



## **From Farm to Future: Charting India's Agricultural Path to Global Competitiveness and SDGs Alignment**

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### **Abstract**

Almost all of the 17 quantifiable Sustainable Development Goals (SDGs) that the UN General Assembly adopted in 2015 to address contemporary global issues by 2030 have some connection to agriculture, giving it a multifaceted significance. Agriculture should be considered an essential component of the SDGs since it serves as a vital link between humans and the environment. This research work undertaken to study the present obstacles faced by agriculture and allied sectors in attaining the SDGs in India, to study the potential of agricultural transformations in India to contribute to the global SDG targets focusing on food security, environmental sustainability, and poverty alleviation, to discover the linkages between agriculture and SDG's, and assess the role of Indian agricultural strategies in addressing these interconnections and to identify vital schemes for renovating Indian agriculture into a globally competitive sector while aligning with the SDGs. This study is based on secondary data, utilizing a variety of credible sources such as government reports, research articles and policy documents to investigate the connection between agriculture and the SDGs in India. Quantitative and qualitative analysis was applied to interpret the data, highlighting key obstacles. This study paper is unusual in that it explains how the agriculture sector and sustainable development goals are related, how the agriculture sector may help achieve the SDG goals, and what policies the policy makers should implement to make this happen. The main obstacles to achieving sustainable productivity include climate change and ecological degradation, overuse of natural resources, inadequate application of sustainable farming practices, chemical fertilizer and pesticide dependency, low efficiency, and price-led growth. Prioritizing the adoption of measures such as increasing productivity, utilizing climate-resilient agricultural practices, consolidating land, integrating technology,



### **Article History**

Received: 09 November 2024

Accepted: 20 December 2024


### **Keywords**

Agriculture Sector;  
End Hunger;  
End Poverty;  
Sustainable Development Goals and Technology Integration.

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Doi: <http://dx.doi.org/10.12944/CARJ.12.3.18>

and improving market access and infrastructure are necessary to improve sustainable productivity. To guarantee that agriculture advances to the next level of growth alongside other sectors, a well-coordinated plan of action and strategy between the federal government and the states is required. This research offers important insights into improving the efficacy of agricultural policies and practices in India and the achievement of sustainable agriculture and SDGs by highlighting crucial areas for reform and strategic alignment.

## Introduction

The accomplishment of the 17 SDGs, also known as Agenda 2030, which were ratified by 193 nations in 2015, depends heavily on agriculture and related industries. Agriculture crops, animals, aquaculture, fisheries, and forests are a source of food and raw materials that date back to the dawn of human civilization. It is the largest employer in the world as well as the primary source of money and food, particularly for the very poor.

The majority of the world's agricultural practices are currently beset by several problems. Furthermore, even though for many people agriculture and its related industries are their primary source of food and a means of subsistence and the SDGs recognize the connection between agriculture and health and nutrition, the vital role that agriculture plays in nutrition still doesn't get enough attention. The various ways that climate change is affecting agriculture, emphasising how extreme weather conditions including heat waves, water stress, storms, floods, and new pest infestations are reducing agricultural output.<sup>1</sup> The growing dependence of agricultural operations on digital technologies has raised awareness of data privacy and ownership.<sup>2</sup> Additionally, the digital divide—a discrepancy in farmers' access to and adoption of digital tools—can worsen inequality and impede the broad adoption of sustainable methods.<sup>3</sup> These difficulties highlight the necessity of all-encompassing approaches to deal with the difficulties of incorporating digital solutions into environmentally friendly farming methods.

Reforms in agriculture are becoming more widely acknowledged as a means of maximizing its potential to contribute to the achievement of the SDGs.<sup>4</sup> "Agriculture and food systems are characterized by a failure to deliver food security for all," as demonstrated, for instance, by the effects of the

current price variations, which highly restrict access to food for the needy while simultaneously placing a high strain on the environment.<sup>5</sup> This is the situation that humanity finds itself in during the Anthropocene era.

