



# Comparative Analysis of Agricultural Productivity in India and China: Structural Constraints and Policy Implications

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**Abstract**— Agriculture continues to play a fundamental role in sustaining the economies of many developing countries by ensuring food availability, generating rural employment, and supporting overall economic stability. Among the major agricultural economies of the world, India and China occupy a prominent position as they together account for a substantial share of the global population and agricultural production. Despite similarities in demographic pressures and dependence on agriculture, the two countries display significant differences in agricultural productivity, technological advancement, and institutional support mechanisms. This study provides a comparative analysis of agricultural production in India and China by examining production statistics, crop yields, policy reforms, and structural characteristics of the agricultural sector. The analysis reveals that while India possesses a large agricultural workforce and extensive cultivated land, China has achieved significantly higher productivity with cereal yields averaging 5,800–6,000 kg/ha compared to India's 3,000 kg/ha. China's total food grain production of approximately 695 million tonnes substantially exceeds India's 354 million tonnes. These differences are primarily attributed to China's greater investments in large-scale mechanization, stronger irrigation infrastructure, advanced agricultural research systems, and coordinated institutional reforms. The study also evaluates the impact of economic liberalization and market-oriented reforms on Indian agriculture, particularly in the context of rising input costs, market volatility, and structural constraints faced by small and marginal farmers. The findings suggest that improving agricultural productivity in India requires greater investment in agricultural research, expansion of irrigation infrastructure, promotion of farm mechanization, land consolidation, and strengthening of post-harvest supply chains.

**Keywords**— *India-China comparison, agricultural productivity, farm mechanization, structural constraints, agricultural policy, food security.*

## I. INTRODUCTION

Agriculture continues to play a fundamental role in sustaining the economies of many developing countries by ensuring food availability, generating rural employment, and supporting overall economic stability. Among the major agricultural economies of the world, India and China occupy a prominent position as they together account for a substantial share of the global population and agricultural production. Despite similarities in demographic pressures and dependence on agriculture, the two countries display significant differences in agricultural productivity, technological advancement, and institutional support mechanisms. Understanding these differences is important for identifying policy strategies that can strengthen agricultural performance and improve farmer livelihoods.

India and China are among the largest agricultural producers in the world and together support more than one-third of the global population. Despite similarities in demographic pressures and historical dependence on agriculture, the two countries exhibit significant differences in agricultural productivity, technological adoption, and institutional support systems. This study provides a comparative analysis of agricultural production in India and China by examining production statistics, crop yields, policy reforms, and structural characteristics of the agricultural sector. The analysis highlights that although India possesses a large agricultural workforce and extensive cultivated land, China has achieved significantly higher productivity through large-

scale mechanization, stronger irrigation infrastructure, advanced research and development systems, and coordinated institutional reforms.

Another important factor influencing the trajectory of Indian agriculture since the early 1990s has been the gradual integration of the sector with global markets. Economic reforms introduced under the framework of Liberalization, Privatization, and Globalization (LPG) reduced several trade restrictions and encouraged greater participation of private enterprises in agricultural input markets and supply chains. These policy changes aimed to improve efficiency and competitiveness by exposing domestic agriculture to market forces. However, the transition towards market-oriented agriculture has also created new challenges for farmers, particularly in relation to price volatility, fluctuating input costs, and increased exposure to international competition.

In the contemporary policy context, particularly during the 2020–21 to 2024–25 period, these market-oriented reforms became more pronounced through initiatives aimed at restructuring agricultural markets, encouraging private investment, and integrating domestic agricultural production with global value chains. The introduction of the Farm Laws in 2020 represented a significant attempt to liberalize agricultural marketing by allowing farmers to sell produce outside regulated mandis, promoting contract farming arrangements, and relaxing stockholding restrictions on agricultural commodities. Although these reforms were eventually repealed following large-scale farmer protests, they reflected a broader policy orientation towards market liberalization in agriculture consistent with LPG reforms.

One of the underlying assumptions of such reforms has been that exposure to global markets and competition would enhance agricultural efficiency and productivity. Under this framework, import restrictions were reduced and agricultural trade was gradually liberalized to allow Indian agriculture to compete internationally. However, this transition has also exposed farmers to greater price volatility and competition from heavily subsidized agricultural systems in developed countries, where farmers benefit from advanced mechanization, technological innovation, and substantial government support.

Furthermore, the liberalization process has facilitated the entry of multinational corporations in the agricultural input sector, particularly in seeds, fertilizers, and agrochemicals. While the presence of these companies has expanded the availability of improved technologies and hybrid seeds, it has simultaneously increased farmers' dependence on commercial inputs and raised the overall cost of cultivation. In many regions, especially those dominated by small and marginal farmers, these rising input costs combined with unstable output prices have intensified agrarian distress.

