# An Empirical Analysis of Public Sector Bank Credit Allocation and Agricultural Economic Stability

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| ARTICLE DETAILS | ABSTRACT |
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| | Agricultural credit is a pillar of support to farming economic stability in developing economies, but the exact processes of transmission in which the provisioning of farming lending by the state banking system affects crop productivity, income stability, and long-term agricultural growth are under-researched in the Indian literature on empirical studies. This paper examines the dynamic nature of the relationship between the allocation of the India agricultural credit by the public sector and the agricultural economic stability during 1990-2022 using a rigorous combination of time series econometric models such as the Schweninger Null / Augmented DickeyFuller (ADF) and PhillipsPerron (PP) unit root tests, Johansen cointegration analysis, Autoregressive Distributed Lag (ARDL) bounds testing model, Vector Error Correction Model (VECM), and Granger causality estimation. The secondary macroeconomic information is found in the Reserve Bank of India (RBI), National Bank of agriculture and Rural Development (NABARD), World Bank, food and Agriculture Organisation (FAO) and Ministry of agriculture and farmers welfare (MoAFW). Variables of interest are public sector agricultural credit disbursements, indices on crop yields, agricultural GDP growth, rainfall index, food price inflation and agricultural productivity. The findings of the empirical study have revealed that there is a statistically significant long-run cointegrating relationship between institutional |

credit and agricultural economic stability. The VECM affirms that there is a negative and significant error-correction coefficient, which implies convergence to an equilibrium at an average pace of adjustment. Findings of the Granger causality indicate that credit disbursement and agricultural GDP have bidirectional causality in the short-run. Some policy implications include the fact that it is possible to rationalise credit timing, further develop rural banking infrastructure and furthermore tie credit disbursement to meteorological cycles to make it substantially lower the volatility of crop yields and ensure sustainable agricultural growth.

## 1. Introduction

Agriculture is a survivor of the Indian economy, and 18.20% gross domestic product (GDP) in India and almost 47 per cent of the labour force as of 2022 still depends on agriculture (World Bank, 2023; Economic Survey of India, 2022-23). Even with the fact that the industrial and services sectors have undergone consistent changes in the past decades, the outcomes of agriculture are still having a conclusive impact on macro-economic stability, rural poverty trends, and the food security of nations. In this environment, accessibility, sufficiency and proper functioning of institutional agricultural credit by itself are the decisive factors in farm-level production and agricultural system sustainability (Mohan, 2006; Ramakumar and Chavan, 2007).

In India, the primary channel through which formal agricultural credit has historically been provided has been the public sector banks (PSBs), which have operated under a dual mandate that incorporates commercial viability and developmental financing. The expected rules set by the Reserve Bank of India (RBI) are that the scheduled commercial banks must reserve at least 18 per cent of their adjusted net bank credit (ANBC) to the agriculture sector as specified in the priority sector lending (PSL) rules (RBI, 2022). The PSBs, due to their wide rural branch network and statutory lending commitments, end up with a disproportionately high burden of this responsibility, hence increasing the significance of being able to comprehend the macro-economic implications of their credit-allocation policies.

The theoretical basis of this association between credit to agriculture and farm consequences is the Keynesian credit-channel theory, which asserts that institutional credit has a direct influence on boosting aggregate demand and investment in productive potential (Bernanke and Blinder, 1988). In the financial

intermediation perspective, the banks make the savings movable and channel it to activities that have high returns, like agriculture and hence capital formation is expedited and production risk is reduced (Diamond, 1984; Levine, 1997). Agricultural development theory, as presented by Johnston and Mellor (1961) and Schultz (1964), also brings to the fore the fact that adopting technical transformation in agriculture must also be sustained through input finance, by the use of credit as the main method of adopting the technology, and boosting of yields.

Despite these theoretical propositions, there are contradicting empirical studies on the exact effect of institutional credit on financial stability in agricultural organisations in India (Kumar et al., 2020; Deshpande and Arora, 2010). Several investigations point to structural bottlenecks such as the lack of correspondence between credit disbursement periods and cultural production periods, the market concentration of banks within the region and the existence of the informal substitutes of credit, which mitigate the productivity-increasing effect of formal bank credit (Misra, 2008; Bist and Bhandari, 2018). It is also emphasised in the growing body of literature that exogenous climatic shocks have a moderate role on credit-productivity nexus, especially the variability in monsoons (Barnwal & Kotwal, 2008; Aggarwal et al., 2017).

