



REVIEW ARTICLE

Structural shifts in Indian agriculture: Analysing productivity, gross domestic product contribution and sectorial dynamics

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Abstract

India's economy majorly depends on the agricultural sector, which also contributes to food security and employs a sizable percentage of the labour force. Despite improvements in agricultural production and crop productivity over the years, the sector's share in gross domestic product (GDP) has been declining. This study examines trends in agricultural growth, the factors affecting its contribution to GDP and the challenges hindering the sector's progress. The analysis reveals that the rise in per capita income to Rs. 19696.00 per month, differences in rates of technical change between sectors, low labour productivity and the prevalence of traditional farming practices have contributed to the declining share of agriculture in GDP. Additionally, India faces a significant food spoilage crisis, with roughly 68 million tonnes of food lost annually, causing an estimated about Rs. 90000 crore to Rs. 1 lakh crore annual economic loss owing to inadequate cold storage and transportation facilities, leading to substantial economic losses. Poor irrigation systems and limited investment in the sector further exacerbate these challenges. To increase agriculture's contribution to GDP, this study suggests several measures, including the provision of storage facilities, efficient agricultural marketing, ensuring minimum support prices, promoting local consumption and strengthening agricultural research and extension systems. Furthermore, the effective implementation of government policies and a long-term strategic approach are crucial for maximising agricultural benefits and fostering economic growth. By addressing the identified challenges and leveraging opportunities, India can enhance the economic contribution of its agricultural sector and improve the livelihoods of its rural population.

Keywords: agriculture; food security; gross domestic product contribution; labour productivity; poverty reduction; production trends; rural economy

Introduction

According to World Bank data (2026), approximately 63.13 % of India's population resides in rural areas (1). Indian agriculture remains a critical sector for the economy, employing approximately 45.76 % of the workforce and contributing 16.5 % of the gross domestic product (GDP). Accelerating agricultural growth is crucial for achieving inclusive development and ensuring food security for India's growing population (2). It is essential for maintaining a country's food security and is a significant source of foreign exchange earnings. The agricultural sector influences the expansion of the secondary and tertiary sectors of the economy through both forward and backward links. In the 1960s, when the average yearly

import of wheat was approximately three million tonnes, we faced a nightmare of a complete food grain shortage prior to and immediately following independence. Nonetheless, with the Green Revolution, India achieved food grain self-sufficiency in the 1970s and has since become a food grain exporter. In recent years, the global food supply chain has faced several challenges. Currently, the Russia-Ukraine conflict disrupted grain exports, particularly in low-income countries (3). In India, food insecurity worsened during the COVID-19 lockdown, with the prevalence increasing from 20 % to 47 % in Bihar. However, government cash transfers can also mitigate food insecurity (4). Despite improvements between 2016 and 2021, published in 2023, food group deprivation remains prevalent among

India's poorest and least educated adults, particularly for high-quality protein sources and fruits (5). In India, the agricultural sector has a rich historical legacy and has attained a level of development that has led it to be regarded as the lifeline of the Indian economy. It plays a vital role in raising the income of nearly 63 % of rural households that depend on agriculture. The service sector currently supports the Indian economy and accounts for the largest portion of the country's GDP, with the industrial sector, as evidenced by the mission statements of top Indian companies that emphasise customer focus, technology integration and service offering (6). Agriculture remains a crucial sector in India, employing approximately 45.76 of the rural population during 2022–23 and indirectly impacting non-agricultural sectors (7). This sector faces challenges such as cereal-centric and resource-intensive production it remains the primary source of food for the entire population, whereas the industrial sector contributes 29.1 % to the GDP with a 33 % workforce and the service sector GDP is 55–60 % with only a 30–32 % workforce (8). India holds the second position worldwide in agricultural production, whereas in the services and manufacturing sectors, it holds the 11th and 12th positions, respectively (9). By increasing farm revenues, creating jobs and lowering food prices, agriculture directly and indirectly lowers poverty and promotes growth. Out of 140 million working people, about 100 million were engaged in agriculture during the year 1951 and until agriculture shared employment, about 45.76 % of the total workforce is engaged in agriculture and allied sector during 2022–23

(10). The enhancement of production of agricultural commodities and cultivated area from 1950–51 to 2024–25 was considerable (Table 1). Despite its significance, India's share of GDP in the agricultural sector has steadily declined over the decades, reflecting broader structural shifts in the economy (11). Although the country has achieved self-sufficiency in food production, a substantial proportion of its population continues to face food insecurity, with over 190 million individuals suffering from undernourishment. Additionally, poverty remains a major socioeconomic challenge, with nearly 30 % of the population living below the poverty line (12). To meet the food requirements of the country's growing population, India adopted several policies to enhance food grain production to improve and increase our food grain production consequently, Indian agriculture has registered impressive growth over resulting total area, production and crop productivity of major agricultural production have increased from 139.8 Mha, 204.9 Mt and 710 kg ha⁻¹ in 1960–61 to 170.0 Mha, 1897.9 Mt and 2053.0 kg ha⁻¹, respectively (13) and now it rises to 357.73 Mt in 2024–25 which is a notable achievement. Fig. 1 depicts how the progress of area, production and productivity of total agriculture produce enhanced continuously, but unfortunately, despite increasing food grain production and introducing numerous new policies, the share of agriculture in total GDP contribution is continuously decreasing from 57.3 % in 1951 to 17.9 in 2024–25 (14), while the industrial sector and service sector revolution brought about a unique pattern of development in economic history (13, 15). The decade-wise

Table 1. Production of agricultural commodities and cultivated area in the country in 1950–51 and 2024–25

Sl. No.	Name of commodity	Year 1950–51	Year 2024–25	Time increase
1	Food grain (Mt)	51	357	7
2	Vegetables + fruits (Mt)	25	333	13.3
3	Milk (Mt)	17	248	14.5
4	Egg (billion)	1.8	149	82.7
5	Fish (Mt)	0.8	197	246
6	Net sown area (Mha)	130	140	1.1
7	Gross sown area (Mha)	150	198	1.3

