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Agrifood Value Chains in India

A State-Level Analysis Using a Social Accounting Matrix

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Abstract

This study describes disparities in per capita income, in the structure of the economy, and in agrifood systems (AFS) across states in India. We use the gross value added (GVA) obtained from state-specific agrifood value chains (AVCs) to describe the size and structure of the AFS in each state of India. This study also presents the size of employment and variability in labor productivity within the AFS across states. A special focus is given to female and youth employment in the state-specific AVCs. The 2017/18 state-level social accounting matrix (SAM) for India is the primary data source for estimating statewise GVA from the AFS. Periodic Labor Force Survey data are used to estimate the size of AFS employment. Our results reveal that the bottom half of the Indian population has an average per capita income of US$1,019, 2.5 times lower than that of the top half. India's AFS is valued at $756 billion, or 31 percent of its GVA. Primary agriculture comprises 59 percent of the AFS, and off-farm activities the rest. The share of off-farm activities in the AFS rises moving from lower-income states to higher-income states, corroborating the theory of structural transformation. The national average share of female workers in total employment is 23 percent and the majority of women who do work are engaged in primary agriculture. The share of women employed in the primary agriculture sector does not change between low- and high-income states in India. In contrast, the share of youth in primary agriculture declines between lower- and higher-income states. Since state governments in India are empowered to design their own policy and development strategies, this study provides an important policy insight to both the federal (central) and state governments.

Keywords: Agriculture, Food System, Value Creation, Value Chain Analysis, Social Accounting Matrix.

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1. Introduction

India achieved remarkable economic progress and structural transformation over the past several decades, pushed by the Green Revolution in the 1970s followed by liberalization in the 1990s. Its gross value added (GVA) grew at an average rate of 6 percent per year between 1990/91 and 2023/24. The contribution of India's agriculture sector to GVA declined from 35 percent to 15 percent over the same period, while the service sector's share grew from 46 percent to 64 percent (Ministry of Statistics and Programme Implementation, various issues; Reserve Bank of India, 2023). India's rural economic structure is also being reshaped by the forces of urbanization, market expansion, increased livelihood opportunities in the nonfarm sector, and changes in land use patterns.

This rapid economic growth and structural transformation led the share of the population living in extreme poverty[1] to fall from 48 percent to 13 percent between 1993 and 2021 (Ministry of Finance 2023; World Bank 2023a). The government's target is to make India a developed nation by 2047, and it has undertaken several economic and institutional reforms to accomplish this goal. If successful, India will transform into an affluent country, with average living standards comparable to those in many European countries (Virmani 2021; Kohli, Sharma, and Sood 2011).

Concurrently, the way food is produced, processed, and sold in India will change significantly, creating opportunities for farmers and agribusinesses to transform commodities into products that are demanded by consumers. Global experience suggests that food system transformation has led to greater involvement of the private sector in agriculture and more focus on developing and improving the quality, productivity, efficiency, and depth of agriculture value chains (AVCs) (Diao, Hazell, and Thurlow 2010; Timmer 1988). Thus, agrifood systems (AFS) in India will evolve.

The specific trends vary across countries because of the diverse structure and growth trajectory of their AFSs (Dorosh and Thurlow 2013). As India is a vast federal country with widely different states, each state's AFS's size and structure will presumably vary accordingly. Nonetheless, India's agriculture sector still employs 44 percent of the workforce, of which 73 percent are men. Therefore, any AFS transformation will significantly impact India's future labor market.

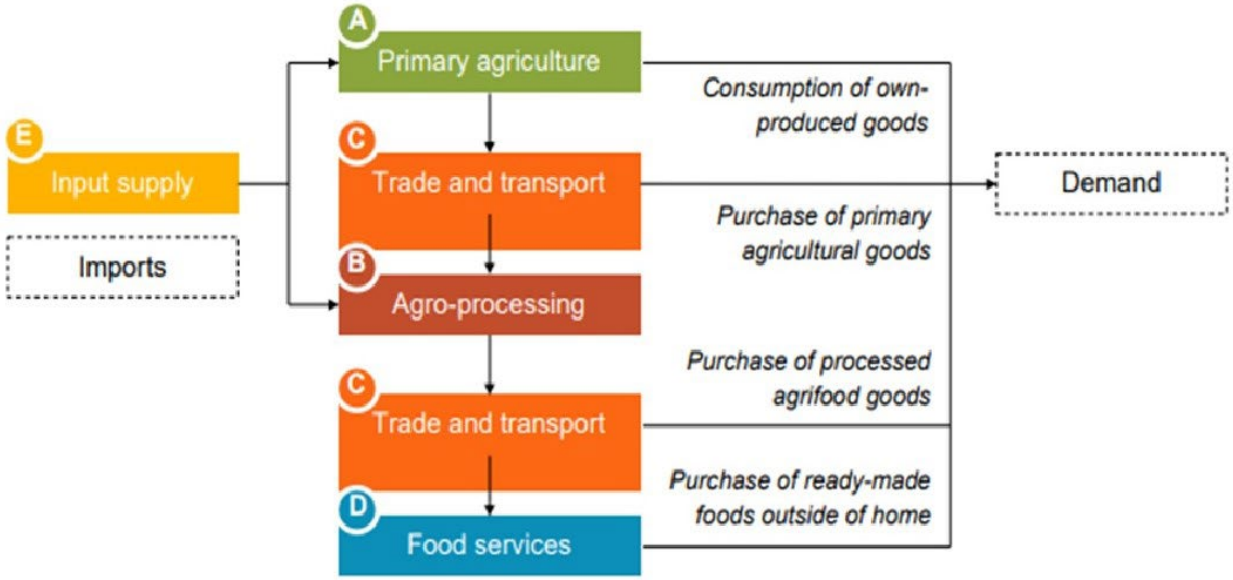
[1] That is, below USD$2.15 per person per day (2017 purchasing power parity [PPP]).