Nevertheless, despite these issues, comparatively low rates have utilised detailed time-series econometric models to denote the long-run equilibrium correlation between public sector farm credit and the economic stability of the Indian agronomy. A majority of prior studies use cross-sectional, panel, or short-horizon design, hence not focusing on the dynamic unification of structures and error-correction features of the relationship between credit and agricultural performance over time (Chandrasekhar, 2011; Pradhan, 2013). This research gap in the literature represents the motivation of the current study.

The given paper makes three contributions to the existing literature. First, it uses a multi-method econometric approach, making use of the use of autoregressive distributive lag (ARDL) of the bounds testing, the vector error-correction modelling (VECM), as well as the Granger causality analysis in the analysis of short-run dynamics and long-run equilibrium correction in the credit-stability nexus. Second, it uses a deeper set of control variables, i.e., rainfall, food-price inflation and agricultural productivity indices, to isolate the independent effect of institutional credit better. Third, it uses a full panel data set between 1990-2022 which encompasses various agricultural policy regimes, credit boom, and macro-economic episodes related to the Indian experience.

## 2. Review of Literature

### 2.1 Agricultural Credit and Productivity: Theoretical Underpinnings

The conceptual association between institutional credit and agricultural productivity has been exceptionally expounded on various planes of development economics. In his masterpiece, Transforming Traditional Agriculture, Schultz (1964) suggested that the smallholder farmers, who are limited by capital constraints, cannot gather modern inputs and methods unless they can access formal credit. According to this perspective, institutional credit that is available facilitates the sacrifice of low-productivity subsistence agriculture to market-oriented agriculture that has high yields. Mellor (1976) further developed this point by associating agricultural credit with the other wider concept of vent-for-surplus in which credit-financed acquisition of improved seeds, fertilisers, and irrigation infrastructure creates surplus production that, in turn, funds industrialisation and growth of farm incomes.

In terms of macroeconomic stabilisation, the credit channel framework of Keynes (1936) is advancing on the basis that productive activity (including agriculture) is essentially vulnerable to the supply and price of credit. Bernanke and Blinder (1988) articulated this claim in the bank lending sector, which shows that the impact of monetary policy on the real output is mediated in part by changes observed in the supply of bank credit. As applied in the agricultural situation, this means that increases in the state-sector bank credit in the farm sector must result in increased input purchases, higher productive investment, and final increases in the yield results.

The financial intermediation theory was further developed by Diamond (1984) and Levine (1997), who argued that the information asymmetry between the savers and the investor could be decreased by the financial institutions, and this would then allow more efficient capital allocation. In the agricultural case, because of informational advantage and presence in rural areas, the banks of the public sector can fulfil the function of an effective intermediary, reducing the price of agricultural capital and channelising resources, and funds, towards high-productivity types of agricultural systems. India and other developing economies have an institutional rationale that is supported by this theoretical reasoning in the mandate of priority sector lending.

### 2.2 Empirical Evidence from India

Empirical literature covering the relationship between agricultural credit and productivity in the Indian setting has a large amount of work. The standard of agriculture has significantly slowed down

after banking sector reforms of the 1990s. Ramakumar and Chavan (2007) reported that as a result of liberalisation, the banking sector restructuring, the developmental orientation of commercial banks has gone down. In their analysis, they found that the share of agriculture in total bank credit had sharply fallen in this period, with negative implications on investment in farms and growth of output. Similar observations were made by Deshpande and Arora (2010) that though the absolute credit flows to agriculture in the post-2004 period actually increased, partly due to the doubling of the agricultural credit target announced by the Government of India, the quality and targeting of credit were ineffective whereby large farmers were capturing a disproportionate amount of institutional lending.

Kumar et al. (2010) used state-level panel-based data to investigate the predictors of agricultural credit uptake in India and obtained a statistically significant association between the density of the network of branches, diversification of crops, and area of irrigation coverage and access to formal credit. According to their findings, increasing the rural banking network was a requirement but not a sufficient criterion to enhance price productivity relates especially where agriculture is in rainfed areas. Similarly, Misra (2008) pointed out the issue of seasonal liquidity of credit, where the highest disbursements are done outside the kharif and rabi sowing period, thus decreasing the productive effects of formal lending.

Mohan (2006) presented an institutional outlook of agricultural credit policy in India, and followed the development of the priority sector framework since its initiation in the 1960s to the present day. He maintained that the series of amendments to the rules of PSL, such as the introduction of sub-targets of small and marginal farmers and direct agriculture, development of awareness about the need to improve access to credit to the most financially marginalised layers of the farming population. Mohan, however, also warned against the existence of perverse incentives in creating target attention methods to the provision of credit and the adverse impact on the quality of credit too.

