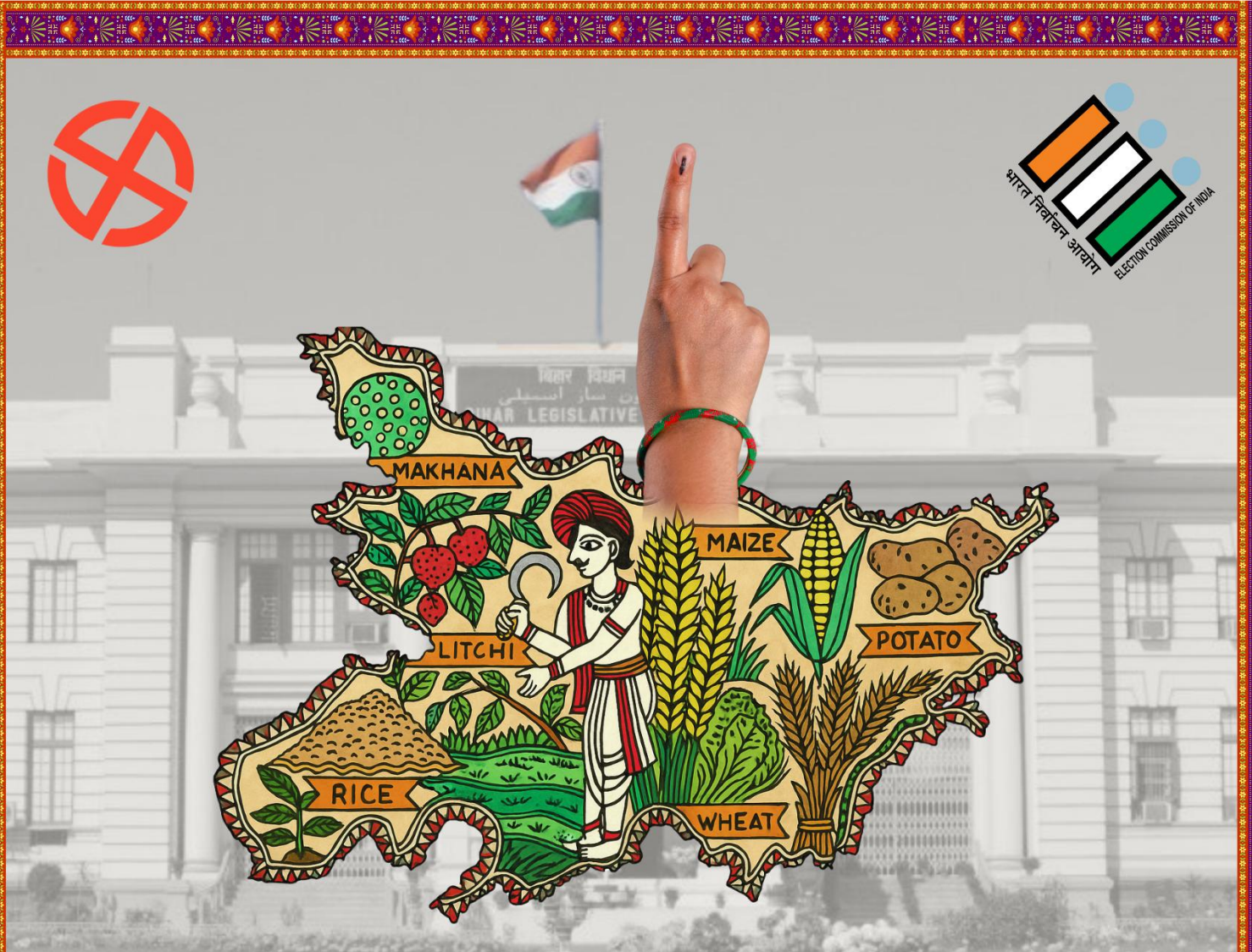


# BIHAR'S ECONOMIC DILEMMA: WHAT IT CAN LEARN FROM SOME LAGGARD STATES?

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# Inside the Issue

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➤ From the Director's Desk

➤ From the Chief Editor's Desk

➤ Research from the Last Quarter

- [Can laggard States Become India's next growth Engine?](#)  
*Harsh Wardhan and Ashok Gulati*
- [A Roadmap for Bihar: Lessons from Madhya Pradesh's Agricultural Reforms](#)  
*Bidisha Chanda and Ashok Gulati*
- [Shrinking Farms, Structural Constraints: Rethinking Agricultural Policy in West Bengal and Bihar](#)  
*Raya Das, Bidisha Chanda and Ashok Gulati*
- [Bihar's Makhana Moment: Turning Promise into Policy](#)  
*Harsh Wardhan, Tanay Suntwal, and Ashok Gulati*
- [Odisha's Green Growth Story: Leveraging Agriphotovoltaics for a Farmer-Centric Livelihood Program](#)  
*Subhodeep Basu, Ashok Gulati, and Akshaya Biswal*

➤ Activities of the quarter

➤ Bibliothèque

# From the Director's Desk



**A**griculture and its allied activities remain the bedrock of Bihar's economy, employing 54% of the state's workforce and contributing 18% to state GDP. Yet there are seasonal issues ailing agriculture, primarily floods (north Bihar), droughts (south Bihar), and waterlogging, lack of power supply, and lack of irrigation and mechanisation in many areas. While some improvements are underway, the large number of small or marginal farmers operating on less than half a hectare of land remains a constraint. There is also the challenge of outward migration, with many young people leaving for other states due to lack of non-farm jobs at home.

Agricultural improvements therefore offer a foundation for rural incomes, but to make them sustainable requires greater value-addition (food processing, agro-industries), better linkages to markets, more export orientation, and mechanisation. The livestock sector offers hope: both in the milk and poultry sub-segments, growth has been very significant. This can augment farmers' incomes despite the small holding size constraint of land. There is scope for Bihar to leverage its horticulture, speciality crops (*litchi*, *makhana*, sugarcane) and build agro-processing hubs. If non-farm employment remains stagnant, agriculture alone cannot be the growth engine. A structural transformation oriented towards industry and services remains critical.

The 2025 elections are hence very important for Bihar: they could determine whether the state leans further into agriculture-led rural

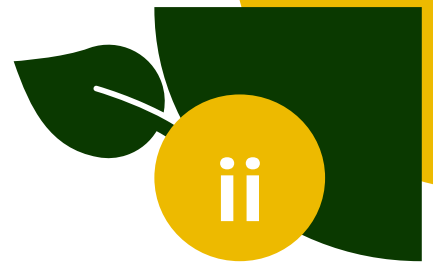
livelihoods or pushes more strongly into non-farm industry/services. For farmers and rural voters, the key questions will be: "Will my farming income improve?", "Will there be better non-farm jobs or agro-industries in my district?", "Will infrastructure and resilience (to floods, climate) improve?" Politically, whichever side addresses agriculture and rural employment more convincingly will gain an edge.

The key question to look out for will be whether the ruling alliance is able to convert development and policy initiatives (especially for agriculture and rural jobs) into electoral support. Areas with frequent flood damage (North Bihar) or drought stress may swing depending on the credibility of the political parties' plans for disaster management, irrigation and drainage. The turnout of youth and women voters, and their verdict on how well their aspirations on jobs, non-farm opportunities and agricultural stability have been met will influence the outcome. Post-election, we will learn to what extent agriculture and rural policy are prioritised: e.g., whether more investment is forthcoming in agro-processing, market linkages, and mechanisation, and how the state handles structural employment shifts. This AFTAB issue looks at all these topics closely. I hope that policymakers find its suggestions useful for transforming Bihar's agriculture and changing the fortunes of its people.

**Shekhar Aiyar**

Director and Chief Executive  
ICRIER

# From the Chief Editor's Desk



**B**ihar is heading for elections in November 2025. It is the second most populous state of India with a population of about 135 million in 2025. Agriculture is vital to Bihar since about 70-75% of Bihar's population depends on farming or allied activities for their livelihood. Unless agriculture becomes vibrant and more remunerative, it is difficult for majority of people in Bihar to become prosperous. Although, agriculture has shown some signs of improvement, but the average per capita income of Bihar remains one of the lowest amongst all major states of India. And this has remained so for the last 35 years or so. That only reflects that the current model of development is not delivering much in Bihar. There is need to rethink and re-analyse the economic status of Bihar, the key drivers of growth, and what more needs to be done to ensure that Bihar is no more in the poor states, often called "BIMARU states".

In this context, this issue of AF-TAB focuses on selected states (Bihar, MP, Odisha, and West Bengal) with a view to learning from each other. Accordingly, the **first article** sets the tone by asking if these states can become India's next growth engine by looking at the persistent development gap, the challenges facing the agricultural sector and strategies that need to be put in place for transforming the agriculture sector. It also talks about how fragmented land holdings lead to loss of opportunities for the farmers. It suggests diversification, value addition and institutional innovation as the way forward for ensuring growth in the agriculture sector.

The **second article** explores how Madhya Pradesh despite once being part of the BIMARU group, faced similar challenges like Bihar and yet a pro-active political leadership from 2005-06 launched reforms focusing on irrigation, ensuring procurement and pushing for diversification in agriculture. This strategy succeeded in case of Madhya Pradesh. Can this be a lesson for Bihar to think over? The key is to move from subsistence staples to some high value agriculture, which is market-driven and also climate-resilient. Given the very small size of the holding in Bihar (0.4 ha), it poses a special challenge and it calls for institutional innovations that can cater to the needs of small and marginal farmers, and yet make a viable business model.

The **third article** examines the challenges and opportunities of agricultural development in West Bengal and how these lessons can be used as a reference point for Bihar. It looks at how these two neighbouring eastern states together accounting for 19% of India's rural population with over 85% marginal farmers, can learn from each other's experiences to transform agriculture and augment farmers' income.

The **fourth article** talks about how *makhana* has come to occupy an important position in Bihar elections. The announcement of a National Makhana Board has aided this momentum but it is yet to be seen if this attention can translate into lasting prosperity and a stronger *makhana* economy. This article examines Bihar's agricultural diversification, the economic potential of high-value crops like *makhana* and other Geographical Indicator

(GI) crops like *litchi*, and the institutional architecture needed to convert symbolism into sustained economic gains.

The **fifth article** examines how Odisha's evolving green growth strategy can unlock new synergies between agriculture and clean energy through upcoming innovations like agriphotovoltaics (Agri-PV). It explores the state's structural challenges, energy deficits, and emerging policy innovations, highlighting

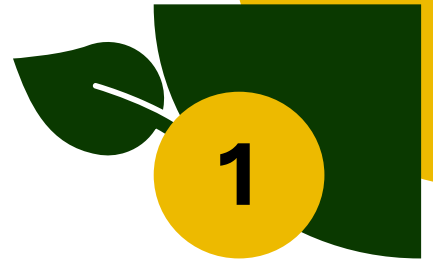
how community-led and farmer-centric Agri-PV models such as the Koraput pilot can enhance rural livelihoods, boost productivity, and position Odisha as a frontrunner in Eastern India's low-carbon agricultural transformation.

I hope these articles serve as valuable resources for policymakers, scientists, and readers helping to boost India's agriculture in these selected states, which can benefit millions and contribute towards India's mission of *Viksit Bharat* by 2047.

**Ashok Gulati**

Distinguished Professor  
ICRIER

# Can laggard states become India's next growth engine?



Harsh Wardhan and Ashok Gulati

## Introduction

In the run-up to the Bihar Assembly elections, Prime Minister Narendra Modi visited the state seven times in 2025 (PMO, 2025), announcing central projects and investments worth thousands of crores (PIB, 2025). At one rally, he referred to the eastern states as “engines of India’s growth”, signalling the economic potential of a region long labelled BIMARU<sup>1</sup> for its backwardness. This renewed attention in the region has rekindled hopes for development.

Yet, as India advances toward its 2047 vision of *Viksit Bharat*, the eastern and central belt, comprising Bihar, Uttar Pradesh, Jharkhand, Odisha, Madhya Pradesh, Chhattisgarh, and West Bengal, trails on most economic indicators. Together, these seven states (laggard states) account for nearly 48% of India’s population, but contribute barely one-fourth of its GDP (MoSPI, 2025). The region’s lag reflects a combination of historical neglect, weak industrialization, slow agricultural modernization and persistent infrastructure deficits. In this context, this article examines whether these laggard states can become India’s next growth engine by analysing the reasons behind their persistent development gap, the critical challenges facing their agricultural sector, and the strategies needed

for transforming their agricultural performance.