In this context, several international and national institutions have provided policy advisories aimed at improving the resilience and competitiveness of Indian agriculture while addressing farmer distress. The World Bank has recommended that India strengthen agricultural productivity by investing in irrigation infrastructure, improving supply chains, promoting climate-resilient farming practices, and enhancing farmers' access to modern technologies and markets. Similarly, the Food and Agriculture Organization (FAO) has emphasized the need for sustainable agricultural intensification, diversification of cropping patterns, and strengthening farmer organizations to improve bargaining power in markets.

At the national level, NITI Aayog has suggested structural reforms such as modernization of agricultural marketing systems, expansion of digital agricultural platforms, improved agricultural logistics, and development of integrated value chains linking farmers directly with processors and exporters. The institution has also highlighted the importance of strengthening the Minimum Support Price (MSP) procurement system and income support schemes to protect farmers against market fluctuations.

Despite these policy recommendations, the implementation of market-oriented reforms without adequate institutional safeguards continues to raise concerns regarding the vulnerability of farmers in an increasingly liberalized agricultural economy. Rising input costs, uncertain market prices, climate-related risks, and limited access to remunerative markets have continued to place significant financial pressure on agricultural households.

Therefore, while the current LPG-oriented policy framework aims to modernize and globalize Indian agriculture, the success of these reforms depends on balancing market liberalization with strong policy support mechanisms, including price assurance, institutional credit, risk-mitigation systems, and investments in rural infrastructure. Without such complementary measures, the continued liberalization of agricultural markets may inadvertently exacerbate farmer distress rather than resolve the structural challenges faced by the agricultural sector.

This study addresses the following research questions: (1) What are the key structural determinants of agricultural productivity differences between India and China? (2) How have policy reforms in both countries shaped agricultural development trajectories? (3) What policy lessons can India draw from China's agricultural modernization experience?

## II. REVIEW OF LITERATURE

Several scholars have examined the role of institutional reforms, technological adoption, and public investment in improving agricultural productivity in developing countries. Comparative studies between India and China particularly emphasize how policy reforms and modernization strategies have influenced agricultural growth trajectories in the two countries.

One of the earliest and most influential studies is by Justin Yifu Lin (1992), who analyzed the impact of rural reforms introduced in China during the late 1970s. His study highlights that the introduction of the Household Responsibility System significantly increased agricultural productivity by providing stronger incentives to farm households. The reforms shifted production decisions from collective farming institutions to individual households, which improved efficiency and output. The findings demonstrate that institutional reforms and secure land-use rights played a crucial role in stimulating agricultural growth in China.

Further research by Shenggen Fan and Philip G. Pardey (1997) examined the relationship between agricultural research investment and productivity growth in China. Their analysis shows that increased public expenditure on agricultural research and extension services contributed significantly to improvements in crop productivity and overall agricultural output. The study emphasizes that sustained investments in agricultural research and technology development are critical drivers of long-term productivity growth.

In the context of agricultural market integration and value chains, Pratap S. Birthal, P. K. Joshi, and Ashok Gulati (2007) examined vertical coordination in high-value agricultural commodities. Their study highlights how contract farming and improved supply chain coordination can enhance market access for smallholder farmers and improve farm incomes. The authors argue that institutional arrangements linking farmers with processors and markets play an important role in modernizing agricultural systems.

Research focusing specifically on China's agricultural modernization has been conducted by Jikun Huang and Scott Rozelle (2018), who demonstrate that China's rapid agricultural transformation has been driven by technological innovation, strong rural institutions, and investments in irrigation and infrastructure. Their findings suggest that policy reforms combined with technology adoption have enabled China to significantly improve crop productivity and rural incomes.

Studies on India's agricultural development highlight the importance of public investment and policy support. For example, Shenggen Fan, Ashok Gulati, and Sukhadeo Thorat (2008) examined the impact of government investment and subsidies on rural poverty reduction in India. Their findings indicate that investments in rural infrastructure, agricultural research, and irrigation have a stronger long-term impact on productivity and poverty reduction compared to subsidies alone.

Recent studies have also emphasized the importance of technological innovation and climate resilience in modern agriculture. Mahajan, Gupta, and Sharma (2023) compared rice production in India and China and found that China achieves higher yields primarily due to better irrigation infrastructure, improved seed technology, and higher levels of mechanization. Their research underscores the significant productivity gap between the two countries.

Similarly, international organizations such as the Food and Agriculture Organization and the World Bank highlight the importance of sustainable intensification, climate-resilient farming practices, and improved supply chains to enhance agricultural productivity. Reports from the Organisation for Economic Co-operation and Development also emphasize that policy reforms, technological innovation, and efficient resource management are essential for improving agricultural productivity and ensuring long-term food security.

Overall, the existing literature indicates that agricultural productivity improvements are strongly influenced by institutional reforms, investments in research and infrastructure, and the adoption of modern technologies. However, comparative studies suggest that while China has successfully implemented coordinated policy reforms and large-scale agricultural modernization strategies, India continues to face structural constraints such as fragmented landholdings, limited mechanization, and uneven irrigation coverage. These findings provide an important foundation for the present study, which examines the structural determinants of agricultural productivity differences between India and China.