## 2.3 Time-Series and Econometric Studies

Pradhan (2013) used the ARDL bounds -testing method to investigate the long-term dynamics between financial development and agricultural production in India, and discovered strong support for the existence of cointegration and a positive long-term elasticity of agricultural GDP in terms of credit supply. Nevertheless, his analysis did not disaggregate by institutional source of credit, leaving untested the issue of whether the impact of the public-sector banks is different compared to the effect of the private and cooperative lenders. Bhandari (2018) implemented a South and northeast Asian economy

panel investigation of the finance-agriculture nexus to find out the two-way Granger causality between financial sector development and agricultural productivity growth.

A VAR model used by Chandrasekhar (2011) to determine the dynamic nature of the interactions between agricultural credit, food inflation, and rural wages in India revealed the fact that the short-run impacts of credit expansion on food prices are significant, which has substantial implications for the macroeconomic stabilisation policy. Aggarwal et al. (2017) factored in meteorological variables in the credit-productivity model, which revealed that the influence of institutional credit on the crop output is greatly reduced during a year of rain-shortage. Their results remind the significance of considering the climatic heterogeneity in the econometric models of the credit-stability nexus.

On the international level, Rehman et al. (2017) investigated the nexus between agricultural credit and agricultural GDP in Pakistan using the VECM algorithm, and the effect of agricultural credit was found to be significant and positive; the long-run nexus of agricultural credit and agricultural GDP is estimated to be 0.34. On the same note, Iqbal et al. (2003) also recorded the detection of a strong positive correlation between rural credit disbursement and crop yield indices in Pakistan, and the timing of credits turned out to be an important moderating factor. These are the results of similar agrarian economies, which can be useful in an external constraint of the Indian analysis.

## 2.4 Credit Timing, seasonality and subsequent yield volatility.

Another strand of the literature, policy-relevant, is specifically concerned with agriculture credit delivery as a temporal aspect. Using district-level data on Maharashtra, Barnwal and Kotwal (2008) revealed significant differences in the timing of credit disbursement and the beginning of the agricultural season on increase in input adoption rates and crop yields. On the contrary, credit that comes after the optimal time of sowing cannot have productive effects because farmers are forced to use it to smooth consumption and not productive investment. The implication of this observation on the design of credit delivery mechanisms is significant to the seasonal agricultural operations (SAO) of NABARD.

Singh and Singh (2016) extended this observation further to include the national level and showed that the inter-district differences in the timing of credit explain a significant part of the calculated difference in crop yield growth rates of Indian states. Their results show that on average, a one-month reduction on the average credit delivery lag hurts yield volatility by some 8 -12 per cent, other things remaining unchanged (rainfall and input prices). Such results are consistent with the theoretical

hypothesis stating that credit timing has such an effect on the marginal productivity of agricultural investment by deciding whether capital is mobilised at the agronomical opportune point.

## 3. Research Gap and Objectives

### 3.1 Identified Research Gap

A critical review of the extant literature reveals several important gaps that the present study seeks to address. First, while panel and cross-sectional studies of the agricultural credit-productivity relationship are relatively abundant, comprehensive time-series analyses employing multiple cointegration and error correction frameworks in the Indian context remain sparse. Second, the majority of existing studies treat agricultural credit as an aggregate measure, without disaggregating by institutional source. This conflation obscures the potentially differential impacts of public sector, private sector, and cooperative credit institutions, each of which operates under distinct regulatory, incentive, and operational constraints. Third, few studies have simultaneously modelled the roles of meteorological variability, food price inflation, and sectoral credit allocation within a unified macroeconomic framework. Finally, the existing literature largely neglects the speed of adjustment mechanism—captured by the error correction term in VECM—which provides a direct measure of the self-correcting capacity of the agricultural economy following credit-supply shocks.

### 3.2 Research Objectives

In light of the foregoing research gap, the present study pursues the following specific

objectives:

**Objective 1:** To examine the short-run and long-run impact of the public sector agricultural

Credit disbursement on crop productivity and agricultural income stability in India over

The period 1990–2022.

**Objective 2:** To analyse the role of credit timing and the seasonal distribution of public

sector bank lending in reducing crop yield volatility.

**Objective 3:** To model the long-run cointegrating relationship between agricultural

credit and agricultural economic stability using the ARDL bounds testing framework

and Johansen cointegration analysis.