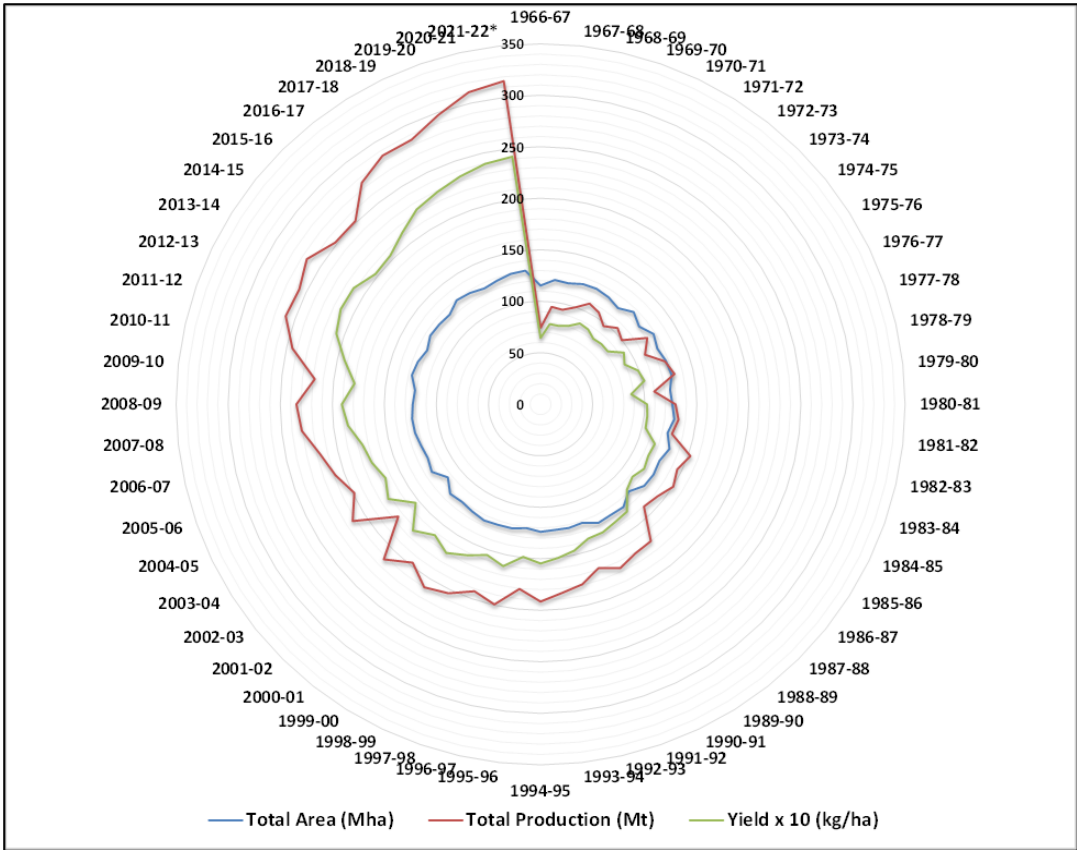


Fig. 1. Area, production and productivity of total agricultural produce (17).

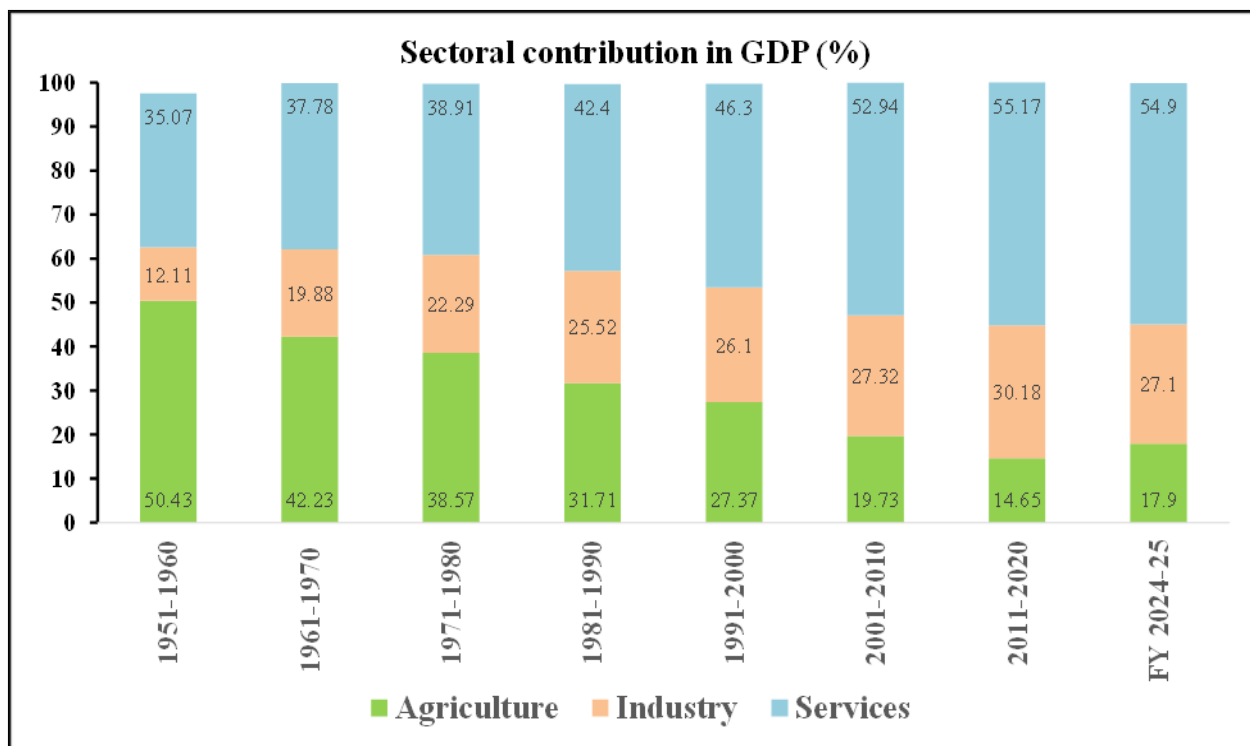


Fig. 2. Average sectoral contribution in gross domestic product (%) (19, 20).