## III. METHODOLOGY

This study employs a comparative analytical approach to examine agricultural productivity differences between India and China. The analysis draws upon secondary data from multiple sources including government publications, international organizations, and academic research. The primary data sources include the Ministry of Agriculture and Farmers Welfare

(Government of India), NABARD annual reports, Reserve Bank of India reports, Economic Survey of India, Fertiliser Association of India, Ministry of Chemicals and Fertilizers, and comparable Chinese agricultural statistics from the National Bureau of Statistics of China and FAO databases.

The temporal scope of the study covers approximately four decades from 1978 to 2024, allowing examination of long-term structural changes and policy reforms in both countries. The analysis focuses on key indicators including food grain production, crop yields, landholding patterns, mechanization levels, irrigation coverage, agricultural research investment, and institutional credit flows. Comparative analysis is structured around six structural determinants: farm size and land consolidation, mechanization and technological adoption, irrigation infrastructure, agricultural research and extension systems, post-harvest infrastructure, and institutional support frameworks. Policy reforms are analyzed chronologically to trace the evolution of agricultural development strategies in both countries.

#### IV. AGRICULTURAL STRUCTURE AND POLICY CONTEXT IN INDIA

##### 4.1 Declining Share of Agriculture in GDP:

One of the most visible outcomes of economic reforms has been the steady decline in agriculture's share in GDP. While this is partly due to rapid growth in the services sector, the agricultural sector has not experienced proportional improvements in productivity and farmer incomes.

TABLE 1  
YEAR-WISE SHARE OF AGRICULTURE IN GDP

Years	Share of Agriculture in GDP
1990-91	30%
2000-01	23%
2010-11	17%
2023-24	15%-16%

Source: Ministry of Agriculture, Government of India; Economic Survey of India

The declining share of agriculture in India's Gross Domestic Product (GDP) is a significant structural feature of the country's economic transformation. While agriculture once constituted a dominant component of the national economy, its relative contribution has steadily declined over the past three decades. This decline can largely be attributed to the rapid expansion of the industrial and services sectors, which have experienced higher growth rates due to technological advancements, urbanization, increased investment, and policy support under economic liberalization.

In contrast, the agricultural sector has continued to face several structural constraints, including fragmented landholdings, limited irrigation coverage, inadequate infrastructure, low levels of mechanization, and vulnerability to climate variability. Furthermore, agricultural productivity growth has remained relatively slow compared to other sectors of the economy. The shift of labour from agriculture to non-agricultural sectors, along with increasing urbanization, has also contributed to the declining share of agriculture in GDP. Although agriculture still employs nearly 45 percent of India's workforce, its contribution to GDP has declined to around 15–16 percent in recent years, highlighting a significant structural imbalance between employment and output in the sector.

##### 4.2 Institutional Credit in Indian Agriculture:

Another important dimension influencing the performance of the agricultural sector is the availability of institutional credit. Over the years, the Government of India has attempted to improve farmers' access to formal financial institutions through commercial banks, cooperative credit institutions, and regional rural banks. Institutions such as the National Bank for Agriculture and Rural Development (NABARD) play a crucial role in refinancing agricultural loans and strengthening rural financial systems.

According to recent estimates, institutional credit to agriculture has increased significantly in the past decade. The agricultural credit target set by the Government of India reached Rs. 20 lakh crore for the year 2023–24, reflecting the expanding role of formal financial institutions in supporting the agricultural sector. NABARD has played an important role in channelizing credit

to rural areas through cooperative banks and regional rural banks, thereby facilitating investment in agriculture, irrigation, farm mechanization, and allied activities.

**TABLE 2**  
**INSTITUTIONAL CREDIT GROWTH IN INDIA (2020-21 TO 2023-24)**

Year	Amount (in crore)
2020-21	15,00,000
2021-22	16,50,000
2022-23	18,50,000
2023-24	20,00,000

*Source: NABARD, Annual Report (various issues); Government of India*

Cooperative credit institutions continue to remain an important source of agricultural finance, particularly for small and marginal farmers. Data from NABARD indicates that cooperative banks and cooperative societies account for nearly 15–17 percent of institutional agricultural credit, while commercial banks contribute the largest share. Short-term crop loans are largely disbursed through Primary Agricultural Credit Societies (PACS) operating under the cooperative credit structure.

**TABLE 3**  
**INSTITUTIONAL SHARE IN AGRICULTURAL CREDIT IN INDIA (RECENT YEARS)**

Institutions	Share in Agriculture Credit (%)	Amount Disbursed (lakh crore)
Commercial Banks	79-81%	Rs. 19-20
Regional Rural Banks	10-11%	Rs. 3.0-3.1
Cooperative Banks	8-10%	Rs. 2.3-2.4

*Source: NABARD, Annual Report (2023–24); RBI, Report on Trend and Progress of Banking in India; Ministry of Agriculture and Farmers Welfare*

The institutional agricultural credit system in India operates under a multi-agency framework, with commercial banks playing the dominant role due to their extensive branch networks and larger capital base. Recent data indicates that commercial banks account for around 79–81 percent of total agricultural credit, while Regional Rural Banks contribute approximately 10–11 percent, and cooperative banks and societies account for about 8–10 percent of total agricultural lending.