**Objective 4:** To evaluate policy implications for sustainable agricultural finance, including

credit delivery mechanisms, rural banking infrastructure, and the alignment of public

sector bank lending with agronomic cycles.

## 4. Data Sources and Methodology

### 4.1 Data Sources

The study utilises annual time-series data spanning the period 1990–2022, yielding 33 observations. This time distance captures multiple policy regimes, including the pre-liberalisation period, the post-1991 banking sector reform era, the 2004–07 agricultural credit expansion drive, and the post-2010 period characterised by financial inclusion initiatives. All data series are sourced from authoritative secondary repositories. Public sector agricultural credit disbursement data are obtained from the Reserve Bank of India's Handbook of Statistics on the Indian Economy and from NABARD's Annual Reports. Agricultural GDP data are sourced from the National Statistical Office (NSO) and cross-validated against the World Bank's World Development Indicators (WDI). Crop yield data are drawn from the Ministry of Agriculture and Farmers Welfare's Directorate of Economics and Statistics, and from the FAO FAOSTAT database. The Indian Meteorological Department (IMD) rainfall index is sourced from the Ministry of Earth Sciences. Food price inflation is proxied using the Consumer Food Price Index (CFPI), available from the RBI and the Ministry of Statistics and Programme Implementation (MOSPI). Agricultural productivity is measured using total factor productivity (TFP) indices from the Economic Survey of India.

### 4.2 Variable Description

The dependent variable is the Agricultural Economic Stability Index (AESI), operationalised as the annual growth rate of agricultural GDP deflated by its five-year rolling standard deviation, a composite measure capturing both the level and variability of agricultural output (Chandrasekhar, 2011). The primary independent variable is the volume of public sector agricultural credit disbursement (PSC) measured in constant 2011–12 Indian Rupees (INR). Control variables include: (i) the All-India

Weighted Rainfall Index (RAIN), representing the monsoon-season cumulative rainfall as a percentage of its long-run normal; (ii) the Consumer Food Price Inflation Rate (CFPI); (iii) the Agricultural Total Factor Productivity Index (TFP), derived from the Economic Survey; and (iv) Agricultural Productivity measured as the ratio of agricultural output value to cultivated area (APROD). All nominal monetary variables are deflated using the GDP deflator to obtain real values.

## 4.3 Econometric Methodology

A successive process of econometric operations is followed in order to undertake an empirical experiment. To begin with, all the variables are tested in terms of the order of integration using both the first Augmented Dickey Fuller (ADF) and Phillips Perron (PP) unit-root tests, with the optimal lag length being calculated using the Schwarz Information Criterion (SIC). The second step is to test the number of cointegrating vectors between the variables using the Johansen maximum-likelihood cointegration test. Third, the AutoRegressive Distributed Lag (ARDL) bounds-testing model described by Pesaran et al. (2001) is estimated, which is suitable in mixed orders of integration and small samples. Fourth, a Vector Error -Correction Model (VECM) is calculated to account for everything about short-run dynamics and the rate of adjustment to the long-run equilibrium. Fifth, the Granger causality tests are performed by the VECM parameter to establish the direction of causation. Lastly, impulse-response functions (IRFs) are created to follow the dynamic. Response of the agricultural stability index to one standard deviation shocks in public sector credit.

## 5. Model Specification and Hypotheses

## 5.1 Baseline Regression Model

The baseline econometric model takes the following general form:

$$AESI_t = \alpha_0 + \beta_1 PSC_t + \beta_2 RAIN_t + \beta_3 CFPI_t + \beta_4 TFP_t + \beta_5 APROD_t + \varepsilon_t \quad ... (1)$$

where $AESI_t$ denotes the Agricultural Economic Stability Index at time t; $PSC_t$ is the log of real public sector agricultural credit disbursement; $RAIN_t$ is the weighted rainfall index; $CFPI_t$ is the consumer food price inflation rate; $TFP_t$ is the agricultural total factor productivity index; $APROD_t$ is agricultural productivity; $\alpha_0$ is the intercept; $\beta_1$–$\beta_5$ are the coefficients of interest; and $\varepsilon_t$ is the stochastic error term, assumed to be white noise. All continuous variables are expressed in natural logarithms to facilitate elasticity interpretation.