contribution of the different sectors' GDP was 50.43 %, 12.11 % and 35.06 % in agriculture, industry and service sector, respectively during 1951–60 whereas, in 2011–20 it was 14.65 %, 30.18 % and 55.17 %, respectively and in FY 2024–25 it was 17.9 %, 27.1 % and 54.9 %, respectively (16) (Fig. 2). Therefore, despite several new policies introduced by the government to reform and increase the pace of agriculture, the share of agriculture sectors in the country's GDP has declined very rapidly, while other sectors, such as the industrial and service sectors, have increased. The growth rate of agriculture (%) was very slow from the beginning, at 3.1 % from 1950 to 1960 and 2.1 % from 2010 to 2015 (17). In Q2 of FY 2025–26, the agriculture sector registered a growth of 3.5 %. The decadal growth of 4.45 % (FY 2016–25), the highest in comparison to previous decades, has primarily resulted from the strong performance in livestock (7.1 %) and fishing and aquaculture (8.8 %), followed by the crop sector at 3.5 % (18). According to a report given by an economic survey, the GDP growth rate of the agriculture, industry and service sectors varied significantly and the agriculture sector experienced a negative growth rate. Since agriculture and related industries still support approximately 45.76 % of the nation's population, their shrinking share of the Indian GDP is a major concern for policymakers. This is because the sector's economic contribution decreases annually. Since agriculture is still the most diverse economic sector in terms of population and plays a major role in India's overall socioeconomic fabric, we must take this steadily declining share of the country's GDP seriously and look for solutions to increase it. In addition, the agricultural sector is crucial for accelerating growth.

In this review, we will try to examine trends in the growth of agricultural production in the country after independence, even though our agricultural area, production and productivity increased with time. We also attempt to understand why the contribution of agriculture to total GDP is continuously declining, identify the factors affecting agricultural growth and examine the difficulties that have affected growth in different sectors and their probable solutions.

The Indian economy's reliance on agriculture

Supply of industrial raw materials

There is a long-run relationship between agricultural growth and other sectors of the economy, where advancements in one sector can drive progress in other sectors. In most developing economies, industrial sectors depend significantly on agriculture, which contributes to the economy through product and market linkages, factor inputs and foreign exchange. Muir stated that "agricultural progress is essential to provide food for the growing non-agricultural labour force, raw materials for industrial production and savings and tax revenues to support broader economic development, earn foreign exchange and create markets for domestic manufactures", a perspective particularly relevant to India. To boost total economic growth, agriculture provides other economic sectors with raw materials, surplus labour and savings. If the agriculture sector grows by 1 %, it boosts industrial sector production by 0.5 % (21). To make agriculture more profitable, the Government of India established the Ministry of Food Processing Industries to stimulate the agricultural economy of India. The Indian government also established a farmers' commission to evaluate their work, progress and other agricultural programs. Because over two-thirds of India's population resides in rural areas, rural regions constitute a major market for industrial goods. The demand for all kinds of industrial products has been fuelled by a significant amount of rural purchasing power and farmers' purchasing power has expanded significantly in recent years since the green revolution began. To address these issues and increase the sector's contribution to GDP, commercialization and research-focused initiatives are crucial. The government has implemented various interventions to achieve the sustainable development goals in agriculture, focusing on poverty alleviation, food security and sustainable land use (22), which necessitates the launch of initiatives to address contemporary challenges, with particular emphasis on agricultural research focusing on productivity enhancement, income diversification, climate resilience and inclusive rural development.

Source of employment

At present, youth unemployment and under-employment are serious concern in several nations and are more severe in villages than in cities. Agriculture is the primary source of employment in developing countries and, with adequate support, can provide a viable alternative to capital-intensive, large-scale corporate farming. Nearly half of all unemployed people worldwide are young people and many more are underemployed, meaning they have insufficient work or unstable, low-quality jobs in the unorganised sector. Therefore, the agricultural sector plays a crucial role in arranging employment. According to the NSSO, 69.5 % of the working population was engaged in agriculture in 1951. At present, approximately 45.76 % of the workforce is employed in agriculture, contributing about 17 % to the national GDP (Fig. 3) (23). As a result of the inability of other economic sectors to create enough jobs to accommodate the expanding population, this ratio dropped to 66.9 % in 1991 and 56.7 % in 2001. In 2016–17, the employment share of agriculture was approximately 52 %, while during 2022–23 share is 45.76 % of total work force (24). However, the number of individuals working in agriculture has increased significantly owing to rapid population growth. Agriculture provides necessities for workers in a variety of sectors.

Provision of food grain

Ensuring food security and advancing agricultural production are crucial for safeguarding and promoting national interests. In this case, the agricultural sector is the only sector that can play a special role in the output of the farming industry, i.e., the grain production branch. With the continuously increasing population, food requirements are also growing, resulting in food grain competition in the world grain markets. Rising geopolitical tensions have significantly affected global agro-industrial supply chains. In such situations, agriculture is the most appropriate resource for the success of competition and food provision for the growing population. At the time of independence, India had a weak agricultural base and low food grain production. However, the country is now largely self-sufficient and no longer depends on food grain imports. The production of food grain in India has increased

from 51 million tonnes in 1950–51 to 357.7 million tonnes in 2024–25 (25). However, more innovation is still needed to ensure greater production, productivity and capacity for major crops. Simultaneously, innovations have the potential to significantly increase the yield and consumer quality properties of sub complex grain products. This has made it possible for the nation to overcome the scarcity of food grains.

Earners of foreign exchange

Since the outset, a significant amount of national income has come from agriculture. India's agricultural exports totalled US\$51.1 billion in FY25, i.e., 11.1 % of total merchandise exports, while agricultural imports amounted to 19.9 billion US dollars, representing 4.35 % of total merchandise imports (26). The total contribution of agriculture trade, about 15 % of total foreign exchange and out of this 70 % of the export earnings of the country come from the export of agricultural commodities like tea, cotton, jute, vegetables, spices, sugar, etc. and some other food and non-food products. Approximately 130 agricultural products and food items, such as Assam tea, Nagpur orange and basmati rice, have been accorded geographical indications in India. Even during the COVID-19 pandemic, the top five agricultural commodities exported from India in 2019–20 accounted for almost 64 % of the country's agricultural exports. Out of the total exported commodities, 19.7 % are cereals, 18.2 per are fish and crustaceans, 9.75 per are meat, 9.74 per are coffee, tea and spices, 6.5 per are sugars and the total net worth of these exported commodities is about 33.9 US billion dollars. Global Agriculture Trade 2024 - US\$ 2.46 trillion. In 2024–25, top 10 Agri exported commodities (As per PC export) were Marine products (US\$ 7.41 billion), Non-Basmati rice (US\$ 6.53 billion), Basmati rice (US\$ 5.94 billion), Spices (US\$ 4.45 billion), Buffalo meat (US\$ 4.06 billion), Sugar (US\$ 2.16 billion), Coffee (US\$ 1.81 billion), Misc Processed Items (US\$ 1.68 billion), Tobacco Unmanufactured (US\$ 1.48 billion) and Oil meals (US\$ 1.34 billion). Top 10 destinations of India's Agri exports are USA, UAE, China, Bangladesh, Saudi Arab, Vietnam, Iraq, Malaysia, Indonesia and Benin (27). Therefore, even though the agriculture the agricultural sector continues to make a significant contribution to foreign exchange earnings, we still need to