Within the cooperative credit structure, Primary Agricultural Credit Societies (PACS) serve as the primary grassroots institutions responsible for disbursing short-term crop loans to farmers. These societies operate at the village level and are linked to District Central Cooperative Banks (DCCBs) and State Cooperative Banks (SCBs), forming a three-tier cooperative credit system designed to provide affordable credit to small and marginal farmers.

Despite their crucial role in rural finance, the relative share of cooperative institutions in agricultural credit has gradually declined over the years due to the expansion of commercial banking networks and technological advancements in banking services. However, cooperative institutions continue to remain important for last-mile credit delivery in rural areas, particularly for farmers who face difficulties accessing formal banking services.

Despite the expansion of institutional credit, several challenges persist. A significant proportion of small farmers still rely on non-institutional sources of credit, including moneylenders and informal lenders, often at high interest rates. Moreover, access to institutional finance remains uneven across regions and categories of farmers. In many cases, rising input costs, market volatility, and climate-related risks have limited the effectiveness of credit in improving farm incomes.

Thus, while institutional credit flows to agriculture have increased over time, the persistent structural challenges faced by the sector continue to constrain its overall contribution to economic growth. Addressing these challenges requires comprehensive policy reforms focusing on productivity enhancement, improved market access, diversification of crops, and strengthening of rural financial institutions to ensure sustainable agricultural development.

## V. RISING INPUT COSTS IN INDIAN AGRICULTURE

Economic liberalization reduced government controls over markets and gradually shifted agricultural inputs toward market-determined prices. As a result, farmers have faced rising costs of various inputs.

### 5.1 Fertilizers:

Fertilizers constitute one of the most significant inputs in modern agricultural production. With the spread of intensive cropping systems, particularly after the Green Revolution, the consumption of chemical fertilizers has increased considerably across states. However, fertilizer use remains highly concentrated in a few agriculturally advanced states.

Data indicate that states such as Uttar Pradesh, Madhya Pradesh, Maharashtra, Punjab, Karnataka, Rajasthan, Gujarat, Bihar, Telangana, and Andhra Pradesh collectively account for more than 88 percent of total fertilizer consumption in India. Punjab is among the highest consumers of fertilizers in the country, with an average consumption of about 223 kg per hectare, which is significantly higher than the national average of around 90 kg per hectare.

**TABLE 4**  
**FERTILIZER CONSUMPTION BY MAJOR STATES (APPROXIMATE)**

State	Share of National Fertilizer Consumption (%)
Uttar Pradesh	17%
Madhya Pradesh	10%
Maharashtra	9.50%
Punjab	6.40%
Karnataka	6.30%
Rajasthan	6.20%
Gujarat	6.10%
Bihar	5.80%
Telangana	5.80%

*Source: Fertiliser Association of India; Agricultural Development Report (2024)*

High fertilizer consumption is generally associated with intensive cultivation of crops such as wheat, rice, and sugarcane. However, the excessive use of fertilizers has also raised concerns regarding soil degradation, environmental sustainability, and rising production costs.

### 5.2 Pesticides:

Pesticide use has increased in India as farmers attempt to control crop losses caused by pests and diseases. The adoption of chemical pest control measures varies widely across states depending on cropping patterns and climatic conditions.

Research indicates that Uttar Pradesh records the highest pesticide consumption, followed by Maharashtra, Andhra Pradesh, and Punjab. Over the last decade, pesticide consumption has increased significantly in several states, including Chhattisgarh, Andhra Pradesh, and Maharashtra, while some states such as Punjab and Karnataka have experienced moderate declines. For instance, Punjab alone consumes approximately 5,270 metric tonnes of pesticides annually, making it one of the largest pesticide-consuming states in India. High pesticide use is particularly associated with commercial crops such as cotton, vegetables, and fruits, which are more vulnerable to pest attacks.

**TABLE 5**  
**STATE-WISE CONSUMPTION OF CHEMICAL PESTICIDES IN INDIA (METRIC TONNES)**

State	Pesticide Consumption (MT)
Uttar Pradesh	11,824 – 13,275
Maharashtra	6,814 – 8,718
Punjab	5,130 – 5,257
Telangana	~4,920
Haryana	~4,064
West Bengal	~3,700 – 4,081
Andhra Pradesh	~1,828 – 1,940
Rajasthan	~1,865 – 1,898
Gujarat	~1,835
Karnataka	~1,830
Chhattisgarh	~1,781
Odisha	~1,144
Bihar	~995
Madhya Pradesh	~599
Kerala	~529
Jharkhand	~455
Himachal Pradesh	~277
Goa	~35

*Source: Ministry of Chemicals & Fertilizers and PPQS statistical database (2023–24)*

### 5.3 Hybrid Seeds:

Hybrid seeds represent another important component of modern agricultural technology. The use of hybrid and high-yielding varieties (HYVs) has expanded rapidly since the Green Revolution, particularly in crops such as maize, cotton, sunflower, and vegetables. The adoption of hybrid seeds is highest in states with commercialized agriculture, including Punjab, Haryana, Maharashtra, Gujarat, Andhra Pradesh, Telangana, and Karnataka.