**5.2 ARDL Bounds Testing Model**

Following Pesaran et al. (2001), the Autoregressive Distributed Lag (ARDL) bounds testing model is specified as:

$$\Delta AESI_t = \alpha_0 + \Sigma_{i=1}^{p} \beta_i \Delta AESI_{t-i} + \Sigma_{j=0}^{\varphi} \gamma_j \Delta PSC_{t-j} + \Sigma_{k=0}^{r} \delta_k \Delta RAIN_{t-k}$$

$$+ \Sigma_{l=0}^{s} \zeta_l \Delta CFPI_{t-l} + \Sigma_{m=0}^{t} \eta_m \Delta TFP_{t-m} + \lambda_1 AESI_{t-1} + \lambda_2 PSC_{t-1}$$

$$+ \lambda_3 RAIN_{t-1} + \lambda_4 CFPI_{t-1} + \lambda_5 TFP_{t-1} + \mu_t \quad \dots (2)$$

The presence of a long-run cointegrating relationship is established by an F-test on the joint significance of the lagged level variables ($\lambda_1$–$\lambda_5$). If the computed F-statistic exceeds the upper critical bound (UCB) of Pesaran et al. (2001), the null hypothesis of no cointegration is rejected. The ARDL model is particularly advantageous in this context, given its applicability to mixed I(0)/I(1) regressors and its robustness in small samples (Pesaran et al., 2001).

**5.3 Vector Error Correction Model**

Following the confirmation of cointegration, the VECM is estimated as:

$$\Delta AESI_t = \alpha + \Sigma_{i=1}^{p} \Gamma_i \Delta X_{t-i} + \Pi X_{t-1} + \varepsilon_t \quad \dots (3)$$

where $X_t$ is the vector of endogenous variables [$AESI_t$, $PSC_t$, $RAIN_t$, $CFPI_t$, $TFP_t$]'; $\Gamma_i$ captures the short-run dynamics; and $\Pi = \alpha\beta'$ is the long-run impact matrix decomposed into the speed-of-adjustment vector $\alpha$ and the cointegrating vector $\beta$. A statistically significant and negative $\alpha$ coefficient confirms that the system converges toward long-run equilibrium following a transient deviation. Granger causality within the VECM framework is established by testing the joint significance of the lagged first differences of each variable in the respective equations (Engle & Granger, 1987).

**5.4 Research Hypotheses**

**$H_1$ (Null):** Public sector agricultural credit disbursement does not have a statistically significant

long-run impact on agricultural economic stability in India.

**$H_2$ (Null):** There is no cointegrating relationship between public sector agricultural credit and

agricultural GDP growth in India over the study period.

**H₃ (Null):** Public sector agricultural credit does not Granger-cause agricultural economic

stability in the short run.

**H₄ (Null):** Credit timing and seasonal distribution of PSB lending do not significantly moderate

 crop yield volatility.

## 6. Results and Discussion

### 6.1 Descriptive Statistics

**Table 1: Descriptive Statistics and Correlation Matrix of Key Variables (1990–2022)**

| Variable | Mean | Std. Dev. | CV | Remarks |
|---|---|---|---|---|
| Real Public Sector Agricultural Credit (PSC), INR billion (2011–12 prices) | 2,847 | 1,965 | 0.69 | Indicates substantial expansion of institutional agricultural credit |
| Agricultural Economic Stability Index (AESI) | 3.21 | — | 0.38 | Reflects considerable inter-annual variability |
| Rainfall Index (% of long-run normal) | 97.8 | 9.4 | 0.10 | Captures monsoon variability |
| Consumer Food Price Inflation (CFPI), % | 7.6 | — | — | High volatility, peaks during crisis periods |
| Total Factor Productivity (TFP), % growth | 1.8 | — | — | Moderate improvement in agricultural efficiency |

Note: **(—) indicates values not reported due to data limitations or excluded to maintain analytical clarity.**

**Panel B: Pairwise Correlation Matrix**

| Variables | log(PSC) | AESI | Rainfall | CFPI | TFP |
|-----------|----------|------|----------|------|-----|
| log(PSC) | 1.00 | **0.67*** | — | — | — |
| AESI | **0.67*** | 1.00 | **0.49*** | **−0.43** | **0.54*** |
| Rainfall | — | **0.49*** | 1.00 | — | — |
| CFPI | — | **−0.43** | — | 1.00 | — |
| TFP | — | **0.54*** | — | — | 1.00 |

*** $p < 0.01$, ** $p < 0.05$

Source: **Author's computation based on RBI, MOSPI, IMD, and Economic Survey of India data.**

The descriptive statistics indicate substantial growth in real public sector agricultural credit during the study period, reflecting enhanced institutional financing support to Indian agriculture. The Agricultural Economic Stability Index (AESI) shows considerable variability, underscoring persistent fluctuations in agricultural performance. Rainfall exhibits moderate variability, highlighting the importance of climatic factors, while food price inflation remains volatile, indicating periodic supply-side stress. Agricultural productivity demonstrates a modest but consistent upward trend.

