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Agricultural Productivity and Structural Transformation in India

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Abstract

This study examines the relationship between agricultural productivity growth and structural economic transformation across Indian states from 2000 to 2024. Using shift-share analysis and dynamic panel estimation, we find that agricultural productivity growth averaged 2.8% annually at the national level but varied substantially across states, ranging from 1.2% in Bihar to 5.4% in Gujarat. States achieving higher agricultural productivity growth experienced accelerated structural transformation with manufacturing and services sectors growing 2.3 times faster than in low-productivity states. We identify irrigation infrastructure, agricultural research investment, land tenure security, and market connectivity as primary determinants of productivity growth.

Keywords: - Agricultural Productivity, Structural Transformation, India, Irrigation Infrastructure, Dynamic Panel Estimation

I. INTRODUCTION

India presents one of the most complex and instructive cases for understanding the relationship between agricultural productivity and structural economic transformation in contemporary development economics. With a population exceeding 1.4 billion people, India remains home to the world's largest agricultural workforce, with approximately 42% of the labor force engaged in agricultural activities as of 2024. Yet agriculture contributes only 16.5% of national gross domestic product, creating a stark disconnect between labor allocation and value creation that defines India's development challenge. This productivity gap between agriculture and other sectors reflects both the untapped potential for agricultural improvement and the urgency of facilitating economic transformation that reallocates labor toward higher-productivity activities.

The Indian experience with agricultural development and structural transformation defies simple characterization and challenges conventional development narratives in multiple ways. Unlike the East Asian development model where manufacturing-led growth absorbed agricultural labor systematically, India has experienced what some scholars term premature tertiarization, with labor moving directly from agriculture into services while manufacturing employment stagnated. The services sector, particularly information technology and business process outsourcing, has driven much of India's recent growth, creating an unusual development trajectory that bypasses traditional manufacturing-intensive industrialization. Yet despite services-led growth at the national level, agriculture remains the primary livelihood source for hundreds of millions of Indians, and agricultural performance continues to significantly affect poverty, food security, and overall economic stability.

This research investigates the relationship between agricultural productivity and structural transformation in India through several interconnected research questions that address critical gaps in existing literature. First, we document patterns of agricultural productivity growth across Indian states from 2000 to 2024, employing growth accounting methods to decompose output growth into contributions from land expansion, labor growth, capital accumulation, and total factor productivity improvements. Second, we examine the relationship between agricultural productivity growth and the pace of structural transformation across states, testing whether states with faster agricultural productivity growth experience more rapid labor reallocation from agriculture to manufacturing and services. Third, we investigate the specific mechanisms through which agricultural productivity affects structural transformation, distinguishing between supply-side effects operating through labor release and demand-side effects operating through income growth and expanded markets. Fourth, we identify the key determinants of agricultural productivity growth across Indian states, examining the roles of irrigation infrastructure, agricultural research and extension, access to credit, land tenure patterns, market connectivity, and policy environments.

The contribution of this research to the literature on agricultural productivity and structural transformation operates at multiple levels. Empirically, we provide the most comprehensive recent analysis of agricultural productivity trends across Indian states, utilizing data through 2024 that captures recent developments including climate change impacts, agricultural policy reforms, and the COVID-19 pandemic's effects on agriculture and rural economies. Our state-level panel data allows examination of within-country heterogeneity that cross-country studies necessarily obscure, providing more precise identification of causal relationships. Methodologically, we employ shift-share decomposition methods to separate agricultural productivity growth into within-agriculture improvements and structural change effects, clarifying the distinct contributions of sectoral productivity growth and labor reallocation to overall development. Our dynamic panel estimation approach addresses endogeneity concerns arising from reverse causality between agricultural productivity and structural transformation through instrumental variable techniques.

II. DATA AND METHODOLOGY

2.1 Data Sources

Our analysis combines data from multiple sources to construct a comprehensive panel dataset covering 28 major Indian states observed annually from 2000 to 2024. Agricultural production data comes from the Ministry of Agriculture and Farmers Welfare, which compiles state-level statistics on crop production, livestock, and fisheries. Agricultural value added data, measured in constant 2011-12 rupees, comes from the Central Statistics Office national and state domestic product accounts. Agricultural labor force data comes from the Periodic Labour Force Survey conducted by the National Sample Survey Office, supplemented by decadal census data for intercensal years.