This brief examines several facets of contemporary agricultural methods and their effects using instances from India. It describes the kind of adjustments needed to make agriculture a major factor in achieving the SDGs.<sup>5</sup> With the government's stated goal of doubling farmer income and connecting it with the SDGs of sustainable agriculture, agriculture in India offers a very compelling and enormous opportunity to become internationally competitive. Agriculture and related activities contribute around 20.2% of our GDP (2020–21).

The age group of 18 to 35 will comprise about 60% of India's population, which is a significant demographic benefit. However, according to the present trend, young people are often not interested in farming as a career, and migration has been rising gradually, contributing to the cities' poverty hubs, which are the most popular places for emigrants to go. The rising flow of migration has contributed to the feminization of agriculture, as men typically leave in pursuit of employment, leaving behind their families. It is obvious that policies should be developed to support chances for decent work and income generation, particularly in rural regions, and that women should be able to work in agriculture.

It is necessary to commercialize Indian agriculture in order to wisely utilize the dividend. To boost employment stability, generate new jobs, and quicken economic growth, a significant portion of the youth must become entrepreneurs. This should be combined with a vigorous campaign for skill development and agricultural export.

### Literature Review

To understand how climate activities (SDG 13) relate to other SDGs and their targets, as well as what steps may be taken to scale up these efforts, this study evaluates four pertinent climate initiatives in the Indian agriculture sector through the lens of the Sustainable Development Goals (SDGs). The scoring method's findings indicate that these activities are related to up to 43 SDG objectives and 15 SDGs. There are a few negative links (trade-offs) but most links are favorable (synergy). Trade-offs include the need for trained labor, high upfront costs, lack of access to money and knowledge, and the aggravation of gender-based inequality. This essay offers a thorough explanation of these trade-offs along with recommendations for mitigating and resolving them.<sup>6</sup> The goal of the current study is to identify the main environmental and social issues that India's agriculture faces while assessing how effective policy reform might spur industry expansion. The findings demonstrate that even though food production has reached a sufficient level, ensuring that all citizens have access to food continues to be a significant concern. Additionally, there is a lack of consistency between some SDGs indicators and the data values that correspond to them. To facilitate the seamless transition of agriculture into a sustainable industry in India, recommendations on the management of agricultural waste and the adoption of planet-healthy diets have also been made.<sup>7</sup> Decision-makers must be aware of possible trade-offs between these objectives to strike a balance between the demands of people and the environment. This research examines the trajectory of land use, land cover, and agricultural production changes in India through 2030, together with their effects on carbon storage and terrestrial biodiversity. The findings indicate that agricultural lands would probably need to grow larger and existing farmlands will need to be enhanced to satisfy the demands of future food production. Nevertheless, biodiversity will be lost as a result of both processes. Policies must be in place to accomplish this intensification while minimizing the loss of biodiversity.<sup>8</sup> A civilization's main goal is to satisfy the needs of its populace. Before developing a plan, all public policy think tanks and implementation units have always placed the welfare and prosperity of their citizens first. Synergy in human-nature interaction has become a crucial requirement in strategy development and

execution due to the growing population and finite resources. A civilization's main goal is to satisfy the needs of its populace. Before developing a plan, all public policy think tanks and implementation units have always placed the welfare and prosperity of their citizens first. Due to resource scarcity and population growth, human-nature interaction synergy has become essential for strategy development and its enactment.<sup>9</sup> Despite rapid economic expansion, India's agriculture industry is highly vulnerable for several reasons. The primary source of income for the impoverished, particularly in rural areas, is agriculture. The main task facing policymakers in light of the growing vulnerability is to devise plans to advance sustainable agriculture to meet the Sustainable Development Goals. In this regard, it is imperative to make sure that continuing efforts are redirected towards greater efficacy and efficiency of diverse projects for creating a roadmap and creating a proven sustainable model that can be shared with other developing nations.<sup>10</sup> Given that half of India's agricultural land is rainforest, climate change poses significant dangers to the country's agricultural sector. The main effects of climate change, possible solutions for adaptation and mitigation, and the government of India's initiatives to make Indian agriculture climate-smart.<sup>11</sup> Based on past experiences, nearly all economies have seen a decline in the proportion of employment in agriculture and related industries in both total employment and national income as economic growth advances. Despite this drop, there is still a need to address the many issues facing the agriculture industry, which is a major problem in both developed and developing nations. Due to its dual role as a cause and a victim of climate change, agriculture needs to adapt to its new environment and cut back on greenhouse gas emissions. The agriculture industry has a variety of dynamic challenges and possibilities, some of which are national in nature and others of which are universal.<sup>12</sup> Together, a few of the chosen SDGs emphasize how important food and agriculture are to achieving more general sustainable development goals.<sup>13</sup> Agriculture remains the mainstay of the economy and plays a crucial role in many emerging nations. To feed the world's projected 9 billion people by the year 2050, agricultural finance is essential since it allows food value chains to grow and allows impoverished farmers to earn more money.<sup>14</sup> An estimated 780 million individuals were

