.19150)
	[0.70220]	[-2.40822]	[-0.04626]	[0.55607]	[0.55607]	[1.40264]
D(REC(-1))	0.111609	1.905575	0.280142	-0.351955	0.122198	0.042453
	(0.31522)	(0.78249)	(0.40121)	(1.29871)	(0.67367)	(0.36644)
	[0.35407]	[2.43526]	[-0.69824]	[-0.27100]	[0.18139]	[0.11585]
D(REC(2))	0.024441	0.297840	0.481053	1.668719	0.169366	0.221554

	(0.39820)	(0.98849)	(0.50683)	(1.64060)	(0.85101)	(0.46290)
	[0.06138]	[0.31131]	[0.94914]	[1.01714]	[0.19902]	[0.71625]
C	0.449282	1.554656	0.487502	2.769931	1.328351	-0.397456
	(0.52373)	(1.30011)	(0.66661)	(2.15780)	(1.11929)	(0.60883)
	[0.85785]	[1.19579]	[0.73131]	[1.28368]	[1.18678]	[-0.65282]

Sources: Authors' calculations

Table 8. Model summary

R-squared	0.600431	0.787686	0.55.9211	0.426329	0.687835	0.670597 Adj. R-
squared	0.229402	0.5905338	0.149906	-0.106365	0.397967	0.038961
Sum sq resids	8.473259	0.5221447	0.1372708	143.8323	38.70079	11.45060
S.E. equation	0.777967	1.931219	0.990205	3.205267	1.662631	0.904378
F-statistic	1.618286	3.995396	1.366246	0.800327	2.372925	1.084199
Log likelihood	-22.99623	-48.45445	-29.75060	-62.64049	-44.26146	-27.21201
Akaike AIC	2.642588	4.461032	3.125045	5.474321	4.161533	2.943715
Schwarz SC	3.308690	5.127135	3.791145	6.140423	4.827635	3.609817
Mean dependent	-0.345786	3.335714	-0.269714	1.329250	0.939643	-0.592857
S.D. dependent	0.886232	3.018037	1.073969	3.047299	2.142820	0.922528

Sources: Author Calculations

Table 7 above shows the vector error correction model coefficients based on the two lag durations and the error correction term. This study's model suggests a short-run relation since the ECM is negative and substantial. 15 percent of the short-run disequilibrium is corrected in years. Finally, successfully identifies the long run cointegration and short run adjustment mechanism.

Table 8 above summarises the models P-value is 0.0000, over 60% of the endogenous variable is explained by the external factors, indicating a good model.

Conclusion

This study investigates the relationship between the agricultural GDP and gross capital formation (GCF), lending interest rate (LIR), broad money (BM), domestic credit to the private sector (DCP), and renewable energy consumption (REC) in India over the period of 1991 to 2023. The time series of data was collected from World Bank Indicators (WDI). The Philips-Peron (PP) unit root test, Johnson cointegration, and vector error correction model are applied to the data analysis. The result of cointegration revealed that there are six cointegration vectors along with their trace and max-eigen statistic, which shows, it is strong evidence for the long-run relationships between agricultural GDP and banking credit, broad money, and capital formation. The long run coefficient shows that all coefficients are highly statistically significant (absolute t-stats > 2). The negative coefficients for the GCF, LIR, DCP, and REC mean that these variables have a positive impact on agricultural GDP in the long run, while the positive coefficient means broad money hurts agricultural GDP in the long run. The variables GCF, LIR, DCP, and REC are increased by 1%, then the agricultural GDP leads to an increase of 0.081 %, 0.07%, 0.115%, and 0.35 %, respectively. And the broad money increased by 1%, then the agricultural GDP would lead to a decrease of 0.23 %. The vector error correction model coefficients based on the two lag durations and the error correction term. This study's model suggests a short-run relation since the ECM is negative and substantial. 15 percent of the short-run disequilibrium is corrected in years.

Recommendations

The government should increase public and private investment in agricultural infrastructure, and also increase subsidies to farmers inputs.

Increase targeted and subsidised lending options for farmers and agricultural entrepreneurs.

Scrutinise and regulate monetary expansion meticulously to prevent inflationary repercussions that hinder agricultural development.

Encouraging financial institutions to provide agriculture-focused loan packages with reduced interest rates.