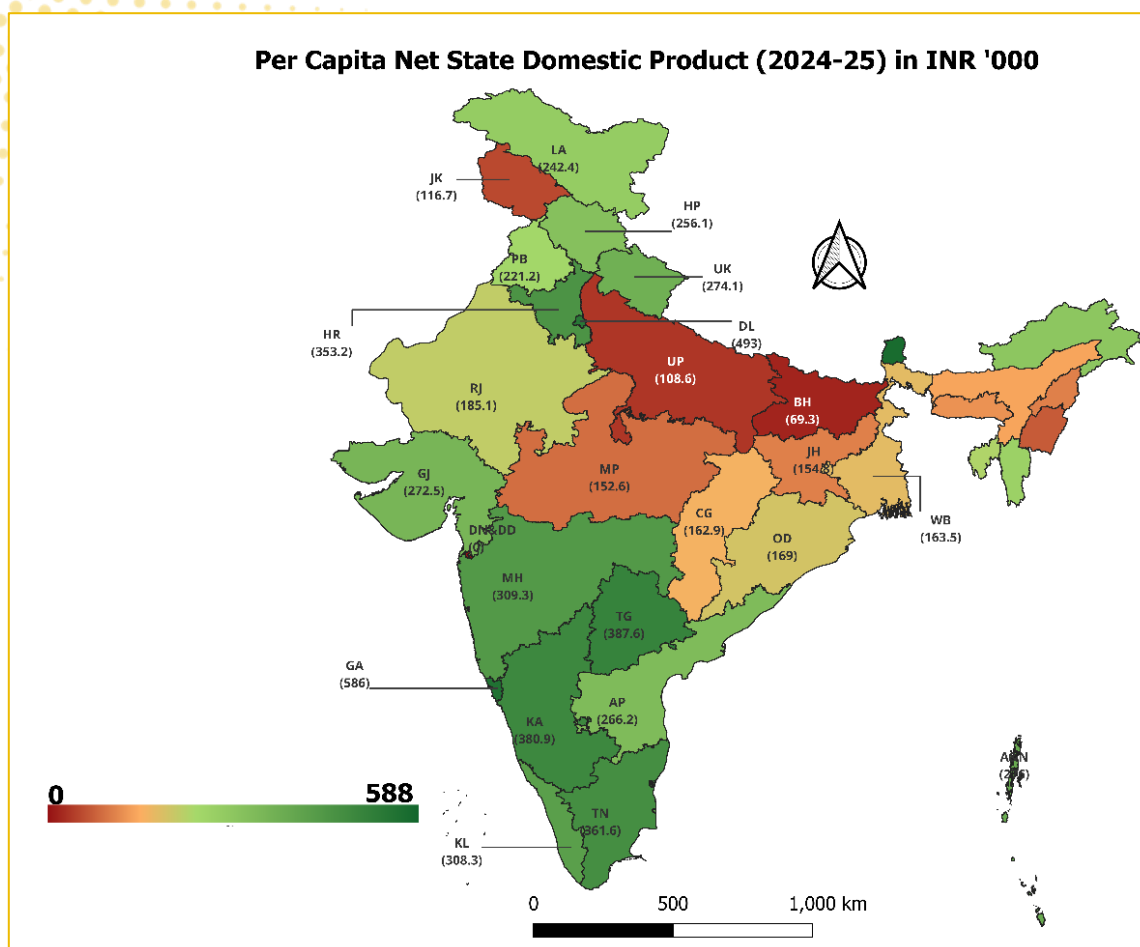
## Diverging Income and Growth Trajectories

Per capita Net State Domestic Product (NSDP) data for 2024–25 reveals a sharp regional divide: prosperity is concentrated in India’s west and south (Karnataka, Telangana, Tamil Nadu, Kerala, Gujarat, and Maharashtra); while Bihar, Jharkhand, UP, MP, Odisha and West Bengal are at the bottom. Bihar’s per capita NSDP, at INR 69,321 in 2024–25, is the lowest in the country, followed by UP (INR 1.09 lakh) and Jharkhand (INR 1.17 lakh) (**Figure 1**).

A comparison across decades (1994–95 to 2024–25) reveals that Bihar and other laggard states, have remained at the bottom despite absolute income gains (see Annexure). In 2001-02, a year after its bifurcation from Jharkhand, Bihar’s per capita NSDP was the lowest at INR 6,111, roughly one-third of India’s average (INR 16,769). More than two decades later, in 2024–25, Bihar still ranks at the bottom, with its per capita income remaining around one-third of the national average. This stagnation in its relative share, despite nominal improvements, highlights the persistent regional disparities in income (MoSPI, Various issues) (Sanyal & Arora, 2024).

<sup>1</sup> Original “BIMARU” states were Bihar, MP, Rajasthan, and UP.

**Figure 1: State-wise per capita NSDP**



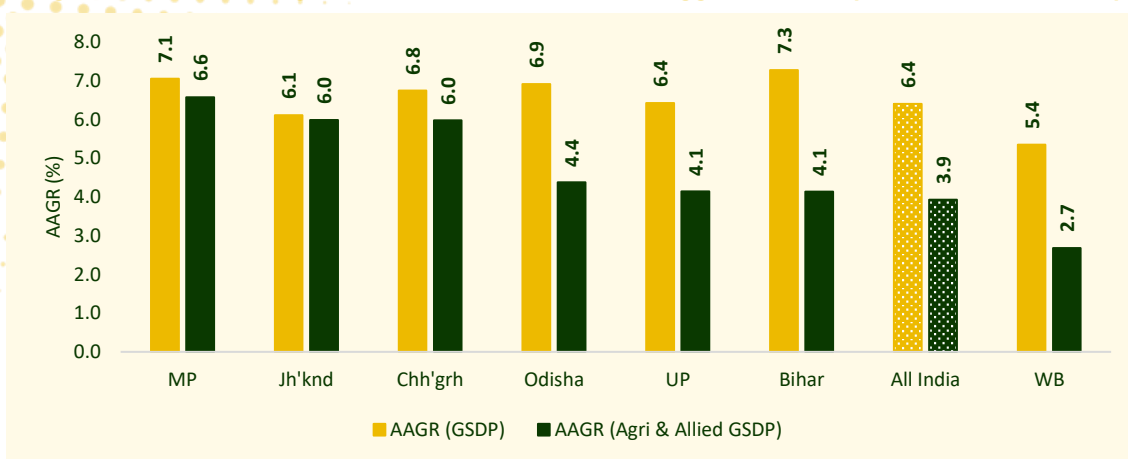
Note: Last available data for Gujarat and few NE states is used

Source: Created using MoSPI data

Across most states, overall GSDP growth outpaced agricultural growth, indicating that agriculture has not kept pace with broader economic expansion. For instance, Bihar recorded the highest overall growth rates of around 7.3%, but agriculture rose about 4.1% (Figure 2). In MP, Jharkhand and Chhattisgarh, agriculture has performed relatively better, growing at over 6%, nearly in line with overall state growth. Odisha and UP show wider gaps, with agricultural growth of 4.4% and 4.1% compared to GSDP growth of 6.9% and 6.4%, respectively. West Bengal remains the slowest, with agriculture growing just 2.7% against 5.4% overall. The trend underscores that even where economies are expanding, agriculture, the main livelihood source for nearly half the workforce continues to lag.

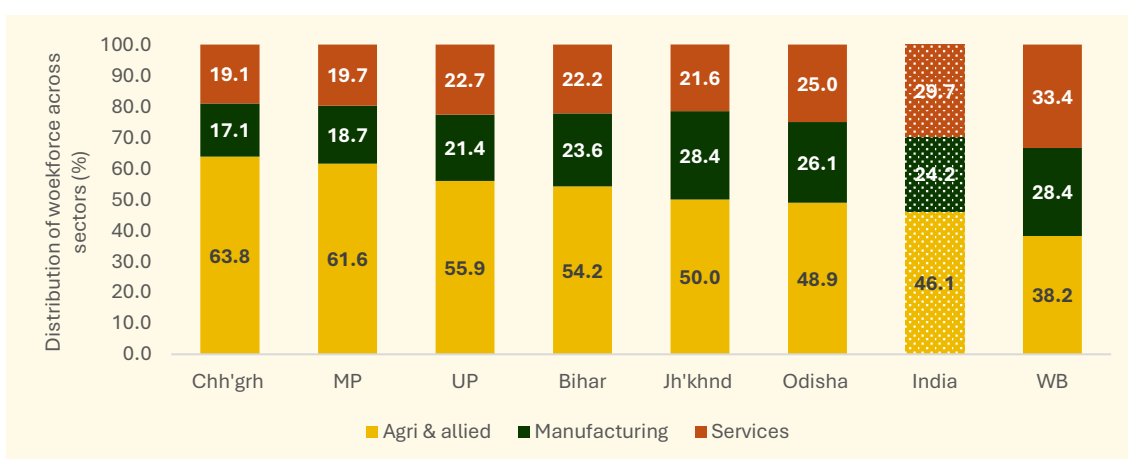
According to the Periodic Labour Force Survey (PLFS), agriculture and allied activities continue to dominate employment in almost all laggard states. The highest share of agriculture workforce was in Chhattisgarh (63.8%), followed by MP (61.6%), UP (55.9%), Bihar (54.2%), Jharkhand (50%), Odisha (48.9%) and West Bengal (38.2%), compared to all India average of 46.1% (2023-24). In agriculturally prosperous states like Punjab and Haryana, it hovers around 27% (MoSPI, 2024) (Figure 3). With limited expansion of non-farm sectors, millions from Bihar and UP migrate to work in construction and services in other states due to lack of local livelihood opportunities.

**Figure 2: GSDP vs. Agriculture GSDP Growth in Laggard States (2005–06 to 2024–25)**



Source: Authors' compilation from MoSPI data

**Figure 3: Workforce distribution by sector (2023-24)**



Source: Authors' compilation from PLFS data (MoSPI, 2024)

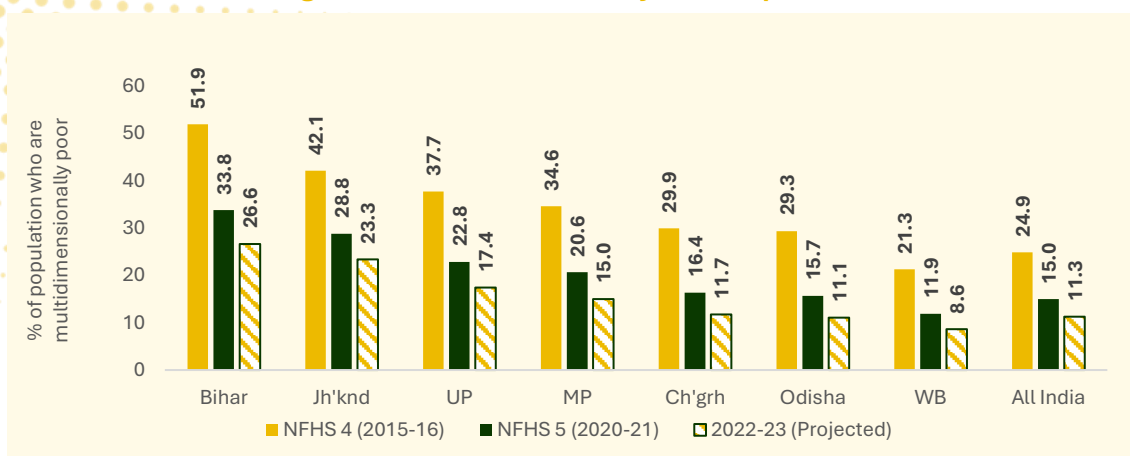
### Poverty Decline with Inequality Intact

During last decade, these laggard states have witnessed rapid poverty reduction, aided by welfare schemes, rural roads, and electrification. However, poverty levels still remain above the national average. India's multidimensional poverty declined from 24.9% in 2015-16 to 15% in 2020-21 and to 11.3% in 2022-23 (NITI Aayog, 2023) (NITI Aayog, 2025). Bihar remains the poorest, with poverty declining from 51.9% in 2015–16 to 33.8% in 2020–21, and projected at 26.6% in 2022–23, followed by Jharkhand (23.3%), UP

(17.4%), MP (15%), Chhattisgarh (11.7%) and Odisha (11.1%). In contrast, Kerala, Tamil Nadu, and Maharashtra have single-digit poverty rates. West Bengal (8.6%) too has nearly converged with the national average.

