J. Agric. Res. Technol., 51 (2) : 208-219 (2026) https://doi.org/10.56228/JART.2026.51211

Endogenous Breaks in India's Agricultural GDP and the Role of Good Governance

R. K. Dolai[1] and D. Mondal[2]
Dept. of Economics, Tamralipta Mahavidyalaya, Tamluk (India)
Corresponding author Email : rajibss44@gmail.com
(Received : 20.12.2025 Accepted : 25.03.2026)

Abstract

India's agricultural GDP from 1960–61 to 2019–20 underwent multiple endogenous structural breaks, identified through a modified Bai-Perron methodology that effectively captures key transitions in the sector's growth trajectory. Five statistically significant breaks were detected, corresponding to major historical events such as the Green Revolution, wars, severe droughts, and shifts in governance and agricultural policy. Analysis of compound annual growth rates (CAGR) across these segments reveals pronounced fluctuations, with phases of contraction (e.g., -0.12865 and -0.11918) followed by strong recoveries (e.g., 0.143987 and 0.133829), reflecting the disruptive impacts of shocks and the restorative influence of good governance, targeted interventions, institutional reforms, and policy-driven initiatives. The Augmented Dickey-Fuller test confirms the stationarity of the series, indicating that the observed shifts stem from structural rather than stochastic factors. While numerous exogenous events influenced agricultural growth, only a few, often in combination with governance challenges, caused significant deviations, resulting in identifiable breaks along the growth path.

Key words : Endogenous Breakpoints, Modified Bai-Perron Method , Indian Agriculture, Stationarity .

Agriculture and its allied sectors form the backbone of India's economy, contributing significantly to GDP and sustaining a large portion of the population. Over the decades, the sector has experienced various transformative phases, including the Green, White, Yellow, and Blue Revolutions, alongside numerous government interventions such as agrarian reforms, land consolidation, and the strengthening of cooperative credit institutions. These policy shifts have played a pivotal role in shaping agricultural performance, often triggered by natural events like droughts and floods, or broader socio-political changes. Importantly, each major policy change or natural disruption introduces a potential break in the agricultural growth trajectory. For instance, the government's decision in the early 1960s to adopt High-Yielding Varieties (HYVs) of wheat and rice, supported by increased use of fertilizers and irrigation, resulted in a substantial boost in productivity. However, such turning points are not always exogenously timed or easily observable. Given the nature of the sector and the historical context of the past six decades, it becomes essential to identify structural breaks endogenously to understand shifts in agricultural GDP more accurately. Events such as severe droughts, technological advancements, the spread of innovations across regions and crops, and key economic reforms may have caused significant but varied impacts on agricultural output. This paper applies statistical methods to identify multiple endogenous structural breaks in Indian agricultural GDP from 1960-61 to 2019-20 and examines the extent to which these shifts align with governance interventions and other external factors.

Many studies have explored structural shifts in the Indian economy to identify key endogenous breaks since Independence.

Notably, Balakrishnan and Parameswaran (2007) observed a marked acceleration in GDP growth in 1978-79, while Ghosh (1999) identified structural breaks in real GDP and GNP during 1988-89 and 1993-94, respectively. Mondal and Saha (2008) proposed a structural break model that demonstrated improved performance in tracking India's post-Independence GNP trends. Their findings align with broader observations that macroeconomic series often follow unstable growth paths due to shifts in policy frameworks.

Within the agricultural sector, Saha and Swaminathan (1994) reported accelerated growth in several Indian states, including West Bengal during the 1980s. Several other studies (Dholakia, 1994; Sinha and Tejani, 2004) identified structural breaks in GDP growth around 1980-81. From a methodological standpoint, the nature of macroeconomic time series has been long debated. Nelson and Plosser (1982) argued that many macroeconomic series contain unit roots, suggesting a difference-stationary process. This raises significant concerns, as applying models like the kinked exponential growth model to such data may yield misleading conclusions. Perron (1989), in a seminal study, challenged standard unit root tests by demonstrating their inefficiency when structural breaks are ignored. He emphasized that neglecting break points can lead to false acceptance of the null hypothesis of a unit root. However, his assumption of exogenous break dates received criticism, paving the way for more refined models.