undernourished in emerging nations.<sup>15</sup> Publicly sponsored agricultural research ought to concentrate on the real-world issues that impoverished and small-scale farmer's encounter. Discrimination of any type against family farmers and the agricultural sector is unacceptable.<sup>16</sup> India ought to look into the potential for generating blue-collar jobs in and related to agriculture. This appears to be desired as well since the agricultural industry is severely lacking in competent labor.<sup>17</sup>

### Objectives

- To inspect the present obstacles faced by agriculture and allied sectors in attaining the SDGs in India.
- To study the potential of agricultural transformations in India to contribute to the global SDG targets focusing on food security, environmental sustainability, and poverty alleviation.
- To discover the linkages between agriculture and SDGs, and assess the role of Indian agricultural strategies in addressing these interconnections.
- To identify vital schemes for renovating Indian agriculture into a globally competitive sector while aligning with the SDGs.

### Materials and Methods

This study employs a qualitative research approach utilizing secondary data sources to examine the interconnections between agriculture and Sustainable Development Goals (SDGs) in India. The methods adopted for the study are as follows:

#### Data Collection

The data for this study were gathered from various secondary sources, including

- Government reports and policy documents (e.g., Ministry of Agriculture, NITI Aayog).
- International agency reports (e.g., FAO, UNDP, World Bank).
- Peer-reviewed journal articles and publications focusing on agriculture, SDGs, and Indian policies.
- Statistical databases such as the Food and Agriculture Organization (FAOSTAT) and IndiaStat.

- Official websites providing insights into specific schemes like PM-Kisan, PMFBY, and Soil Health Card Scheme.

### Inclusion Criteria for Data

- Data published within the last 15 years to ensure relevance to contemporary challenges and policies.
- Reports and studies explicitly linking agriculture and allied sectors to SDG targets.
- Policies and schemes with measurable impacts on food security, environmental sustainability, and poverty alleviation in the Indian context.

### Analysis Framework

The study employs a thematic analysis approach to analyze the data. The key steps include

#### Mapping Obstacles and Transformations

Data were systematically reviewed to identify existing barriers in agriculture and allied sectors concerning the attainment of SDG targets. Additionally, opportunities for agricultural transformation to support food security, environmental sustainability, and poverty alleviation were assessed.

#### Exploring Linkages between Agriculture and SDGs

The role of agriculture in achieving SDG targets was analyzed by categorizing data under themes such as economic growth, environmental management, and social equity.

#### Assessment of Agricultural Strategies

Government initiatives and strategies aimed at addressing agriculture-related SDGs were examined. Special focus was given to schemes aligning with goals such as zero hunger (SDG 2), clean water and sanitation (SDG 6), and climate action (SDG 13).

#### Identifying Vital Schemes

A comparative analysis was conducted to highlight key policies and programs that could transform Indian agriculture into a globally competitive sector while maintaining alignment with the SDGs.

### Methodological Considerations

To ensure the validity and reliability of the findings.

- The data were cross-verified from multiple sources to avoid bias.
- Trends and outcomes were contextualized within India's socio-economic and environmental frameworks.
- Policy effectiveness was assessed based on measurable impacts reported in the literature.

This methodology enables a comprehensive exploration of the intricate relationship between Indian agriculture and the SDGs, offering actionable insights for stakeholders and policymakers.