Correlation analysis reveals a strong positive and statistically significant association between public sector agricultural credit and agricultural economic stability, suggesting that enhanced institutional credit plays a stabilising role in the agricultural sector. Rainfall and productivity are also positively correlated with AESI, while food price inflation shows a significant negative relationship, validating the theoretical expectations and justifying their inclusion as control variables in the econometric model.

## 6.2 Unit Root Test Results

| Variable | ADF (Level) | ADF (1st Diff) | PP (Level) | PP (1st Diff) | Decision |
|----------|-------------|----------------|------------|---------------|----------|
| **AESI** | Non-Stat | Stationary | Non-Stat | Stationary | $I(1)$ |
| **log(PSC)** | Non-Stat | Stationary | Non-Stat | Stationary | $I(1)$ |
| **RAIN** | **Stationary** | - | **Stationary** | - | $I(0)$ |
| **CFPI** | Non-Stat | - | **Stationary** | - | $I(0)$* |

The test of stationarity of all series was estimated by means of the Augmented Dickey Fuller (ADF), as well as Phillips Perron (PP) tests with and without deterministic time trends. The results show that AESI, log (PSC), TFP and APROD are non-stationary at levels but reach stationarity in first differences, hence confirming them as I(1) processes. Both tests indicate that the rainfall index (RAIN) is stationary at levels (I(0)) and is in line with the fact that monsoon behaviour does not have a definite trend. Consumer Food price inflation (CFPI) also shows I(0) stationarity in the PP test, whereas the ADF test shows borderline I(1) behaviour; it was therefore discussed as I(0) in future analysis. Integration of variables has a mixed order that includes some I(0) and some I(1), hence the reason I used the ARDL bounds -testing technique and not the common Johansen procedure, which assumes all variables are I(1) (Pesaran et al., 2001). The best lag length of the VAR system according to the Akaike Information Criterion (AIC) is two, which is consistent with the frequency of the annual and moderate size of the data, too.

## 6.3 Cointegration Results

The model used in equation (2) was tested using the ARDL bounds test, where lag orders were chosen using Schwarz Bayesian Information Criterion (SBIC). F-statistic of the joint null hypothesis of no long-run level relationship (l 1 = l 2 = l 3 = l 4 = l 5 = 0 ) is 6.83, which is greater than the upper critical value of 4.01 at 5% level of significance (Pesaran et al., 2001). Based on this, the null hypothesis of non-cointegration is rejected, and it is therefore confirmed that there is a stable long-run relationship among the variables. The maximum eigenvalue test and the Johansen trace statistic applied to the I(1) subset of variables support this conclusion: each of them shows the presence of at least two cointegrating vectors at the 5% level of significance.

The predicted long-run ARDL estimates suggest that a $1^-$ per cent change in real public sector agricultural credit will result in a 0.28 per cent change in the Agricultural Economic Stability Index, other things being equal. Such elasticity is statistically significant (t = 4.62) and almost in agreement with the estimates presented by Pradhan (2013) and Rehman et al. (2017) in similar economies. The primacy of technological progress as an agent of agricultural preciosity is confirmed by the fact that, in the long-run, Agricultural TFP has the highest impact on the AESI with an elasticity of 0.51 (t = 6.21, p < 0.01). There is also a positive long-run effect of the rainfall index (coefficient = 0.19, t = 3.44, p = 0.01), but food price inflation has a strong negative effect (coefficient = -0.14, t = 2.89, p = 0.01), which is also expected in the theory of inflation disrupting real agricultural income.

**6.4 VECM Outcomes and Correction of Errors.**

The process of estimation using the VECM used two lags, which was proposed by the AIC. The AESI equation can approximate error-correcting (ECT) as 0.312, and this value has a statistical significance of 5% level (t = 3.18). The level of magnitude and negative sign of the ECT proves that the agricultural stability index moves to the long-run equilibrium upon a temporary disruption at a rate of about 31.2 per cent per annum. This means that about 31 per cent of the amount of deviation out of a long run equilibrium is being corrected within the space of one year- a rate, which is also in line with the structural inertia normally seen in agrarian systems where there is a multi-year crop-cycle, and the time taken to effect disbursement of credits in a bureaucratic way (Chandrasekhar, 2011).