Despite progress, these states still host most of India's poor, reflecting welfare-led gains without structural transformation. Weak education, health, and asset ownership continue to trap households in low productivity (NITI Aayog, 2023). The World Bank estimates India's extreme poverty at 5.75% (PPP 2021), though state-level data are unavailable.

**Figure 4: Multidimensionally Poor Population**



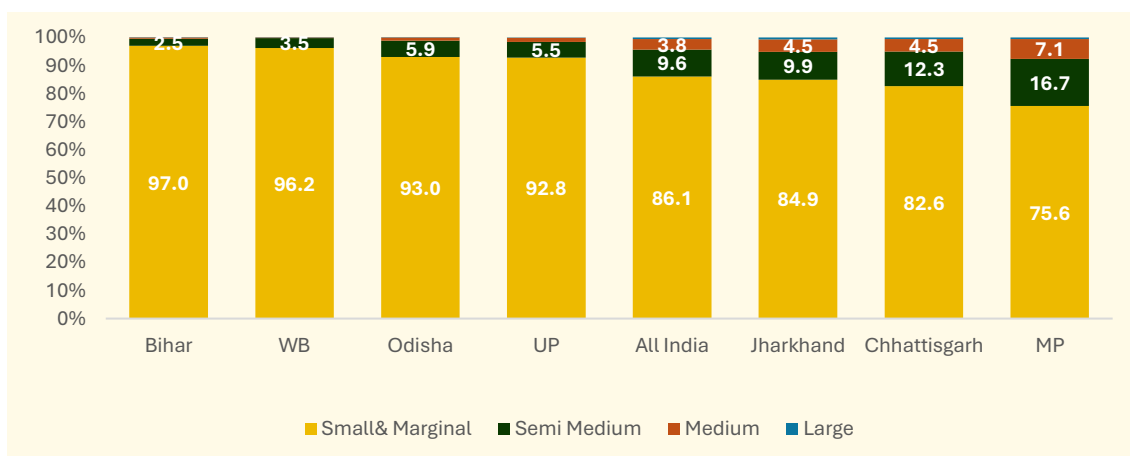
Source: (NITI Aayog, 2023), (NITI Aayog, 2025)

### Fragmented Land and Fragmented Opportunity

The structure of landholdings reveals why agricultural transformation in these states have lagged. Small and marginal farmers

(owning less than 2 hectares) constitute over 90% of cultivators in Bihar (97%), West Bengal (96.2%), Odisha (93%), and UP (92.8%). This fragmentation poses challenges for mechanisation, efficient irrigation, and adoption of modern technology.

**Figure 5: Share of landholding size in laggard states**



Source: Agricultural Census (MoAFW, 2019)

In contrast, MP (75.6%) and Chhattisgarh (82.6%) with relatively larger holdings, have achieved better productivity and diversification. Larger plots allow for mechanisation, irrigation investment, and crop rotation, resulting in higher returns.

Bihar has one of the lowest average landholdings at 0.39 ha, second only to Kerala

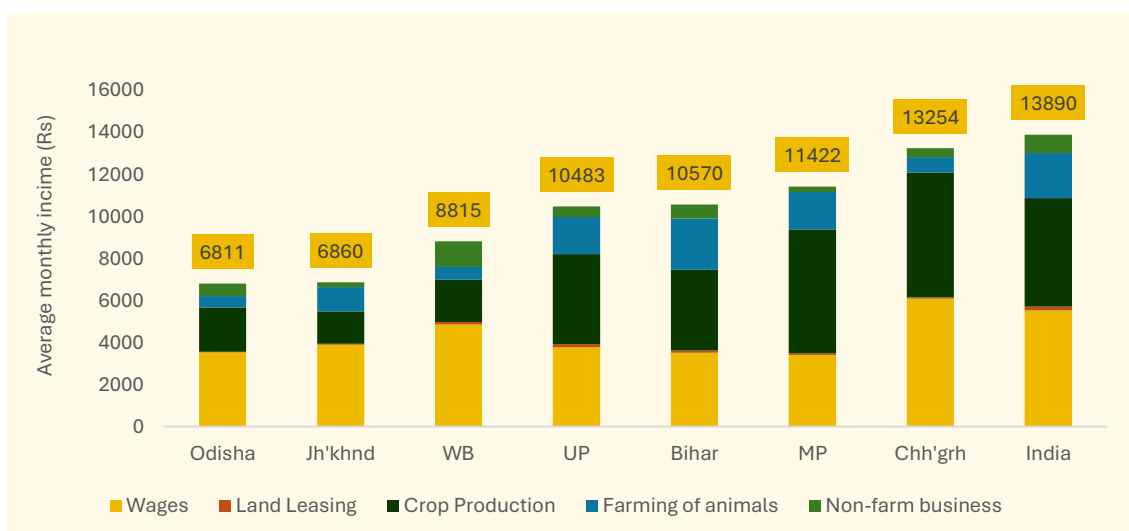
(0.18 ha) and well below the national average of 1.08 ha, underscoring severe fragmentation. Jharkhand (1.10 ha) and Chhattisgarh (1.24 ha) have larger holdings, while West Bengal (0.76 ha) and UP (0.73 ha) resemble Bihar's smallholder pattern. This fragmentation constrains mechanisation, productivity, and farm incomes (MoAFW, 2019).

Income data further underscores the disparity. Based on Situation Assessment Survey (SAS) data (MoSPI, 2019), (extrapolated for 2023-24 using CPI-AL), the average monthly income of a farm household in Bihar was INR 10,570, among the lowest in India. Jharkhand (INR 6860) and Odisha (INR 6811) report even lower incomes, earning barely half the national average of INR 13890 (Figure 6). UP (INR 10,483) and West Bengal (INR 8,815) also remain below the national average. In contrast, Chhattisgarh (INR 13,255) and MP (INR 11,422) perform relatively better. More importantly, in most of these laggard states, a larger share of income comes from wages

rather than crop or livestock activities, indicating underemployment and low agricultural returns. States with diversified agriculture, such as Punjab, Haryana, and Gujarat, demonstrate more balanced income portfolios and greater resilience to market and climate shocks.

With over 75-80% of population in these states living in rural areas, agriculture is vital to their welfare. Yet weak irrigation, storage, and connectivity limit diversification and market access, trapping farmers in low productivity, low income, and migration cycles.

**Figure 6: Average Monthly Income of Agri Households**



Data for 2023-24 is extrapolated using CPI-AL data. For Jharkhand and Chhattisgarh, CPI-AL data of Bihar and MP, respectively, is used.

Source: SAS, (MoSPI, 2019)

### Unlocking agricultural potential of laggard states:

Transforming these laggard states into a true growth engine for *Viksit Bharat* by 2047 requires a coordinated, multi-sectoral approach that targets the agricultural base, rural infrastructure, and human capital.

Firstly, **diversification and value addition** must be at the centre of the strategy. With small

average landholdings, income growth cannot rely solely on cereals. Shifting towards higher-value crops, livestock, dairy, fisheries, horticulture is essential. These sectors yield 3-4 times more income per hectare than cereals, generate more employment per unit of land, and buffer farmers against climate and market shocks.

Secondly, **robust rural infrastructure and efficient value chains** are critical for connecting farmers to markets. Investments in

cold storage, food processing units, aggregation centres, and reliable logistics networks will reduce post-harvest losses and improve farmgate prices. Efficient value chains connecting farmers, FPOs, and private buyers can bring scale, transparency, and competitiveness to produce from laggard states.

**Thirdly, education, skills, and technology adoption** must be accelerated. Modernising farming techniques, introducing mechanisation, and expanding rural non-farm employment will diversify livelihoods and reduce vulnerability. Renewable energy solutions, such as solar-powered irrigation and agrivoltaics systems already piloted in Odisha can drive down energy costs, improve productivity, and create new revenue streams for rural households.

**Finally, institutional innovation** is essential to overcome smallholder fragmentation. Strengthening FPOs, promoting cooperative models, and leveraging digital platforms National Agriculture Market (eNAM) and Open Network for Digital Commerce (ONDC), can aggregate farmers for collective marketing, input procurement, and mechanisation services. Building agro-processing clusters around FPO networks will enhance market power, improve value addition, and ensure farmers capture a greater share of the final price.

Laggard states represent India's unrealized potential. Bridging the development gap through inclusive agricultural growth, human capital development, and investment-led reforms can unleash an immense source of national prosperity and can reshape these states into a resilient, market-linked, and inclusive, contributing to the vision of a *Viksit Bharat* by 2047.

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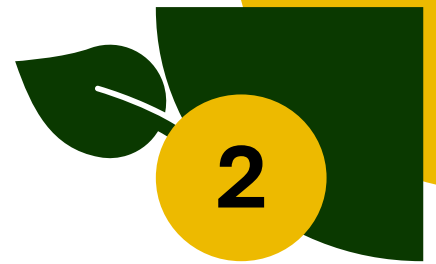
## Annexure

### State-wise Per Capita NSDP at current prices

State/UT	1994-95 (Share %)	2011-12 (Share %)	2024-25 (Share %)
Bihar	3372 (38)	21750 (34)	69321 (34)
Uttar Pradesh	5767 (65)	32648 (51)	108572 (53)
Jharkhand	6455 (73)	41254 (65)	116663 (57)
Madhya Pradesh	7099 (80)	38497 (61)	152615 (74)
Assam	6493 (73)	41142 (65)	159185 (78)
Chhattisgarh	6983 (79)	55177 (87)	162870 (79)
West Bengal	7711 (87)	51543 (81)	163467 (80)
Odisha	5795 (65)	48387 (76)	168966 (82)
Rajasthan	7647 (86)	57192 (90)	185053 (90)
Punjab	14066 (159)	85577 (135)	221197 (108)
Himachal Pradesh	9451 (107)	87721 (138)	256137 (125)
Andhra Pradesh	8732 (99)	69000 (109)	266240 (130)
Gujarat	12640 (143)	87481 (138)	272451 (133)
Uttarakhand	8260 (93)	100314 (158)	274064 (133)
Kerala	9632 (109)	97912 (154)	308338 (150)
Maharashtra	13654 (154)	99597 (157)	309340 (151)
Haryana	12879 (145)	106085 (167)	353182 (172)
Tamil Nadu	10503 (119)	93112 (147)	361619 (176)
Karnataka	8960 (101)	90263 (142)	380906 (186)
Telangana	-	91121 (144)	387623 (189)
All India	8857 (100)	63462 (100)	205324 (100)

Note: In parentheses, state NSDP as % of All India NDP

Source: MoSPI



# A Roadmap for Bihar:

## Lessons from Madhya Pradesh's Agricultural Reforms

*Bidisha Chanda and Ashok Gulati*

In the run-up to the 2025 Bihar elections, politics is once again dominated by giveaways over governance, despite its low per capita incomes. This election must shift from dole-based rhetoric to policies that deliver sustainable, high growth, especially in agriculture. Despite 15 years of RJD rule (1990-2005) and two decades under the BJP/JDU coalition (2005-present), Bihar remains at the bottom among major states, with a per capita income rank of 28 compared to India's 15. To break this cycle, Bihar must learn from a state that once shared its struggles but transformed its trajectory - Madhya Pradesh (MP).

The contrast between Bihar and MP, both BIMARU (Bihar, MP, Rajasthan, Uttar Pradesh) states, is striking. Since 2005, MP's strong political leadership has driven reforms in irrigation, procurement, and diversification, achieving 6.6% annual agricultural growth (2005-06 to 2024-25) and increasing agriculture's share of GSDP from 28% to 41% (MoSPI, n.d.). In contrast, Bihar remains stuck with low-productivity farming: 88% rural population, 54.2% workforce in agriculture, and an average landholding of 0.39 ha (PLFS, 2023-24; Agriculture Census, 2015-16). Bihar's multidimensional poverty headcount is 27% (NITI Aayog, 2024), and its per capita income is the lowest among major states at ₹69,321 in 2024-25. Between 2002-03 and 2018-19, Bihar's average monthly farm income rose 64%, from INR 6,364 to INR 10,570, whereas MP's doubled, increasing 127% from

INR 5,023 to INR 11,422 (SAS, 2002-03; 2018-19). Yet political parties continue populist competition. Nitish Kumar pledges free electricity, tripled pensions from INR 400 to INR 1,100 per month, and jobs for 1 crore youth; PM Modi transferred INR 10,000 to 75 lakh women under the INR 7,500 crore Mahila Rojgar Yojana; and Tejashwi Yadav proposes INR 2,500 monthly cash support for women, 200 free electricity units, and a government job per family. Election promises far exceed Bihar's INR 3.17 lakh crore budget (2025-26), which raises serious concerns about financial feasibility.