### Results & Discussions

Agriculture's economic share of India's GDP has steadily declined to less than 15 percent as a result of the industrial and services sectors' explosive growth, but the sector's importance to the nation's social and economic fabric is far greater. A competitive, diverse, sustainable, and productive agricultural sector must quickly arise in order to do this. Challenges facing the agriculture sector are critical to India's overall growth and to enhancing the welfare of the rural people.

#### Climate Transformation and Ecological Degradation

Drastic weather patterns, floods, and droughts brought on by climate change pose serious dangers to agriculture.

#### Overuse of Natural Resources

Degradation of the land and overuse of groundwater are two main issues. For instance, according to data from the Central Ground Water Board, 89% of India's extracted groundwater is utilized for agriculture, which significantly depletes aquifers.

#### Insufficient Application of Sustainable Farming Methods

An absence of incentives and knowledge regarding the use of sustainable farming methods including conservation tillage, crop rotation, and organic farming.

#### Chemical Fertiliser and Pesticide Dependency

Using chemical fertilizers and pesticides excessively can harm the ecosystem and have negative health effects.

### Low Efficiency and Price-Led Growth

India's growth in the agriculture sector, albeit excellent in most products and states, has remained lower than the potential. We are less productive than most major agricultural nations. Modernization in the industry is happening slowly. Large-scale innovations in technology, agricultural methods, and postharvest value addition are clearly lacking. There hasn't been much of an improvement in farming methods that heavily rely on inputs, such as flood irrigation and fertilizer broadcasting. The majority of crops have seen increases in productivity along with an increase in the average cost of production; hence, in order to maintain incremental production at a profit, output prices must rise. The agricultural industry is becoming more and more reliant on government assistance. As a result, the industry is becoming less competitive.

#### Increasing Productivity

Encourage the application of fertilizers, cutting-edge irrigation methods, and high-yield variety seeds. For example: The Pradhan Mantri Krishi Sinchai Yojana (PMKSY) attempts to enhance water use efficiency through micro-irrigation devices.

#### Using Climate-Resilient Agricultural Practices

Promote climate-smart agricultural techniques like agroforestry, conservation tillage, and crop diversity. For instance, creating crop varieties and agricultural techniques that are climate-resilient is the main goal of the National Innovations in Climate Resilient Agriculture (NICRA) project.

#### Land Consolidation

To increase production and resource efficiency, encourage cooperative farming and land consolidation.

For instance, India might learn from the successful cooperative farming system in Israel, where farmers share resources and advantages.

#### Technology Integration

Encourage the use of contemporary farming technologies by offering grants and educational opportunities.

**Enhancing Market Access and Infrastructure**

To lower post-harvest losses and enhance market access, invest in rural infrastructure, like as roads, cold storage, and processing facilities. The launch of the eNAM platform will give farmers improved access to markets and price discovery. As an illustration, consider the creation of Farmer Producer Organisations (FPOs) to strengthen market connections and collective negotiating power.

encouraging land consolidation, incorporating contemporary technologies, and enhancing market infrastructure is needed to address the issues facing Indian agriculture. India may attain sustainable productivity increases in its agriculture sector and inclusive growth by putting these policies into practice. For Indian agriculture to remain viable and prosperous in the long run, policymakers need to give priority to these reforms.

A multifaceted strategy that incorporates increasing productivity, implementing sustainable practices,