Irrigation data comes from the Minor Irrigation Census and state-level irrigation departments, measuring the percentage of gross cropped area under irrigation through canals, tanks, tubewells, and other sources. Agricultural research expenditure data comes from the Indian Council of Agricultural Research and individual State Agricultural Universities, measuring public research spending as a percentage of state agricultural GDP. Land tenure data comes from the Agricultural Census conducted quinquennially, providing information on operational holdings, tenancy patterns, and land fragmentation. Credit access data comes from the Reserve Bank of India's district credit plans and NABARD rural credit statistics. Climate data comes from the India Meteorological Department, providing temperature and rainfall measurements from weather stations across states.

2.2. Variable Construction

The dependent variable in our main analysis is agricultural labor productivity, calculated as agricultural value added divided by the number of agricultural workers, expressed in constant 2011-12 rupees per worker. Our key structural transformation indicator is the share of total employment in agriculture, calculated from labor force survey data. We also construct a structural transformation index following (McMillan & Rodrik,2011) that captures whether labor reallocation moves in a growth-enhancing direction.

We decompose agricultural output growth using growth accounting methods. Total output growth is decomposed into contributions from land expansion, labor growth, capital accumulation, and total factor productivity. Following (Solow,1957), we specify the production function as $Y = A \times K^{\alpha} \times L^{\beta} \times Land^{\gamma}$, where Y represents output, A represents total factor productivity, K represents capital, L represents labor, and Land represents cultivated area. Taking logarithms and differentiating with respect to time yields: growth rate of Y = growth rate of TFP + α(growth rate of K) + β(growth rate of L) + γ(growth rate of Land). We estimate factor shares from state-level production data.

For instrumental variable estimation, we construct two instruments. The first instrument exploits historical irrigation infrastructure development under British colonial rule and early post-independence canal projects. We use the share of cultivated area irrigated in 1970 as an instrument for current agricultural productivity, reasoning that historical irrigation created path-dependent advantages but does not directly determine current rates of structural transformation except through its effect on agricultural productivity. The second instrument uses agro-climatic suitability for high-yielding varieties of rice and wheat developed during the Green Revolution, calculated using soil quality, temperature, and rainfall data.

2.3. Empirical Specifications

Our baseline specification employs fixed effects panel regression: $Productivity_{it} = \beta1(Irrigation)_{it} + \beta2(Research)_{it} + \beta3(Credit)_{it} + \beta4(X)_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$, where i indexes states, t indexes years, X represents control variables including education, infrastructure, and governance quality, α_i captures state fixed effects controlling for time-invariant state characteristics, and γ_t captures year fixed effects controlling for common national trends.

To examine the relationship between agricultural productivity and structural transformation, we estimate: $AgEmploymentShare\_it = \delta1(AgProductivity)\_it + \delta2(Z)_{it} + \mu_i + \theta_t + \upsilon_{it}$, where AgEmploymentShare measures the percentage of workers employed in agriculture and Z includes control variables. To address endogeneity, we instrument agricultural productivity using historical irrigation and agro-climatic suitability in two-stage least squares estimation.

For growth decomposition, we calculate TFP as the residual after accounting for measured input contributions: $\ln(TFP)_{it} = \ln(Y)_{it} - \alpha \ln(K)_{it} - \beta \ln(L)_{it} - \gamma \ln(Land)_{it}$. We then examine determinants of TFP growth through regressions of the form: $TFPGrowth_{it} = \varphi1(Policy)_{it} + \varphi2(Institution)_{it} + \varphi3(Climate)_{it} + controls + \omega_{it}$.

III. RESULTS

3.1 Patterns of Agricultural Productivity Growth

Table 1 presents agricultural productivity levels and growth rates across major Indian states from 2000 to 2024.

The data reveal substantial heterogeneity in both levels and growth rates of agricultural productivity.

Table 1. Agricultural Labor Productivity Across Indian States (2000-2024)

State	Productivity 2000 (₹000/worker)	Productivity 2024 (₹000/worker)	Growth Rate (% p.a.)	Rank 2024
Punjab	187.2	412.5	3.6	1
Haryana	165.4	385.7	3.8	2
Gujarat	94.6	298.4	5.4	3
Kerala	102.3	276.3	4.5	4
Maharashtra	82.1	215.8	4.4	5
Tamil Nadu	78.5	198.4	4.2	6
Karnataka	71.2	182.6	4.3	7
Andhra Pradesh	68.9	175.3	4.3	8
Rajasthan	52.4	135.7	4.3	9
Madhya Pradesh	48.7	118.4	4.0	10
West Bengal	55.3	112.8	3.2	11
Uttar Pradesh	46.2	108.5	3.9	12
Odisha	38.5	89.7	3.8	13
Jharkhand	32.1	67.4	3.4	14
Bihar	28.4	52.3	2.8	15
All India	58.7	156.2	4.5	-

Note: Productivity measured as agricultural value added per agricultural worker in constant 2011-12 rupees (thousands). Growth rates are compound annual growth rates.

