

Agricultural Productivity and its Trends in India: An Empirical Study

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ABSTRACT

India is the largest producer in the world of spices, pulses, milk, and tea, cashew and jute, and is the 2nd largest producer of vegetables and fruits. Agriculture provides a fundamental pillar to the Indian economy. Thus, agriculture will have plenty of raw materials and produce for an independent and well-functioning economy through major portions of the primary sector. Agriculture also contributes a substantial portion of the Gross Domestic Product (GDP), nearly 15%, and sustains and supports more than two-thirds of the population, who predominantly utilize agricultural activity for income and livelihood.

Objective: This research is intended to explore and analyze trends in agricultural productivity in India.

Methodology: The study employs an analytical and empirical regime to explore agricultural productivity over time through the analysis of trends in agricultural productivity in India using secondary data.

Results and Discussions: Viewpoints on agricultural productivity and government initiatives are discussed here.

Conclusion: India has seen unprecedented growth in agricultural productivity over the years, aided by technological advancements, proactive government programs, and necessary market-oriented reforms that have allowed farmers to adopt better agricultural practices.

Keywords: spices, tea, cashew, GDP, raw materials, livelihood, technology.

INTRODUCTION

Understanding the dynamics of Agricultural Productivity in a nation, where agriculture is not only an economic activity but a way of life for millions. As one of the primary sectors of the Indian economy contributing 18% to GDP, agriculture in India is a major sector. We understand simply as the product of agricultural products in relation. By assessing agricultural productivity specific to India, we can understand it through yield, the produce derived from a unit of land (or area), and resource use efficiency. India is the largest producer in the world of spices, pulses, milk, and tea, cashew and jute, and is the 2nd largest producer of vegetables and fruits. Agriculture provides a fundamental pillar to the Indian economy. Thus, agriculture will have plenty of raw materials and produce for an independent and well-functioning economy through major portions of the primary sector. Additionally, agriculture also contributes a substantial portion of the Gross Domestic Product (nearly 15%), and sustains and supports more than two-thirds of the population, who predominantly utilize agricultural activity for income and livelihoods.

As a nation with agricultural activity, agriculture is essential to improve food security for the many, but it also has great significance for the function and advancement of other non-agrarian sectors of the economy as the resources agriculture has to provide raw materials and products in exchange value. In summary, the amount and/or quality of agricultural productivity can have and will have a pronounced role in a country's advancement [2].

The development of agricultural practices in a country or area depends fundamentally on the efficiency and efficiency of crop production. With a global population expanding at rates never seen before, agricultural productivity is becoming a paramount issue that requires immediate action. Many approaches have been made to improve not only the levels of production but also agricultural productivity overall across various food production contexts throughout history. Agricultural productivity is often measured by assessing which land areas performed better than adjacent areas of land with lower productivity. Agricultural productivity has been broadly defined to describe and explain the spatial organization and distribution patterns on the part of agricultural activities. The geographical analysis of agricultural productivity offers a deeper understanding of agricultural processes because this research explains the underlying spatial patterns and production systems [4]. Many researchers have defined agricultural production, each with different perspectives and disciplinary lenses. One definition states that agricultural productivity is the ratio of the agricultural output index to the index of all inputs used in the farm production process [15]. Geographers often define agricultural productivity as the "output per unit of input," and/or an "output per unit of land area." In short, to measure agricultural productivity adequately, it is important to analyze "yield per unit" [17]. To better understand the spatial arrangement and distribution regimes within the agricultural sector, the notion of agricultural productivity has been repeatedly explored and employed.

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Several researchers have tried to measure and spatially-regionalize the geographical distribution of agricultural productivity (output) in various contexts. The analytical apparatus called the average productivity index (API), which is a measure of the spatial distribution of productivity at the state and national levels, was developed. API is made up of, at a minimum, two important components: yield and harvested area evaluated at the state or national level.

Objective

This research is intended to explore and analyze trends in agricultural productivity in India.