Bai and Perron (2003) made a significant advancement by developing a robust methodology for detecting multiple structural breaks in linear models. Their dynamic programming algorithm allowed efficient estimation of break dates and testing of structural changes using formal statistical tools. Applying such frameworks, Dolai and Mondal (2023) identified six structural sub-phases in Indian agriculture using dummy-variable regressions, linking breaks to policy shifts like the Green Revolution, droughts, irrigation patterns, fertilizer use, and resource availability. In subsequent studies, Mondal and Dolai (2024) emphasized that incorporating structural breaks significantly enhances the predictive accuracy of time series models, facilitating better policy inferences. Additionally, Dolai and Mondal (2025) highlighted the long-run relationships among growth-determining variables, reinforcing the dynamic interaction between structural changes and agricultural performance. Pradhan and Mondal (2024a) examine structural breaks in India’s manufacturing growth (1970-71 to 2019-20) using kink and Bai-Perron-based methods, identifying multiple growth regimes, while Pradhan and Mondal (2024b) analyze India’s GDP growth over the same period, estimating endogenous breaks that divide the economy into policy-driven growth phases with peak growth during 2005-06 to 2019-20. Extending, Dolai and das (2025) apply fuzzy logic to soil-yield interactions, linking productivity improvements to good governance in sustainable agricultural policy. Complementing this, Zivot and Andrews (1992) introduced a procedure for identifying a single endogenous structural break based on formal testing. Yet, this approach was extended by Lumsdaine and Papell (1997), who argued that allowing for two endogenous breaks results in more powerful unit root tests, especially when structural changes are pronounced.

Methodology

This study examines critical turning points and endogenous structural breaks in Indian agriculture from 1960-61 to 2019-20, focusing on the role of governance through policy decisions, reforms, and interventions. After testing stationarity using the Augmented Dickey-Fuller (ADF) test, the Modified Bai-Perron methodology is applied to identify multiple breakpoints in agricultural GDP and assess their alignment with government actions, natural events, and technological changes.

Tools for empirical testing:

Unit Root Test : The unit root hypothesis has long served as a foundation for assessing the degree of persistence in economic time series. In this study, we test the validity of the unit root hypothesis against the alternative hypothesis of a flexible trend stationary process with the possibility of multiple endogenous structural breaks. To do this, we apply the Augmented Dickey-Fuller (ADF) Unit Root Test to determine whether the data series under consideration is stationary.

Let the logarithm of Agricultural GDP be denoted as Y_t=ln (Agrit). The ADF test is based on the following three regression forms:

1. Without Constant and Trend $\Delta Y\_t= \delta Y_{(t-1)}+ u_t$

2. With Constant $\Delta Y\_t= \alpha + \delta Y_{(t-1)}+ u_t$

3. With Constant and Trend $\Delta Y\_t= \alpha+ \beta T + \delta Y_{(t-1)}+ u_t$

Where, $Y_t=Y_t - Y_{(t-1)}$ is the first difference of the log-transformed series, t represents the time trend, and $u_t \sim$ i.i.d $(0, \sigma^2)$ is the white noise error term, δ is the coefficient being tested for a unit root.

The null and alternative hypotheses are defined as:

H0 : $\delta = 0$ (the series has a unit root; non-stationary),

H1: $\neq 0$ (the series is stationary).

The test statistic used is:

$$t = \frac{\delta - 1}{SE(\delta)}$$

However, since the distribution of this statistic does not follow th e conventional Student's t-distribution under the null hypothesis, critical values provided by Fuller (1976) are used to determine significance.

To account for potential autocorrelation in the residuals, the ADF test includes a number of lagged first-difference terms. The optimal lag length is typically selected using information criteria such as AIC or BIC.

Decision Rule :

If $t^* >$ ADF crtitical value, not reject null hypothesis, i.e., unit root exists (non-stationary).

If $t^* <$ ADF critical value, reject null hypothesis, i.e., unit root does not exist (stationary).

This test serves as a preliminary step in determining the stationarity characteristics of the time series before conducting structural break analysis or further econometric modeling.

Modified Bai-Perron Method : In this study, we adopt the Modified Bai-Perron methodology introduced by Mondal and Saha (2008), which extends the classical multiple structural break framework by incorporating kink-based nonlinear transitions. Unlike the original Bai-Perron method that models abrupt changes in intercepts or slopes, this modified approach captures smooth and gradual structural changes through the use of polynomial kink functions. The methodology allows for single, double, or triple kink points, representing increasing degrees of curvature within each regime between breakpoints. Mathematically, the model is expressed as

$Y_t= \mu_i + \beta_{i0} X_t^0 + \beta_{i1} X_t^1 + \cdots + \beta_{im} X_t^{(m)} + \varepsilon_{it}$ for Ti-1 < $t \leq$ ti

Where, Y_t is the dependent variable at time t, μ_i is the regime-specific intercept, β_{ij} are the coefficients for the j^{th} order polynomial term in regime i, X_t^j represents the j-th order of the regressor (often time or a transformation of time), $m \in \{1,2,3\}$ corresponds to the degree of the polynomial (i.e., single, double, or triple kink), and ε_{it} denotes the error term, assumed to be white noise or corrected for autocorrelation and heteroscedasticity.