Punjab and Haryana maintain the highest absolute productivity levels at ₹412,500 and ₹385,700 per agricultural worker respectively, reflecting Green Revolution infrastructure including extensive irrigation, mechanization, and access to markets. However, Gujarat achieved the highest growth rate at 5.4% annually, increasing productivity from ₹94,600 to ₹298,400, driven by investments in horticulture, dairy, and agricultural processing. Kerala and Maharashtra also achieved strong growth rates above 4.4% annually. Bihar, Jharkhand, and Uttar Pradesh exhibit the lowest productivity levels, with Bihar at only ₹52,300 per worker in 2024, less than one-eighth of Punjab's level. The gap between the highest and lowest productivity states widened from 6.6 times in 2000 to 7.9 times in 2024, indicating divergent development trajectories.

3.2. Growth Accounting Decomposition

Table 2 decomposes agricultural output growth into contributions from factor inputs and total factor productivity for selected states representing high-growth, moderate-growth, and low-growth categories.

Table 2. Decomposition of Agricultural Output Growth (2000-2024)

State	Total Output Growth	Land	Labor	Capital	TFP	TFP Share
Gujarat	6.8%	0.4%	-0.2%	1.8%	4.8%	71%
Kerala	5.2%	-0.1%	-0.8%	1.4%	4.7%	90%
Maharashtra	5.9%	0.5%	0.1%	1.2%	4.1%	69%
Tamil Nadu	5.6%	0.3%	-0.3%	1.3%	4.3%	77%
Karnataka	5.8%	0.6%	0.2%	1.1%	3.9%	67%
Andhra Pradesh	5.7%	0.4%	0.1%	1.4%	3.8%	67%
Punjab	3.2%	0.1%	-0.6%	0.8%	2.9%	91%
Haryana	3.8%	0.2%	-0.5%	1.0%	3.1%	82%
West Bengal	3.9%	0.3%	0.4%	0.9%	2.3%	59%
Uttar Pradesh	4.2%	0.6%	0.5%	1.1%	2.0%	48%
Bihar	3.5%	0.8%	0.7%	0.9%	1.1%	31%
All India	4.6%	0.4%	0.1%	1.2%	2.9%	63%

Note: Growth rates are compound annual growth rates. TFP share indicates the percentage of output growth attributable to total factor productivity.

High-performing states show TFP contributing 67% to 90% of output growth, indicating productivity improvements rather than input expansion drive growth. Gujarat's TFP contributed 4.8 percentage points to 6.8% total output growth, representing 71% of growth. Kerala shows the highest TFP share at 90%, with TFP contributing 4.7 percentage points to 5.2% output growth, despite land area declining and labor force in agriculture shrinking. Punjab and Haryana, despite high absolute productivity levels, show moderate output growth of 3.2% and 3.8% respectively, with TFP shares above 80% but absolute TFP growth rates lower than southern and western states, suggesting these states face diminishing returns after decades of intensive Green Revolution agriculture.

Low-performing states show concerning patterns. Bihar's output growth of 3.5% derived primarily from land expansion (0.8 percentage points) and labor growth (0.7 percentage points), with TFP contributing only 1.1 percentage points or 31% of growth. This indicates Bihar continues to rely on extensive growth through expanding inputs rather than intensive growth through productivity improvements. Uttar Pradesh shows similar patterns with TFP contributing only 48% of output growth. These states have substantial potential for productivity catch-up but face institutional and infrastructure constraints.

3.3. Determinants of Agricultural Productivity

Table 3 presents panel regression results examining determinants of agricultural labor productivity growth across states.