The short-run VECM outcomes indicate that the lagged first differences of the public sector credit (= $\Delta PSC_{n-1}$) have a positive and statistically significant influence on the current state of agricultural stability (= 0.19, t = 2.31, p < 0.05). It proves that credit shocks incur significant and swift effects on agricultural performance in a particular agricultural year, as is consistent with the short-run transmission mechanism determined by Kumar et. al. (2010). The short-run estimate of the relationship between rainfall and annual crop-yield performance is very high when compared to the respective estimate at the long-run (0.31 and 0.19, respectively), indicating the over-reaction to monsoon performances (Barnwal and Kotwal, 2008). In the short-run equation, the lagged change in food-price inflation ($\Delta FPI_{n\,n-1}$) retains a negative and significant influence (coefficient = 0.09, t = 2.11, p < 0.05) that shows that inflationary shocks reduce agricultural stability due to their cost effect on farm input prices.

**6.5 Granger Causality Results**

The Granger-Causality tests performed in the framework of VECM provided a number of interesting results. The assumption that the source of Granger causality does not flow unidirectionally in the short-term between credit and the Agricultural Economic Stability Index was rejected at the 5% level (2 = 7.84, p = 0.02), thus confirming the hypothesis that there is a unidirectional short run cause and effect relationship between credit and the index of economic stability in the public sector agriculture sector. On the other hand, the opposite hypothesis that AESI does not Granger-Causality, PSC was also rejected (2 = 5.61, p = 0.04), which stated that there was bidirectional short-run Granger causality between credit disbursement and agricultural stability. This two-way street is in line with the theoretical reasoning that the agricultural performance in the form of increased farm income and lower standards of loan default encourages the bank to be more willing to provide the subsequent rounds of agricultural credits

(Levine, 1997). The Granger-causality of AESI by AGP is statistically significant ($\chi 2$ =9.12, p = 0.01), whereas the causality in the opposite direction is not (p = 0.21), implying an agricultural stability-enhancing supply-led relationship without a significant feedback between the two in the short run. No Granger-cause-effects relationship exists between the rainfall index and PSC (p = 0.48), which additionally demonstrates that PSC is not systematically responded to by banks in the public sector in relation to the credit disbursements they provide, which in turn reflects a very serious policy failure to readjust financial delivery to the performance of the weather (Aggarwal et al., 2017; Singh and Singh, 2016).

### 6.6 Impulse Response Analysis

Generation of the impulse response functions is done using a generalised decomposition of the VECM residuals to ensure orthogonality (Pesaran and Shin, 1998). The reaction of AESI to a one standard deviation positive shock in the PSC is positive and statistically significant in the initial four periods, with its peak effect of +0.18 standard deviations in period two, after which the effect becomes smaller and smaller towards zero during periods 6, 7 and 8. This changing trend indicates that the income-adjusting benefits of public sector credit on agricultural products are realised with a one to two-year lag, reflecting the presence of many seasons of agricultural investment, like buying irrigation equipment, farm mechanization and planting orchards, contributions made by credit. The reaction of AESI to a shock in rainfall is quicker and stronger, peaking in period one (+0.31 standard deviations) and converting to zero in period four, i.e. captures the significant and high-frequency impact of monsoon variability on crop yield (Barnwal, 2008). All of the results above highlight the secondary impact of institutional credit and climatic conditions in determining agricultural economic stability.

### 7. Policy Implications

The policy implications of this empirical research lead to various policy projects that can be taken in governing agricultural credit in India. These recommendations are of three levels, and they are the regulatory and supervising level, the institutional level of the public sector banks and the more general agrarian policy architecture.

First, the positive and substantial long-run elasticity of the AESI against public sector credit (0.28) supports the fact that the increase in the volume of the institutional farm credit has a stabilising influence on the economic performance of agriculture. Yet, the conclusion that this elasticity is significantly less than that of TFP (0.51) implies that credit growth has been maximally efficient when this growth has been supplemented by complementary investment in agricultural technology, extension and research and development services. The policymakers are not to consider credit volume as an independent tool of agricultural development but rather blend credit policy in a more comprehensive approach of input market reforms and diffusion of technology (Schultz, 1964; Johnston and Mellor, 1961).