**Table 1: linkage between SDGs and the Agriculture Sector**

SDG	Link with Agriculture
SDG 1: End poverty	Reducing poverty is correlated with raising agricultural returns because the majority of the impoverished in emerging nations depend on it for their livelihood. The possession and management of natural resources and land, which are necessary resources for engaging in agricultural activity, are important indicators.
SDG2: End hunger	Closely associated with sustainable agriculture
SDG3: Ensure healthy lives	May only be attained by eating wholesome food generated in agriculture and related industries.
SDG5: Gender Equality and Empower all women	Women are underappreciated in agriculture while playing a significant role. Their decision-making abilities, empowerment, and availability for caregiving are avenues for utilizing agriculture to support nutrition.
SDG 6: Sustainable management of water	Agriculture is impacted by increasing water usage efficiency across sectors, integrated water resource management, and the preservation and restoration of water-related ecosystems.
SDG7: Ensure access to modern energy for all	Reduction of the pollution caused by agriculture's reliance on fossil fuels
SDG8: Promote economic growth, I and productive employment, and decent work for all	A significant portion of the working population is employed in agriculture, which has an impact on the realization of good employment and economic growth.
SDG10: Reduce inequality	Pay disparities and asset ownership in the agricultural sector
SDG12: Ensure sustainable consumption	Reducing food loss and waste, sustainable production practices, and sustainable management of all natural resources
SDG13: Take immediate action towards climate change and its impacts	Enhancing agriculture's ability to adapt to the effects of climate change, cutting greenhouse gas emissions without compromising food production
SDG 14: Conserve and sustainably use the oceans	Pollution reduction, sustainable fish harvesting, and preservation of marine and coastal habitats.
SDG 15: Protect, restore, and promote sustainable use of terrestrial ecosystems	These are all the inputs used in agriculture; overuse of land and indiscriminate growth in agriculture have resulted in devastation and a reduction in forest area and biodiversity.

(Source: Compiled by authors)

Looking ahead, the 2030 Agenda for Sustainable Development distinctly delineates the route towards equitable prosperity. To leave no one behind, the world must overcome its complicated problems by taking revolutionary action, adopting sustainable practices, and addressing the underlying causes of hunger and poverty. Food and agriculture, as the primary link between humans and the environment, can contribute to the realization of several SDGs. Table 1 reflects the importance of the agriculture sector in achieving the SDGs target manifest by the 2030 Agenda.

In addition to promoting inclusive growth, agriculture is important for national quality of life, sustainability, nutrition and health, and climate change. The necessity for a fresh vision for agriculture as we proceed in the twenty-first century is highlighted by all of these considerations.<sup>18</sup> The new vision for agriculture is organized under the following headings.

- Development towards effectiveness
- Creation of Jobs
- Food Security for Health and Nutrition
- Transitioning from Shortage to Surplus Management
- Knowledge-Intensive Agriculture with High Input
- Sustainability and Climate Change
- Manufacturing and Manufacturers
- Regulations, Reforms, and Policy Interventions

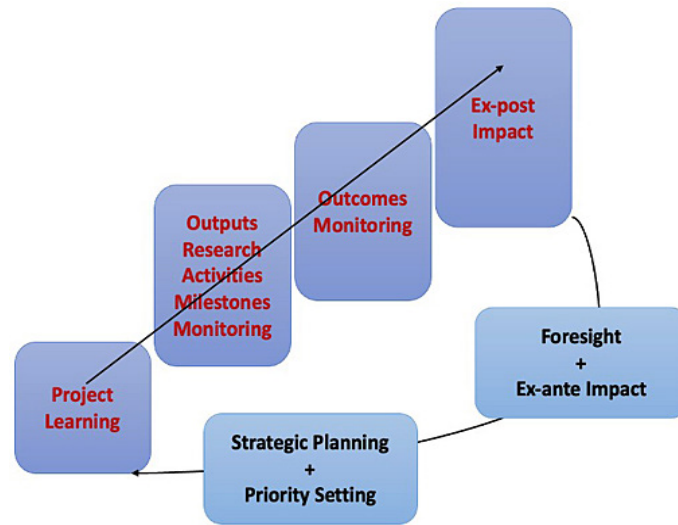
A paradigm change in how the agriculture sector is viewed overall is necessary to achieve significant increases in farmer income and agricultural transformation. Science-led technological advancements, a larger involvement for the private sector before and after harvest, a liberalized output market, an active land lease market, and a focus on efficiency would prepare agriculture to meet 21st-century problems and help achieve New India's objectives. Using data that was available for the Indian states, eight indicators covering the four topics of water, land, energy, and weather were connected and evaluated in order to assess the current condition of sustainable agriculture practices and national policies.

Globally, venture capital and private equity funds are showing a great deal of interest in this industry.

