

Use of Technologies for Sustainable Agriculture Development

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Article Info	ABSTRACT
<p>Article History: Received: 18th Sep 2025 Accepted: 02nd Oct 2025 Published: 17th Oct 2025</p>	<p>To increase the efficiencies and productivity in agriculture sector, most of techniques are revolutionized; it includes precision farming techniques, robotics, sensors, drones, and the application of artificial intelligence and data analytics. These technologies increased productivity in agriculture, reduced costs, and more sustainable agricultural practices. The present study elaborates on the use of technologies in agriculture. The objectives of present study were based on the objectives -1 .To study the importance of sustainable agriculture 2. To study technologies for sustainable farming 3. To study the gap to implement a technology. The are mainly based on secondary data .The collected data are evaluated by various sources.</p>
<p>Keywords: Sustainable Agriculture, Government initiatives, Technologies for sustainable agriculture</p>	

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Introduction:

India's traditional agricultural practices are unsustainable and have a detrimental impact on both the environment and human health. The implementation of sustainable agriculture is required to ensure the long-term feasibility of agriculture in India. By implementing the advanced technologies farmers can sustain the agriculture. An Indian agriculture account for 18.29 percent of gross value added in 2019-20 but still employs 45.6 percent of the workforce. This highlights that a significant portion of the Indian population depends on agriculture for their livelihoods. But the percentage of the population employed in agriculture has gradually declined over the years as the country has diversified its economy and developed other sectors, such as services and manufacturing.

Objectives

1. To study the importance of sustainable agriculture
2. To study technologies for sustainable farming
3. To study the gap to implement a technology

Research Methodology:

The collected data are evaluated by various sources .The secondary data are used for that study

What is sustainable agriculture?

Sustainable agriculture means farming that considers the well-being of the soil, environment, and local communities in the long run. The main goal of sustainable agriculture is to address the increasing food demand without compromising natural resources for future generations. It ensures the production of food, fiber, and other agricultural products while safeguarding the environment, public health, human communities, and animal welfare. Sustainable agriculture gives importance to the conservation and regeneration of essential natural resources like soil, water, and air to benefit future generations.

To increase the output of the agricultural sector, India has made significant progress, but there is still considerable work ahead to fully adopt and implement sustainable agricultural practices. The Indian farmer is confronting one of the important challenges that are declining soil fertility due to the excessive use of chemical fertilizers, pesticides, and intensive farming practices. Adopting sustainable agriculture practices in India is critical for the long-term sustainability of the agriculture sector.

What are the government initiatives for the agriculture sector?

The Indian government introduced various initiatives for the agriculture sector, such as the Pradhan Mantri Fasal Bima Yojana, Pradhan Mantri Krishi Sinchayee Yojana, the Soil Health Card Scheme, and the National Agriculture Market (eNAM) platform, for the development of the agriculture sector. The main motives of the government of these initiatives are enhancing farmer

productivity, mitigating risks, improving agricultural practices, and increasing income levels in the country.

The Pradhan Mantri Fasal Bima Yojana (PMFBY) is significant as it offers farmers a comprehensive risk management solution with a uniform and affordable premium rate nationwide. The scheme receives around 5.5 crore farmer applications every year.

Some technologies for sustainable farming

Accuracy Farming: An accuracy farming includes sensors, GPS mapping, and data analytics to monitor and optimize crop performance. By using accuracy farming techniques, farmers can reduce the use of fertilizers and pesticides in their fields, improve water management, and increase yields in agriculture sector.

Agro forestry: An agro forestry is a land-use integrated management system that combines trees and shrubs with crops and livestock to create a more sustainable and productive farming system. This approach can provide various benefits, such as soil conservation, biodiversity conservation, and carbon sequestration.

Vertical Farming: It cultivates crops in stacked layers, usually under controlled conditions. Vertical farming can potentially increase local food production while reducing water consumption and optimizing resource utilization. This makes it an appealing option for Indian urban agriculture. This method can reduce the need for pesticides and herbicides while increasing crop yields and lowering transportation costs.

Hydroponics: In this methods plant grows in nutrient-rich water without soil. It allows for efficient water and nutrient use, year-round cultivation, and reduced dependence on traditional agricultural practices. The hydroponics approach can increase yields and can potentially revolutionize food production, especially in urban areas with limited space and resources.

Renewable Energy-Based: The renewable energy technologies like solar and wind power can be used to power farming operations. This approach can reduce greenhouse gas emissions and dependence on fossil fuels.

Robotics and Automation-Based: Robotics and automation technologies can help reduce labor costs, improve crop yields, and reduce the use of fertilizers and pesticides.