Given this backdrop, the primary aim of this study is to estimate the size of national AFS and its structure across states in India. We use the GVA obtained from state-specific agrifood value chains (AVCs) to represent the size of each state's AFS. We also estimate the size of employment and variability in labor productivity within the AFS across states. We place a special focus on female and youth employment in the state-specific AVCs. The state-level social accounting matrix (SAM) for India for 2017/18 is the primary data source for estimating statewise AFS GVA. This SAM considers 33 of 36 states in India (including union territories) and 29 crop value chains, 6 livestock value chains, and 2 fisheries value chains for each state. Periodic Labor Force Survey (PLFS) data are used to estimate AFS employment (NSO 2019). Since state governments in India are empowered to design their own policy and development strategies, this study provides an important policy insight to both the federal (central) and state governments in India.

2. Concept and construction of agrifood value chains

Many ways exist to conceptualize an AFS. For many, it is a complex network of actors connected by their differing roles in supplying, consuming, and governing agrifood products and jobs (Coltrain, Barton, and Boland 2000; Canning 2011; USDA 2013; Willett et al. 2019; FAO 2018; Dwivedi et al. 2017). In the conceptual framework adopted in this study, an AFS is characterized by five distinguishable components (A to E in Figure 1). We apply this framework in our analysis using available economywide data and household survey data that allow us to estimate the total size of the AFS and its components on both the supply and demand sides of the economy.

Figure 1. Components of an agrifood system



Source: Diao, Hazell, and Thurlow (2023).

Primary agriculture (A), the first component of an AFS, includes the supply, demand, and trade of all agricultural products, often grouped as crops, livestock, fishing, and forestry. Agro-processing (B) is part of the broader manufacturing sector and includes only those manufacturing subsectors associated with processed food and other agriculture-related nonfood products, such as yarn and timber. Input supply (E) is the portion of intermediate inputs used directly in agricultural and agro-processing production (for example, fertilizers and financial services). Inputs that are produced by farmers and processors themselves are excluded to avoid double-counting, since they are captured in components A and B. Only the portion of inputs generated by local producers are included, calculated as the share of agriculture and processing's input demand in total economywide demand for that input. For example, if farmers and processors use one-third of the petroleum produced domestically in the economy, then one-third of the domestic petroleum sector is considered part of the AFS. If all petroleum is imported, then this input does not contribute to the input component of the AFS (component E). Trade and transport services (C) consider only the portion of such services associated with transporting, wholesaling, and retailing of agrifood products between farms, firms, and final points of sale (that is, either domestic or foreign markets). The trade and transport sectors included in the national accounts data do not separate their services for agrifood and the rest of the economy, so this is estimated using product-level data on transaction cost

margins. Transaction costs are the main source of demand for trade and transport services, and so a portion of these sectors can be attributed to the AFS based on the total share of trade margins on agrifood products relative to the total margins on all marketed products. Finally, food services (D) are associated with services provided in both food production and consumption, plus a portion of the hotel and accommodation sector. Producers of food services (that is, meals prepared outside the home) run standalone operations (for example, restaurants or stalls), whereas hotels often operate restaurants in addition to providing accommodation and other services. The portion of the hotel and accommodations sector assigned to the AFS is based on the share of agrifood inputs in the sector's overall intermediate inputs. In summary, an AFS is essentially the sum of all relevant on- and off-farm economic activities and products across all AVCs within a country.

To measure these five components of India's AFS, we use a state-level SAM for India for 2017/18. This SAM follows the standard structure of the NEXUS SAM for India constructed by the International Food Policy Research Institute (IFPRI 2024)[2]. It considers 30 states and 3 union territories of India.[3] Further, it comprises 111 production activities, 13 types of labor, and 5 household expenditure quintile classes, where each quintile is further split between rural farm, rural nonfarm, and urban households. In this SAM, all state-level economic activities are linked with the national market for their input requirement and the sale of output. Households across states are linked through the transfer of remittances and the national market is linked with the rest of the world through current and capital accounts transactions. Appendix 1 briefly describes the stages used to construct the state-level SAM.

3. India's agrifood system: Global context

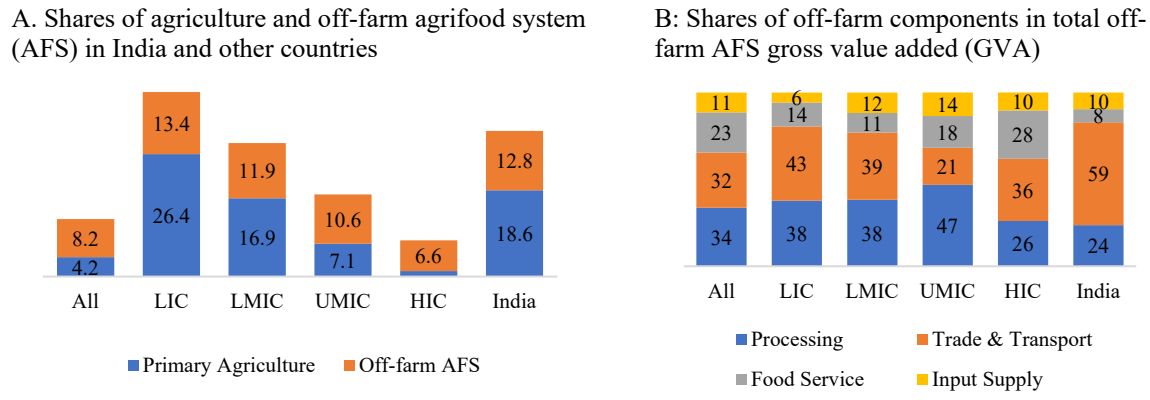
Figure 2 compares India's AFS with other country groups, as defined by the World Bank's classification of low-, middle-, upper-middle, and high-income countries. Primary agriculture contributes 4.2 percent of the world's gross domestic product (GDP), whereas off-farm agrifood activities contribute 8.2 percent (panel A, Figure 2). Thus, the worldwide AFS contributes 12.4 percent to the world's GDP. Further, AFS structures vary across countries. For example, the share of off-farm agrifood activities is higher in high-income countries (HIC) than in low-income