Second, it is demonstrated by the Granger causality result that rainfall has no significant impact on public sector bank credit disbursement, which illustrates the essential discrepancy between climatic signals and credit delivery mechanisms. The regulatory advice provided by NABARD and the RBI should motivate public sector banks to work out monsoon-linked credit disbursement arrangements that will put money into circulation ahead of the kharif and rabi sowing seasons and also revise credit conditions in drought-prone districts. The current institutional structure of Seasonal Agricultural Operations (SAO) credit offered by NABARD is a potentially helpful institutional mechanism driving such reforms, though its extent of existing application is too limited in response to inter-district meteorological variation (Misra, 2008).

Third, it also means that food price volatility affects economic stability in the agricultural sector undermine because the long-run coefficient of food price inflation is significant and negative (the value is -0.14). The result favours the augmentation of price stabilisation mechanisms of commodities such as strategic buffer stocks, price support operations by the Food Corporation of India, and improved operations of commodity futures markets. At the same time, the RBI must match its monetary policy reaction to food inflation in a manner that is sensitive to the response of agricultural credit demand and the agricultural investment level because high-interest-rate reactions to a food price shock can counterintuitively increase agricultural instability by increasing the cost of agricultural borrowing (Chandrasekhar, 2011).

Fourth, the parameter of the speed of adjustment (0.312) suggests that the agricultural economy would rectify around 31 per cent deviations of the long-run equilibrium within a year. Though this is a favourable rate, it implies also that the system hoards about 69 per cent of any disequilibrium after the initial year- a sign of the rigidity of the structural systems in agricultural credit provision, in land markets, and in rural infrastructural provision. To accelerate the speed of adjustment would entail simultaneous improvements in a number of areas, such as the digitisation of agricultural credit provision, the extension of rural banking correspondent networks, and the upgrading of the agricultural market infrastructure to lower transaction costs in marketing agricultural farm produce obtained through credit.

Finally, the Granger causality PSC and AESI is a basic relationship that assumes there is a virtuous cycle using credit to increase agricultural stability, to be associated with an increase in bank confidence and subsequent credit extension, which, in turn, leads to a decrease in the risk-adjusted cost of UK agricultural lending by banks (RBI, 2022; NABARD, 2022).

## 8. Conclusion

The paper is an empirical validation of the connection between public-sector bank credit dispersal and agricultural economic viability in India between the years 1990 and 2022.  It uses an extensive inflation of time-series econometric methods, such as ARDL limits examination, VECM and Granger causality investigation to examine this connection.  The main results can be summed up in the following manner: First, there is a stable and statistically significant long-run cointegration relationship between the agricultural credit of the public sector in terms of disbursement and the Agricultural Economic Stability Index (AESI), which has a long-run credit elasticity value estimates of 0.28.  Second, convergence to equilibrium along the long-run can be verified by the error-correction term of the VECM, which would indicate the convergence to a value of around 31.2 per cent/year.  Third, the short-run Granger causality is bidirectional between the credit of the public-sector (PSC) and the AESI, as to display the relationships of complementary supply and demand based on credit.  Fourth, there is a strong independent effect of food-price inflation and rainfall variability on agricultural stability, and, hence, the credit-productivity nexus can be described as multidimensional.

The implications of these findings as far as agricultural finance policy in India and other similar emerging economies are concerned are great.  The desirable long-run credit elasticity justifies the persistence and expansion of priority-sector lending requirements to the public-sector banks, whereas the observed climatic misalignment of credit delivery models makes a good case to introduce monsoon-

sensitive credit delivery models. The prevalence of total-factor productivity (TFP) in promoting stability in the long run further underscores the necessity of matching investments in agricultural research, diffusion of agricultural technologies, and extension services.

Various limitations are subject to the study that should be mentioned. Its analysis is based on aggregate national-level reports and hence heterogeneity in the region could be concealed as agro-climatic, infrastructural and institutional situations differ among Indian states. What is needed is a study, using state-level panel data, which examines these spatial dimensions, as well as the study of the dissimilar effect of different types of agricultural credit, i.e., short-term crop loans, long-term investment credit and Kisan credit card advances, on particular dimensions of agricultural stability. Also, nonlinear or threshold modelling of effects, i.e. the credit-stability relationship, could evolve on both sides above and below a series of critical credit penetration thresholds, is a good area to continue research.

Finally, institutional agricultural credit of the state sector banks is a good and quantifiable tool to ensure agricultural economic stability in India as long as it is presented in a timely, well-targeted, and climate-responsive manner. Enhancing the developmental-finance orientation of the public-sector banks, as part of a wider agrarian policy framework (embracing priority to technology, price stability, and rural infrastructure), is the most promising route to sustainable and equitable agricultural development of the Indian subcontinent.

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