In analyzing structural breaks within a time series, if the entire period under consideration consists of m+1 regimes, then there exist m kinks demarcating transitions between adjacent regimes. These kinks may take the form of single, double, or triple transitions, reflecting increasingly complex structural shifts. If we denote m_d as the number of double kinks and m_r as the number of triple kinks, then the total number of resulting sub-periods becomes $N=m+m_d+2m_r$. Among these, m_d+2m_r sub-periods are relatively short, typically spanning only one to two years each. In total, the number of breakpoints becomes N-1. To identify the optimal set of breakpoints, we fit kink-linear paths across the data series under the assumption that the series may exhibit the maximum number of plausible breaks. The selection of the best-fit model is based on maximizing the adjusted R-squared, which balances model fit against loss in degrees of freedom. Although the inclusion of a new variable or kink generally increases the R-squared, this does not necessarily improve model quality, as it simultaneously reduces the degrees of freedom, hence the need for adjusted R-squared as a more reliable criterion. The process continues until the adjusted R-squared is maximized without reducing degrees of freedom to zero, a condition that would overfit the model. Mondal (2008) proposed selecting the kink-linear path that maximizes adjusted R-squared while retaining a viable degree of freedom, thereby ensuring interpretability. This process results in several meaningful sub-periods-referred to as regimes-that may be separated by single, double, or even multiple kinks. To systematically identify the optimal break structure, all possible sub-period combinations are evaluated using the Bayesian Information Criterion (BIC), which penalizes overfitting based on the expression $BIC=n \ln(RSS/n)+(m+1) \ln(n)$, where the first term (negative) reflects model benefit and the second term (positive) represents the penalty. BIC offers a theoretically sound framework for selecting the most interpretable and statistically significant model. To ensure each regime captures meaningful structural characteristics, we impose a minimum regime duration of approximately 10-12 years, assuming that shorter durations may only reflect noise or short-term anomalies. For a 60-year dataset, this constraint implies a maximum of six regimes if all are exactly 10 years long with no intermediate kinks. However, allowing for fewer regimes, say four or five, increases the flexibility to accommodate double or triple kinks and longer-lasting structural phases. To enhance model flexibility at the boundaries, we introduce a final modification by allowing the regimes at the beginning and end of the time series to span a minimum of 5 years, acknowledging that edge regimes may be truncated due to data limitations. This adjustment raises the theoretical maximum to seven regimes. Implementing this complex methodology is computationally intensive and often unmanageable using standard statistical software. Therefore, to execute the extensive set of regressions and model evaluations required, we developed our own customized programs using FORTRAN, enabling exhaustive and efficient search over all plausible regime and kink configurations.

Compound Annual Growth Rate (CAGR) : The Compound Annual Growth Rate (CAGR) for a variable Y_t in year t relative to the previous year t-1 is commonly calculated as $(Y_t-Y_{(t-1)})/Y_{(t-1)}$, and is based on the principle of compound growth, where an initial amount P grows at a constant annual rate r for n years to reach A = P(1 + r)^n. Assuming a constant trend growth rate g_t = r, r can be estimated by regressing the natural logarithm of Y_t on t. Starting from $Y_t = Y_0 (1+r)^t$ and applying the natural logarithm yields $\ln(Y_t) = \ln(Y_0) + (\ln(1+r))\, t$, where the estimated coefficient of t provides ln(1 + r). The growth rate r is then obtained as r = exp(estimated coefficient) - 1, and multiplying by 100 expresses the CAGR in percentage terms.

Database : We use time-series data on Agricultural GDP in India from 1960-61 to 2019-20, collected from the Directorate of Economics and Statistics, Ministry of Agriculture, and various issues of the Statistical Abstract, Government of India. The data are expressed at constant prices with the base year 2011-12 and have been transformed into computational variables using the natural logarithmic scale.

Results and Discussion

Unit Root Test results in Indian Agricultural GDP : To assess the stationarity of the Indian Agricultural GDP time-series data from 1960-61 to 2019-20, we conducted the Augmented Dickey-Fuller (ADF) Unit Root Test under four different model specifications. The goal was to determine whether the data series is stationary at level or requires transformation through differencing. A visual inspection of the series (Fig. 1) reveals an upward trend, suggesting non-stationarity in its level form.

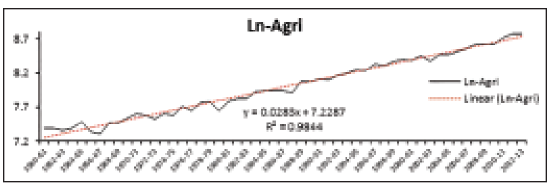

Fig. 1. India's GDP (log) in the agriculture sector during the period 1960-61 to 2019-20.

The Augmented Dickey-Fuller (ADF) unit-root test was applied to India's agricultural GDP (log form) for 1960-61 to 2019-20 under three specifications (no intercept/no trend; intercept only; intercept and trend) with automatic lag selection. At the level, the ADF statistic for the no-intercept/no-trend model is 6.015932 (p = 1.000), which is above the critical values (-2.606163, -1.946654, -1.613122), so we fail to reject the null of a unit root. Under the intercept-only model the ADF statistic is 2.175292 (p = 0.9999) and again fails to reject the null relative to its critical values (-3.560019, -2.91765, -2.596689). However, in the intercept-and-trend specification the ADF statistic is -5.199875 (p = 0.0004), which lies below all relevant critical values (-4.121303, -3.487845, -3.172314), so the null is rejected and the series is stationary in that specification.