These states have higher levels of agricultural productivity due to improved seed varieties. However, hybrid seeds are often produced and marketed by private companies, which increases farmers' dependence on commercial seed markets. The cost of hybrid seeds is generally much higher than traditional varieties, and farmers are required to purchase new seeds every season, thereby increasing the cost of cultivation.

### 5.4 Diesel and Electricity:

Energy inputs such as diesel and electricity play a crucial role in agricultural production, particularly for irrigation and mechanized farming operations. Diesel is widely used for operating tractors, pump sets, and harvesting machines, while electricity is used primarily for groundwater irrigation. States with extensive irrigation infrastructure such as Punjab, Haryana, Uttar Pradesh, and Gujarat have relatively high electricity consumption for agriculture. In contrast, states with lower irrigation coverage rely more on diesel-powered pump sets.

Rising global crude oil prices and periodic increases in electricity tariffs have significantly increased the cost of agricultural operations. Since irrigation is essential for crops such as rice, wheat, and sugarcane, higher energy costs directly affect farm profitability.

### 5.5 Farm Machinery:

Agricultural mechanization has expanded rapidly in recent decades as farmers adopt tractors, harvesters, threshers, and other modern equipment to improve productivity and reduce labour dependency. Mechanization levels are highest in states like Punjab, Haryana, Uttar Pradesh, Gujarat, and Maharashtra. These states have a higher density of tractors and agricultural machinery due to larger farm sizes and better access to credit. However, the rising cost of machinery, fuel, and maintenance has increased the financial burden on farmers. Although mechanization improves efficiency and reduces labour requirements, the high capital investment required for machinery often forces farmers to rely on institutional or non-institutional credit, thereby increasing indebtedness.

In recent years, fertilizer prices and diesel costs have increased substantially, raising the cost of cultivation. Small and marginal farmers, who constitute more than 85 percent of total farmers in India, are particularly vulnerable to these rising input costs.

## VI. COMPARATIVE ANALYSIS OF AGRICULTURAL PRODUCTION: INDIA AND CHINA

Agriculture remains one of the most important sectors in developing countries. Both India and China have historically relied on agriculture to support rural livelihoods and ensure food security. These countries together account for nearly 36 percent of the world's population, making agricultural productivity crucial for global food supply.

Over the past four decades, China has undergone rapid agricultural transformation through policy reforms, technological adoption, and infrastructure development. In contrast, India's agricultural growth has been slower and more uneven due to structural challenges such as fragmented landholdings, limited mechanization, and dependence on monsoon rainfall.

### 6.1 Food Grain Production Comparison:

Agriculture continues to play a crucial role in ensuring food security in both India and China, which together account for a significant share of global food grain production. However, the scale and productivity of agricultural production differ considerably between the two countries.

**TABLE 6**  
**FOOD GRAIN PRODUCTION COMPARISON**

Country	Food Grain Production
India	~354 million tonnes
China	~695 million tonnes

*Sources: Ministry of Agriculture, Government of India; National Bureau of Statistics of China*

In 2024–25, India produced approximately 354 million tonnes of food grains, which include major crops such as rice, wheat, maize, and pulses. This production reflects consistent growth over the past decades due to the expansion of irrigation, improved seed varieties, and government support programs. Despite this progress, productivity levels remain relatively moderate compared to other major agricultural economies.

China, on the other hand, produces around 695 million tonnes of cereals, almost double the food grain production of India. The higher output in China can largely be attributed to greater crop productivity, intensive cultivation practices, higher mechanization levels, and extensive adoption of modern agricultural technologies. China has also invested heavily in agricultural research, irrigation infrastructure, and rural mechanization, which has significantly improved yield levels.

Consequently, although India possesses comparable agricultural land and a large farming population, China's higher yield per hectare and technologically advanced farming systems enable it to achieve substantially greater food grain production. These differences highlight the importance of improving productivity, mechanization, and technological adoption in Indian agriculture to narrow the production gap.