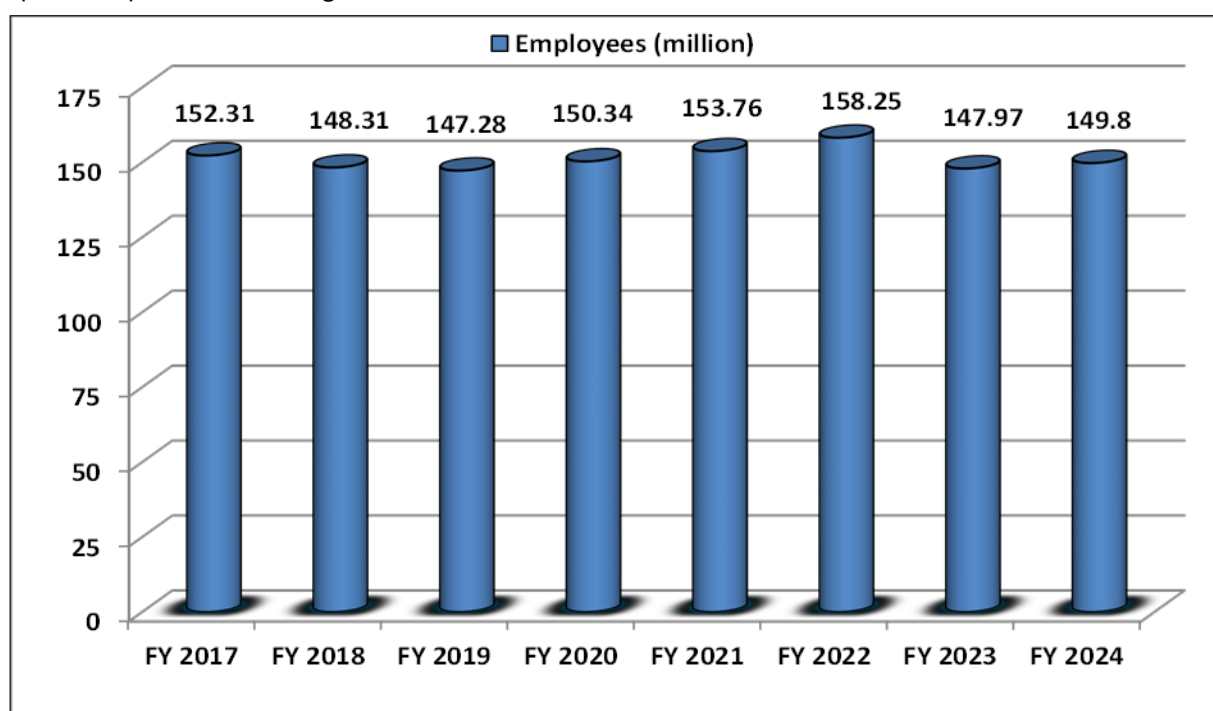


Fig. 3. Number of employees in agriculture sector in India FY 2017–24 (23).

concentrate on commercialising agriculture and exploring it globally, as countries' current share of global trade may be less than 2 %, despite efforts to double farmers' incomes and increase India's agricultural trade. Since most people rely on agriculture for their living, it remains the primary sector, even if its share of national revenue has been steadily declining as a result of the growth of secondary and tertiary industries.

Source of revenue for the government

In a country like India with a developing economy, the agricultural sector plays an important role, which is one of the causes of prosperity, as the Indian economy still depends on the agricultural sector. The development of the agriculture sector is the basic requirement for sectoral diversification and economic development. Rural communities rely heavily on agriculture for their income; therefore, a viable local government in villages would need to impose form of agricultural taxation or revenue mobilisation mechanism to support local development. One of the major sources of revenue for both state and central governments is agriculture, which collects substantial income from raising land revenue. A small portion of the federal and state governments' overall revenue comes from agricultural taxes, irrigation fees, taxes on goods that growers buy and so on. The federal government also receives money from export duties. Land revenue and agricultural income taxes are the primary taxes imposed on the agricultural industry. Nearly every state in the nation collects land revenue, but only six namely West Bengal, Assam, Bihar, Kerala, Odisha, Tamil Nadu, impose an agricultural income tax.

Some other crucial roles of agriculture

- Extension of the market for industrial output.
- Supplying raw food materials to the non-agricultural segment of the economy.
- Generating demand for products made by industries other than agriculture.
- Supplying investable surplus for non-agricultural sector investments in the form of savings and taxes.
- Using a large percentage of labourers who lack education, are illiterate and lack skills.
- Improving rural welfare.

Causes of the declining share of the agriculture sector in GDP

Honourable Finance Minister Smt. Nirmala Sitharaman stated: There is an immediate need to improve agricultural infrastructure so that we can produce more, while also conserving and processing agricultural outputs efficiently (18). This will ensure enhanced remuneration for our farmers. To increase agricultural growth and its share in GDP, there is an urgent need to expand irrigation facilities, strengthen agricultural research and extension systems and develop high-yielding, stress-tolerant crop varieties capable of withstanding heat, cold and drought conditions, while ensuring their affordability to farmers. India's share of GDP spent on agricultural research (including R&D) in 2024 is approximately 0.4 % of its agricultural GDP, with overall national R&D spending at 0.64 % of GDP; this is considered quite low compared to some global peers. At the same time, other countries such as Brazil spend about 1.8 % and China 0.6 % of its agricultural GDP on agricultural research, highlighting India's relative underinvestment. Another major cause of decreasing share is the high growth in other sectors, i.e., the service and industrial sectors. Various factors have influenced the declining share of agriculture in India's GDP. Farmers face significant risks due to climate change and market fluctuations, particularly those affecting small and marginal farmers. Therefore, to increase the share of agriculture in GDP, we need collaboration between policymakers, researchers and practitioners to promote the adoption of the latest technologies and effectively address the sector's challenges. Thus, the major reasons for the declining shares are discussed below.