In first differences the results are more decisive. For the no-intercept/no-trend specification the ADF statistic is 0.174236 (p = 0.7326), which remains above the critical values (-2.611094, -1.947381, -1.612725), so the null cannot be rejected. By contrast, the intercept-only model yields an ADF statistic of -11.61076 (p = 0.0000), and the intercept-plus-trend model gives -6.114392 (p = 0.0000); both lie well below their respective critical values and strongly reject the unit-root null, indicating stationarity after first differencing under those specifications. These results indicate that the series is integrated of order one, I(1), except under the trend-included specification where it appears stationary at the level. Establishing this stationarity is crucial for ensuring the validity of subsequent econometric analysis, particularly for structural break detection and long-run modeling.

Modified Bai-Perron results in Indian Agricultural GDP : Applying the Modified Bai-Perron approach, which accommodates multiple breakpoints-including the possibility of single,

Table 1. Augmented Dickey-Fuller Unit Root Test Result

Level		No intercept, no trend Lag length 2 (Automatic Selection)		Intercept but no trend Lag length 6 (Automatic Selection)		Intercept and trend Lag length 0 (Automatic Selection)	
		t-Statistic	Prob.*	t-Statistic	Prob.*	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistiAugmented Dickey-Fuller test statisticc		6.015932	1	2.175292	0.9999	-5.199875	0.0004
Critical values	1% level	-2.606163		-3.560019		-4.121303	
	5% level	-1.946654		-2.91765		-3.487845	
	10% level	-1.613122		-2.596689		-3.172314	
First Difference		No intercept, no trend Lag length 7 (Automatic Selection)		Intercept but no trend Lag length 0 (Automatic Selection)		Intercept and trend Lag length 4 (Automatic Selection)	
		t-Statistic	Prob.*	t-Statistic	Prob.*	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistiAugmented Dickey-Fuller test statisticc		0.174236	0.7326	-11.61076	0	-6.114392	0
Critical values	1% level	-2.611094		-3.548208		-4.137279	
	5% level	-1.947381		-2.912631		-3.495295	
	10% level	-1.612725		-2.594027		-3.176618	

double, or even triple kinks between any two regimes-significantly increases the computational intensity of the analysis, as millions of potential combinations must be evaluated. The model with the smallest Bayesian Information Criterion (BIC) value is chosen as the best fit to ensure both statistical rigor and interpretability. In this study, the minimum BIC value of -389.46 corresponds to a model with six regimes and five structural breaks, representing the optimal segmentation of the agricultural GDP series from 1960-61 to 2019-20. The first four regimes span relatively short durations of 5 to 6 years, while the later regimes are considerably longer. Based on this optimal division, the six sub-periods are: Sub-period I (1960-61 to 1963-64), Sub-period II (1966-67 to 1971-72), Sub-period III (1973-74 to 1978-79), Sub-period IV (1981-82 to 1986-87), Sub-period V (1989-90 to 2001-02), and Sub-period VI (2003-04 to 2019-20). The five structural breaks demarcating these sub-periods are: Break-1 (1963-64 to 1965-66), Break-2 (1971-72 to 1972-73), Break-3 (1978-79 to 1980-81), Break-4 (1986-87 to 1988-89), and Break-5 (2001-02 to 2002-03), with three breaks displaying triple kink patterns and two showing double kinks, reflecting different intensities of transition between growth phases (see Fig. 2).

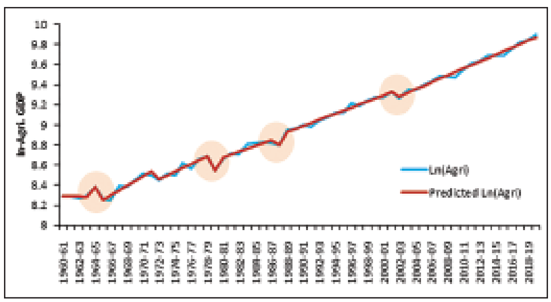

Fig. 2. Growth Path (Actual and Projected) of Agricultural GDP in India during the period 1960-61 to 2019-20.

In the case of double kinks, the middle sub-period typically spans a short duration of 1 to 2 years, serving as a transition phase between two longer regimes. Similarly, in the case of triple kinks, the two middle sub-periods are also brief, lasting 1 to 2 years each, highlighting rapid adjustments or abrupt policy or economic shifts. These short-duration regimes likely represent periods of uncertainty, reform implementation, or structural adaptation. To gain a more comprehensive understanding of each regime and its associated break, we now proceed to a detailed discussion of all six regimes and the five structural breaks. This analysis is supported visually through Figures 3, 4, 5 and 6 which illustrate the kink-based transitions and the segmented growth trajectory of Indian Agricultural GDP over the period from 1960-61 to 2019-20.