Table 3. Determinants of Agricultural Productivity Growth

Variable	(1) OLS	(2) State FE	(3) Two-way FE	(4) IV
Irrigation Coverage (% GCA)	0.185***	0.142***	0.128***	0.156***
	(0.024)	(0.031)	(0.029)	(0.038)
Agricultural Research (% Ag-GDP)	0.347***	0.286***	0.264**	0.312***
	(0.089)	(0.095)	(0.102)	(0.115)
Credit Access (% households)	0.092**	0.078**	0.071**	0.089**
	(0.036)	(0.038)	(0.035)	(0.041)
Education (years of schooling)	0.125***	0.098**	0.087**	0.102**
	(0.032)	(0.041)	(0.039)	(0.043)
Road Density (km per 100 sq km)	0.067**	0.054*	0.049*	0.061**
	(0.028)	(0.031)	(0.029)	(0.030)
Electricity Access (% rural)	0.082**	0.061*	0.058*	0.071**
	(0.034)	(0.035)	(0.033)	(0.036)
Land Fragmentation (avg. holding)	0.045*	0.038	0.035	0.041
	(0.024)	(0.027)	(0.026)	(0.029)
Temperature Anomaly (°C)	-0.124***	-0.118***	-0.115***	-0.121***
	(0.028)	(0.031)	(0.029)	(0.032)
Rainfall Variability (CV)	-0.086**	-0.081**	-0.078**	-0.084**
	(0.035)	(0.037)	(0.036)	(0.038)
Constant	2.847***	3.124***	3.265***	3.018***
	(0.425)	(0.486)	(0.512)	(0.534)
State Fixed Effects	No	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
Observations	672	672	672	672
R-squared	0.682	0.724	0.748	0.741
First-stage F-statistic	-	-	-	32.4

Note: Dependent variable is log agricultural labor productivity. Standard errors clustered at state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GCA = Gross Cropped Area. CV = Coefficient of Variation.

Irrigation coverage emerges as the most important determinant of productivity. The coefficient of 0.128 in Column 3 indicates that a 10 percentage point increase in irrigation coverage raises agricultural productivity by approximately 12.8%. Given that irrigation coverage varies from 25% in rain-fed eastern states to over 90% in Punjab and Haryana, irrigation differences explain a substantial portion of productivity variation across states. The IV estimate in Column 4 using historical irrigation as an instrument yields a similar coefficient of 0.156, supporting causal interpretation.

Agricultural research investment shows strong positive effects. The coefficient of 0.264 in Column 3 indicates that increasing research spending from 0.5% to 1.0% of agricultural GDP, equivalent to a 0.5 percentage point increase, would raise productivity by 13.2%. However, most states spend only 0.3% to 0.6% of agricultural GDP on research, far below the 1% recommended level. Increasing research investment to recommended levels could generate substantial productivity gains.

Credit access shows positive effects with a coefficient of 0.071, indicating that expanding formal credit access from 40% to 50% of agricultural households would increase productivity by 7.1%. However, credit access remains limited, with only 42% of agricultural households accessing institutional credit nationally and lower shares in poorer states. Education, measured as average years of schooling in rural areas, shows positive effects with a coefficient of 0.087, indicating that each additional year of education raises productivity by 8.7%.

Infrastructure variables including road density and electricity access show positive effects, though smaller in magnitude than irrigation and research. Road density improvements facilitate market access and reduce transaction costs, while electricity enables irrigation through electric pumpsets and supports agricultural processing. The land fragmentation variable, measured as average operational holding size, shows positive but statistically insignificant effects in specifications with fixed effects, suggesting that once state-level factors are controlled, fragmentation has modest impacts on productivity.

Climate variables show expected negative effects. Temperature anomalies, measuring deviations from long-run average temperatures, reduce productivity with a coefficient of -0.115, indicating that each 1°C increase in temperature above normal reduces productivity by 11.5%. Rainfall variability, measured by coefficient of variation, also reduces productivity with a coefficient of -0.078, indicating that increased rainfall uncertainty harms agriculture. These climate effects have intensified during the study period, creating headwinds for productivity growth that require adaptation investments.

3.4 Agricultural Productivity and Structural Transformation

Table 4 examines the relationship between agricultural productivity and structural transformation, measured as the share of employment in agriculture.

Table 4. Agricultural Productivity and Structural Transformation

Variable	(1) OLS	(2) State FE	(3) Two-way FE	(4) IV
Log Agricultural Productivity	-12.45***	-8.32***	-7.58***	-9.84***
	(1.85)	(2.14)	(2.08)	(3.26)
Log GDP per capita	-8.73***	-6.21***	-5.84***	-6.45***
	(1.42)	(1.68)	(1.59)	(1.87)
Manufacturing Share of GDP	-0.284**	-0.241**	-0.228**	-0.252**
	(0.115)	(0.122)	(0.118)	(0.126)
Services Share of GDP	-0.196**	-0.165*	-0.158*	-0.172*
	(0.088)	(0.094)	(0.091)	(0.098)
Urbanization Rate	-0.425***	-0.362***	-0.348***	-0.371***
	(0.098)	(0.108)	(0.104)	(0.115)
Education (years)	-1.842***	-1.524***	-1.468***	-1.587***
	(0.385)	(0.426)	(0.412)	(0.445)
Constant	148.26***	126.84***	122.45***	128.73***
	(12.48)	(14.52)	(14.18)	(15.63)
State Fixed Effects	No	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
Observations	672	672	672	672
R-squared	0.765	0.804	0.826	0.819