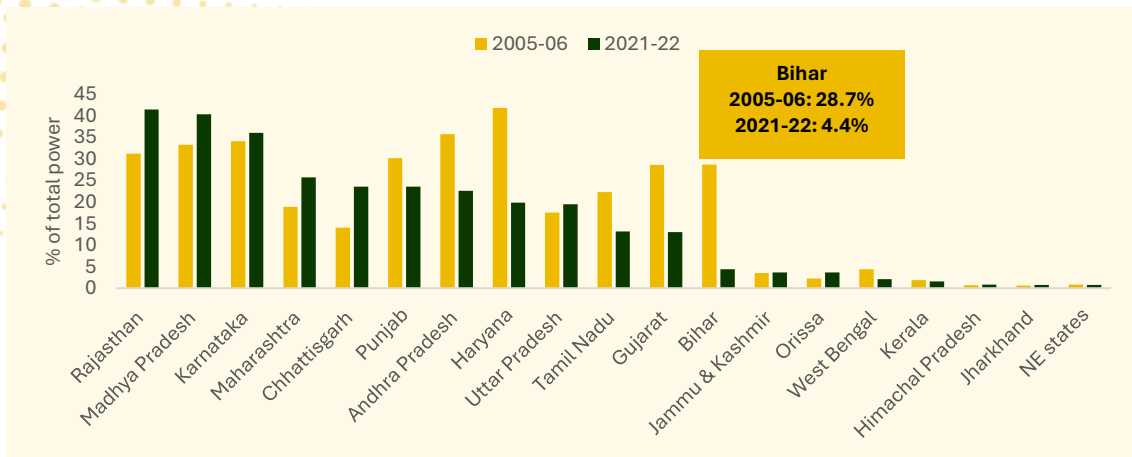
### The Structural Roadblocks

#### 1. The Electricity Deficit Behind Low Farm Productivity

Agriculture consumed in Bihar just 4.4% of the total electricity consumed in 2021-22, down from 28.7% in 2005-06 (Figure 7). The issue is not tariff affordability: farmers pay only INR 0.55 per unit, but poor supply: low-voltage, erratic power with no dedicated feeders makes grid irrigation a notional subsidy.

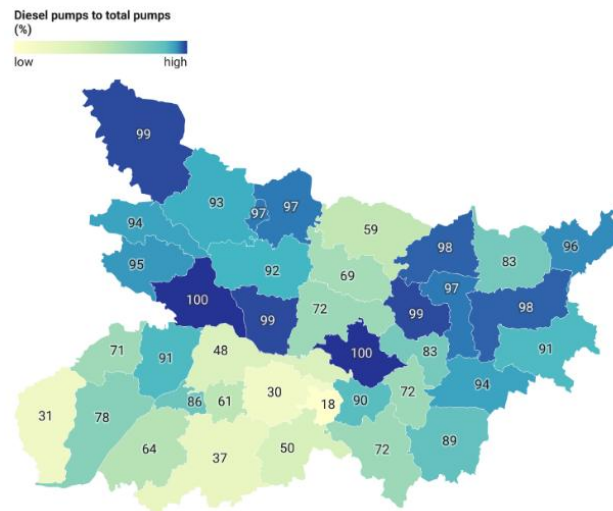
Hence, irrigation depends overwhelmingly on diesel. The Sixth Minor Irrigation Census (2017-18) found 77% of pumps (0.53 million of 0.69 million) were diesel-powered, including dual-source systems. Though district data vary (Figure 8), the pattern is uniform: Bihar is trapped in a high-cost, diesel-dependent equilibrium.

**Figure 7: Agriculture power consumption in states: 2005-06 and 2021-22**  
(as% of the total power consumed in the state)



Source: Agriculture Statistics at a glance, various years

**Figure 8: District-wise diesel pump sets to total pump sets in Bihar**



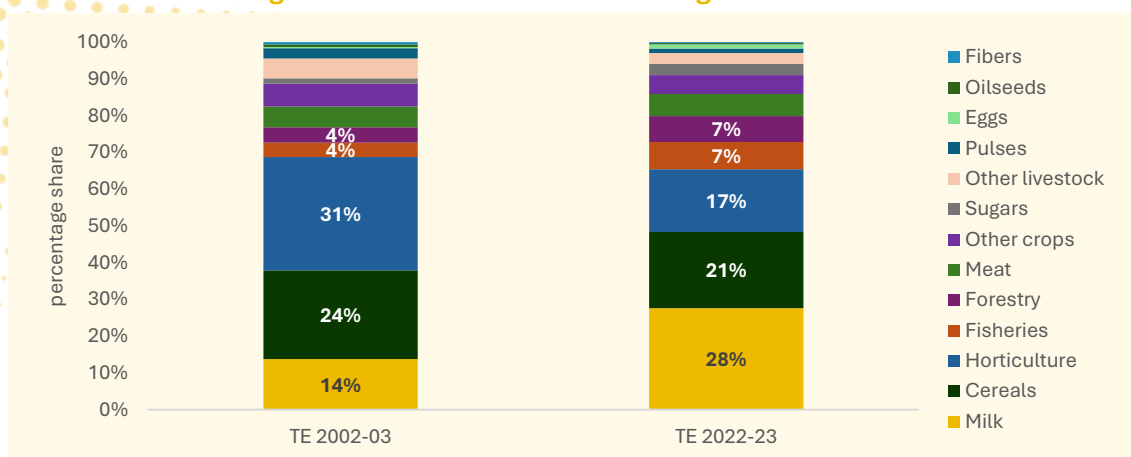
Source: Sixth Minor Irrigation census, 2017-18

Diesel irrigation is expensive and inefficient, a 5 HP diesel pump costs INR 65-70 per hour, versus INR 15-18 for an equivalent electric pump. Bihar's smallholders pay 3-4 times more for irrigation than farmers with reliable electricity (Kishore, 2019). The outcome is higher input costs, lower margins, and greater emissions, while fiscal resources remain tied to diesel subsidies that peaked at INR 264 crore in 2018-19 (Bihar Economic Survey, 2023-24). The lesson from MP is clear, invest in rural electrification, solarization, and feeder separation and not fuel subsidies.

## 2. Sudha Dairy Success Story

Bihar's own experience offers a striking contradiction to its wider agrarian distress - the highly successful dairy sector that contributes 28% of the state's Agri-GVO (Figure 9). The success is anchored in the Bihar State Milk Co-operative Federation Ltd (COMFED) that manages the Sudha brand. Modelled on Gujarat's Amul, COMFED operates a three-tier cooperative system connecting producers, unions, and the state federation.

**Figure 9: Share of sub-sectors in Agri-GVO in Bihar**



Source: MoSPI

Established in 1983, SUDHA has grown from procuring 1 lakh litres/day in the late 1990s to 20.85 lakh litres/day by 2019-20, operating 22 dairy plants with a combined capacity of 33 lakh litres/day. This has boosted rural incomes and created a technology-enabled cold chain reaching Jharkhand, Assam, and Delhi-NCR, alongside exports of *ghee* and *makhana*.

The COMFED model rests on four pillars:

- Guaranteed Procurement – thousands of village-level milk societies with assured offtake and modern chilling facilities.
- Backward Linkages – support for feed, veterinary care, and artificial insemination.
- Reliable Payments – direct bank transfers ensuring timely, transparent, and fair remuneration.
- Value Addition – diversified dairy products with strong consumer trust.

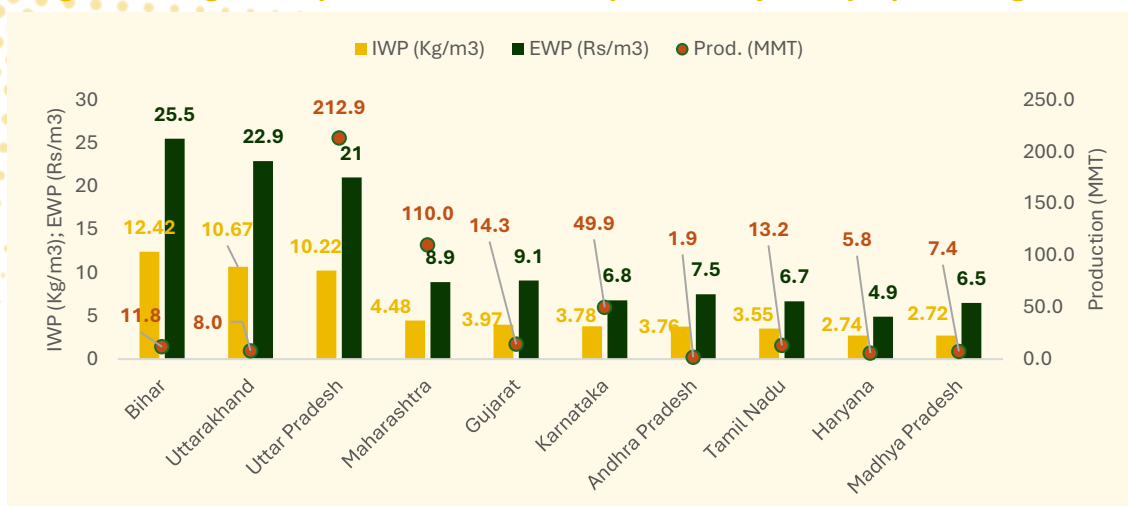
The milk sector’s share in Agri-GVO has doubled from 14% in TE 2002-03 to 28% in TE 2022-23, and around 76% of the consumer rupee reaches producers, far higher than the

30-40% typical in crop value chains (Gulati et al., 2021). COMFED’s success shows that farmer-centric value chains and not subsidies hold the key to sustainable, income-led rural growth.

### 3. The Ecological Advantage

Bihar’s agriculture faces climate extremes - floods in the North, droughts in the South. Over 70% of North Bihar is flood-prone (BSDMA, GoB), and this masks a strength: water abundance. In 2024, 88.4% of blocks were “safe” aquifers, giving Bihar an edge over water-stressed western and southern states. This potential is underutilized due to weak irrigation, erratic power, and limited market access. MP’ growth is investment-led, not subsidy-driven. Between 2000-01 and 2022-23, MP’s irrigation ratio more than doubled, from 24 to 56% (DES), enabled by feeder separation and reliable farm power, with agriculture consuming over 40% of the total electricity (MoA&FW, 2022). Steady power boosted cropping intensity, diversification, and private investment, reinforced by the e-*Uparjan* system for transparent procurement and timely payments.

**Figure 10: Sugarcane production and water productivity in major producing states**



Source: Sharma et al., 2018; UP Ag dashboard

Bihar can replicate this model in its sugarcane sector, turning hydrological surplus into an economic engine. Despite producing only 2.6% of India’s sugarcane (11.8 MMT, 2024-25), Bihar leads in irrigation water productivity (12.42 kg/m<sup>3</sup>) (Figure 10) and economic water productivity INR 25.5/m<sup>3</sup> (Sharma et al., 2018). Reviving this legacy requires a pivot to ethanol-linked sugarcane, rational resource pricing, and drip irrigation.

## Policy Recommendations

### 1. Pivot to sugarcane-based ethanol

The best option for farm profitability and industrialization is the bio-ethanol economy, anchored in the national Ethanol Blending Programme (EBP). Bihar must use its Ethanol Production Promotion Policy, already approving 47 interest-subsidy projects, to expand beyond 22 operational distilleries (8 molasses, 14 grain). Priority should be reviving defunct mills and scaling capacity to meet EBP targets, assuring off-take for sugarcane and maize farmers. Creating an investor-friendly environment for private distilleries ensures market stability without MSP burdens.