The first structural break presents a triple kink, delineated by inflection points A, B, and C as illustrated in Figure 3. This break spans the period from 1963-64 to 1965-66, during which Indian agricultural GDP experienced a recovery delay of approximately one year and one quarter before regaining the trajectory of growth initially observed prior to the disruption, marked as point D. A notable observation in the figure is the collinearity between points A and D, suggesting that the growth path ultimately realigned with its pre-interruption trend. In the early phase of this break, there is a pronounced

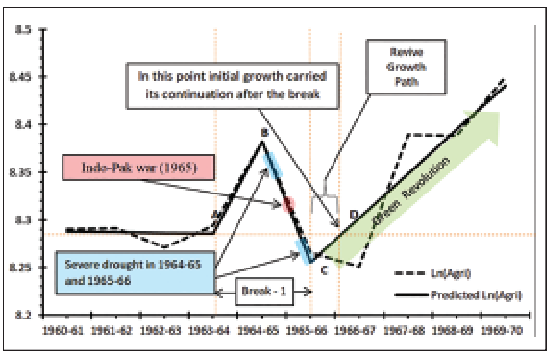

Fig. 3. The Growth path of Agricultural GDP in India during the period 1960-61 to 1969-70.

surge in the growth rate, lasting approximately one year, indicative of a sharp upward shift in agricultural output. This growth acceleration can be attributed primarily to significant government interventions under the early Green Revolution, which introduced modern agricultural practices, including high-yielding varieties (HYVs), expanded irrigation infrastructure, and greater use of chemical fertilizers and pesticides across several regions and crop types. The compound annual growth rate (CAGR) during the first segment of this break was approximately 10.19 percent, and this growth is statistically significant, as reflected in Table 2.

In the second phase of the first break, a marked decline in the agricultural GDP growth trajectory is observed, lasting for approximately one year. This downturn can be primarily attributed to two critical factors. First, the impact of two successive droughts in 1964-65 and 1965-66 led to a dramatic contraction in agricultural output, an overall 17 percent decline, including a 20 percent reduction in foodgrain production. This sharp fall necessitated emergency food aid from the United States to mitigate the crisis. Second, the Indo-Pak conflict of 1965 resulted in heightened defense expenditure, diverting fiscal resources away from agriculture and limiting the government's capacity to support rural production systems. The compound annual growth rate (CAGR) during this segment was approximately -11.918 percent, with a p-value of 0.000328, indicating high statistical significance at the 5% level. Following this phase, a revival in the growth trajectory is observed, primarily driven by strong government interventions under the systematic implementation of the Green Revolution. The concentrated introduction of high-yield variety (HYV) seeds, chemical fertilizers, and other modern inputs across select regions produced immediate and transformative effects. This strategy backed by deliberate governance

Table 2. Growth Analysis of Each Break and Sub-Period in Agricultural GDP in India (1960–61 to 2019–20)

Breaks		CAGR	Standard Error	t Stat	P-value
Sub Period – I		-0.0008	0.0121	-0.0703	0.9443
Break - 1	1st Part	0.10187	0.03515	2.75999	0.00833
	2nd Part	-0.1192	0.03262	-3.8904	0.00033
Sub Period – II		0.0475	0.0051	9.1149	0.0000
Break - 2		-0.0722	0.02598	-2.8865	0.00597
Sub Period – III		0.0382	0.0051	7.3518	0.0000
Break - 3	1st Part	-0.1287	0.03262	-4.2216	0.00012
	2nd Part	0.14399	0.03262	4.12373	0.00016
Sub Period – IV		0.0289	0.0051	5.5879	0.0000
Break - 4	1st Part	-0.0457	0.03262	-1.4333	0.15868
	2nd Part	0.13383	0.03023	4.15541	0.00014
Sub Period – V		0.0308	0.0018	16.9914	0.0000
Break - 5		-0.0396	0.01832	-2.2045	0.03264
Sub Period – VI		0.0351	0.0012	28.159	0.0000

measures, public investment in agricultural research, input subsidies, rural credit schemes, and market price stabilization policies, not only catalyzed a significant rise in agricultural output but also laid the foundation for food security and poverty reduction. Following this recovery, agricultural GDP expanded at a compound annual growth rate (CAGR) of 4.75% during 1966-67 to 1971-72, entering a steady growth path that reflected notable improvements in sectoral productivity and the positive impact of effective governance. Between 1967-68 and 1970-71, foodgrain production increased by 35 percent, while net food imports dropped sharply from 10.3 million tonnes in 1966 to 3.6 million tonnes in 1970. Concurrently, domestic food availability rose from 73.5 million tonnes to 89.5 million tonnes, marking a decisive move towards self-sufficiency in food production.