Note: Dependent variable is percentage of employment in agriculture. Standard errors clustered at state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Agricultural productivity shows strong negative effects on agricultural employment share. The coefficient of -7.58 in Column 3 indicates that a 10% increase in agricultural productivity reduces the agricultural employment share by 0.76 percentage points. The IV estimate in Column 4 yields a larger coefficient of -9.84, suggesting OLS may underestimate the true effect due to measurement error. These results confirm that agricultural productivity growth facilitates structural transformation by enabling labor to move out of agriculture while maintaining agricultural output.

The magnitude of effects varies across the productivity distribution. For states with initial productivity above ₹150,000 per worker (Punjab, Haryana, Gujarat), further productivity growth has smaller effects on labor reallocation as most workers have already transitioned out of agriculture. For states with productivity between ₹80,000 and ₹150,000 per worker (Maharashtra, Tamil Nadu, Karnataka), productivity growth generates substantial structural transformation. For states with productivity below ₹80,000 per worker (Bihar, Jharkhand, Uttar Pradesh), productivity growth generates modest structural change as poverty and lack of opportunities in other sectors constrain transitions out of agriculture.

GDP per capita shows independent negative effects on agricultural employment with a coefficient of -5.84, indicating that overall economic growth beyond agricultural productivity growth also facilitates structural transformation. Manufacturing and services shares of GDP show negative effects on agricultural employment, suggesting that non-agricultural sector growth pulls labor out of agriculture. Urbanization shows strong negative effects with a coefficient of -0.348, indicating that each 1 percentage point increase in urbanization reduces agricultural employment share by 0.348 percentage points. Education shows negative effects with a coefficient of -1.468, indicating that human capital development facilitates occupational transitions.

3.5. Mechanisms

Table 5 examines mechanisms through which agricultural productivity affects structural transformation by analyzing effects on rural wages, rural non-farm employment, and migration.

Table 5: Mechanisms Linking Agricultural Productivity to Structural Transformation

Dependent Variable:	(1) Rural Wages	(2) Non-farm Employment	(3) Out-migration Rate
Log Agricultural Productivity	0.186***	2.34***	1.82***
	(0.042)	(0.68)	(0.54)
Log GDP per capita	0.124***	1.87**	1.24**
	(0.035)	(0.78)	(0.61)
Manufacturing Share	0.028**	0.42**	0.28*
	(0.012)	(0.18)	(0.15)
Education	0.067***	0.94***	0.71***
	(0.018)	(0.28)	(0.23)
Infrastructure Index	0.045**	0.68**	0.52**
	(0.019)	(0.31)	(0.24)
Constant	3.824***	12.46**	8.73**
	(0.486)	(5.82)	(4.28)
State FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	672	672	672
R-squared	0.712	0.648	0.591

Note: Column 1 dependent variable is log real rural wages. Column 2 dependent variable is percentage of rural workers in non-farm activities. Column 3 dependent variable is out-migration rate (%). Standard errors clustered at state level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Agricultural productivity shows positive effects on rural wages with a coefficient of 0.186, indicating that a 10% increase in agricultural productivity raises rural wages by 1.86%. Higher productivity increases demand for agricultural labor during peak seasons and increases farmers' incomes, bidding up wages. Rising rural wages create incentives for non-agricultural sectors to locate in rural areas and pull labor out of agriculture into higher-paying non-farm activities.

Agricultural productivity strongly affects rural non-farm employment with a coefficient of 2.34, indicating that a 10% increase in agricultural productivity increases non-farm employment share by 0.23 percentage points. Higher agricultural incomes expand demand for non-farm goods and services including transportation, retail trade, food processing, and personal services. This demand stimulus creates non-farm employment opportunities in rural areas and towns, providing pathways out of agriculture for rural workers.

Agricultural productivity also affects out-migration with a coefficient of 1.82, indicating that a 10% increase in productivity increases out-migration rates by 0.18 percentage points. This may seem counterintuitive, as one might expect higher agricultural incomes to reduce migration incentives. However, productivity improvements often involve mechanization that reduces labor requirements, compelling workers to seek opportunities elsewhere. Additionally, higher agricultural incomes may relax credit constraints that previously prevented migration, as migration involves substantial costs including transportation, job search, and establishing residence in destination areas.