Since 2010, there has been a USD 1.9 billion inflow that has benefited almost 14 million farmers. Over the previous five years, there has been a 48% rise in the sector. However, the introduction and application of technology must have an end-to-end effect on the whole value chain. The majority of funding is currently being directed into the input and output management supply chain in an effort to automate processes, increase efficiencies, and link farmers to input and product markets. Production efficiency in and of itself has not yet increased. If we wish to raise our yield per hectare and have an influence on farmer earnings, we must give this greater thought and attention. Technology can have a significant impact on managing water, evaluating soil, and controlling pests in order to increase production phase efficiency.

It is encouraging to see that digitization is already making headway. Both of these things have to occur. The first is a one-time project to digitize farmer data and land records. Of the 10–12 million land records held by farmers, 8–10% have already been digital.<sup>19</sup> In this initiative, states like Telangana and Hyderabad are setting the standard. The mapping of land parcels using drones and satellite photos comes in second. Among other things, real-time data and information about the crops cultivated in different regions and the productivity of farmers can be obtained via satellite photography. Many of these cycles that are mapped will produce trustworthy data that all stakeholders, large and small, may use and put to use. Modernizing the system must be done in tandem with embracing and adopting intelligent digital tools that provide real-time guidance on planting cycles, soil sensors, and product quality (at the input level). One instance would be introducing technology from outside, such as crop protection products spraying with drones. This will make it possible to make a big change from the existing situation, in which neither the farmer nor the different stakeholders have access to such data or technology.

The CGIAR's CAFS program in South Asia, with headquarters in New Delhi, has been using the Impact Pathway methodology in its national and regional initiatives for some time now, as shown in Figure 1.



**Fig. 1: Impact Pathway Framework<sup>20</sup>**

The methodology facilitates the delineation of precise routes to results and influence, as well as a mutual understanding among practitioners. The method aids in locating and combining program synergies and improves comprehension of end-user and subsequent user needs.

**Conclusion**

Almost all of the 17 quantifiable Sustainable Development Goals (SDGs) that the UN General Assembly adopted in 2015 to address contemporary global issues by 2030 have some connection to agriculture, giving it a multifaceted significance. Agriculture should be considered an essential component of the SDGs since it serves as a vital link between humans and the environment. While agriculture is at the forefront of the SDGs, it also faces numerous difficult obstacles that call for collaboration between industry, policy, science, and other domains. The greatest barrier to sustainable development is the severe worldwide hunger and malnutrition that renders people unproductive and negatively impacts their standard of living. 800 million people worldwide suffer from hunger, with developing nations being the most affected. To feed these sizable populations—as well as the projected 2 billion additional people who may join the undernourished by 2050—better changes to the global food and agriculture systems are needed.

In order to assist reduce the risks of hunger, investments in agriculture are urgently needed to increase agricultural output and sustainably produce food. Publicly sponsored agricultural research ought to concentrate on the real-world issues that impoverished and small-scale farmers confront. The study papers contain a variety of technological forms, but only farmers are able to use and commercialize them. Although most farmers are aware of the condition of their soil, they are unable to use these technologies to refill it because of socioeconomic limitations. On the other hand, growing nutrient deficiencies and environmental degradation have caused farmers distress in a number of ways. The government's preferred tool for advancing agricultural technology in India is subsidy.

To guarantee that agriculture advances to the next level of growth alongside other sectors, a well-coordinated plan of action and strategy between the federal government and the states is required.

**Acknowledgment**

The authors sincerely thank the faculty of Kristu Jayanti College and all respondents for their invaluable support and contributions to this research.

**Funding Sources**

The author(s) received no financial support for the research, authorship, and/or publication of this article.



**Conflict of Interest**

The authors do not have any conflict of interest.

**Data Availability Statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Ethical Statement**

This research did not involve human participants, animal subjects, or any material that requires ethical approval.

**Author Contributions**

- **Bijin Philip:** conceptualized the study.
- Geethu Anna Mathew and Roshen Therese Sebastian - designed the methodology, and conducted data analysis.
- **Ajai Abraham Thomas:** assisted with data collection.
- **Jeeva Masimuthu:** managed the literature review, and manuscript drafting.

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