**TABLE 7**  
**MAJOR CROP-WISE COMPARISON: INDIA VS CHINA**

Crop	India Production (MMT)	China Production (MMT)	India Yield (t/ha)	China Yield (t/ha)	Key Gap
Rice	~147–150	~145	~4.3	~7.1	China produces similar output with much less land due to higher yield
Wheat	~113–117	~140	~3.5	~5.5	China has much higher productivity per hectare
Maize (Corn)	~35	~280–290	~3.2	~6.1	Very large production and yield gap
Soybean	~12–13	~20	~1.2	~1.9	China has higher yield and mechanized cultivation
Potato	~60	~95	~24	~33	China leads in productivity and processing industry

*MMT: Million Metric Tonnes; t/ha: tonnes per hectare*

*Sources: Ministry of Agriculture, Government of India; National Bureau of Statistics of China; FAO Statistical Database*

## VII. STRUCTURAL DETERMINANTS OF AGRICULTURAL PRODUCTIVITY GAP

The comparative analysis of major crops between India and China reveals that the difference in agricultural output is primarily driven by productivity-related structural factors rather than land availability. While India possesses comparable or even larger areas under cultivation for several crops, China consistently achieves higher production due to superior technological adoption, irrigation infrastructure, mechanization, and institutional support mechanisms. These factors collectively contribute to a substantial productivity gap between the two countries.

**TABLE 8**  
**COMPARATIVE AGRICULTURAL PERFORMANCE INDICATORS**

Indicator	India	China
Average cereal yield	~3000 kg/ha	~5800–6000 kg/ha
Rice yield	~3.5 t/ha	~4–6.5 t/ha
Wheat yield	~3.5 t/ha	~5–6 t/ha

### 7.1 Farm Size and Land Consolidation:

One of the most significant structural differences between the two countries lies in the size and organization of agricultural landholdings. In India, agriculture is characterized by highly fragmented and small landholdings, with the average farm size being less than two hectares. Such fragmentation limits the efficient use of modern agricultural machinery, irrigation systems, and large-scale farm management practices. Small farmers often lack the financial capacity to invest in improved seeds, fertilizers, and mechanized equipment.

In contrast, China has undertaken extensive land consolidation and cooperative farming initiatives, which have enabled larger operational farm units. Larger farm sizes facilitate the use of modern machinery, efficient irrigation systems, and advanced agricultural practices. As a result, Chinese farmers are able to achieve higher productivity per hectare, thereby increasing total agricultural output.

## **7.2 Mechanization and Technological Adoption:**

Agricultural mechanization is another critical determinant of productivity. China has made substantial investments in farm mechanization, including tractors, combine harvesters, automated transplanting machines, and precision farming technologies. These technological advancements significantly reduce labor constraints, improve the efficiency of farm operations, and enhance crop yields.

In India, although mechanization has improved in certain regions such as Punjab and Haryana, many parts of the country still rely on traditional farming practices and manual labor. Limited access to mechanized equipment, particularly among small and marginal farmers, results in lower efficiency in land preparation, sowing, irrigation, and harvesting. Consequently, crop productivity remains relatively lower compared to China.

## **7.3 Irrigation Infrastructure and Water Management:**

The availability and management of irrigation infrastructure play a crucial role in determining agricultural productivity. China has invested heavily in large-scale irrigation networks, reservoirs, and water management systems, ensuring that a significant proportion of agricultural land remains irrigated throughout the year. Reliable irrigation reduces dependence on rainfall and enables farmers to maintain consistent crop yields.

India, on the other hand, still relies heavily on monsoon rainfall, especially in rain-fed agricultural regions. Although irrigation facilities have expanded in recent decades, uneven distribution of irrigation infrastructure across states leads to variability in crop productivity. Regions with inadequate irrigation often experience lower yields and higher vulnerability to climatic fluctuations, thereby affecting overall agricultural output.

## **7.4 Agricultural Research, Development, and Extension Services:**

Investment in agricultural research and development (R&D) is another factor that contributes to China's productivity advantage. China has established strong agricultural research institutions that focus on developing high-yield crop varieties, hybrid seeds, and advanced cultivation techniques. These innovations are rapidly disseminated to farmers through effective extension services.

While India also has a robust agricultural research network through institutions such as the Indian Council of Agricultural Research (ICAR), the transfer of technology to farmers remains uneven and slower. Limited awareness, insufficient extension services, and financial constraints often prevent farmers from adopting improved agricultural technologies at a large scale.

## **7.5 Post-Harvest Infrastructure and Market Integration:**

China's agricultural sector is supported by well-developed post-harvest infrastructure, including cold storage facilities, transportation networks, food processing industries, and efficient supply chains. These systems reduce post-harvest losses and enable farmers to obtain better market prices, thereby incentivizing higher production.

In contrast, India faces significant challenges related to inadequate storage facilities, limited cold-chain infrastructure, and inefficient marketing systems. A substantial portion of agricultural produce is lost during storage and transportation, reducing the effective output and income of farmers. These constraints discourage investments in productivity-enhancing technologies.

## **7.6 Institutional Support and Government Policies:**

China's agricultural development has been supported by strong institutional frameworks and coordinated government policies aimed at improving productivity. Government programs provide subsidies for farm machinery, irrigation equipment, and technological innovations. In addition, policies promoting rural infrastructure development and farmer training have strengthened the agricultural sector.

India also provides substantial policy support through subsidies, minimum support prices, and agricultural schemes. However, the fragmented implementation of policies and regional disparities often limit their overall effectiveness. As a result, the benefits of agricultural modernization are not uniformly distributed across the country.