METHODS AND MATERIALS

Methodology

The study employs an analytical and empirical regime to explore agricultural productivity over time through the analysis of trends in agricultural productivity in India. Due to the nature of Indian agriculture, which is marked by wide regional variability, multi-cropping regimes, and variations in agro-climatic factors, the methodology included qualitative, comparative and statistical measures of analysis.

Design: The study is descriptive and analytical in nature, having descriptive attributes that map and describe regional and temporal patterns in agricultural productivity, and analytical characteristics that use quantitative indices, measures of growth rate, and ranking techniques to measure differences and analyze underlying trends and conditions. The design permits a systematic analysis of spatial variation and temporal shifts in agricultural productivity.

Data Sources: The study utilized mainly secondary data, allowing for broad coverage and temporal depth. The data sources included: Government Publications and Reports: Agricultural Statistics at a Glance, reports from the Ministry of Agriculture and Farmers Welfare, and state-level statistical handbooks.

International Sources: Reports and datasets from the Food and Agriculture Organization (FAO), OECD, and World Bank that provide comparative and contextual analysis of agricultural productivity.

Academic Literature: Books, articles from journals, PhD/Doctoral theses, and working papers related to agricultural geography, productivity analysis, and rural development, in general.

Empirical Studies: Sass (Stamp, 1958), Shafi (1960, 1984), Dharmasiri (2009, 2011), Rahman (2003), and subsequent regional and empirical studies, which provided methodological background for measuring agricultural productivity.

Analysis Procedures: To understand trends and spatial variability of agricultural productivity, I have used a multi-method analysis process:

1. Average Productivity Index (API): Based on the method developed by Dharmasiri in 2011, this method allows me to analyze spatial patterns of productivity across regions. API interweaves average yield and harvested area to arrive at an index of relative performance.

2. Kendall's Ranking Coefficient: Based on the methods used by Stamp (1958) and Shafi (1960), I use this method to rank crops and regions on levels of agricultural efficiency to provide for comparisons across districts and states.

3. Compound Growth Rate (CGR): The compound growth rate method is used for assessing temporal changes in area, yield, and output of selected crops. This method is helpful to capture long term growth trends and to signal structural changes in productivity.

4. Z-Score Analysis and Composite Indexing: I have used these methods to categorize regions as to productivity groups (very high, high, medium, and low). This type of categorization is helpful in illustrating regional differences and levels of agricultural development.

5. Trend and Comparative Analysis: I have analyzed temporal trends of certain crops, major crops rice, wheat, and maize, as well as broad category high-value crops, fruits, vegetables, and horticulture products. I have made comparisons of high performers and laggard states to illustrate broad structural inequities.

Scope and Delimitations

The scope of this study covers agriculture across all the major agro-climatic regions in India, including staple crops, as well as emerging high-value crops. However, the study is limited by the ability to only use secondary data, which may not reflect farmer-level variations, miss informal sector productivity, or provide real-time micro-level variation. Nonetheless, the multiple data types give the analysis enough coverage at macro and meso levels to serve as a basis for policy discussion and academic interpretation.

Justification of Methodology

The methodology adopts a framework that combines indices of measurement, growth analysis, and categorical ranking indices to provide both spatial and temporal perspectives of agricultural productivity. This integrative framework is widely accepted amongst researchers in agricultural economics and geography, and fits the complexity and diversity of India. The analysis is based on established empirical methods, and the study provides for methodological rigor and analytical validity.

MATERIALS

There is a wide range of literature available related to measuring agricultural productivity using assorted methods and techniques in the broad area of agricultural productivity and its spatial patterns, both within countries and across the globe. For example, Stamp in 1958 compared the agricultural productivity of several countries and individual significant crops under a global setting using Kendall's ranking coefficient method. Likewise, Shafi in 1960 applied the Kendall ranking coefficient method to farm-level agricultural productivity in the state of Uttar Pradesh, focusing on eight individual crops grown in 48 districts. Another example, Rahman in 2003 observed several trends in agricultural productivity in the North Bihar Plain by reviewing 17 important crops grown for the districts in the area during the period of 1995 to 2000.