Per capita income

The economic survey 2024–25 shows that the government has not been able to shift people from the agriculture sector to services or manufacturing. The share of the manufacturing sector in providing employment in 2023–24 declined from 12.1 % to 11.4 % and the share of the services sector decreased from 31.1 % to 29.7 %, in comparison to 2017–18 (18). Agriculture GDP has grown at 4.02 % per annum during 2014–15 to 2024–25, while overall GDP growth has been 6.05 % during the same period. Though this growth rate has been quite respectable to feed the large and growing Indian population, especially with basic staples, yet the level of income of an average agri-household remains quite low. To estimate current income levels of agricultural households, 2018–19 SAS data was projected to 2024–25 using real agricultural GDP growth, which averaged 4.72 % annually since 2018–19 and adjusting it for inflation

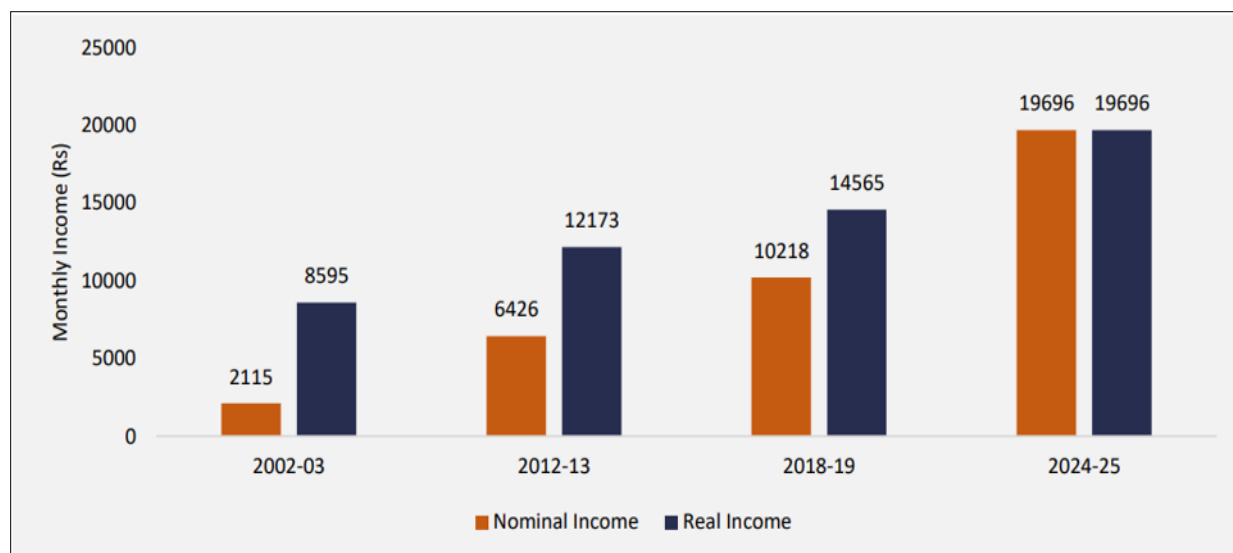


Fig. 4. Average income of agricultural households in India (INR). Source: Estimated by authors from Situation Assessment Survey (28).

and payments under Pradhan Mantri Kisan Samman Nidhi (PM-KISAN). Based on this, the estimated All-India average monthly income of agricultural households in 2024–25 is INR 196962.00 (Fig. 4) (28). Agricultural labour moves from agriculture to the manufacturing sector as per capita income rises. Increasing income per capita at a given commodity price causes spending to shift away from food items toward manufactured goods and services, thereby reducing the relative contribution of agriculture to GDP (29). When food prices fall relative to overall prices in a closed economy, returns to the factors used in agricultural production diminish. This will lead to overall net migration rate of labour in India was estimated at 28.9 % (30), which will lower the relative growth rates of agricultural output and employment. Generally, there are two types of expenditure in the community:

Necessities spending: include food and clothing: In this category low-income families and only the bottom 10 % of household necessities form an overwhelming proportion of their consumption basket. Currently, they spend 63 % of their total consumption on necessities (31).

Discretionary spending: By the end of households, discretionary spending outpaced necessities in the end of the 1990s. In FY15, Indian households spent 52 % on expenses other than food and clothing (48 %) (31). Consumption baskets for Indian households have evolved over the last two decades. Spending can be broadly divided into two categories. The trend in the share of consumption in these two categories followed the opposite direction, with

discretionary spending gradually gaining prominence in the consumption basket. Per capita monthly cereal consumption continuously decreased in rural areas, was about 13.4 g, while in urban areas it was around 13.6 kg in 1993–94, which is in 2022–23, this declined to approximately 9.4 kg in rural and 8.0 kg in urban areas (Fig. 5). This change is due to changes in dietary habits and the per capita consumption of non-agricultural products such as chicken has increased in rural and urban areas (32). In the mid-1980s, per capita poultry meat consumption was at a very low base of 0.2 kg; by 1997–99, it was enhanced to 0.6 kg and by 2020, consumption had risen abruptly, reaching an all-time high of 3.23 kg before experiencing a dip in 2021 due to COVID-19. The share of food decreased in total spending because the growth rate of food components was lower than that of total spending by Indian households (Table 2). This shift in consumption patterns is one of the main reasons for the gradual decline in agriculture's share of India's GDP. The nominal income is given for the year under consideration, while real incomes are calculated in 2024–25 prices to make them comparable.