# **VIII. COMPARATIVE AGRICULTURAL POLICY REFORM TIMELINE (1978–2024)**

The following timeline presents key agricultural policy reforms in India and China over the past four decades, providing context for understanding divergent development trajectories.

**TABLE 9**  
**COMPARATIVE AGRICULTURAL POLICY REFORM TIMELINE (1978–2024)**

Period	China – Major Agricultural Reforms	India – Major Agricultural Reforms
1978–1984	Introduction of the Household Responsibility System, which replaced collective farming with household-based production incentives and significantly increased productivity.	Post-Green Revolution consolidation. Expansion of irrigation, fertilizers, and HYV seeds to increase food grain production.
1985–1993	Liberalization of agricultural markets; reduction of state procurement monopoly and introduction of market pricing for agricultural commodities.	Expansion of Minimum Support Price (MSP) and procurement system to ensure price support for major crops like wheat and rice.
1994–2003	Land tenure reforms allowing transfer of land-use rights and promotion of township and village enterprises to diversify rural income.	Economic liberalization influences agriculture; emphasis on diversification into horticulture and dairy sectors.
2004–2012	Introduction of annual "No.1 Central Document" focusing on agriculture, rural development, and farmer income growth; increased subsidies for seeds, machinery, and irrigation.	Launch of major national schemes including National Food Security Mission (2007) and Rashtriya Krishi Vikas Yojana (2007) to increase crop productivity and investment in agriculture.
2013–2017	Promotion of large-scale farming, land consolidation, agricultural mechanization, and modernization of supply chains.	Launch of schemes such as Pradhan Mantri Krishi Sinchai Yojana (2015) and Pradhan Mantri Fasal Bima Yojana (2016) to improve irrigation and risk management.
2018–2020	Policies promoting digital agriculture, rural revitalization strategy, and modernization of agricultural value chains.	Income support scheme Pradhan Mantri Kisan Samman Nidhi launched in 2019.
2020–2021	Continued agricultural modernization and rural revitalization policies focusing on mechanization and high-tech farming.	Introduction of 2020 Indian agriculture acts to liberalize agricultural markets (later repealed in 2021).
2022–2024	Expansion of smart agriculture, digital platforms, and high-value agriculture to enhance productivity and rural incomes.	Focus on climate-resilient agriculture, digital agriculture mission, and strengthening farmer producer organizations (FPOs).

Sources: Lin (1992); Huang & Rozelle (2018); Ministry of Agriculture, Government of India; various policy documents

### IX. REFORMS AND POLICIES REQUIRED TO BOOST AGRICULTURAL PRODUCTION

Agricultural production in many developing countries, particularly India, can be significantly enhanced through a comprehensive set of institutional, technological, and market-oriented reforms. Lessons from countries such as China, which has achieved substantial gains in agricultural productivity through coordinated policies and modernization strategies, indicate that a combination of structural reforms and technological investments is essential for improving farm output and farmer incomes.

One of the most important reforms is the strengthening of agricultural research and innovation systems. Increased public investment in agricultural research institutions, universities, and extension services can accelerate the development and dissemination of improved seed varieties, biotechnology applications, and climate-resilient crops. Enhanced collaboration between research institutions and farmers would ensure that scientific innovations are effectively translated into field-level productivity gains. Expanding agricultural extension networks and promoting digital knowledge platforms can further improve farmers' access to modern farming techniques and best practices.

Another crucial reform involves expanding agricultural mechanization and the adoption of modern technologies. Mechanization reduces labour costs, increases efficiency in farm operations, and minimizes post-harvest losses. Governments

can promote mechanization by providing subsidies for farm machinery, establishing custom hiring centers for small and marginal farmers, and encouraging the adoption of precision agriculture tools such as drones, sensors, and satellite-based crop monitoring systems. The integration of digital technologies and artificial intelligence in agriculture can help optimize resource use and improve productivity.

Improving irrigation infrastructure and water management systems is also essential for enhancing agricultural output. In many regions, agricultural production remains heavily dependent on rainfall, which makes farmers vulnerable to climate variability. Expanding irrigation coverage, promoting micro-irrigation technologies such as drip and sprinkler systems, and improving water-use efficiency can significantly stabilize crop production and increase yields.

Land reforms and farm consolidation represent another important policy area. Fragmented landholdings reduce economies of scale and limit the adoption of mechanized farming practices. Policies that encourage land leasing, cooperative farming, and the formation of farmer producer organizations can help small farmers pool resources, access modern technologies, and improve their bargaining power in agricultural markets.

Finally, strengthening agricultural markets and supply chains is essential for ensuring that higher production translates into higher farmer incomes. Investments in rural infrastructure, storage facilities, cold chains, and food processing industries can reduce post-harvest losses and enhance value addition. Market reforms that improve price transparency and expand access to national and international markets can also encourage farmers to diversify into high-value crops.