### 2. Solar-Powered Irrigation

The ethanol pivot requires affordable, reliable power for irrigation, reducing costly diesel dependence. Bihar has zero sanctioned pumps under Component B (Standalone Solar Pumps) of PM-KUSUM and must urgently seek central sanctions, provide state top-ups, and ease credit access to enable 97% marginal and smallholders to adopt solar pumps. This shift will cut diesel costs and unlocks double-cropping, raising the stagnant cropping intensity of 140%.

### 3. Build Commodity-Specific Value Chains

Bihar cannot replicate MP’s generalized MSP procurement for rice; it must target commodities with comparative advantage. The COMFED-SUDHA model, with dairy contributing 28% of Agri-GVO (TE 2022-23), demonstrates that robust value chains drive farm incomes. This approach should extend to priority crops like *makhana* and *litchi*, leveraging GI recognition. The state must invest in modern cold chains and regulated market access to tap premium domestic and export markets, ensuring farmers capture a larger share of the consumer rupee.

#### 4. Supporting women's employment in Bihar' apparel sector

The Government of Bihar should boost women's formal employment in the growing apparel sector by following the example of recent investments like Pearl Global factory. A practical way to do this is by giving financial help to employers, covering at least 50% of their contributions to the Employees' Provident Fund (EPF) for women workers. This support would build on existing state schemes and national programs that successfully encourage formal jobs for women, helping more women get steady and secure work while strengthening Bihar's apparel industry.

#### Conclusion

To truly overcome poverty, low productivity, and halt the out-migration of labour, Bihar must prioritize substantial investment in industrial development. The state's heavy reliance on agriculture has limited income growth and job opportunities for its vast labour force, leading many to seek work elsewhere. Industrialization offers a path by creating productive employment locally and increasing per capita incomes. The recent establishment of Pearl Global apparel factory demonstrates the potential of industrial projects to absorb labour in formal jobs. However, this example remains isolated, and Bihar must scale up such initiatives across sectors through robust policy support, infrastructure development, and skill enhancement programs.

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# Shrinking Farms, Structural Constraints: Rethinking Agricultural Policy for West Bengal and Bihar

*Raya Das, Bidisha Chanda, and Ashok Gulati*

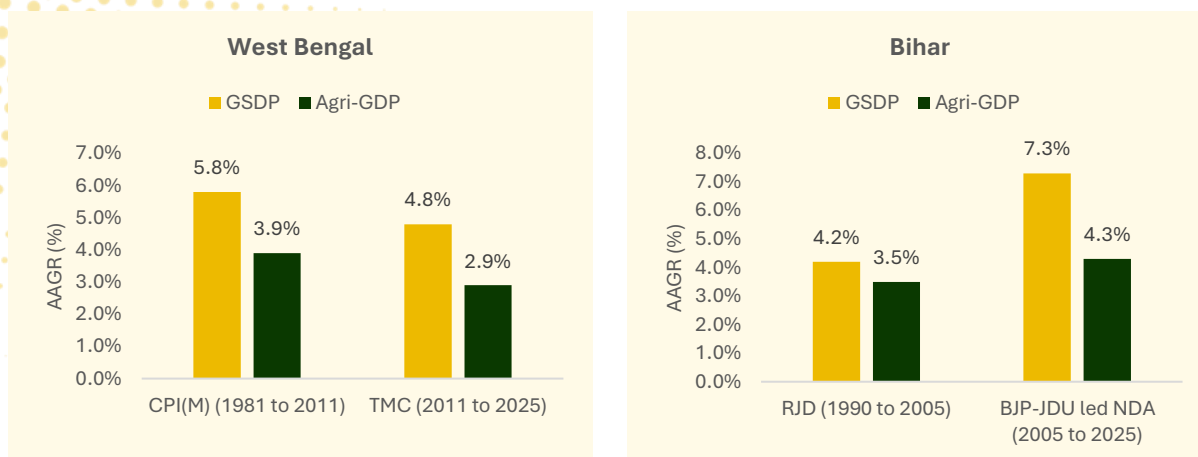
**M**ajor challenges in the laggard states of India are the continuous marginalisation of land, low returns due to lack of bargaining position, market access, and lack of access to institutional credit. This article examines the challenges and opportunities of agricultural development in West Bengal. In the context of the upcoming Bihar Assembly Election 2025, this article looks at how these two neighbouring eastern states housing nearly one-fifth of India's rural population and over 85% its farmers being marginal cultivators (less than 1 hectare) can learn from each other's experiences to transform agriculture and augment farmers' income.

The Average Annual Growth Rate (AAGR) of Gross State Domestic Product (GSDP) in West Bengal stood at 4.8%, compared to 6.1% at the all-India level during the Trinamool Congress (TMC) period (2011–12 to 2024–25). Within this, the agricultural GSDP grew at a modest 2.9%, significantly lower than the national average of 4.1% at 2011–12 constant prices (MoSPI, 2025). During the Communist Party of India-Marxist CPI(M) period, West Bengal

recorded an agricultural GDP growth of 3.9%, in comparison to all India level of 3.1% and an overall GSDP growth of 5.8%, with all India average of 6% during this period. In contrast, Bihar experienced faster agricultural growth in the subsequent period. From 2005 to 2025, under the BJP–JDU-led NDA government, Bihar's agri-GDP grew at 4.3%, reflecting a phase of catching up (**Figure 11**).

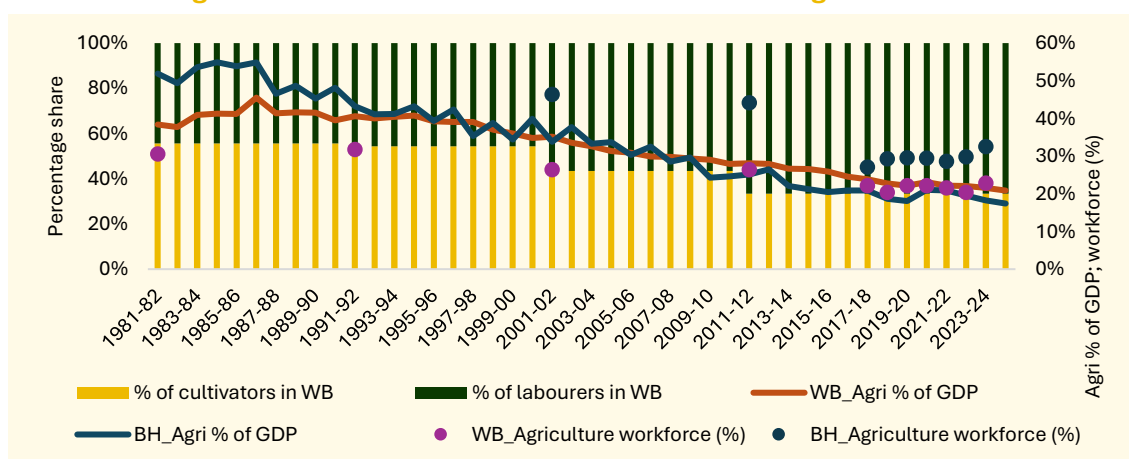
Agriculture's share in West Bengal's GSDP declined sharply from 51% in 1970–71 to 18% in 2023–24, a trend mirrored in Bihar, where it fell to 19% over the same period (**Figure 12**). However, the structural imbalance between the economic contribution of agriculture and its workforce dependence is less in West Bengal than in Bihar. In 2023–24, nearly 54.2% of Bihar's workforce remained engaged in agriculture, compared to 38.2% in West Bengal, against an all-India average of 46.1% (PLFS, 2023–24). This indicates that while both states face challenges of slow structural transformation, it is more challenging in Bihar. The shares of agricultural labourers have risen in both states comprising 72% of Bihar's and 67% of West Bengal's agricultural workforce.

**Figure 11: Growth rates of Agri-GDP and GDP in WB and Bihar at 2011-12 constant prices**



Source: MoSPI

**Figure 12: Structural transformation of West Bengal and Bihar**



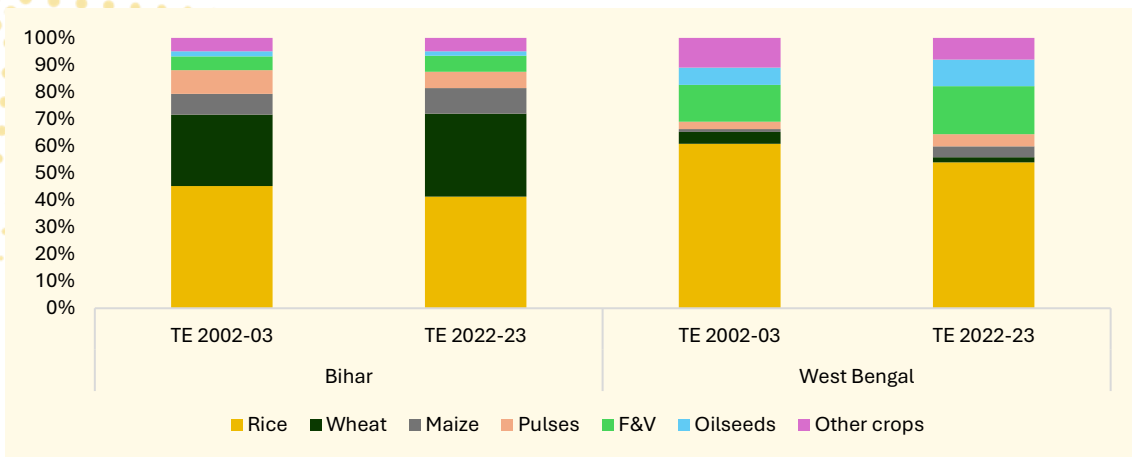
Source: MoSPI; PLFS; Census, various years

## Agriculture Development in West Bengal and Bihar

In West Bengal, the crop sector's share in AGVA declined from 62% in 2011–12 to 55% in 2023–24. Livestock's share rose from 19% to 24%, while forestry and fisheries remained nearly stagnant at 5% and 16%, respectively. In Bihar, livestock accounts for a higher 32% of AGVA, indicating the relative success of

cooperative driven growth. On agricultural GVA per hectare of gross cropped area (GCA), West Bengal ranks second among eastern states at INR 3 lakh per hectare, compared to INR 2.5 lakh per hectare in Bihar driven by higher cropping intensity and greater share of area under high-value crops like fruits and vegetables, which occupy 18% of West Bengal's GCA (highest in all India excluding north-east states) versus just 6% in Bihar.

**Figure 13: Cropping Patterns in Bihar and West Bengal (Share in GCA)**



Source: Land Use Statistics

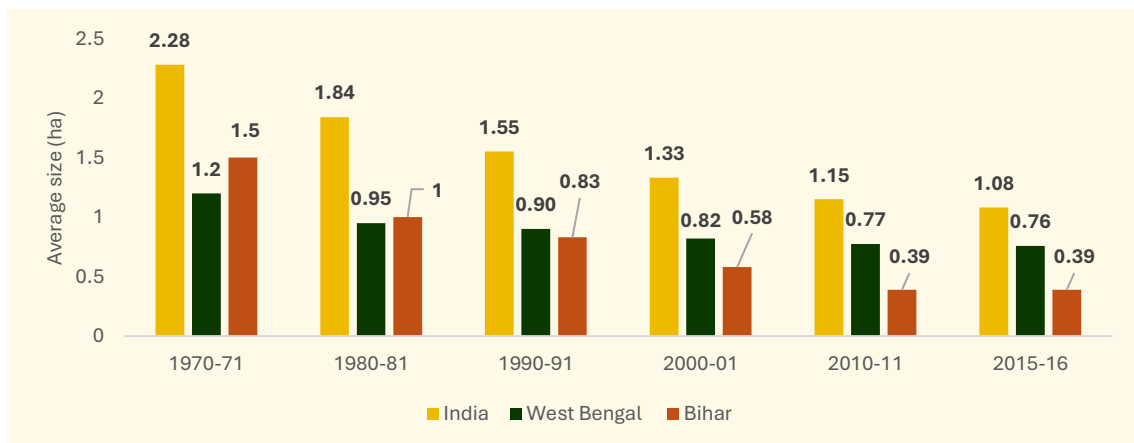
## Challenges in agriculture development

### 1. Decline in landholding size

A major challenge is declining holding size and economic viability of farming. In West Bengal, average operational holding declined from 1.2 ha in 1970-71 to 0.76 ha in 2015-16, while in Bihar (Figure 14), it fell even more sharply, from 1.5 ha to 0.39 ha during the same period

(Agriculture Census). This decline is due to demographic pressure, inheritance-based subdivision, and limited non-farm jobs. Marginalisation has eroded economies of scale and constrained investment in capital-intensive technologies. Leased-in land constitutes 21% of holdings in West Bengal and 24% in Bihar (SAS, 2018–19). But informal seasonal tenancy would be much higher<sup>2</sup> and lack of tenure security restricts tenants' access to credit and incentives to reinvest.