References

1. Agbodji, A. E., & Johnson, A. A. (2021). Agricultural Credit and Its Impact on the Productivity of Certain Cereals in Togo. Emerging Markets Finance and Trade, 57(12), 3320–3336. https://doi.org/10.1080/1540496X.2019.1602038

2. Chandio, A. A., Ozdemir, D., Vigne, S. A., & Du, A. M. (2024). Towards sustainable agricultural development and food security in East Asia: The role of broad money and banking credits. International Review of Economics and Finance, 96. https://doi.org/10.1016/j.iref.2024.103677
3. Chopra, R., Magazzino, C., Shah, M. I., Sharma, G. D., Rao, A., & Shahzad, U. (2022). The role of renewable energy and natural resources for sustainable agriculture in ASEAN countries: Do carbon emissions and deforestation affect agriculture productivity? Resources Policy, 76. https://doi.org/10.1016/j.resourpol.2022.102578
4. Dnyaneshwar Vishnu Gore Assistant Professor, S., & Neeta Dnyandeo Shinde, M. (2014). An Analysis of Capital Formation in Indian Agriculture and ITS Implications for More Inclusive Growth of Indian Economy. In An International Peer-reviewed Journal (Vol. 6). www.iiste.org
5. Dwivedi, S., Sharma, P., & Bhat, A. (n.d.). An Analytical Study of Capital Formation in India: With Special Reference to Indian Agriculture. www.IndianJournals.com
6. Fan, S., Jiang, M., Sun, D., & Zhang, S. (2023). Does financial development matter the accomplishment of rural revitalization? Evidence from China. International Review of Economics and Finance, 88, 620–633. https://doi.org/10.1016/j.iref.2023.06.041
7. Farooq, U., Gang, F., Guan, Z., Rauf, A., Chandio, A. A., & Ahsan, F. (2023). Exploring the long-run relationship between financial inclusion and agricultural growth: evidence from Pakistan. International Journal of Emerging Markets, 18(7), 1677–1696. https://doi.org/10.1108/IJOEM-06-2019-0434
8. Gebbers, R. A. (2010). Precision Agriculture and Food Security. In Science (Vol. 327, Issue 5967, pp. 825–828). https://doi.org/10.1126/science.1182768
9. Gregory, P. J., Ingram, J. S. I., & Brklacich, M. (2005). Climate change and food security. Philosophical Transactions of the Royal Society B: Biological Sciences, 360(1463), 2139–2148. https://doi.org/10.1098/rstb.2005.1745
10. Hu, Y., Liu, C., & Peng, J. (2021). Financial inclusion and agricultural total factor productivity growth in China. Economic Modelling, 96, 68–82. https://doi.org/10.1016/j.econmod.2020.12.021
11. Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector ESTIMATION AND HYPOTHESIS TESTING OF COINTEGRATION VECTORS IN GAUSSIAN VECTOR AUTOREGRESSIVE MODELS. In Source: Econometrica (Vol. 59, Issue 6).
12. Kumari, A., & Garg, V. (2023). Impact of credit on sustainable agricultural development in India. Journal of Sustainable Finance and Investment, 13(1), 560–571. https://doi.org/10.1080/20430795.2021.1964811
13. Lai, C. H., Hu, S. W., Wang, V., & Chao, C. C. (2017). Agricultural R&D, policies, (in)determinacy, and growth. International Review of Economics and Finance, 51, 328–341. https://doi.org/10.1016/j.iref.2017.06.005
14. Md. Qamruzzaman. (2024). Nexus between foreign direct investment, gross capital formation, financial development and renewable energy consumption: evidence from panel data estimation. GSC Advanced Research and Reviews, 18(1), 182–200. https://doi.org/10.30574/gscarr.2024.18.1.0011
15. Narayanan, S. (2016). The productivity of agricultural credit in India. Agricultural Economics (United Kingdom), 47(4), 399–409. https://doi.org/10.1111/agec.12239
16. Ozdemir, D. (2024). Reconsidering agricultural credits and agricultural production nexus from a global perspective. Food and Energy Security, 13(1). https://doi.org/10.1002/fes3.504
17. Pruntseva, G., Danylyshyn, B., Popadynets, N., Kopylyuk, O., & Kotsan, I. (2024). Substaminale development in agricultural investments and the food security system. E3S Web of Conferences, 567. https://doi.org/10.1051/e3sconf/202456701020
18. Raifu, I. A., & Aminu, A. (2019). Financial development and agricultural performance in Nigeria: what role do institutions play? Agricultural Finance Review, 80(2), 231–254. https://doi.org/10.1108/AFR-06-2018-0045
19. Raj Kharel, K., Poudel, O., Mani Upadhyaya, Y., & Nepal, P. (2024). Effect of Private Sector Credit on Economic Growth in Nepal. Financial Markets, Institutions and Risks, 8(1), 142–157. https://doi.org/10.61093/fmir.8(1).142-157.2024
20. Stafford, J. V. (2000). Implementing precision agriculture in the 21st century. Journal of Agricultural and Engineering Research, 76(3), 267–275. https://doi.org/10.1006/jaer.2000.0577
21. Yadav, I. S., & Goyari, P. (2024). The effects of financial development on crop productivity: ARDL evidence from Indian agriculture. Journal of Financial Economic Policy. https://doi.org/10.1108/JFEP-05-2023-0126
22. Zhang, N., Wang, M., & Wang, N. (2000). Precision agriculture*/ a worldwide overview. www.elsevier.com/locate/compag