[2] NEXUS SAM is developed as part of IFPRI's Nexus Project that aims to develop toolkits and establishes common data standards,

[3] Though part of Delhi comes under union territory and the state of Jammu and Kashmir was split into two union territories in 2019, given the data available for 2017/18, we considered them both as states in this SAM. This SAM excludes Dadra and Nagar Haveli, Laksha Deep, and Daman and Diu due to data availability.

countries (LIC). In the latter, off-farm agrifood activities comprise almost one-half the size of the primary agriculture components of the AFS. In contrast, primary agriculture is negligible in HIC and off-farm activities dominate their AFSs. India's AFS resembles that of low-middle-income countries (LMIC). Its primary agriculture and off-farm agrifood activities contribute 18.6 and 12.8 percent to India's GDP, respectively. In other words, India's AFS contributes almost 31.4 percent to its GDP.

Figure 2. India's agrifood system versus other countries



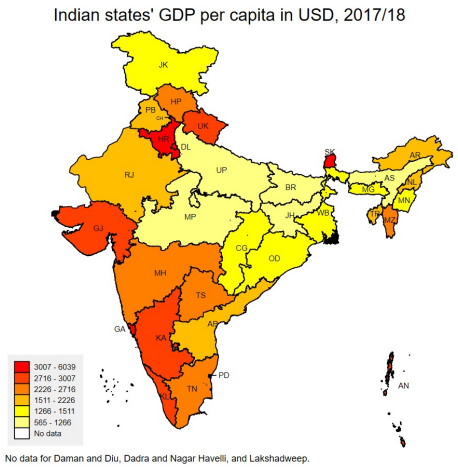
Source: IFPRI's Agrifood System Database (Diao, Hazell, and Thurlow (2023)) and 2017/18 Indian State SAM.
Notes: LIC are low-income countries; LMIC are lower-middle-income countries; UMIC are upper-middle-income countries; and HIC are high-income countries. These country classifications are based on the World Bank's classification using the ATLAS method (WDI Database, https://databank.worldbank.org/source/world-development-indicators).

Trade and transport components together contribute 59 percent to total off-farm agrifood value added in India, which is higher than both the world average (32 percent) and the LMIC average (39 percent) (panel B, Figure 2). On the other hand, India's share of processing in off-farm agrifood value added is 24 percent, significantly lower than both the world average share (34 percent) and the LMIC average (38 percent). India's processing component share in off-farm value added is close to that of HIC (26 percent), but the share of food services in HIC is three times higher than in India. The low share of processing and food service components in India's AFS implies that Indian consumers consume more homecooked food than outside food, and the trade and transport activity add value by mediating between farmers and final consumers of agricultural produce.

4. India's agrifood system: State-level analysis

This section describes disparities in per capita income, in the structure of the economy, and in AFSs across states in India. Indian states' per capita income, measured in terms of per capita GVA, varied from $500 to $6,000 in 2017/18 (Figure 3). Most of the poor states are in the central and eastern parts of India, whereas the richer states are in the western and southern parts. Bihar, in east India, has the lowest per capita income ($565), while Goa, in the southwest, has the highest ($6,039). High growth in the urban economy led to the emergence of states like Goa and Delhi, which can be compared to high-growth countries in Latin America. In contrast, agriculture-led development rendered states like Bihar and Uttar Pradesh more comparable to some of the low-income countries in Sub-Saharan Africa (Pingali et al. 2019). Though the Green Revolution played an important role in catalyzing economic growth in many Indian states, it did not benefit all of them. States that built their agriculture sectors on comparative advantages such as better access to global markets, agroclimatic conditions, and high-skilled farm capacity for production (for example, Punjab and Andhra Pradesh) benefited more from the technological advances of the Green Revolution. In some states, the Green Revolution provided the impetus for growth (for example, Tamil Nadu and Haryana), but development strategies that focused on comparative advantages in skill and infrastructure availability rather than on absolute advantages (for example, availability of land) proved more successful for structural transformation. Finally, states with no comparative advantages in the production of rice and wheat were left behind in the development process. Consequently, huge disparities in per capita income persist across states.

Figure 3. Per capita income by Indian state, 2017/18



Source: Authors' construction.

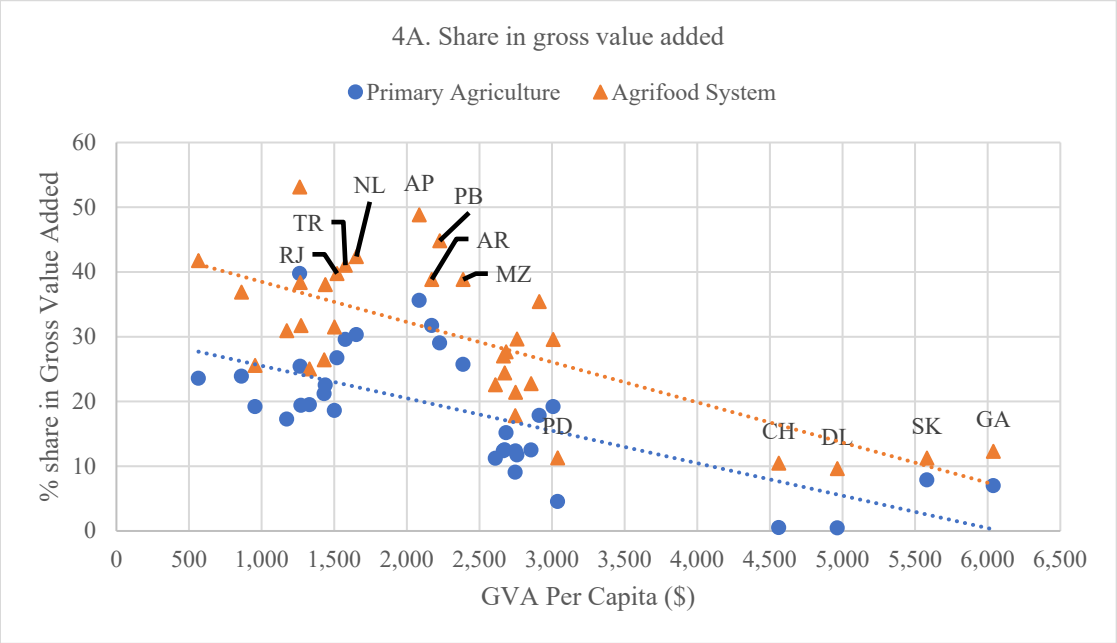
The disparity across states is also reflected in the structure of their economies and their AFSs (Figure 4). The downward linear trends in panel A reveal that states' shares of both primary agriculture and the AFS GVA decline as we move from poorer to richer states. For example, the share of primary agriculture for states with per capita income less than $1,500 ranges between 20 percent to 40 percent, whereas this share is less than 20 percent for states with per capita income greater than $2,500. On the other hand, the share of the AFS in GVA varies between 25–50 percent for relatively poor states (per capita income less than $1,500) and between 10–35 percent for relatively better off states (per capita income more than $2,500). The share of the AFS in GVA is higher than the share of primary agriculture due to the presence of off-farm activities (panel A), while the share of off-farm activities in the AFS is higher in richer states than in poorer ones (panel B).