**Figure 14: Average area of operational holding in West Bengal, Bihar vs All India**



Source: Agriculture census, various years

<sup>2</sup> From the field survey of three villages from three agro-ecological regions, the study finds out that 46.7% of land is under tenancy among peasantry in West Bengal (Das, 2022).

## 2. Lack of access to market

Farmers in West Bengal and Bihar face severe market constraints, with nearly 90% of the produce sold to local traders and intermediaries, underscoring fragmented and informal systems (SAS, 2018–19). These channels impact price discovery and bargaining power, keeping returns low for the farmers. From 2020–21 to 2024–25, official rice procurement averaged around 12% of the production (FCI; UPAg). Limited procurement infrastructure and few alternative channels force distress sales for farmers.

## 3. Access to institutional credit

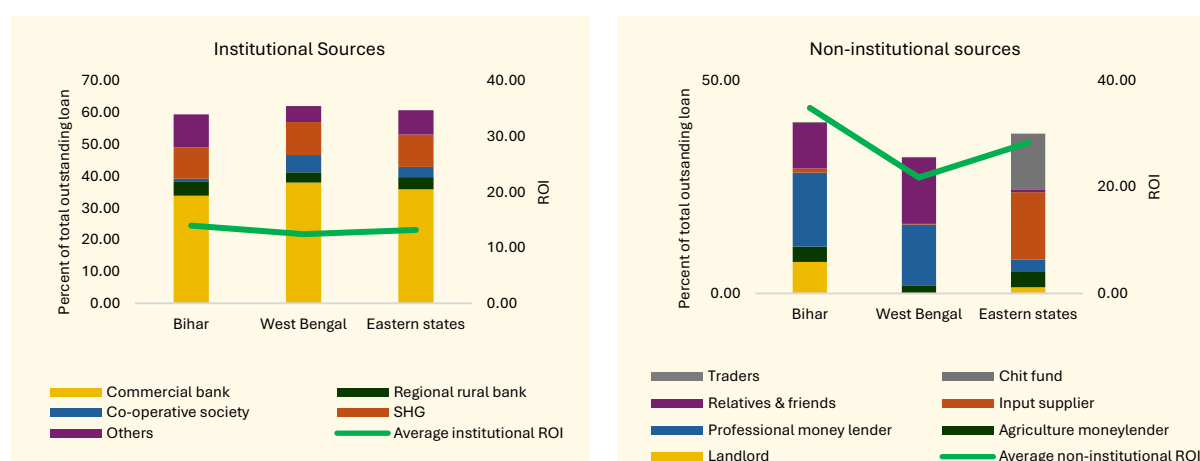
Access to affordable credit is a major challenge. Despite expansion of institutional networks through Kisan Credit Cards (KCC) and cooperative reforms, reliance on informal sources is high due to lack of working capital before the production season. In West Bengal, 32% of outstanding farm loans come from non-institutional lenders such as moneylenders and traders with an average rate of interest

(ROI) at 21.74% (AIDIS, 2018–19). In Bihar, the share of informal loan is even higher at 42%, with a higher ROI of 34.8%, about three times that of institutional credit of the state (Figure 15).

## 4. Impact of Climate Change

West Bengal has six agro-ecological regions, with the red laterite and coastal saline zones most vulnerable to climate stress. Southern Bengal and the Sundarbans face salinisation, cyclones, and land degradation, while the western arid belt suffers from water scarcity, poor irrigation, and high-water rents<sup>3</sup>—irrigation intensity is only 45% in Purulia (red lateritic zone) versus 73% in Burdwan (old alluvium region). Bihar faces similar challenges: nearly 70% of its area is flood-prone, with North Bihar hit by floods and South Bihar by recurrent droughts. Expanding irrigation, adopting climate-resilient and protected cultivation, and improving water management are critical to safeguarding livelihoods and boosting farm incomes.

Figure 15: Access to Credit among agricultural households in West Bengal and Bihar



Source: Unit level data AIDIS 2018-19

<sup>3</sup> For instance, in a village in red lateritic region of Birbhum the price of water during Boro (Winter paddy) was INR 16,302 per hectare in 2019. The

private ground water market is oligopolistic and the charge varies depending on the demand of water (Das, 2022).

## Policy Implications

### 1. Reorienting Budget Priorities: From Welfare to Development

West Bengal's agri-food budgetary spending (AFBS) increased from INR187 billion in 2014–15 to INR 289 billion in 2024–25 (2011–12 prices), but its GSDP share stayed stagnant around 3.5%. Bihar's AFBS rose from INR 163 billion to INR 232 billion, 5.2% of its GSDP. In 2023–24 (RE), 49% of West Bengal's AFBS was from the centre and 51% was contributed by the state; safety nets comprised 44% of the centre's share and 36% of the state share (34% food subsidy<sup>4</sup>, 2% MGNREGA). Only 4% of state budget went to crop husbandry and 7% to capital irrigation, highlighting the need to reorient spending towards rural infrastructure, technology, and value-chain development.

### 2. Strengthening Microfinance and Institutional Credit

West Bengal and Bihar need to expand institutional credit supply to strengthen rural financial inclusion. Digitisation of land records and formalisation of the lease market can improve farmers' eligibility for formal loans, especially for tenants and smallholders. West Bengal's *Krishak Bandhu* scheme<sup>5</sup> that extends benefits to tenant cultivators, offers a model for recognising farmers beyond ownership. Replicating such a framework in Bihar could improve tenant access to credit, insurance, and welfare schemes. Strengthening Self-Help Group (SHG) linkages and promoting group-based lending models can enhance credit access in rural areas. Additionally, value-chain financing and electronic Negotiable Warehouse Receipt

<sup>4</sup> The *Khadya Sathi* scheme, launched in 2016 by the Government of West Bengal, covers subsidized food grains (5 kg per person/month at INR 2/kg) to nearly 90% of the state's population. The scheme operates under the ambit of the National Food Security Act (NFSA), 2013, but is supplemented by state funding to cover additional beneficiaries outside NFSA lists.

Systems (e-NWRS) can reduce dependence on informal moneylenders and improve liquidity for producers.

### 3. Value Chain Integration for High-Value Agriculture

West Bengal has rapidly expanded its area under fruits and vegetables, outpacing other eastern states and signalling a shift to high-value crops. Large post-harvest losses among high-value perishables and limited processing capacity restrict these gains. While Bihar can position itself as a *makhana* export hub, West Bengal could lead in horticulture and aquaculture exports through value-chain financing. Sustaining this transition requires investment in value-chain financing, cold chains infrastructure, and agro-processing clusters.

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<sup>5</sup> The scheme provides direct financial assistance of up to INR10,000 per year in two installments for Kharif and Rabi seasons. Sharecroppers are also eligible. Since 2021–22, PM-KISAN is being implemented alongside this scheme in the state.

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# Bihar's Makhana Moment:

## Turning Promise into Policy

*Harsh Wardhan, Tanay Suntwal and Ashok Gulati*

### Introduction

As Bihar gears up for the upcoming Assembly elections, makhana, one of its most distinctive crops is once again in the spotlight. Leaders across the political spectrum are seen beside ponds in Mithilanchal, interacting with Mallah (traditional fisherfolk) communities, and promising new schemes. Yet, beyond these promises lies a critical policy question: Whether this attention can translate into lasting prosperity and a stronger makhana economy?

The announcement of a National Makhana Board in the Union budget 2025-26, followed by its symbolic launch in Purnia, marks a significant policy milestone. Its true impact will depend on how it functions, whether as a catalyst for value addition and market expansion, or merely another bureaucratic body. The debate over establishing its headquarters between Darbhanga (Centre of traditional pond-based makhana cultivation and home to ICAR-National Research Centre for Makhana) and Purnia, (hub of field-based cultivation and home to Bholu Paswan Shastri Agricultural College) highlights the diverse regional strengths shaping Bihar's makhana economy.

This article examines that question through a policy lens, exploring Bihar's agricultural diversification, the economic potential of high-

value crops like makhana and other Geographical Indicator (GI) crops like litchi, and the institutional architecture needed to convert symbolism into sustained economic gains.

### Bihar's Agricultural Landscape: Diversification amid Constraints

Agriculture is the backbone of Bihar's economy, employing about 54.2% of the workforce and contributing 23.1% to Gross State Value Added (GSVA) (2023-24) (MoSPI, 2024) (MoSPI, 2025). With 97% of the landholdings classified as small or marginal, agriculture in Bihar is both a necessity and a livelihood compulsion (MoAFW, 2019). Between TE2013-14 and TE2023-24, the share of cereals declined from 24% to 21%, fruits and vegetables from 20% to 16%, and other crops from 11% to 7%, while livestock surged from 31% to 41%, and fisheries grew from 5% to 7% (MoSPI, 2025). This structural shift indicates a silent transition toward high-value sectors. Crops like makhana and litchi, supported by agro-climatic advantages and cultural familiarity, are emerging as niche opportunities.

However, Bihar's agricultural system is struggling with deep structural constraints. Fragmented holdings, weak land leasing frameworks and low mechanization limit productivity gains. Irrigation is uneven, with the northern floodplains oscillating between

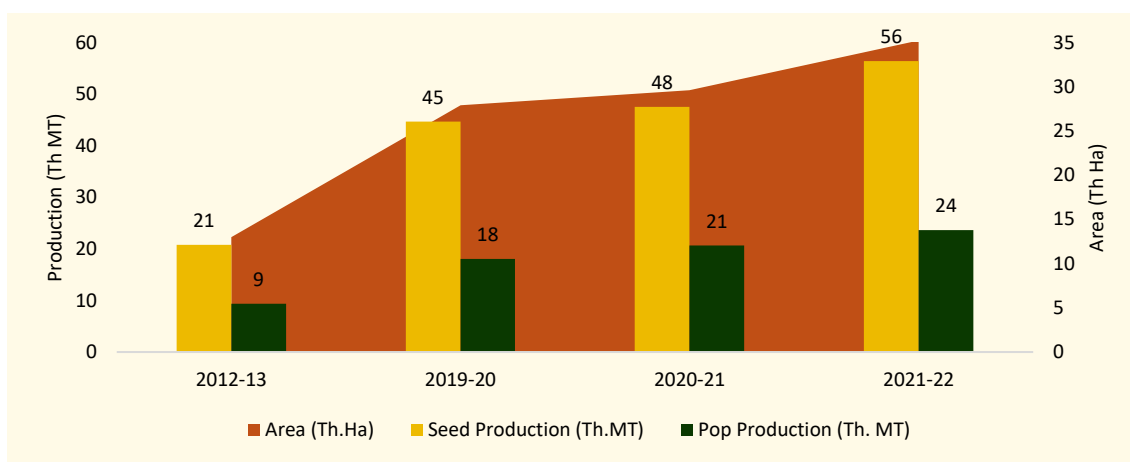
drought and waterlogging. Weak extension services, limited credit access, and the absence of robust marketing institutions further constrain value realization. Despite the creation of FPOs and cooperatives, their reach is limited compared to Maharashtra or Gujarat.

Bihar’s post-harvest infrastructure gap is particularly stark. Despite being the third largest potato producing state, accounting for about 14.8%, its cold storage capacity

constitutes barely 1.6% of India’s total, leading to significant post-harvest losses in perishable commodities.

To unlock its potential, Bihar can leverage its agro-climatic diversity through targeted investments in efficient agricultural value chains, branding and marketing of high value crops like makhana, litchi and other GI-certified products (GOB, 2024-25).