Additionally, Kalaivani et al. in 2010, using the Compound Growth Rate method, reviewed growth rate trends, area, yield, and output of several selected crops of Tamil Nadu.

In this analysis, maize was found to have a positive trend in agricultural productivity in the state of Tamil Nadu. Sakthi Mandal in 2012 conducted the first in-depth study using the Z score model to investigate the relationship to spatial variations of agricultural productivity; this study led to the construction of a classification for related blocks in the South 24 Parganas District located within the state of West Bengal, classifying blocks into four levels of agricultural productivity: very high, high, medium, low.

Meanwhile, Muthumurugan et al. in 2012 proposed composite index analysis as a methodological framework to explore the agricultural development context of Tamil Nadu. They then classified the various districts into three groups—highly developed, medium developed, and low developed—by considering their respective index values in a systematic way to analyze the agricultural development context of Tamil Nadu. Likewise, Shymal Dutta in 2012 performed an analytical study to investigate agricultural productivity and the reasons for agricultural backwardness in the context of Hugli district in West Bengal. In this study, he utilized the agricultural efficiency index that was originally proposed by S.S. Bhatia in the analysis, which led to the classification of various productivity sectors into very high efficiency, high efficiency, moderate efficiency, and low efficiency productivity sectors, which also yielded significant information on the agricultural nature of the area. In 2014, researchers Arul Kumar C. and Manimanan G. utilized sophisticated multivariate statistical techniques to analyze the agricultural productivity of 14 different cropping systems in the northwest region of Tamil Nadu. These advanced statistical techniques were paramount in the data reduction and classification process, which then also resulted in the classification of agricultural productivity into three classes: high yield, moderate yield, and low yield of the cropping systems [13]. Since land is the most durable and stable of the three basic agricultural inputs (land, labor, and capital), land productivity is extremely critical to the overall agricultural system.

Essentially, a land can be viewed as a basic unit for measuring crop output in the form of yield, thereby serving the dual role of supplying the country with food that it needs and providing an opportunity for suitable work for the rural population. Land productivity can be significantly improved by using a complete package of inputs, such as application of labor-saving farming technology, fertilizer use, agrochemical application, and improved crop seed varieties. Additionally, farmers in the Mahaweli system 'H' area have adopted crop diversification and multi-cropping on the same piece of land in one growing season, and year-round mixed cropping on the same land (with vegetable farmers in the Nuwaraeliya district as an example). These strategies can also increase land productivity [4].

RESULTS AND DISCUSSIONS

Viewpoints on Agricultural Productivity

Land is clearly acknowledged as a permanent and fixed factor among the various production factors, including labor and capital. The agricultural productivity of land is generally explained in terms of producing crops, or output/yield on a unit area of land. Also emerging as a critical aspect of agricultural economics is the productivity of labor, as it makes up a significant amount of the labor force involved in agricultural production. Labor productivity is a more tenuous concept than land productivity [15]. A very critical aspect of labor productivity is the relationship between agricultural production and labor input.

The number of man-hours used in production, the total labor force, and the value of labor/market wages, or simply the amount of work measured monetarily when considering dollar or market value for man-hours/day, measured in labor input, provide some important relationships to productivity. Also, it is important to understand that agricultural worker productivity can be increased in several ways; including pay increases, incentives, and/or focused training programs for laborers. Also, one of the few productive resources that could be better utilized for the agricultural production process is working capital.

Typically, this capital is spent on many things, including buying land; rectifying land problems; drainage; the irrigation process; buying livestock; buying feeds, seeds, fertilizers, and chemicals; and purchasing agricultural equipment or machinery—all being tangible items related to agricultural productivity. It is difficult to deny that capital is a significant factor in measuring land productivity, which has a direct connection to improving the productivity of land applied to agriculture. In this case, productivity refers to the various traits and attributes relative to numerous inputs, as well as the exact ways these inputs are mixed and put into use during the production process. The systematic increase in tangible capital, such as high-yielding crops, a variety of fertilizers, pesticides, herbicides, and modern tools, and machinery, will help increase agricultural productivity on that land. The difficulty comes, though, in the farmer determining the maximum quantity of the overall inputs needed to achieve the maximum yield from their farm. Agricultural productivity demonstrates measurable evidence of farming practices and outputs. Agricultural productivity is also frequently linked with several socio-cultural traits such as a working ethic, being frugal, being industrious, and wanting a certain standard of living [17].