## X. DISCUSSION

The comparative analysis presented in this study reveals significant structural differences between Indian and Chinese agriculture that explain the persistent productivity gap between the two countries. While both nations began their post-independence development trajectories with similar challenges of food insecurity and rural poverty, their policy choices and investment priorities have led to divergent outcomes.

China's agricultural transformation can be understood as the result of coordinated institutional reforms initiated in the late 1970s. The Household Responsibility System represented a fundamental shift in incentive structures, allowing farmers to retain surplus production above state procurement quotas. This institutional change, combined with sustained investments in irrigation, mechanization, and agricultural research, created conditions for rapid productivity growth. Importantly, China's reforms were implemented in a sequenced manner, with institutional changes preceding technological investments, allowing farmers to respond to market signals with improved productive capacity.

India's agricultural trajectory, by contrast, has been characterized by a different policy mix. The Green Revolution of the 1960s and 1970s successfully increased food grain production through the adoption of high-yielding varieties, expansion of irrigation, and government procurement at guaranteed prices. However, the institutional framework that supported this growth—centered on state procurement, input subsidies, and regulated markets—has proven more difficult to reform than in China. The fragmented nature of agricultural policymaking in India's federal system, combined with the political sensitivity of agricultural issues, has constrained the implementation of comprehensive reforms.

The structural constraints identified in this analysis—fragmented landholdings, limited mechanization, uneven irrigation coverage, and weak post-harvest infrastructure—are interconnected. Fragmented landholdings limit the economic viability of mechanization; without mechanization, productivity remains low; low productivity reduces farmers' capacity to invest in irrigation and other improvements; and weak infrastructure reduces the returns to any productivity gains achieved. Addressing these constraints requires coordinated policy interventions rather than piecemeal reforms.

The policy reform timeline presented in this study illustrates the different reform trajectories. China's reforms began earlier (1978) with fundamental institutional changes that transformed the incentive structure for farm households. Subsequent reforms built upon this foundation, gradually liberalizing markets while maintaining strong public investment in agricultural research and infrastructure. India's reforms, particularly since 1991, have focused more on market liberalization and reduced state intervention, but have been less successful in addressing the underlying structural constraints of the sector. The recent experience with the 2020 farm laws, which were ultimately repealed, illustrates the political challenges of agricultural reform in India.

The implications for policy are clear. Improving agricultural productivity in India requires a comprehensive approach that addresses structural constraints while building institutional capacity. Increased investment in agricultural research and extension is essential for developing and disseminating improved technologies. Expansion of irrigation infrastructure,

particularly in rain-fed regions, can reduce vulnerability to climate variability and enable productivity improvements. Policies that facilitate land consolidation and promote cooperative farming can help overcome the diseconomies of small farm size. And strengthening post-harvest infrastructure and supply chains can ensure that productivity gains translate into improved farmer incomes.

However, these reforms must be implemented with attention to their distributional consequences. Small and marginal farmers, who constitute the majority of India's agricultural workforce, are particularly vulnerable to market volatility and rising input costs. Any reform strategy must include adequate safety nets, including well-functioning price support mechanisms, affordable institutional credit, and risk management tools such as crop insurance.

## XI. CONCLUSION

This study examined the comparative performance of the agricultural sectors in India and China, with particular emphasis on production patterns, structural characteristics, and policy frameworks influencing agricultural productivity. The analysis indicates that although India possesses extensive cultivated land and a large agricultural workforce, its productivity levels remain significantly lower than those of China. China has achieved higher crop yields and overall agricultural output primarily through sustained investments in irrigation infrastructure, widespread mechanization, stronger agricultural research systems, and coordinated institutional reforms. In contrast, Indian agriculture continues to face structural constraints such as fragmented landholdings, uneven irrigation coverage, limited technological adoption, and inadequate post-harvest infrastructure.

The findings suggest that improving agricultural productivity in India requires a comprehensive policy approach focusing on strengthening agricultural research and extension services, expanding irrigation infrastructure, promoting farm mechanization through accessible technologies, and improving agricultural supply chains and storage facilities. Policies encouraging land consolidation, farmer producer organizations, and digital agricultural platforms can further enhance efficiency and market access for farmers. At the same time, policy frameworks should balance market-oriented reforms with institutional safeguards that protect farmers from price volatility and climate-related risks.

The comparative policy timeline demonstrates that China's agricultural transformation resulted from coordinated reforms implemented over several decades, combining institutional change with sustained public investment. India can draw lessons from this experience while adapting strategies to its own institutional context and political economy constraints. The challenge for Indian agricultural policy is to address structural constraints without undermining the livelihoods of the small and marginal farmers who form the backbone of the sector.

Future research may focus on quantitative analysis of productivity determinants using econometric models, region-specific assessments of technological adoption, and the role of digital agriculture and climate-resilient farming practices in enhancing long-term agricultural sustainability. Such studies would provide deeper insights into policy interventions that can help bridge the productivity gap and promote sustainable agricultural development.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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