Figure 4 also reveals that Andhra Pradesh, Punjab, Rajasthan, Nagaland, Arunachal Pradesh, Mizoram, and Tripura have a higher share of primary agriculture in GVA than states with relatively lower income. States like Andhra Pradesh and Punjab benefitted from the Green Revolution, which transformed their agriculture sector, leading to higher per capita income despite primary agriculture playing a significant role in these states. On the other hand, states like Nagaland, Arunachal Pradesh, and Mizoram benefitted from agroforestry, while Rajasthan's focus on livestock production contributed to both higher agricultural share and per capita income as compared to low-income agrarian states in India. Thus, agricultural share can remain high in states

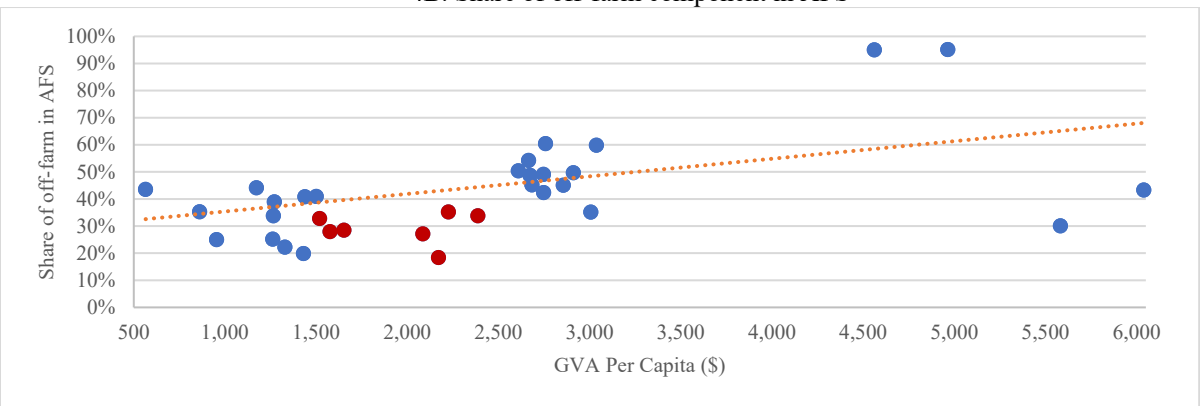
with comparative advantages and higher income. However, the agricultural advantage is observed only for states with per capita income of up to $2,000. When per capita income surpasses approximately $3,000, manufacturing and services emerge as the key economic activities.

Therefore, the higher a state's income, the lower the dominance of its primary agriculture sector and the greater the importance of off-farm activities. This outcome is consistent with the global trend observed in Figure 2.

Figure 4. Agrifood system across individual Indian states and territories, 2017/18



Source: Authors' compilation.
Note: AP – Andhra Pradesh, AR – Arunachal Pradesh, PB – Punjab, MZ – Mizoram, RJ – Rajasthan, TR – Tripura, NL – Nagaland.



Source: Authors' calculations using the 2017/18 India state-level SAM.
Note: GVA is measured in basic prices and current US dollars. Off-farm includes processing, trade, and transport of agrifood products, food services, and supply of non-agrifood inputs to agriculture and processing.

Considering the above facts, a deep dive into the spatial variations in India's AFS would be interesting. However, for this paper, we group Indian states and union territories into three income categories: low-income states (LIS), with per capita income < $1,500; middle-income states (MIS), with per capita income of $1,500–3,500; and high-income states (HIS), with per capita income >$3,500. MIS are further classified into Green Revolution States (GRS) and "other" MIS.[4] GRS are those where the Green Revolution was successfully implemented, and include Punjab, Haryana, Andhra Pradesh, and Tamil Nadu (Pingali et al. 2019). Due to their historical significance in the context of agricultural reform in India, we group GRS separately to understand how different their AFSs are from other states in India.

Table 1 decomposes India's AFS into different state income groups and provides a comparative picture of the size and structure of their AFSs. India's national AFS is valued at around $756 billion (2017/18 estimate), or 31 percent of its national GVA. Of this, LIS contribute 36 percent ($269 billion), MIS 41 percent ($310 billion), and GRS 22 percent ($166 billion), while the contribution from HIS is negligible.