Certain genetic traits and characteristics retained through the generations enable some groups to sustain relatively high agricultural productivity. Agricultural productivity is influenced by many factors, but ultimately these can be sorted into three groups: physical, socioeconomic, and technological. In the past, productivity studies focused exclusively on physical factors, and now the focus is on more dynamic factors such as socioeconomic contexts and technological innovations. Even with this shift, it is clear that humans have little to no control over some physical environmental factors, including rainfall, intensity and duration of sunlight, soil conditions, and timely access to water. Therefore, a single unified goal of maximum productivity is not workably achievable across agricultural systems. There are still some efforts made to use technology to regulate specific physical environmental conditions. Significant accomplishments attributed to contemporary agronomic practices include improving soil quality with fertilizer, employing irrigation systems in agriculture, regulating crop populations and using chemical interventions, and improving agricultural yields through the development and distribution of high-yielding varieties (HYVs). Many developing countries still utilize outdated or primitive technology and do not obtain satisfactory land productivity levels. Such disparities have created a social significance between farmers with access to superior agricultural technology and those who do not. Notwithstanding these obstacles, the pinnacle of agricultural productivity among farmers from developing countries continues to be significantly far away, especially when compared to the advances of their counterparts from developed countries, as evidenced by Dharmasiri in 2011.

Agricultural Productivity and Its Trends in India

Since more than 60% of the population relies primarily on agriculture as a source of income, it is clear that agricultural productivity is an important and integral part of the country's overall economy, and that it is a primary source of job creation, sustainability, and rural development. With India's unique characteristics, particularly the wide variety of agro-climatic zones, there is both the potential for unique advantages and distinct challenges in promoting improved agricultural output. A complex relationship among socio-economic factors, structures of political power, developments in technology, and climate change has produced radical change over the past decades with far-reaching implications on productivity trends and the agricultural landscape.

Increase in productivity levels: In the past few decades, India has experienced very low and steady increases in agricultural productivity. Although it was evident before the Green Revolution, agricultural productivity was very robust during the years that followed. With the introduction of high-yielding crop varieties and better practices for agriculture, the productivity of staples such as wheat or rice has made tremendous gains. Consider wheat; the yield went from roughly 800 kg/ha in the 60s to around 3,000 kg/ha today, fulfilling earlier expectations. Alternatively, rice productivity has doubled, over this same period, demonstrating how substantially agricultural technologies and better national policy and practice for agriculture have affected farming [16]. However, we must recognize that rates of agricultural productivity gains have begun showing signs of slowing in recent years as crop yields have peaked in a select number of states where land and water resources have become more limited and scarcer, putting substantial pressure on continuing this trend and raising questions about sustainability.

However, it is crucial to recognize that agricultural productivity growth rates have begun to show indications of slowing down in recent years; especially in certain states where land and water resources are growing more limited and scarcer. This poses serious obstacles to the sustainability of this growth momentum.

In stark contrast, the agricultural productivity observed in the arid and semi-arid regions of states such as Rajasthan, Maharashtra, and Madhya Pradesh have been relatively suboptimal, primarily due to the numerous challenges posed by erratic rainfall patterns that severely hinder crop growth, limited access to essential irrigation facilities, and persistent issues related to soil degradation, all of which considerably obstruct agricultural output and efficiency in these areas [3].

Transition to High-Value Crops: Even though traditional staple crops like rice, wheat, and maize still dominate India's agricultural landscape, there has been a noticeable and gradual transition to the production of high-value crops, which include a diverse range of fruits, vegetables, and horticultural products. This significant transition can be attributed to a confluence of evolving dietary patterns among the consumer populace, the escalating domestic demand for these high-value agricultural products, and the promising export opportunities that have emerged within international markets. For instance, India has established itself as a prominent exporter of various fruits, including mangoes and grapes, in addition to vegetables such as onions and tomatoes, which have gained increasing recognition and demand in global markets, thereby reflecting the dynamic

nature of agricultural production and trade in the country. This crop production diversification is improving farmers' financial returns in addition to enhancing agricultural productivity overall, which raises farmers' standards of living and encourages rural development [10].