The second structural break, occurring between 1971-72 and 1972-73, is characterized by a double kink formed at points E and F, while the third break, from 1978-79 to 1980-81, is defined by a triple kink at points H, I, and J (see Fig. 4). In the double kink configuration, the growth trajectory resumes continuity at point G, while in the triple kink, this role is played by point J. The post-break recovery paths are captured by the segments FG and IJ, respectively. Of particular note is the IJ segment, which exhibits a resilient rebound in growth, effectively offsetting the preceding downturn. This pattern suggests that the initial decline during the break was subsequently reversed, restoring the long-term growth trajectory. The primary causes of the 1971-72 to 1972-73 break include the Indo-Pak War of 1971, which led to a significant diversion of public investment away from agriculture, and the severe drought of 1972, which impacted agricultural output and disrupted the livelihoods of nearly 50 million people across Rajasthan, Himachal Pradesh, and Uttar Pradesh. Consequently, the agricultural GDP experienced a statistically significant contraction of 7.2% during this period. However, timely government intervention, characterized by targeted damage-control policies, strategic governance measures, and rapid mobilization of resources, including emergency relief, restoration of irrigation facilities, and reallocation of budgetary funds, helped contain the disruption to a brief duration and facilitated a rapid return to the original growth path path in the recovery segment FG. After this recovery, agricultural GDP entered Sub-period III (1973-74 to 1978-79) and grew at a compound annual growth rate (CAGR) of 3.82%, reflecting moderate gains in productivity. Despite major challenges, including the Indo-Pak War (1972), oil shocks (1973), severe droughts (1974 and 1979), the state of emergency (1975-77), the Andhra Pradesh cyclone (1977), and the suspension of democracy, the sector managed to maintain its growth trajectory. However, the growth rate and level during this sub-period were not very high, which does not strongly reflect effective governance compared to other phases.

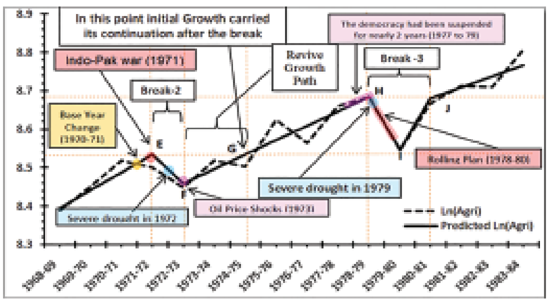

Fig. 4. The Growth path of Agricultural GDP in India from 1968-69 to 1983-84.

The third structural break, spanning 1978-79 to 1980-81, is primarily attributed to a combination of governance-related shifts and severe climatic shocks (see Figure 4). A major drought in 1979 severely disrupted agricultural output, affecting approximately 200 million people across Eastern Rajasthan, Himachal Pradesh, Punjab, and Uttar Pradesh. Simultaneously, the political landscape underwent a significant transition with the Janata Party assuming power. The new government dismantled several existing agricultural policies and introduced the Rolling Plan (1978-1980), which prioritized employment generation over direct agricultural productivity. These governance changes, coupled with adverse weather conditions, resulted in a statistically significant decline of 12.86% in agricultural GDP during the first phase of the break. In 1980, the return of the Congress government marked a decisive policy shift, with governance strategies refocused on poverty alleviation and broad-based economic growth through policy diversification. This new approach facilitated a rapid resurgence in agricultural performance, driven by increased subsidies, targeted support programs, and institutional backing, even though real public investment in agriculture declined. Notably, private investment by farmers continued to expand, playing a crucial role in sustaining the recovery. The second phase of the break recorded a statistically significant 14.39% increase in the agricultural growth trajectory. Following this recovery, agricultural GDP entered a new phase (1981-82 to 1986-87), growing at a compound annual growth rate (CAGR) of 2.89%. While the growth rate was modest, but level remained high, indicating that government activities played a role in sustaining the agricultural growth path. Despite challenges such as the severe droughts in 1985 and 1987, the sector managed to maintain stability and resilience. The collinearity between the initial and final points of the triple kink suggests that the early losses were effectively neutralized by the subsequent rebound, restoring the long-term growth path.

The fourth structural break, occurring between 1986-87 and 1988-89, is characterized by a triple kink formed at points K, L, and N (see Fig. 5). The growth trajectory resumed its original trend following the break, as evidenced by the collinearity between points K and M, with point K marking the onset of the disruption and point M denoting the continuation of the pre-break path. During this brief interruption, the growth rate declined moderately from point K to L over a one-year

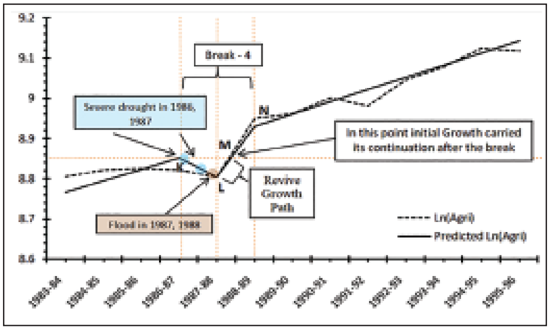

Fig. 5. The Growth path of Agricultural GDP in India from 1983-84 to 1995-96.

span, registering a 4.6% contraction. However, this decline was promptly reversed, as the growth trajectory from point L to N demonstrated a statistically significant rebound of 13.4%. Importantly, the recovery not only offset the initial loss but also sustained positive momentum beyond the break. This pattern suggests a short-lived shock that was quickly absorbed by the sector, reflecting both adaptive capacity and timely government interventions that mitigated long-term impacts.