Almost 51 percent of Indians live in LIS, 2 percent in HIS, and the remaining 47 percent in MIS (both other MIS and GRS) (Table 1). The average per capita GVA of LIS is $1,019, five times lower than in HIS and one-half of that in MIS. Furthermore, the average per capita income of LIS is even lower than that of least developed countries worldwide ($1,105), while the average per capita income of HIS is on par with middle-income countries worldwide.[5] LIS's primary agriculture sector contributes 25 percent of their GVA and off-farm activities another 13 percent, for an overall total AFS contribution of 38 percent to GVA. MIS's contribution of primary agriculture is significantly lower (28 percent) than that of LIS but their off-farm sector contributes a comparable 13 percent. On the other hand, the off-farm sector's contribution to GVA in HIS is higher than the contribution of primary agriculture (Table 1). In GRS, the primary agriculture sector's share in GVA is higher than in MIS, as is the contribution of off-farm activity.

[4] Our classification is based on the above description of states' income and structural disparities.
[5] Per capita GVA data are from the World Bank's World Development Indicator database; all estimations are in current 2017/18 US dollars.

Table 1. Decomposing GVA across Indian state income groups, 2017/18

	India	State and territory income group			
		LIS	MIS	HIS	GRS
Number of states*	33	10	15	4	4
Population (millions)	1,370	704	454	22	190
Share of total (%)	100	51.4	33.1	1.6	13.9
Total GVA ($ billion)	2,414	717	1,114	112	472
Share in India's GVA (%)	100	29.7	46.1	4.6	19.5
Agrifood system GVA ($ billion)	756	269	310	11	166
Share of total GVA (%)	31.3	37.5	27.8	10.0	35.2
Agriculture GVA ($ billion)	448	178	167	1	102
Share of total GVA (%)	18.6	24.8	15.0	1.3	21.5
Off-farm Agrifood GVA ($ billion)	308.1	90.8	142.9	9.7	64.6
Share of total GVA (%)	12.8	12.7	12.8	8.7	13.7
GVA per capita ($)	1,762	1,019	2,453	5,039	2,482

Source: Authors' calculations using the 2017/18 India state-level SAM.
Note: States and territories are grouped based on level of GVA per capita: low-income states (LIS) (less than $1450); middle-income states (MIS) ($1450 to $3500); high-income states (HIS) (above $3500); and Green Revolution States (GRS) (Punjab, Haryana, Andhra Pradesh, and Tamil Nadu).
*States include administrative states of India plus union territories as of 2019. This study excludes two union territories (Dadra and Nagar Haveli; Lakshadweep) due to unavailability of data.

4.1 Employment and labor productivity in state agrifood systems

India's primary agriculture sector still employs 44 percent of workers nationwide. Therefore, in the context of this study, it is important to analyze the size and the structure of AFS employment in the Indian economy and eventually the variation in labor productivity across states. However, the state-level SAM does not consider employment in physical units, but instead by the labor wage payment by different activities. Therefore, to incorporate employment in this analysis we use the National Sample Survey Office of the Government of India's PLFS 2017/18 data to estimate the activity-level distribution of workers across states (Table 2).

India's AFS employs 271 million workers, of which primary agriculture employs 210 million, suggesting that 61 million workers are engaged in off-farm agrifood activities. Average labor productivity (that is, GVA per worker) in off-farm activity is $5,035 per worker per year, double that of workers engaged in primary agriculture ($2,132 per worker per year) in India.

Across activities, 57 percent of total workers in India are employed in the AFS, a share that declines moving from LIS to HIS (Table 2). The share of AFS in employment in LIS is 61 percent, followed by 56 percent in MIS, 51 percent in GRS, and 21 percent in HIS. It is interesting to observe that the share of workers in primary agriculture is less in GRS than in MIS, while the

opposite is true for off-farm employment. Furthermore, the share of primary agriculture in GVA is higher in GRS than in "other" MIS. This implies that although nonfarm activities dominate the economic structure of MIS, the primary agriculture sector has been transformed from labor-intensive to capital-intensive in GRS; as a result, agriculture sector labor productivity is higher in GRS than in MIS. In sum, Table 2 reveals significant variations in average labor productivity between LIS and HIS in India. Moreover, off-farm labor productivity within the AFS is significantly higher across all states in India.

Table 2 also shows that India's overall labor market is dominated by male workers—women constitute only 23 percent of total employment in India. A comparison between state income groups reveals that HIS have the lowest share of female employment (16 percent), while GRS have the highest (29.4 percent). This implies that the pattern of women's employment across states is somewhat distorted and that the primary agriculture sector remains the major employer of female workers.

Table 2. Decomposing employment in on- and off-farm activities across Indian states and territories, 2017/18

	India	State and union territory income group			
		LIS	MIS	HIS	GRS
Total employment (millions)	477	225	169	8	75
Share of total (%)	100	47.1	35.5	1.7	15.7
Agrifood system employment (millions)	271	137	94	2	38
Share of state's total employment (%)	56.9	61.2	55.5	20.5	50.8
Agriculture employment (millions)	210	110	74	0.3	26
Share of state's total employment (%)	44.0	48.8	43.8	3.6	34.6
Off-farm agrifood employment (millions)	61	28	20	1	12
Share of total (%)	12.8	12.4	11.7	16.9	16.2
Female share of employment (%)	23.1	18.8	26.2	16.2	29.4
Agrifood system	26.9	21.5	32.1	16.2	33.6
Agriculture	29.7	23.1	36.1	40.1	39.2
Off-farm	17.1	15.2	17.3	11.1	21.7
Youth share of employment (%)	24.8	26.1	23.7	28.3	22.9
Agrifood system	21.9	23.9	20.4	24.9	18.4
Agriculture	20.4	22.6	18.8	17.3	15.8
Off-farm	27.1	28.9	26.5	26.5	24.0
GVA per worker ($)	5,061	3,191	6,572	14,056	6,298
Agrifood system	2,787	1,954	3,294	6,848	4,366
Agriculture	2,132	1,623	2,251	5,094	3,913
Off-farm	5,035	3,259	7,196	7,219	5,338

Source: Authors' calculations using the 2017/18 India state-level SAM; 2017/18 employment data are from India's Periodic Labor Force Survey (PLFS) (NSO 2019) and Chand and Singh (2022).
Note: Employment includes paid and unpaid workers ("usual status" as per PLFS). Youth employment includes workers aged between 15 and 29 years.