**Figure 16: Area and production of makhana in Bihar**



Source: Compiled from data from Bihar Horticulture Development Society (Government of Bihar, 2024)

### Makhana’s Emergence: From Local Pond to Global Shelf

Makhana is a unique aquatic crop from Mithila. Bihar accounts for over 85% of India’s output from about 30,000 hectares, sustaining nearly three lakh farmers. The Government of India has, for the first time, started recording data on makhana, estimating an area of 27.83 th. ha and a production of 55.7 th.MT. In comparison, Bihar’s Horticulture Department had reported, till 2021–22, a cultivated area of 35.22 th. ha and production of 56.39 th. MT. The gap between the two sets of figures highlights the lack of consistent, nationwide data on makhana cultivation (Figure 16). Over the past decade, it has evolved from a local delicacy to a national superfood, aided by health trends, GI tagging (2022), and policy support including

new Harmonised System of Nomenclature (HSN) codes, crop insurance, and an INR 100-crore National Makhana Board.

The Kharif-2025 Crop Assistance Scheme has for the first-time extended coverage to makhana growers. Bihar targets expansion to 70,000 hectares and output of 78,000 MT by 2035, with value projected to rise almost sevenfold and employment generation exceeding 7 lakh livelihoods (Sahani, 2025). These policy moves position the crop as a niche high value crop with strategic relevance in the state’s rural economy.

Yet, the sector’s potential remains limited by deep structural bottlenecks. Though hailed as a superfood, makhana’s production and harvesting are still rudimentary. Farmers, largely from the Mallah community, toil in

stagnant, muddy ponds, exposing themselves to infections and waterborne diseases. Processing is equally harsh as seeds are roasted manually over open fires in poorly ventilated spaces, causing heat, smoke, and respiratory issues. An unorganised marketing system adds price volatility, poor infrastructure, and weak farmer bargaining power. The absence of the APMC Act in Bihar hinders data collection and market transparency, while limited mechanisation, high costs, and lack of training keep processing inefficient, inconsistent, and prone to export rejections (Wardhan, Suntwal, Bansal, Laxmikant, & Gulati, 2025).

### **The National Makhana Board: From Bureaucracy to Institution-Building**

The government's new National Makhana Board is a major institutional effort to boost production, post-harvest management, processing, marketing, and exports while fostering R&D, capacity building, and scheme convergence (Jha, 2025). The board will be chaired by a central appointee, with representation from key ministries, Bihar and other producing states, growers, processors, exporters, Indian Council for Agricultural Research (ICAR) institutes, National Bank for Agriculture and Rural Development (NABARD), and Bihar Agricultural University (BAU) (GOI, 2025).

The Board's success depends on avoiding the bureaucratic hurdles that has plagued some Indian commodity boards. While Tea and Spices Boards have integrated research and branding successfully, others have stagnated. The Makhana Board must learn from these mixed results, particularly the need to address quality issues like pesticide residues that limit exports.

To ensure its effectiveness and sustainability, the Board's governance structure should function as a Public-Private Partnership (PPP), integrating all stakeholders, and keeping FPOs at the core of decision-making. Chairman should be a dedicated, long-term sector champion. Given global trade demands, the Board must prioritize value chain modernization and mechanization to meet strict Sanitary and Phytosanitary (SPS) standards and reduce export rejection rates.

### **Potential of other GI**

#### **Commodities: Litchi and Beyond**

Bihar has 13 registered GI products, of which Mithila Makhana, Shahi litchi, Zardalu Mango, and Magahi paan hold strong cultural and economic significance (APEDA, 2024). Shahi litchi, for instance, cultivated mainly in Muzaffarpur and neighbouring districts (Vaishali, Samastipur, East Champaran, and Begusarai) is a delicacy and a major source of livelihood for small orchard owners. This premium variety received the GI tag in 2018, enhancing its identity and marketability. Bihar accounts for about 23% of India's total litchi production, with cultivation spread over 39.23 thousand hectares or nearly 40% of the total area (MOA&FW, 2024-25).

The Shahi variety makes a significant contribution to this output, providing seasonal employment to thousands of farm families and labourers. Recent improvements in air cargo services and 28 dedicated trains deployed by Indian Railways to facilitate timely transport of this highly perishable fruit (Verma, 2025). Despite these measures, key challenges remain. Litchi is highly perishable with a short shelf life of just 2–3 days under ambient conditions, though it can be extended upto few weeks through refrigeration and cold chain. Ongoing research at Rajendra Prasad Central Agricultural University aims to extend this to

about a month (RPCAU, 2025). Exports also remain limited, with India's litchi exports valued at only USD 0.33 million in TE 2024–25.

### Conclusion: Politics or Economics?

The question if Bihar's farmers will see real gains in productivity and exports, or whether current attention will fade as electoral rhetoric, finds its answer in the state's evolving crop strategies. Evidence from Makhana and Litchi suggests that progress is possible, but only through sustained reform and investment. In Makhana, mechanisation of processing, expansion of pond-based cultivation, and improved quality control can enhance exportable varieties. If India wants to make makhana truly global, the entire value chain needs modernization, from mechanized harvesting to safer, cleaner, and more efficient processing. The private sector must play a key role in driving this transformation, while the government can act as an initial enabler through support, training, and infrastructure but it cannot and should not do makhana business alone (Wardhan, Suntwal, Bansal, Laxmikant, & Gulati, 2025). In Litchi, extending shelf life, building cold-chain infrastructure, and improving orchard management are essential to move beyond limited exports. These examples show that Bihar's agricultural progress will be shaped less by promises and more by how effectively policies are implemented on the ground determining if niche crops become true drivers of growth and contributors to agri-export vision.

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# Odisha's Green Growth Story:



5

## Leveraging Agriphotovoltaics for a Farmer-Centric Livelihood Program

*Subhodeep Basu, Ashok Gulati, and Akshaya Biswal*

### Introduction

Agriculture remains one of the cornerstones of Odisha's economy, employing nearly 49% of the workforce. (Government of Odisha, 2025a). Although agriculture's share in the Gross State Domestic Product (GSDP) has declined from 37% in TE1992–93 to 18.5% in TE2023–24 due to expansion of industry and services, its role in poverty reduction, food security, and rural employment remains vital (MoSPI, 2025).

Recent policy reforms have improved irrigation and diversification, yet the sector continues to face deep structural constraints of low incomes, smallholdings, poor post-harvest systems, and unreliable energy infrastructure (Mishra, et al., 2024). Odisha's shift toward a low-carbon and decentralized energy model now provides an opportunity to reimagine agriculture as a driver of rural prosperity powered by clean energy. This article examines how Odisha's evolving green growth strategy can unlock new synergies between agriculture and clean energy through upcoming innovations like agriphotovoltaics (Agri-PV). It explores the state's structural challenges, energy deficits, and emerging policy innovations, highlighting how

community-led and farmer-centric Agri-PV models such as the Koraput pilot can enhance rural livelihoods, boost productivity, and position Odisha as a frontrunner in Eastern India's low-carbon agricultural transformation.

Enduring Challenges of Productivity, Power, and Poverty in Odisha's Farm Sector Despite notable progress in recent years<sup>6</sup>, Odisha's agriculture faces deep-rooted structural and energy constraints that hinder income growth and resilience. The state's average monthly farm income, at INR 5,112, is barely half the national average of INR 10,200 in 2018-19 (MoSPI, 2019). Smallholders dominate the landscape, with 93% of holdings below two hectares (MoAFW, 2019) and have limited access to mechanization, credit, and markets. Agriculture remains highly subsistence-oriented, with rice monocropping occupying nearly two-thirds of the cultivated area and yields for paddy and pulses trailing national averages.

Climate variability compounds these structural challenges. Frequent droughts, floods, and cyclones depress productivity and discourage crop diversification. Post-harvest losses are widespread due to inadequate

<sup>6</sup> Odisha's agriculture has grown rapidly, recording about 5% annual GSDP growth between 2011–12 and 2022–23, outpacing West Bengal, Bihar, and Jharkhand, and exceeding the national average of 3.9%. The state's

overall GSDP also expanded faster, averaging 6.5% annually against India's 6.1% (MoSPI, 2025).

storage and processing facilities. Odisha's total cold storage capacity stands at only 0.58 million metric tonnes (MMT) which is less than 1.5% of India's total and over 70% of its 133 units are non-functional (MoFPI, 2024). In many districts, farmers lack basic packhouses or pre-cooling units, leading to spoilage of perishable produce and reduced farm-gate prices.

Energy access remains a decisive bottleneck in agricultural modernization. Power is vital for irrigation, mechanization, and post-harvest operations, yet Odisha's agricultural electricity consumption was only 806 million units in 2021–22, a mere 2.7% of total power use (Government of Odisha, 2025a). With per-hectare power consumption of 70 kWh, well below Punjab or Tamil Nadu, the state's agriculture remains energy-poor (Hoda et al., 2021). Despite near-universal electrification under Saubhagya scheme<sup>7</sup> rural Odisha continues to face unreliable, low-voltage power and frequent load-shedding, particularly in the western and southern regions.

Odisha also has the highest proportion of inhabitants from scheduled tribes and scheduled castes of all the states in India (39.9% compared to 24% nationally). Western Odisha, home to a high concentration of Scheduled Tribe and Scheduled Caste populations, remains especially vulnerable. Recurrent droughts, low irrigation coverage, and limited livelihood options drive distress migration and deepen poverty, disproportionately affecting women. Strengthening decentralized renewable energy systems and women-centric livelihood programs is therefore critical to addressing

these persistent structural and energy barriers.

## Agrivoltaics: Converging Agriculture and Clean Energy

Odisha's Vision 2047 positions renewable energy as a strategic pillar for achieving a USD 1.5-trillion economy by 2047 (Government of Odisha, 2025b). The state aims to raise the renewable share of installed capacity from 18% to 70% and of generation from 10% to 55%, with solar energy as the cornerstone. The target of 100% agricultural solarisation under PM-KUSUM underscores this ambition. However, these goals will remain aspirational unless renewable deployment becomes more farmer-centric.

Agrivoltaics (Agri-PV) offers such a pathway. Unlike conventional solar parks that displace agriculture, Agri-PV integrates photovoltaic panels within farmland to enable dual land use of crop cultivation below and energy generation above. Grid-connected Agri-PV systems allow farmers to sell surplus electricity to the grid, creating new income streams and turning them into "prosumers." The approach encapsulates the idea of "solar as the third crop" diversifying income, enhancing land productivity, and strengthening energy security. Beyond economics, Agri-PV provides environmental co-benefits. Partial shading improves soil-moisture retention and reduces heat stress, valuable in Odisha's erratic climate. At the system level, decentralized solar generation can reduce grid congestion and help lower AT&C losses targeted to fall to 7% by 2047 (Government of Odisha, 2025b).

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<sup>7</sup>Launched in September 2017 by the Ministry of Power, the **Saubhagya Scheme (Pradhan Mantri Sahaj Bijli Har Ghar Yojana)** aims to achieve **universal household electrification** across India by providing electricity connections to all unelectrified rural and urban households, with a special focus on poor and remote areas.

## Designing Farmer-Centric and Community-Led Agri-PV Model in Koraput

Scaling agrivoltaics (Agri-PV) in Odisha requires farmer-centric, financially viable models that balance economic feasibility with social equity under PM-KUSUM Component A. Success will hinge on blending viability-gap funding (VGF), concessional finance, and simplified land-leasing norms to attract private participation while safeguarding farmer interests. Institutional capacity-building is equally vital. Farmer Producer Organizations (FPOs) and Panchayati Raj Institutions (PRIs) must be equipped to manage assets, negotiate power-purchase agreements, and oversee maintenance. Odisha's solar roadmap rightly emphasizes vendor oversight and grievance redressal mechanisms to ensure accountability and quality assurance.

A promising illustration of this approach is the 1 MW Agri-PV pilot in Kulabir village, Nandapur block of Koraput district in Western Odisha, implemented jointly by ICRIER and Heifer International. Situated in the Eastern Ghats, one of India's most climate-vulnerable and economically deprived regions, the project adopts a community-owned model where smallholders collectively manage the installation through a women lead FPO. Elevated panels allow continued cultivation of shade-tolerant, high-value crops like turmeric and ginger while reducing evapotranspiration and stabilizing yields. Part of the solar power generated will be used locally for irrigation and small-scale agro-processing, while surplus electricity will be sold to the grid, creating an annuity-like income stream.