The severe droughts of 1986 and 1987, coupled with devastating floods in 1987 and 1988, were major contributors to the endogenous structural break observed during this period. These extreme weather events inflicted widespread damage on the agricultural sector across large parts of India. The 1987 drought alone affected nearly 300 million people, particularly in eastern and northwestern regions, severely reducing agricultural productivity. Simultaneously, the 1987 floods impacted 24,518 villages across several states, while the 1988 floods in Punjab inundated 9,000 out of 12,989 villages, making it the largest flood in Punjab's recorded history and disrupting the lives of over 3.4 million people. These climatic shocks led to the observed triple kink in the growth trajectory (points K, L, and N in Figure 5), where a modest decline of 4.6% was rapidly reversed by a 13.4% surge. After this recovery, agricultural GDP entered Sub-period V (1989-90 to 2001-02) and grew at a CAGR of 3.08%, maintaining steady growth despite adverse climatic conditions and challenges such as cyclones, floods, the Gulf War, and economic reforms, reflecting the positive impact of effective governance.

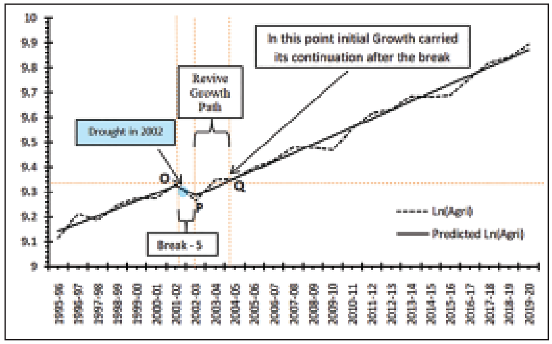

Fig. 6. The Growth path of Agricultural GDP in India from 1995-96 to 2019-20.

The final structural break in Indian agricultural GDP occurred over a one-year period from 2001-02 to 2002-03, forming a double kink at points O and P (see Figure 6). This disruption was primarily induced by the erratic and widespread drought of 2002, one of the most severe in recent decades. The seasonal rainfall deficit reached 21.5%, leading to rainfall levels that were 56% below normal. The drought severely impacted approximately eight major states, including Gujarat, Madhya Pradesh, Orissa, Rajasthan, Chhattisgarh, Himachal Pradesh, Maharashtra, and the Northern Territory. Some of these states experienced two or even three distinct drought spells within the same year. As a result, nearly 19% of India's land area was categorized under "moderate drought" conditions, while 10% faced "severe drought," significantly impairing agricultural productivity. This led to a 3.9% decline in agricultural GDP during the break year. The initial growth trajectory resumed from point Q, which is collinear with point O, but only after a delay of one additional year. Strong governance and timely government interventions, including targeted damage control measures and the implementation of the National Seeds Policy of 2002, played a vital role in mitigating the impact and reviving growth. The Seeds Policy aimed at the planned development of the seed sector, strengthening intellectual property protections, safeguarding farmers' interests, and conserving agrobiodiversity. Complementing this, the National Agriculture Policy of 2000 provided strategic governance direction for long-term agricultural growth by promoting sustainable practices, infrastructure development, and private sector participation. Together, these governance measures enabled a swift recovery from the drought-induced shock and restored the agricultural economy to its original growth trajectory. Finally, agricultural GDP achieved the growth path of Sub-period VI (2003-04 to 2019-20), growing at a CAGR of 3.51%, showing resilience to natural calamities and reflecting the role of effective governance in sustaining sectoral growth.

Conclusion

The structural dynamics of India's agricultural GDP from 1960-61 to 2019-20 reveal significant non-linear behavior marked by multiple endogenous breaks, as identified using the Modified Bai-Perron method. The Augmented Dickey-Fuller Unit Root test confirms the stationarity of the data, validating the presence of structural changes rather than long-term stochastic trends. Through the Modified Bai-Perron methodology, five statistically significant breakpoints were identified, dividing the entire period into six distinct regimes, three marked by triple kinks and two by double kinks. Each break reflects a turning point triggered by major exogenous shocks, such as wars, political disruptions, severe droughts, and floods, interacting with governance and policy responses that either mitigated or amplified their effects on the agricultural growth trajectory. The first break (1963-64 to 1965-66) shows how early gains from the Green Revolution were undermined by environmental and geopolitical turmoil, with limited institutional capacity to cushion the shock. The second (1971-72 to 1972-73) and third (1978-79 to 1980-81) breaks highlight the combined influence of climate-induced distress and political instability, where subsequent recovery was driven by governance reforms, targeted government interventions, and economic realignment. The fourth break (1986-87 to 1988-89) captures the compounding effects of consecutive years of droughts and floods, yet also reflects the resilience fostered by adaptive governance measures and rapid policy action. Finally, the fifth break (2001-02 to 2002-03) shows the vulnerability of agriculture to climatic variability-particularly the 2002 drought-and the effectiveness of timely government-led initiatives such as the National Seeds Policy and broader agricultural reforms in restoring the long-term growth path.