In contrast, only 22 percent of youth workers are employed in AFS activities in India. Within this, 27 percent of all workers in the off-farm sector are youth, versus 20 percent in primary agriculture. This pattern of youth employment is mostly the same across state income groups.

4.2 Decomposing the off-farm component of agrifood systems across state income groups

The previous section analyzed the role of off-farm agrifood activities in enhancing farmers' livelihood opportunities and income across states in India. Therefore, it is important to understand the value added and the employment structures of the off-farm AFS across state income groups (Table 3).

Table 3. Decomposing agrifood systems by Indian state income group, 2017/18

	India	State and territory income group			
		LIS	MIS	HIS	GRS
Off-farm activity ($billion)	308.1	90.8	142.9	9.7	64.6
[Off-farm AFS GVA]	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Processing (%)	23.7	19.8	25.9	14.1	25.8
Trade & Transport (%)	59.2	68.5	54.6	40.5	59.1
Food Service (%)	7.5	4.6	7.9	43.4	5.4
Input Supply (%)	9.6	7.1	11.6	2.0	9.7
Off-farm activity (millions No.)	61.0	28.0	20.0	1.0	12.0
[Off-farm AFS employment]	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Processing (%)	23.5	24.6	22.3	31.8	21.7
Trade & Transport (%)	57.5	60.0	56.0	36.1	56.8
Food Service (%)	14.7	13.2	15.4	31.1	15.1
Input Supply (%)	4.4	2.2	6.4	1.0	6.4

Source: Authors' calculations using the 2017/18 India state-level SAM; 2017/18 employment data are from India's Periodic Labor Force Survey (PLFS) (NSO 2019) and Chand and Singh (2022).
Note: GVA is measured in basic prices and current USD. LIS are low-income states and territories; LMIS are lower-middle-income countries; MIS are middle-income countries; and HIS are high-income countries. Employment includes paid and unpaid workers ("usual status" as per PLFS). Figures in parenthesis are the sum of shares of each component.

The trade and transport component dominates the off-farm AFS in LIS and MIS, contributing more than one-half to their off-farm agrifood GVA (Table 3). In HIS, food service dominates the off-farm AFS, contributing almost 43 percent. The employment structure in the off-farm AFS follows almost the same pattern. This implies that the higher the off-farm share in agrifood GVA, the higher the share of employment for that off-farm activity. Thus, for an off-farm agrifood component, if the share of employment is lower than its contribution in off-farm agrifood GVA, that activity has higher labor productivity within the off-farm AFS. For example, in LIS the share of employment corresponding to the trade and transport component is 60 percent and its contribution to off-farm agrifood GVA is 69 percent, suggesting that this component has relatively higher labor productivity within the off-farm AFS of LIS. On the other hand, the processing component employs 25 percent of total off-farm agrifood labor and contributes only 20 percent to the off-farm agrifood GVA in LIS. Hence, this is a relatively low-productivity component within the off-farm AFS in LIS.

Thus, we observe that the labor productivity is higher in processing and food services components of AFS in most states, which provides an opportunity for technological intervention along with off-farm component expansion.

5. Unpacking agrifood value chains across Indian states

So far in this study, we have analyzed the entire AFS across Indian states as a single entity and split it into primary agriculture and off-farm activity (and its components). This section splits the entire AFS into different value chain activities to understand their contributions in the AFS's GVA. Table 4 has two parts:

- The national average shares of each value chain activity in India's AFS; and
- The contribution of states to the GVA of each value chain.

We group 38 agricultural and allied activities into 12 value chain activity groups (Table 4).

Table 4. Breakdown of national level agrifood GVA by value chain and state income group

Value chain activities	A. Contribution of value chain in agrifood system (%)					B. Share of off-farm components in each value chain (%)				
	India	State and union territory groups				India	State and union territory groups			
		LIS	MIS	HIS	GRS		LIS	MIS	HIS	GRS
Agrifood system	100	100	100	100	100	41	34	46	87	39
Cereals (5)	13	18	8	29	16	33	28	39	98	29
Roots and tubers (3)	1	3	1	0	1	28	28	32	22	22
Pulses (3)	3	4	2	0	1	15	14	18	17	13
Oilseeds (3)	4	4	6	2	3	41	37	43	82	38
Fruits & vegetables (5)	14	17	13	12	12	30	27	34	79	23
Sugarcane (1)	5	6	5	2	4	65	56	72	99	70
Cotton & fibers (2)	11	3	15	1	15	85	80	82	100	93
Tea, coffee, & cocoa (3)	1	2	1	2	0	70	63	74	100	68
Tobacco & other crops (4)	10	10	11	6	6	37	39	38	63	27
Livestock (6)	23	20	22	37	28	30	29	32	89	22
Fisheries (2)	7	7	6	7	11	46	37	62	68	37
Forestry (1)	7	7	10	2	4	34	31	35	67	37

Source: Authors' calculations using the 2017/18 India state-level SAM.
Note: Unallocated includes sectors that cannot be mapped to specific value chains, such as "other food processing." Numbers in parentheses of each value chain describe the number of primary activities included in each value chain activity.