Reduced harvestable land quality, insufficient funding and outdated technologies

Harvestable land quality in Indian agriculture has drastically decreased because of excessive chemical use, soil erosion and fragmentation. Crops' productivity and sustainability are hampered by a lack of funding and restricted access to new technologies. Because of monocropping, excessive use of chemical fertilisers and

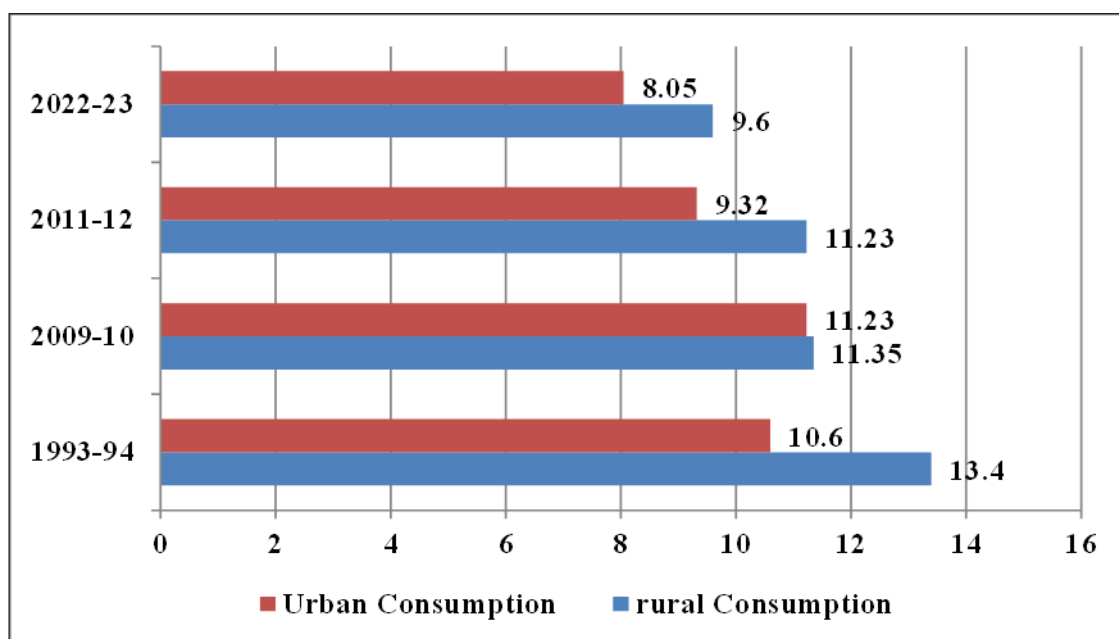


Fig. 5. Per capita, cereal consumption has been on the decline since 1993–94 (34).

Table 2. Growth in household spending (%) on different components (22)

Consumption categories	FY 1994–2005	FY 2006–15	FY 2016–21
Food	3.0	4.2	5.3
Health care	7.1	8.2	8.3
Education	11.5	8.9	8.9
Conveyance	8.7	9.1	9.1
Non-food EMC	4.9	4.1	5.0
Durable goods	9.8	10.1	10.3
Consumer service	10.6	6.8	6.9
Others	8.4	5.8	6.8
Total consumer market	5.0	5.7	6.7

EMC: environmental monitoring criteria.

inadequate irrigation techniques, approximately 30 % of Indian agricultural land is currently degraded, leading to decreased soil fertility, erosion and poor water retention. In addition to decreasing the economic viability of small farms, fragmented landholdings make it extremely difficult to invest in sustainable practices or soil replenishment. In Indian agriculture, these forces work together to perpetuate a cycle of low production and slow reduction in rural agricultural prosperity.

Differences in rates of technical change between sectors

Technical progress occurs more slowly in emerging nations' agricultural sectors than in their non-agricultural sectors; consequently, the non-agricultural sector is growing much faster. This has directly affected the declining proportion of agriculture. Examples of how new changes are directly harming the agricultural sector and benefiting the industrial sector. If we discuss mango crops, where, in old times, labour was involved in the identification of mangoes that were ready for ripening, a natural ripening process, plucking them, which involved occasional monitoring, manual harvesting, then transport to the market and selling them. All these operations are carried out by men and bring benefits, which increase the income of rural people. However, there is currently no need for such expertise. Raw mangoes were cut, dipped in monochrome, packed and sent to a city hypermarket. Thus, chemical factories directly benefit from this. The chemicals used for ripening mangoes harm human and animal health, which medical factories take advantage of. The US has done this exceedingly well; it has a 1 % GDP contribution from farmers and 17 % from the healthcare sector, whereas India has 17 % GDP from agriculture and 4 % GDP from the healthcare sector (35). In the same manner as for the cultivation of rice crop, for application of FYM in the field and ploughing the field, plantation of rice nursery, harvesting, paddy storage mills were used and for de-husk, the paddy use of local mills whenever needed, etc. works goes on for almost 4–6 months and ultimately benefits were collected at the village level and farmers so, people have both work and money. However, under the new GDP, urea is used as a fertiliser, tractors are used for ploughing, transplanting of seedlings, other related work for cultivation, machines used for harvesting, big mills for one-time dehusking and chemicals used for long-term storage of rice. For the seed production process, most of the studies were operated through manpower, such as manually identifying the best seeds in the final stages of the crop and storing them with traditional techniques, such as applying cow dung ash, neem leaves, etc., in mud pots. The following year, this seed was used after considerable effort and patience. However, now a day's new system is being adopted by private companies i.e. hybrid seed, which is prepared by private companies and benefits from harvest, transportation to the

Table 3. Comparative labour productivity in agriculture (36)

Country	Average labour productivity (Rs.)
India	1632
England	16456
Japan	18120
USA	19264
West Germany	17690

market and selling, regardless of the syndicate price. Hybrid seeds cannot be stored and users buy new seeds the following year under the assumption that they are better than their own crops. Agriculture and biotech companies have invented many chemicals to store seeds and many chemicals to spray as pesticides. Therefore, much of the above agriculturally associated GDP was captured by new industries, leaving people associated with agriculture idle for most of the time, so their GDP contribution decreased. Thus, labour jobs are taken up by new industries, such as chemicals, diagnosis and hospitals and with the onset of rains, all these industries will have full sales. In this situation, how can we consider that the contribution of the GDP share will increase in the agricultural sector?