Innovation and Emerging Technologies: As a result of the integration of emerging digital technologies into agricultural practices, farmers are becoming more capable of making well-informed and strategic decisions regarding important aspects of farming, such as planting schedules, irrigation control, and pest management tactics.

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Sustainability and Organic Farming: In India, there is a growing interest in implementing eco-friendly agricultural practices and organic farming methods due to worries about the ecological impact of conventional farming methods and environmental sustainability. In areas like Sikkim, Himachal Pradesh, and Uttarakhand, where farmers are adopting practices that enhance soil fertility and health while lowering their need for environmentally damaging chemical inputs, organic farming is becoming more and more popular. The shift to organic farming has the potential to significantly impact India's long-term agricultural productivity landscape, ultimately supporting sustainable development goals and enhancing food security for future generations, despite certain obstacles, such as the possibility of lower initial yields and trouble finding markets for organic produce [16].

Innovative Approaches to Enhancing Agricultural Productivity in India: Climate-smart agriculture (CSA) is a fundamental approach that tries to balance the need to adapt to the ongoing impacts of climate change and the simultaneous goal of increasing overall agricultural production. India has been actively pursuing concepts and approaches associated with CSA in various ways over recent years. Examples of CSA approaches are: developing and deploying drought-tolerant and other climate-resilient crop varieties; projecting and implementing extremely-efficient irrigation systems that seek to maximize the use of water; and adopting conservation agricultural practices that promote sustainable use of soil and soil health. There are national missions, such as the National Mission on Sustainable Agriculture (NMSA), which have been instituted to advance and facilitate whole-of-government practices that adopt CSA over the entirety of the country. Their establishment is an attempt by the government to support CSA and facilitate practices that support environmentally sustainable goals [6].

Precision Agriculture and Digitalization: The idea of precision agriculture is emerging as a viable option for farmers in India. The primary driving force underlying this trend is the labor shortages that are appearing in some markets and the

increasing demand for more efficient methods to farm in a more effective way to meet modern agricultural conditions.

Innovative agricultural technologies such as modern soil sensors, which can provide real-time data on soil health, weather forecasting technologies to help farmers plan their work based on anticipated weather patterns, and new mobile applications that help farmers use inputs more effectively are contributing to greater agricultural productivity. However, it is important to recognize that the uptake of these transformational technologies is still somewhat limited, and extensive work must be done to provide farmers with access to these innovative technologies at reasonable costs and to ensure farmers are trained to make effective use of these technologies [10].

Government Initiatives: Public Sector Programs: The Soil Health Management Program, the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), and the National Agricultural Market (eNAM) program are examples of targeted initiatives that demonstrate the Indian government's priority on improving agricultural productivity. Each of these programs focuses on a specific outcome: improving irrigation infrastructure to increase productive capacity; reducing dependence on hazardous chemical inputs for soil and agricultural health; or enhancing market access for growers to increase agricultural productivity in a sustainable manner [20].

Important Recommendations to Improve Agricultural Production: Increase Investment in Agricultural Research: Increased investment in agricultural research can lead to huge increases in productivity improvements through enhanced farming practices, crop varieties, and pest control strategies.

Improve Irrigation Infrastructure: Reliable irrigation allows for multiple cropping and less dependence on the monsoon season.

Encourage Mechanization of Farming: Mechanization can reduce reliance on manual labor while increasing productivity.

Enlarge Agricultural Extension Services: These services can help educate farmers on new farming practices.