The livestock sector is the highest contributor (23 percent) to the national AFS's GVA, followed by fruits and vegetables (14 percent), cereals (13.5 percent), cotton and fibers (11 percent), and

tobacco and other crops (10 percent) (Table 4A). This pattern also holds for all state income groups. Livestock's contribution to the AFS's GVA increases as we move from LIS to HIS. However, no clear trend is seen in the share of cereals across state income groups (Table 4A). Cereals activity contributes 29 percent to the AFS's GVA in HIS, versus 18 percent and 16 percent in LIS and GRS, respectively, for three reasons. First, cereals are a staple food in most Indian states, and especially in LIS. Second, the purpose of the Green Revolution was to boost cereals production; hence cereals are one of the major contributors to GRS's AFS. Third, cereals are a major source of livestock feed in India, so this activity plays an important role in sustaining HIS's livestock activity. Apart from cereals, high-value crops like fruits and vegetables and tobacco and other crops contribute 27 percent to the AFS's GVA in LIS. In GRS, high-value crops like cotton and fibers along with fruits and vegetables and fisheries contribute 38 percent to the AFS's GVA. In MIS, cereals contribute only 8 percent of AFS GVA, while greater contributions arise from livestock (22 percent), cotton and fiber (15 percent), fruits and vegetables (13 percent), tobacco and other crops (11 percent), and forestry (10 percent). The above analysis demonstrates that the AFS's structure is not significantly different between LIS and GRS, but the technological transformation in the latter differentiates them. As a result, we observe a higher GVA per worker in GRS than in LIS (Table 2). On the other hand, the AFSs in MIS are more diversified compared to those of other state groups, as noncereal activity dominates in MIS. Although cereals dominate the AFSs in HIS, this group contributes only $11 billion (that is, less than 2 percent of the total $756 billion value added by India's entire AFS). Hence, we can argue that the structure of AFS is more transformed for those states which are similarly structurally transformed.

The national average contribution of off-farm agrifood activities in the AFS's GVA is 41 percent, with the highest contribution in HIS (87 percent), followed by MIS (46 percent) (Table 4B). Further, the share of off-farm activities in the AVC increases with increased state income. Off-farm agrifood activities dominate in noncereal value chain activities like fibers, tea and coffee, and sugarcane across all state income groups. It is also interesting to note that in the LIS and GRS, cereal value chains contribute 18 percent and 16 percent in their AFS's GVA, respectively, as compared to an 8 percent contribution in AFS's GVA of MIS. On the other hand, off-farm components in the cereals value chain constitute 34 percent and 39 percent in LIS and GRS respectively which are less than the contribution in MIS (46 percent). Apart from cereals, the share of off-farm components in the livestock value chain is higher in MIS than in LIS and GRS. More

importantly, the off-farm share of livestock in GRS is 22 percent, versus 32 percent in MIS and 29 percent in LIS. Therefore, even though the Green Revolution transformed agriculture in some states, its benefits are limited within the primary agricultural system even 50 years after its implementation. On the other hand, in states that could transform their economic structure, off-farm activity emerged and made important contributions in enhancing labor productivity and farmers' income. Indeed, primary agriculture still dominates India's AFS even after five decades of Green Revolution progress and three decades of structural reforms to India's economy.

6. Conclusion and policy implications

India's AFS is complex due to the country's heterogenous agroclimatic conditions and economic structures of its states. Moreover, India's structural transformation has had a significant impact on AVCs, income opportunities for smallholder farmers, and employment opportunities for women and youth. Public policy and investment further complicate the issue. To analyze this complex issue, this study examines India's AFS through three different lenses by analyzing: (1) on- and off-farm shares in various crops' production across states; (2) the structure (demographic and gender) of AFS employment across states; and (3) the value-added contribution from different value chain activities within the AFS. We use a state-level SAM for 2017/18 as a primary database for this analysis. Though several national SAMs have been conducted for the Indian economy over the last five decades, the state-level SAM constructed for this study is the first ever to be disaggregated to 33 states and to account for the flow of money across states through a wide range of economic activities.

Our study reveals that the Indian economy is like that of multiple other countries. High-income urbanized states like Goa, Delhi, Sikkim, and Chandigarh are comparable to some middle-income countries, while agricultural states like Bihar and Uttar Pradesh are more comparable to some low-income countries in Sub-Saharan Africa. States like Punjab, Haryana, Andhra Pradesh, and Tamil Nadu—which built their agriculture sectors on comparative advantages such as ease of access to global markets, agroclimatic conditions, and high-skilled farm capacity for production—benefitted from the technological advances of the Green Revolution. As a result, these GRS are considered MIS, despite their primary agriculture sectors contributing one-third to their GVA. In other MIS in India, manufacturing and services are the dominant economic activities, and such agricultural advantages disappear from the economic system.

Though the share of primary agriculture in GVA reduces with structural transformation, its off-farm linkages cannot be ignored. In this context, we find that India's AFS contributes 31.3 percent to national GVA, whereas primary agriculture contributes about 18.6 percent. However, more than one-half of the AFS GVA in India originates from primary agricultural activities. On the other hand, primary agriculture's contribution to the AFS declines as per capita income increases. In moving from LIS to HIS, off-farm activities' contribution to value-added also increases. Thus, economic transformation is also transforming India's AFS.

Livestock activity plays a significant role in India's AFS, contributing 23 percent to its GVA. GVA per worker for this activity is 20 percent more than the national average and more than double that of the primary agriculture sector in India. As a result, states with relatively higher shares of livestock in the AFS have higher agricultural GVA per worker. Despite this, the off-farm components in the livestock value chain are lower than those in the cereals value chain in India.

This study also finds that the gender composition in India's labor market is highly imbalanced. Of total employment in India, only 23 percent of workers are women. Nonetheless, most female workers are engaged in agriculture: their share of employment in primary agriculture (30 percent) is higher than their overall employment at the national level. Further, women's participation in total employment does not improve with increased per capita state income. In both LIS and HIS, shares of female workers are less than 20 percent. In India, it is observed from the fact that women are largely engaged in unpaid household chores and provide uninterrupted food services to the members of their households. However, neither the national accounts statistics nor this study include unpaid food services within households in estimating AFS GVA. In this context, one can argue that women's increased participation in paid work will increase demand for outside food by households, eventually leading to further AFS transformation in India.