The analysis shows that the trajectory of India's agricultural GDP was not only shaped by environmental and geopolitical shocks but also significantly influenced by governance quality, policy interventions, and institutional capacity. In all the structural breaks, growth decelerated due to natural disasters or political instability but was typically revived within a year or two through effective governance. In the first period, the Green Revolution strategy itself reflected good governance by stabilizing growth after a major disruption. By contrast, in the third sub-period, both the growth rate and level were modest, suggesting weaker governance effectiveness, whereas in the fourth sub-period, despite sharp fluctuations, strong governance played a key role in recovery and sustaining momentum. In the later sub-periods, the agricultural sector maintained both higher levels and consistent growth rates, further showing the critical role of governance in building resilience and sustaining long-term agricultural development.

Declaration

The paper is original and has not been submitted elsewhere for publication.

References

Balakrishnan P., Parameswaran M. 2007. Understanding Economic Growth in India:A Prerequisite; Economic and political weekly 42(27):2915-2922.

Dholakia, R. H. 1994. Spatial Dimension of Acceleration of Economic Growth in India, Economic and Political Weekly, Vol.29, No.35, August 27 - September 2, pp. 2303-2309.

Dolai, R. and Mondal, D. 2023, Agricultural Growth in India: A Comparative Analysis of Sub-periods from 1960-61 to 2019-20, PRAGATI: Journal of Indian Economy, 10 (2), 1-13.

Dolai, R. K., and Das, P. 2025. Analysing Rice Productivity in India using a Fuzzy Logic Model based on Soil Quality Parameters, Spectrum of Engineering and Management Sciences, 1-14.

Dolai, R. K. and Mondal, D. 2023, Cointegration between Agricultural GDP and Inputs in India: An Empirical Analysis, Sch J Econ Bus Manag, 5, 118-129.

Dolai, R. K. and Mondal, D. 2025, Relative importance of agricultural factors on India's GDP growth. Farming & Management, 10(1), 65-74

Ghosh, M. 1999. Structural Break and Unit Root in Macroeconomic Time Series: Evidence from a Developing Economy, Sankhya (The Indian Journal of Statistics), Vol.61, Part 2, Series B, pp. 318-336.

Jushan Bai And Pierre Perron. 2003. Computation And Analysis Of Multiple Structural Change Models.

Lumsdaine, R. L. and Papell, D. H. 1997. Multiple trend breaks and the unit-root hypothesis. Review of economics and Statistics, 79(2), 212-218.

Mondal D, Mondal Saha. S. 2008. Growth, Break and Instability: Towards a Unified Methodology. Vidyasagar University Journal Of Economics, 13:22-36.

Mondal, D. 2008. On the test of significance of linear multiple regression coefficients, Communications in Statistics: Simulation and Computation,Vol. 37, No. 4 (August).

Mondal, D. and Dolai, R. 2024. Necessity of Incorporating Break-in-trend in Aggregate Time Series Data: Evidence from Agricultural GDP in India, Pragati: Journal of Indian Economy, 11(2), 27-38.

Nelson, C. R. and Plosser, C. I. 1982. Trends and Random Walks in Macro-Economic Time Series: Some Evidence and Implications, Journal of Monetary Economics 10, 139-162.

Perron, P. 1989. The Great Crash, the Oil Price Shock and the Unit Root Hypothesis,'' Econometrica 57,1361-1401.

Pradhan, D. and Mondal, D. 2024a. Fifty Years of India's Manufacturing Sector Growth Journey- An Endogenous Break Perspective, International Journal of Innovative Research in Engineering and Management, 11(6), 1-7.

Pradhan, D. and Mondal, D. 2024b. Growth of and Fluctuations in India's GDP and GDP Accruing from Agriculture During 1970-71 to 2019-20, International Journal of Innovative Research in Engineering and Management, 11(5).

Saha, A. and Swaminathan, M. 1994. Agricultural Growth in West Bengal in 1980s: A Dis-aggregation by Districts and Crops, Economic and Political Weekly, Vol. 29, No. 13, March 26, pp. A2-A11.

Sinha, A. and Tejani, S. 2004. Trend Break in India's GDP Growth Rate: Some Comments, Economic and Political Weekly, Vol.39, No.52, December 25-32, pp. 5634-5639.

Zivot, E. and Andrews, D. W. K. 1992. Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis, Journal of Business and Economic Statistics 10:3, 251-270.