What are the gaps in adopting sustainable agriculture?

Lack of awareness and knowledge: It is a main restriction to adopting sustainable agricultural

practices. Many farmers must know the benefits of sustainable agriculture practices or how to implement them effectively for widespread use of these technologies.

Limited Access to Finance for Agriculture: To Sustainable agriculture practices often needs significant infrastructure and technology investments. However, many small and marginal farmers need more access to finance to make these investments in agriculture.

Inadequate Policy and Regulatory Framework: Adopting sustainable agriculture practices is not always supported by India's policy and the regulatory framework. Ex. farmers may need more incentives to adopt sustainable practices, or regulations may prohibit certain sustainable practices. The National Mission for Sustainable Agriculture receives only 0.8 percent of the Ministry of Agriculture and Farmers Welfare (MOAFW) budget.

What are the Gaps in Adopting Sustainable Agriculture?

Lack of awareness and knowledge: To adopting sustainable agricultural practices. Lack of awareness is a main barrier. Many farmers must know the benefits of sustainable agriculture practices or how to implement them effectively for widespread use of these technologies in agriculture.

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Lack of Market Access: Many farmers are forced to sell their produce to intermediaries at low prices, as they cannot access direct markets to sell their produces.

Inadequate Infrastructure: Inadequate infrastructure, such as rural roads, storage facilities, and cold chains, is a significant challenge for the agriculture sector in India.

Climate Change: The Climate change poses significant challenges to the agriculture sector in India, particularly in terms of water availability, pest and disease management, and crop yields. The changing weather patterns, including irregular rainfall and rising temperatures, affect crop productivity and increase farmers' vulnerability. Women are particularly susceptible. The Global

Food Security Index (GFSI) score for sustainability and adaptation decreases as gender inequality increases.

What has the Government done to Improve Dissemination of Technological Information to Farmers?

According to, the NSSO survey, only 6% of farmers in India has access to information on modern agricultural practices. To remark this issue, the government has launched several initiatives, such as the Kisan Call Centre and the mKisan portal. The Kisan Call Centre had received over 21 million calls from farmers across India, indicating the importance of such initiatives in improving the dissemination of technological information to farmers.

Some agri tech startup case studies

AgriApp Technologies Pvt. Ltd. works on precision and predictive agriculture while building a strong Agri-Ecosystem to benefit farmers, the economy, and ecology. AgriApp works to fill the gap between farmers and the right kind of strategic information, thus making the farmers ready for high efficiency. technology-enabled agricultural production and marketing.

Khetee promotes agroecological farming through the agro forestry model. Khetee has created a unique fellowship program for farmers and aspiring farmers to help them build agro ecological model farms. Khetee organizes training programs for farmers regularly to help them build their capacity in regenerative farming.

Aumsat provides precision-driven, satellite-based, AI-enabled hydrological analysis for locating, predicting, and forecasting groundwater resources, saving cost economically and logistically by 75 percent.

Pudhuvai Green Gas Chemicals Fertilizers Private Limited is an innovative bioenergy startup that specializes in manufacturing organic waste agri-raw materials. Through their unique process, they produce methane and hydrogen as valuable by-products, which are utilized as environmentally friendly green fuels.

Sense it Out is a deep-tech startup that focuses on providing technology-driven solutions to address targeted climate change challenges in the agriculture sector. Their product, SICCA (Sensor-based Intelligent Crop Centric Automation), leverages indigenously developed sensor technology to make irrigation management more competent, reliable, and efficient.

Conclusion

A multifaceted approach will be necessary to close gaps in India's agricultural sector, necessitating investments in R&D, regulatory and policy reforms, and creating infrastructure and extension services to encourage adopting sustainable agricultural practices. Technology must be implemented with other sustainable farming practices to achieve sustainable farming systems. Farmers in India have adopted various sustainable agricultural practices to ensure agriculture's long-term sustainability, like crop rotation and organic farming. Furthermore, improved crop varieties, rainwater harvesting, and drip irrigation systems are examples of sustainable agricultural practices in India.

Despite adopting sustainable farming practices in India, the country faces numerous challenges in ensuring long-term sustainability. For example, indiscriminate pesticide and fertilizer use persists in many parts of the country, resulting in soil degradation and water pollution. Furthermore, climate change poses a significant threat to India's agricultural sustainability.

Sustainable agriculture practices have the potential to boost agricultural productivity, reduce production costs, and enhance the quality of crops. It may also promote the production of healthier and safer foods, which is beneficial to public health.

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