Low labour productivity in agriculture

Labour productivity is the real GDP per hour worked by labour. This means that whatever work is done by labourers or any other inputs is better than the labour involved in doing that work or output in a given time. The average number of hours worked multiplied by the appropriate and trustworthy employment indicator for each nation is the labour productivity data shown in Table 3 (36). For the assessment of labour productivity of different countries, a combination of a model based on the different economic climates of individual countries and world economies has been analysed as an index for 2010–11. In this table, we can see that labour productivity is much lower, i.e., Rs. 1632, compared to other countries, which is one of the main reasons for the declining share of GDP in agriculture.

The low productivity in Indian agriculture

Approximately 100 million of India's 140 million working-age population were employed in agriculture in 1951 and 52 % of the country's 500 million workers were employed in the agricultural sector. However, productivity growth in agriculture is still slower than in the manufacturing and service sectors. Inputs' productivity in the Indian agriculture sector has increased over the years, but at a global level, input productivity in agriculture is much lower and other agricultural factors like mechanisation and average farm size are also lower (Table 4) (37). Low input productivity is one of the reasons that the percentage share of agriculture has reduced from almost half to one-sixth of the GDP. Major reasons for low input productivity are a mix of antiquated farming methods, tiny and dispersed land

Table 4. Comparative agricultural productivity of crops and other factors (37)

Country	Major Crop	Productivity (tonnes/ha)	Mechanisation in agriculture (%)	Average farm size (ha)	Workforce in agriculture (%)	Gross domestic product (GDP) % from agriculture
India	Rice	2.5–2.6				
	Wheat	3.4	20 %	2.3	~42–50	~17
	Cotton	0.5				
China	Rice	6.5				
	Wheat	5.9	~90–95	8.7	~25	~8
	Cotton	1.9				
USA	Maize	11				
	Wheat	3.6	~90	250	~1.5	~1
	Maize	10.4				
Southeast Asia (Vietnam)	Rice	~6.3	60–80	3.1	~30	~15
	Rice	5				
Bangladesh	Maize	8.7	25	0.3–0.54	35	11
	Wheat	3				

holdings, inadequate technology utilisation, degraded soil, financial limitations and an excessive reliance on monsoons. Smaller farms, less mechanisation and insufficient infrastructure are the key reasons why India's agricultural productivity in 2024 will still lag behind that of big nations such as China, the US and top Southeast Asian producers. Overall, despite improvements, India's agricultural output still lags far behind that of the most productive nations, owing to factors such as resource management, landholding structures and the adoption of new technologies.

Change in employment and lifestyle from rural to urban

The migration of a significant portion of our working population to urban jobs in search of higher remuneration and job security has resulted in a gradual shift from rural employment to urban jobs over the past few decades, attributable to the rapid growth of urbanization. A significant transformation in both employment opportunities and lifestyle occurs as a result of migration from rural to urban areas in India. This transition is characterised by a transition from agricultural work to a variety of jobs in industry and services, as well as a transition from traditional, community-oriented living to a fast-paced, modern lifestyle. In rural areas, the workforce shifts from agricultural and allied occupations to jobs in corporate, manufacturing and service industries in urban areas because more regular wage jobs, better job security and higher salaries are found in large cities. More than 90 % of wage workers hold regular employment compared to only 33 % in rural areas. Moreover, higher standards of living and greater earning potential are the result of living in an urban area, which offers easier access to amenities, technology, infrastructure, healthcare and education. As a result of this shift, agriculture-related employment has declined, while regular non-farm jobs have partially increased and informal and casual work have increased.

Problems with Indian agriculture for lower productivity

In a country with an agrarian economy such as India, the speedy and sustainable development of agriculture and allied activities is a potent tool for the progress of the country.

Small farm holding

Land and labour are the major inputs for any farm to obtain more benefits and productivity. In India, farms are generally small and the workforce per farm is higher on these farms than on large farms. The profitability tends to increase with farm size, while productivity per acre shows mixed evidence depending on crop type and technology adoption (38). The prevalence of smallholders, or 86 % of all farmers, owning 45.76 % of landholdings (39) and the growing feminisation of the agriculture sector, where 73.6 % of rural women workers are farmers with 12.6 % of landholdings, are two notable trends in Indian agriculture. There is insufficient utilisation of technology, contemporary agricultural practices, low labour productivity and disguised unemployment. Low income and productivity are mostly caused by these factors.

Largely traditional farming

Traditional agriculture faces challenges in improving productivity owing to the improper use of modern inputs and a lack of complementary practices. The excessive use of agrochemicals and intensive tillage negatively affect soil microbial diversity and sustainability (40). Due to the uneven distribution of land, the allocation of labour and other necessary inputs is very difficult, so the efficiency of these inputs is very low, resulting in low productivity and under-employment, dominating traditional agriculture.

Highest food spoilage rate

With steady growth rates in recent years, India's agricultural industry has shown incredible resilience. However, in India, there is a huge lack of cold storage, an efficient rural transport system and an almost non-existent effective retail channel structure at the rural level, which makes India one of the highest food spoilage rates. Food travels to Indian consumers through a slow and inefficient chain of traders. This results in a lower contribution to the value realized in Dollar's term, since it lowers the final accrual of production. As per the report, the estimated food wastage in India in 2022 is 55 kg/capita/year in India which is significantly lower than the global average of 79 kg/capita/year (41). United Nations Environment Programme has stated in food waste index report that 68.7 million tonnes of food is wasted annually in Indian homes and it stands 2nd worldwide in terms of household wastage of food which is about Rs. 90000 crore to Rs. 1 lakh crore per year (42). Total losses include 30–40 % of agricultural produce due to inadequate storage, inefficient supply chain management, poor post-harvest handling. High wasting during wedding and functions. Up to 40 % of fresh produce is wasted each year before it reaches customers (Table 5) and 30 % of farmers supply spoils (43).

Poor road transportation facility

In any country, the market is the primary medium through which farmers can sell their produce promptly without deterioration in quality. However, there is a lack of logistics connectivity to ensure that their products reach the market in time, especially perishable milk, fruits and vegetables. If these products are carried through a bumpy road network, several other crops, such as fruits, mangoes, grapes, oranges and bananas, may also suffer losses from standing. The best transportation facility is important for increasing agricultural productivity, maintaining the quality of agricultural products, ensuring the timely placement of products in the market and facilitating interactions among different geographical and economic factors from new locations. However, due to a lack of transportation or poor transportation, Indian agriculture wastes billions of rupees annually. According to Dalwai Committee report (2023), Rs. 92651 crore per year in postharvest losses are due to poor storage and transportation facilities and, an investment of Rs. 89375 crores, which is less than the annual postharvest losses, can improve the storage and transportation facilities of agricultural products. The untimely transport of goods increases the gap between demand and supply and increases transportation costs. In summary, transportation facilities enable agriculture and embolden farmers to invest more and increase their production. Without this transportation facility, large quantities of thoroughly farmed produce are wasted.