<sup>8</sup> It is important to note that the payback period and internal rate of return (IRR) presented in this analysis are based on a conventional PM-KUSUM Component A financial structure, which assumes a 60% debt and 40% equity ratio. However, the current model is structured as a primarily grant-

At a feed-in tariff of INR 4.40 per kWh, the Koraput pilot demonstrates strong financial feasibility with less than 5-year payback period and an internal rate of return (IRR) of 25%<sup>8</sup>. With such a high IRR, it has potential to not substantially augment farmers' incomes but also provide decentralised green energy in rural areas. In addition, to being economically viable, the model addresses the core imperatives of Odisha's energy transition which are decentralization, community ownership, and equitable value capture. By aligning with India's "Model Solar Village" scheme (funded at INR 800 crore) and PM-KUSUM-A, the model exemplifies how localized, community-led Agri-PV systems can transform villages from passive electricity consumers into active generators and stewards of clean energy, anchoring Odisha's shift toward a just and inclusive green rural economy.

## Integrating Agri-PV with Rural Development

Agri-PV's transformative potential extends beyond farm boundaries. Linking it with solar-powered cold storage, and food-processing units could reduce post-harvest losses and strengthen rural value chains. Such integration is relevant for western and southern Odisha, where high perishability and weak logistics limit market access.

Embedding Agri-PV within livelihood and women's empowerment programs would advance *SDG 5 (Gender Equality)* by enhancing women's access to technology and entrepreneurship; **SDG 7 (Clean Energy)** through decentralized generation; **SDG 8 (Decent Work and Economic Growth)** via job

based intervention to create a proof of concept. Our idea is to showcase that at this fit (even without any grant support) the model is economically viable.

creation; and **SDG 13 (Climate Action)** through emission reduction and resilience.

Institutionally, Odisha could establish a “Green Agriculture Mission” that converges renewable energy, irrigation, and mechanization programs. Coordinating across the Departments of Agriculture, Energy, and Panchayati Raj and leveraging blended finance or carbon-credit mechanisms can accelerate decentralized solar adoption while ensuring fiscal sustainability.

### The Road Ahead: From Vision to Execution

Odisha’s green growth strategy demonstrates that energy and agriculture can evolve symbiotically. Agrivoltaics provides a framework to achieve multiple objectives of clean energy expansion, enhanced farm income, and climate resilience within the same spatial footprint. Yet, implementation capacity will determine outcomes.

The state must move from pilots to scalable mainstream programs, integrating Agri-PV into district irrigation plans and agricultural investment pipelines. Continuous evidence generation on crop performance with shadow effects, and providing remunerative terms of agreement for farmers (eg- favourable FiT) will be key to refining such a technology and policy design in favour of the farmers. Partnerships among research institutions, private developers, and local communities are essential to ensure that innovation remains both inclusive and adaptable. To achieve impact at scale, substantial investments will be required, either through allocations from the State budget or concessional financing from multilateral agencies such as the Asian Development Bank or the World Bank.

With its ambitious renewable-energy roadmap, robust institutional base, and strong

political commitment, Odisha is uniquely positioned to lead Eastern India’s green agricultural transformation. Agrivoltaics, if executed with sensitivity to local contexts, can redefine the state’s agrarian landscape turning farms into clean-energy hubs, enhancing livelihoods, and anchoring Odisha’s transition to a climate-resilient rural economy.

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# Activities of the quarter

6

## APSI in the Field

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1. ICRIER Agrivoltaics team visited Kundanpur, Rajasthan to gather on-ground insights from EPCs, DISCOMs, and farmers under PM-KUSUM to refine locally tailored APV models, July 3-4, 2025
- 2.- 4. Visit to Nashik, Maharashtra to study Grapes, Onion, Pomegranate and Tomato Value Chain 6-10 October, 2025.
5. Meeting with Additional Chief Secretary, Department of Industries, Government of Bihar
6. Visit to Go Green Factory in Muzaffarpur, Bihar, October 12-14, 2025

# Events

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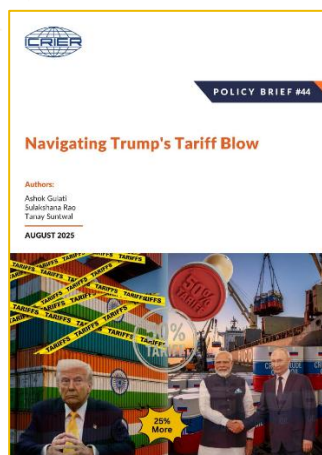
1. Harsh Wardhan served as a panelist at “Makhana 360°: A Roundtable for Sustainable Growth & Global Market Access” in Patna, July 29, 2025
2. Ashok Gulati delivered a special address at the at SunKranti – APV Summit 2025, Bhubaneswar, July 30, 2025
3. Subhodeep Basu and Bidisha Banerjee delivered a session on Plough to Panel in Neemli, Rajasthan organized by Centre for Science and Environment, presenting APV business models, Rajasthan pilot learnings, and key policy solutions, August 6, 2025
4. Harsh Wardhan and Suvangi Rath presented their work Strategies to Boost India’s Agri-Exports: Unlocking Global Markets”, at the National Conference on Agricultural Exports, organized by the Reserve Bank of India (RBI) College of Agricultural Banking, Pune on 21–22 August 2025.
5. – 6. Presentations at the National Conclave on "Weaving India Together" organised by Central Agricultural University, Imphal, October 8, 2025

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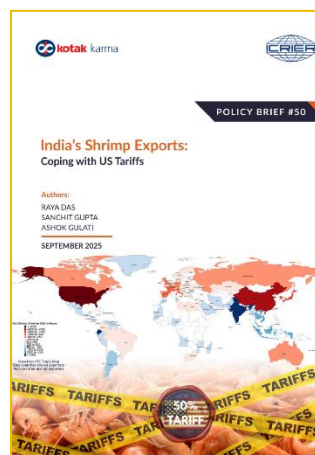
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## Publications in the previous quarter

### POLICY BRIEF



- [Navigating Trump's Tariff Blow](#), Policy Brief No. 44, co-authored by *Ashok Gulati, Sulakshana Rao, and Tanay Suntuwal*



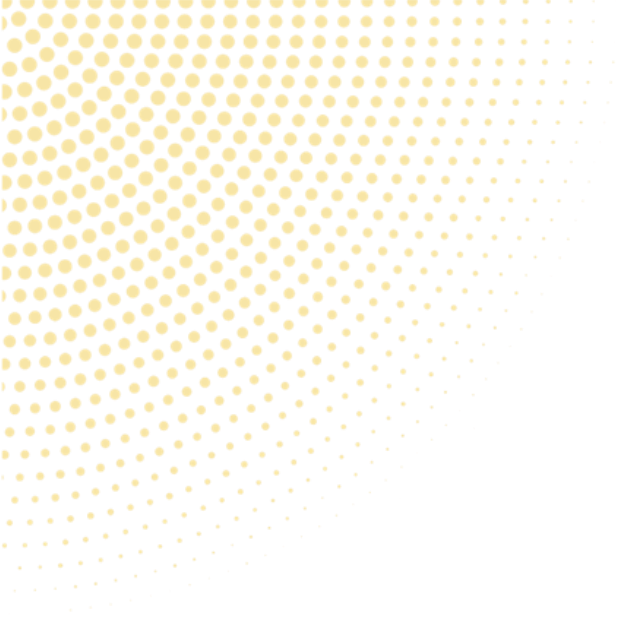
- [India's Shrimp Exports: Coping with US Tariffs](#), Policy Brief No. 50, co-authored by *Rava Das, Sanchit Gupta, and Ashok Gulati*

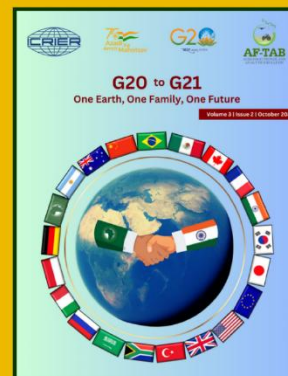
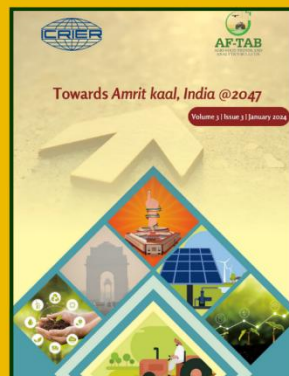
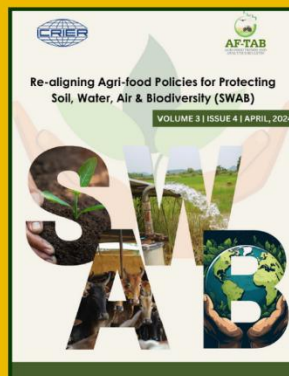
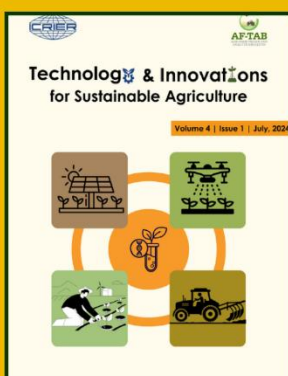
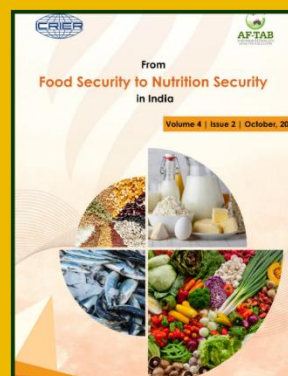
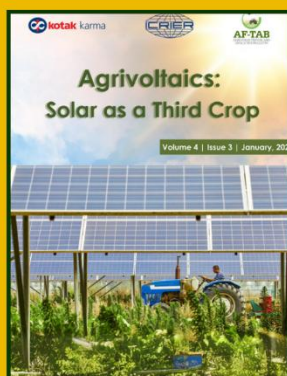
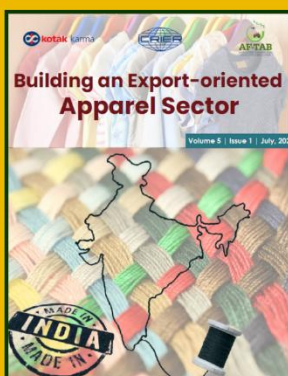
### OP-EDS

- Ashok Gulati (September 29, 2025): "[Food Security amid uncertainty](#)" also published in the Financial Express under the title "[Reducing risk for Viksit Bharat](#)".
- Ashok Gulati and Tanay Suntuwal (September 15, 2025): "[Resist pressure, lower tariffs](#)" also published in the Financial Express under the title "[Shed the 'tariff king' crown](#)".
- Ashok Gulati (September 1, 2025): "[Under Cover of Trade Deficit](#)", The Indian Express also published in the Financial Express under the title "[Power politics, trade and tariffs](#)".
- Ashok Gulati and Ritika Juneja (August 18, 2025): "[The Next Leap Forward](#)", The Indian Express also published in the Financial Express under the title "[India@79: From Independence to influence](#)".
- Rava Das and Sanchit Gupta (August 7, 2025): "[Shrimp Farmers reeling under US Tariff need a lifeline](#)", LiveMint.
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- Ashok Gulati, Leonardus Vergutz and Ritika Juneja (July 21, 2025): "[The soil of a nation](#)", The Indian Express also published in the Financial Express under the "[Healing Soils in India](#)".
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## MEDIA INTERVIEWS

- Ashok Gulati (September 20, 2025): [India's Choice: Tariff King or Competitiveness Champion](#), Interview with Anil Padmanabhan, Capital Calculus
- Ashok Gulati (September 20, 2025): [खाद सब्सिडी में कालाबाजारी, Expert ने MSP, Farm Law, PM Modi, Free Ration पर क्या राज़ खोले](#), Interview with Shruti Agarwal, The Lallantop.
- Ashok Gulati (September 20, 2025): [Modi Govt's Trade Redlines are Inconsistent, Irrational, Indefensible and Should be Scrapped](#), Interview with Karan Thapar, The Wire.
- Ashok Gulati (September 16, 2025): [Farm Tariffs Deadlock In India-US Talks](#), Exclusive Interview with Rajdeep Sardesai, India Today
- Ashok Gulati (July 22, 2025): [Farming in a hotter India](#), Interview with Arpita Kedia, She Talks Green
- Ashok Gulati (July 12, 2025): [The urgent need for agricultural reforms in India and explains what's really happening on the ground](#), Interview with Monika Halan, Growwing India
- Ashok Gulati (July 9, 2025): [Can India open agriculture? | India - US trade deal- the red lines](#), Interview with Shweta Punj, Money Control





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