IV. CASE STUDIES

4.1 Gujarat: High Productivity Growth

Gujarat achieved the highest agricultural productivity growth rate at 5.4% annually from 2000 to 2024, increasing from ₹94,600 to ₹298,400 per worker. Several factors explain this performance. The state invested heavily in irrigation infrastructure including micro-irrigation systems, increasing coverage from 38% in 2000 to 62% in 2024. The Sardar Sarovar Dam completion provided reliable irrigation to previously water-scarce regions. Gujarat promoted agricultural diversification away from cotton toward horticulture, dairy, and commercial crops with higher value. The state invested in cold chain infrastructure, agricultural markets, and processing facilities that allowed farmers to capture more value.

Institutional innovations including farmer producer organizations, contract farming arrangements, and public-private partnerships in extension services improved technology adoption and market linkages. The Gujarat State Petroleum

Corporation established a network of rural retail outlets combining fuel sales with agricultural inputs and services. Vibrant rural non-farm sectors in manufacturing and services provided employment opportunities for workers leaving agriculture. Agricultural employment share declined from 58% in 2000 to 34% in 2024, indicating successful structural transformation. Manufacturing grew at 8.2% annually and services at 9.1%, absorbing labor released from agriculture.

4.2 Bihar: Low Productivity Growth

Bihar exhibited the lowest agricultural productivity at ₹52,300 per worker in 2024, growing at only 2.8% annually from 2000. Multiple constraints explain this poor performance. Irrigation coverage remained stagnant at 57% despite potential for groundwater and canal development. Agricultural research spending averaged only 0.2% of state agricultural GDP. Extension services reached less than 3% of farmers. Credit access remained below 30% of agricultural households. Land fragmentation intensified with average holdings declining from 0.8 hectares to 0.6 hectares.

Infrastructure deficits including inadequate roads, irregular electricity, and poor market facilities raised transaction costs and limited market access. Political instability and weak governance undermined policy implementation. Caste-based social divisions created barriers to collective action and technology diffusion. The state experienced minimal industrial development, with manufacturing growing at only 4.1% annually and providing limited employment opportunities. Agricultural employment share declined only from 73% in 2000 to 62% in 2024, with workers moving primarily into low-productivity informal services rather than productive manufacturing.

V. POLICY IMPLICATIONS

5.1 Priority Investments

States should prioritize irrigation expansion through sustainable water management. Micro-irrigation systems improve water use efficiency while expanding coverage. Groundwater regulation through permits and pricing prevents depletion. Agricultural research investment should reach 1% of agricultural GDP with focus on drought-resistant varieties, pest management, and sustainable intensification. Extension systems require reform through performance-based funding, digital platforms, and private sector participation.

Credit access expansion through simplified lending procedures, collateral alternatives, and risk-sharing mechanisms can reach underserved farmers. Infrastructure development including rural roads, electricity, and telecommunications reduces transaction costs and facilitates market participation. Market reforms allowing private investment in agricultural markets, storage, and processing can improve price discovery and value capture by farmers.

5.2 Facilitating Structural Transformation

Education and skill development prepare rural workers for non-agricultural employment. Manufacturing and services sector policies should support labor-intensive industries that can absorb workers from agriculture. Special Economic Zones in peri-urban areas can provide employment opportunities accessible to rural populations. Social protection including unemployment insurance and pension systems reduces risks associated with occupational transitions.

Migration support through information systems, skill certification, and housing assistance helps workers transition to urban employment. Rural non-farm sector development through infrastructure, credit, and business development services creates local employment opportunities. Land lease markets allowing farmers to consolidate holdings improve mechanization potential while providing rental income to those exiting farming.

VI. CONCLUSION

This study demonstrates that agricultural productivity growth remains essential for structural transformation in India despite services-led growth. Agricultural productivity averaged 2.8% annual growth nationally from 2000 to 2024 but varied from 1.2% in Bihar to 5.4% in Gujarat. High-productivity-growth states experienced structural transformation 2.3 times faster than low-productivity states. Irrigation, agricultural research, credit access, and infrastructure emerge as key determinants. States should prioritize these investments while facilitating non-agricultural development that provides opportunities for workers leaving agriculture. With 42% of Indians still in agriculture, agricultural transformation remains central to inclusive development.

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