Youth between 15 and 29 years of age constitute 27 percent of India's total population. The share of youth workers in total employment is 24 percent, close to the 22 percent in India's AFS. The share of youth employment in off-farm activities increases from LIS to HIS. In contrast, youth participation in primary agriculture declines from 22.6 percent in LIS to 17.3 percent in HIS. Recent PLFS data reveal that the unemployment rate is higher among Indian youth (15 percent) than in any other age group (PLFS 2017/18). To reap the demographic dividend, India needs to

create more employment opportunities for youth. In this regard, transformation of the AFS could lead to creation of more employment opportunities in off-farm activities for India's youth.

In experts' opinions, the national policies that led states to follow a single type of development strategy have now become high-risk strategies. States focusing on agriculture-led growth strategies need to redirect their economies to benefit from global opportunities based on their comparative advantage (Pingali and Sunder 2017). While the importance of linkages between agriculture and nonagriculture in driving the growth process has long been recognized (Hirschman 1958; Johnston and Mellor 1961), not enough emphasis is placed on the growth and development of efficient AVCs in India (Kumar and Sharma 2016). This study should help Indian policymakers understand the AVCs and AFSs of different states, enabling them to develop state-specific policies and investment strategies to transform their respective systems and state economies.

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Appendix 1: Construction of state-level SAM in India

Stages of constructions	Data sources
Stage 1: Disaggregate national Supply Use Table across states.	• Used national Supply Use Table (SUT) for 2017/18 available at the website of the Ministry of Statistics and Programme Implementation (MOSPI). Link for reference: https://mospi.gov.in/publication/supply-use-tables. **Disaggregated agriculture, forestry, and fisheries sectors across states using:** • State-wise value of output. The data on state- and itemwise value of crops' output are available from National Statistical Office (NSO 2022), MOSPI. • Statewise intermediate input and value added output ratio for agriculture. The plot-level summary data under the Cost of Cultivation 2017/18 are available at Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare. Link for reference: https://desagri.gov.in/document-report-category/plot-wise-summary-data/. • Statewise value added for agriculture, livestock, forestry, and fishing. The data on gross state value added by economic activities are available at the National Accounts Division, MOSPI. Link for reference: https://www.mospi.gov.in/data. • Statewise intermediate use for livestock, forestry, and fishing. For the aggregate sector, value added and output data from MOSPI are used to estimate statewise intermediate use. Further, national SUT is used to disaggregate to SAM sectors. Disaggregated mining sectors across states using: • Statewise value of output. The data are taken from Indian Mineral Statistics at a Glance, 2017-18 from Indian Bureau of Mines (2020) and Energy Statistics 2018 from Central Statistical Office (2018), MOSPI. • Statewise value added from mining sector. The data on gross state value added by economic activities are available at the National Accounts Division, MOSPI. Link for reference: https://www.mospi.gov.in/data. • Intermediate and value-added output ratio. National average ratios are assumed for states. National average intermediate and value added output ratios are obtained from national Supply Use Table for 2017/18. Disaggregated manufacturing sectors across states using: • Statewise value of output, value added, and intermediate input use for organized manufacturing sectors. The data are obtained from Annual Survey of Industries for the year 2017/18, National Statistical Office, MOSPI (Annual Survey of Industries 2020). Link for reference: https://www.mospi.gov.in/asi-summary-results.

Stages of constructions	Data sources
	• Statewise value added of aggregate manufacturing sector (organized + unorganized). The data are obtained from gross state value added by economic activities available at National Accounts Division, MOSPI. Link for reference: https://www.mospi.gov.in/data. • Statewise share of output and value added for each organized sector that has been used to disaggregate manufacturing sector output and value added of national SUT 2017/18. <u>Disaggregated service sector across states using:</u> • Statewise value added of service sectors. The data are obtained from gross state value added by economic activities available at the National Accounts Division, MOSPI. Link for reference: https://www.mospi.gov.in/data. • Further, disaggregation of service sector is done by using National Sample Survey Organisation (NSO) 74th round survey report 2016/17: "Technical Report on Services Sector Enterprises in India" (NSO 2019).
Stage 2: **Estimate** private final consumption expenditure state-level	• Used NSSO 68th round survey report 2011/12 on households' consumption expenditure: "Household Consumption of Various Goods and Services in India 2011-12" (NSSO 2014). This survey is also referred as HCES 2011/12.
Stage 3: **Estimate** value added into payment for various types of labors and capitals	• Used Periodic Labor Force Survey (PLFS) data 2017/18 (NSO 2019) to disaggregate types of labor engaged in various activities across states.
Stage 4: Estimate factor income distribution by households	• Used NSSO 68th round survey report 2011/12: "Employment and Unemployment Situation in India" (NSSO 2014).
Stage 5: **Estimate** government expenditure account	• Used Comptroller and Auditor General of India (CAG) data on state governments revenue and expenditure.
Stage 6: Transfer payments accounts	• Used NSSO 64th round survey report on "Migration in India, 2007-08'" to obtain intrahousehold transfers for domestic remittances across states (NSO 2010). • Used Reserve Bank of India data on international remittances receipt across states. Link for reference: https://www.rbi.org.in/scripts/BS_ViewBulletin.aspx?Id=17882. • Intragovernment transfers obtained from CAG data. Intra-enterprise transfers are estimated using national accounts statistics data for the year 2017/18. The distribution of enterprise transfer across states is estimated using the "Technical Report on Services Sector Enterprises in India" (NSSO 2019) and Annual Survey of Industries data (Annual Survey of Industries 2020).
Stage 7: Taxes, savings, and investment	• Used Planning Commission report on the "Estimation of Investment, its Composition and Trend for Twelfth Five Year Plan (2012-13 to 2016-17)" to estimate the economic activitywise Gross Fixed Capital Formation (GFCF) by states (Planning Commission 2012).

Stages of constructions	Data sources
	• Commodity tax rates are obtained from national SUT 2017/18. • Public finance statistics for government tax revenue and expenditure 2017/18 are used to disaggregate total commodity tax collection by states.
Stage 8: Balancing state-level SAM	• Minimizing entropy considering state-level macroeconomic data as constraint.

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