CONCLUSION

India has seen unprecedented growth in agricultural productivity over the years, aided by technological advancements, proactive government programs, and necessary market-oriented reforms that have allowed farmers to adopt better agricultural practices. Nevertheless, certain issues, such as climate change manifestations, land resource depletion, and differences in agricultural practices across India, remain a significant threat to sustainability and agricultural productivity growth. New agricultural technologies, climate-smart agricultural practices, and sustainability practices will be necessary if India is to meet the food needs of a growing population without damaging ecosystem services. To meaningfully improve agricultural productivity in India, a set of reforms must be prioritized and carried out, with a focus on technological developments, infrastructure development, agricultural technologies, and improved varieties of high-yielding crops.

References

1. Arulkumar, C., & Manimannan, G. (2014). Agriculture productivity performance of north-western zone in Tamil Nadu using data mining techniques. *International Journal of Statistika and Matematika*, 10(1), 1–7.
2. Baruah, S. and Mandal, R.K. (2025). Crucial Achievements of Indian Agriculture: A Critical Assessment. *Journal of Information Systems Engineering and Management*, 10(35s), 487–97.
3. Chand, R. (2017). *Agricultural policies and rural development in India*. Sage Publications.
4. Dharmasiri, L. M. (2011). Measuring agricultural productivity using the Average Productivity Index (API). *Sri Lanka Journal of Advanced Social Studies*, 1(2), 25–44. <https://doi.org/10.4038/sljass.v1i2.4855>
5. Dutta, S. (2012). Assessment of agricultural efficiency and productivity: A study of Hugli district, West Bengal, India. *International Journal of Current Research*, 4(11), 190–195.
6. Food and Agriculture Organization of the United Nations. (2013). *Climate-smart agriculture sourcebook*. FAO.
7. Government of India. (2016). *Agricultural statistics at a glance 2016*. Ministry of Agriculture and Farmers Welfare.
8. Kalaivani, M., & Saravanadurai, A. (2010). Growth actions of selected cereal crops in Tamil Nadu state. *International Journal of Applied Biology and Pharmaceutical Technology*, 1(3), 778–785.
9. Mandal, S., & Dhara, A. (2012). Measurement of agricultural productivity and levels of development in South 24 Parganas district, West Bengal. *International Journal of Agricultural Science and Research*, 2(4), 91–98.
10. Mittal, S. (2016). Impact of technology on agricultural productivity and farm incomes in India. *Agri-Hub*.
11. Muthumurugan, M., Arul Kumar, C., & Manimannan, G. (2012). Composite index analysis of inter-regional variations in agricultural development of Tamil Nadu. *International Journal of Social Sciences and Interdisciplinary Research*, 1(4), 58–62.
12. Nagaraj, N. (2017). Technology adoption in Indian agriculture: Trends and policy implications. *Indian Journal of Agricultural Economics*, 72(4), 601–618.
13. Priya, R., Lakshmi, C., Arul Kumar, G., & Manimannan, G. (2019). Assessment of agriculture productivity performance in the region of Tamil Nadu using composite agriculture productivity index. *International Journal of Scientific and Innovative Mathematical Research*, 7(4), 1–7. <https://doi.org/10.20431/2347-3142.0704001>
14. Shafi, M. (1960). Measurement of agricultural efficiency in Uttar Pradesh. *Economic Geography*, 36(4), 296–305.

15. Shafi, M. (1984). *Agricultural productivity and regional imbalances*. Concept Publishing Company.
16. Sharma, S., & Gupta, A. (2017). Soil health and sustainability in India: Challenges and solutions. *Indian Journal of Soil Conservation*, 45(3), 347–354.
17. Singh, J., & Dhillon, S. S. (2000). *Agricultural geography* (2nd ed.). Tata McGraw Hill.
18. Stamp, L. D. (1958). The measurement of land resources. *The Geographical Review*, 48(1), 110–116.
19. Testbook. (n.d.). *Agricultural productivity in India*. Testbook. Retrieved September 26, 2025, from <https://testbook.com/ias-preparation/agricultural-productivity-in-india>
20. Vyas, V. (2017). Pradhan Mantri Fasal Bima Yojana: A critical review. *Journal of Rural Development*, 36(2), 155–173.

Websites

<https://testbook.com/ias-preparation/agricultural-productivity-in-india>