Poor irrigation system

Research has consistently demonstrated that irrigation significantly enhances agricultural productivity and efficiency in developing countries compared to rainfed systems. In Brazil, irrigated farms are 2.51 % more technically efficient than rain-fed farms. In India, implementing deficit irrigation strategies in rainfed areas with water-harvesting structures improved crop productivity by 20 % and

Table 5. Agricultural waste in India (43)

Crop	Wastage (%)
Rice	11.90
Wheat	14.07
Fruits	3.60
Vegetables	7.08
Others	6.04

expanded the irrigated area by 140 % and approximately 40 % of the world's cereal production is contributed by only 17 % of the irrigated land on Earth (44). Therefore, irrigation plays a significant direct and indirect role in reducing poverty and improving the economic growth of any country, thereby improving the standard of living of farmers. However, despite several efforts and advancements, Indian agriculture continues to suffer from a lack of a reliable and managed supply of water through artificial irrigation systems. According to the National Council of Applied Economic Research (NCAER) data, only 27 % of the land is watered by public irrigation, such as canal irrigation; 18 % is irrigated by private measures, including wells and ponds; and 4 % is irrigated by combining public and private irrigation (45). The remaining area is dependent on rainfall. The NCAER also observed significant variations in agricultural productivity attributable to differences in irrigation access. Because irrigation has a direct positive impact on the overall amount of crops produced during a particular cropping season, it raises the annual revenue per acre of land. Second, irrigation may make it possible to plant a plot in a year with an additional crop season. Out of the net sown area, the area under irrigation is substantially increased from 17.56 % in the year 1950–51 to 59.30 % in the year 2023–24 indicating steady progress in expanding irrigation coverage across agricultural land in the Country (46). India's agricultural output will inevitably decline in the absence of a reliable and regulated water-supply system. Poor irrigation systems result in crop failure, harvesting delays and eventually, significant losses for farmers.

Investment and subsidies

According to elementary growth theory, the growth of any sector depends mainly on investments and its capital-output ratio. Investment in agriculture has been 8–12 % of the agricultural GDP. Public sector investment in the agricultural sector accounts for only 0.6 % of the agricultural GDP as compared to the service sector, which is one of the reasons for low growth in total factor productivity. According to some studies, the return on investment in agriculture is three times greater than that on subsidies. We have a large number of subsidies for fertilisers, which are the least productive. We focus more on the development of industries than on agriculture because all raw materials are obtained from agriculture. India was very late in drafting its best agricultural policy. Rising input costs, including labour, combined with relatively low minimum support prices (MSPs), have adversely affected farm profitability and output incentives. Costs have been high and MSP has been low to incentivize production. The most important factor preventing agriculture from contributing to a share of GDP is the dependence of Indian agriculture on monsoons.

Probable ways to raise the agriculture sector's contribution to total gross domestic product

The provision of adequate storage facilities, enhanced holding capacity and efficient transportation systems is essential for improving agricultural marketing. Indian farmers receive only 10–23 % of the price paid by consumers, compared with 64–81 % in developed countries (30). Globally, farmers receive an average of 27 % of consumer expenditure on food consumed at home, with this share decreasing as income rises. Therefore, we must develop a chain that provides an easy approach for farmers to obtain the maximum price for their products. However, supermarket channels in India offer significantly higher farm gate prices (20 % or more) than traditional markets owing to fewer intermediaries and

lower transaction costs. Farmers' agricultural produce should not be allowed to be purchased below the MSP by the buyer (government agency or private businessman) and should try to reduce input costs used in agriculture.

We should focus more on agriculture and industry than on services through scientific and commercial approaches.

- An increase in agricultural yields an increase in industry and vice versa.
- As much as possible, we should consume locally produced products. Imports of commodities will decrease, directly contributing to the country's economy.
- For lands that are not in use, the government should run a wasteland development program and use that land for production purposes as per its capacity.
- Efficient use of groundwater and irrigation with maximum irrigation use efficiency or minimum losses of irrigation water.
- Agricultural research and extension systems must be stronger so that farmers can obtain new technologies and schemes brought by the government for their welfare.
- Government support price schemes can be effective in ensuring high output, subsidizing consumption for the poor and maintaining food security, particularly when the value of reserve stock is high.

Conclusion

It is impossible to overstate the significance of agricultural exports to the nation's economic development. The strategic objectives and policies of the government affect agricultural trade. India's agriculture sector has the potential to increase exports to other nations. Through the export of a range of agro-based products, India's agricultural commerce has significant potential to generate foreign exchange. Field crops, horticulture, dairy, livestock, poultry and fisheries are just a few of the agri-products that can be exported from India. We can now satisfy our own needs for food security and develop to the point where we can export goods to other nations. The findings indicate that this trend is driven by inter-sectorial disparities in technological advancement, low labour productivity, inadequate infrastructure and limited capital investment. Persistent dependence on traditional farming practices, poor irrigation infrastructure and inadequacies in post-harvest management further constrain agricultural competitiveness and income growth. Strengthening agriculture's role in the national economy requires a comprehensive policy framework emphasising productivity enhancement, technological diffusion and market efficiency. Strategic investments in irrigation, storage, transport and value chain development are essential to reduce post-harvest losses and stabilise farmer incomes. By integrating technological innovation, infrastructural development and inclusive growth strategies, India can ensure that its agricultural transformation contributes more effectively to national economic growth and rural welfare. There is far too much work to be done to connect our cropping systems with globally accepted production, storage, packing, shipping and handling regulations.

Authors' contributions

AC drafted the manuscript. AKS, SK, RKK and DKM conceptualisation and review of the study and checked the language of the manuscript. JPP, GS, MM and MR were involved in data analysis, data collection and interpretation, MZH assisted and prepared the figures and graphs. SKD assisted in the preparation of the final manuscript. All authors have read and approved the final manuscript.

Compliance with ethical standards

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