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Sustainability in Indian Agricultural Sector

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Abstract

"True economic development is measured not just by wealth, but by the well-being of people and the health of our planet."

Sustainable agriculture is imperative for ensuring global food security, environmental protection, and economic stability. This research explores the challenges facing conventional farming, evaluates sustainable farming practices, and assesses their environmental, social, and economic benefits. It highlights practical examples from around the world and emphasizes the critical role of innovation and policy reform in building a resilient agricultural future. Sustainable agriculture emphasizes the responsible use of natural resources, minimizes negative environmental impacts, and supports the well-being of farmers and communities.

The present study is based on secondary data. Data has been gathered from secondary sources such as books, journals, articles & government official websites. The present article analyses few practical examples of sustainable agriculture practices being implemented around the world. Technology being a game-changer for sustainable agriculture. Precision farming, use of AI and IoT for crop monitoring, mobile apps for market access and weather alerts, and satellite imagery for land management are transforming traditional farming systems into more efficient and sustainable models. The future of Indian agriculture lies in integrating traditional wisdom with modern innovation. Collaboration between farmers, policymakers, researchers, and agribusinesses is vital to ensuring food security while preserving the environment. By embracing sustainable practices, India can create a resilient and prosperous agricultural ecosystem for generations to come.

Keywords: Agriculture, economic development, sustainability, environment, technology, innovation, organic farming

Introduction:

India's agriculture sector forms the backbone of its economy, employing nearly half of the workforce and contributing significantly to rural livelihoods, supporting millions of livelihoods and contributing significantly to the nation's GDP. However, this sector is at a crossroads—faced with challenges like resource depletion, climate change, water scarcity and unsustainable practices. Achieving sustainability in Indian agriculture is not just a choice but a necessity for ensuring food security, environmental protection, and economic stability, there is a growing need to transition towards sustainable agriculture.

Sustainable agriculture refers to farming practices that meet the current demands for food, fibre, and fuel while ensuring the health and vitality of the environment, economic viability, and social equity for future generations. It emphasizes the responsible use of natural resources, minimizes negative environmental impacts, and supports the well-being of farmers and communities.

Methodology:

The present study is based on secondary data. Data has been gathered from secondary sources such as books, journals, articles & government official websites.

The Need for Sustainability in Agriculture

1. Environmental Challenges:

- Loss of biodiversity, soil erosion, and deforestation.
- Unsustainable water use and pollution from agricultural runoff.

2. Economic Pressures:

- Declining profits for smallholder farmers

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- Market instability and rising input costs.
- 2. **Social Impacts:**
 - Rural poverty and inequity in resource distribution.
 - Migration due to unviable agricultural practices.

Key elements of sustainable agriculture

- **Environmental stewardship:** Protecting ecosystems, preserving biodiversity, and maintaining soil and water health.
- **Economic profitability:** Ensuring farmers and agricultural enterprises remain financially stable over the long term.
- **Social responsibility:** Promoting fair labor practices, equitable resource distribution, and improved livelihoods for farming communities.

Sustainable Practices in Agriculture

To mitigate these issues, Indian agriculture must adopt eco-friendly practices, including:

Conservation Agriculture:

- Minimal soil disturbance, crop rotation, and cover cropping.
- Benefits: Improved soil health, increased yields, and reduced erosion.

Agroforestry:

- Integrating trees and shrubs with crops and livestock.
- Benefits: Enhances biodiversity, sequesters carbon, and improves livelihoods.

Efficient Water Use:

- Drip irrigation and rainwater harvesting.
- Benefits: Conserves water and reduces stress on freshwater ecosystems.

Organic Farming:

- Avoids synthetic chemicals; uses compost and biological pest control.
- Benefits: Protects soil and water quality while promoting biodiversity.

Technological Innovations:

- Precision agriculture, AI, and IoT for resource optimization.
- Benefits: Boosts productivity and reduces environmental impact.

Precision Agriculture

- Leveraging technology to optimize resource use and improve yields.

Water Management

- Adopting techniques like drip irrigation and rainwater harvesting.

Crop Diversification

- Growing varied crops to boost resilience against climate change.

Environmental Benefits of Sustainable Agriculture

- **Soil Health:** Reduces erosion and improves fertility.
- **Carbon Sequestration:** Enhances soil and plant carbon storage.
- **Biodiversity Conservation:** Protects pollinators and ecosystems.
- **Water Conservation:** Reduces overuse and prevents pollution.

Socio-Economic Impact

1. Empowering Farmers:

- Access to education, finance, and technology.
- Improved rural livelihoods and reduced poverty.

2. Market Opportunities:

- Growing consumer demand for sustainable and organic products.
- Fair trade practices ensuring equity and profitability.

Current Challenges of Indian Agriculture

1. **Climate Change Impact** – Erratic monsoons, increasing temperatures, and extreme weather events threaten crop yields and food security.
2. **Overuse of Chemical Inputs** – Excessive reliance on synthetic fertilizers and pesticides deteriorates soil health and pollutes water bodies.
3. **Water Scarcity** – Groundwater depletion due to inefficient irrigation techniques leads to reduced agricultural productivity.
4. **Loss of Biodiversity** – Mono cropping and deforestation diminish soil fertility and disrupt ecosystems.
5. **Overuse of Resources:** Excessive use of groundwater for irrigation, largely due to water-intensive crops like paddy and sugarcane, has led to alarming levels of groundwater depletion in many states.
6. **Soil Degradation:** Intensive farming, excessive chemical fertilizer use, and mono-cropping have significantly degraded soil fertility.
7. **Fragmented Land Holdings:** Small and marginal farmers, who make up over 85% of all landowners, often lack access to technology and markets, making sustainable practices harder to implement.

Result Of Government Initiatives For Sustainable Agriculture

India has introduced several policies to support sustainable agriculture:

1. **Soil Health Card Scheme** – Encourages farmers to monitor soil quality and adopt appropriate practices.
2. **Paramparagat Krishi Vikas Yojana (PKVY):** Promotes organic farming through cluster-based approaches.
3. **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY):** Aims to improve irrigation efficiency with the motto “More Crop per Drop”.
4. **Soil Health Card Scheme:** Helps farmers understand their soil condition and use fertilizers accordingly.
5. **National Mission on Sustainable Agriculture (NMSA):** Focuses on climate-resilient farming and resource-efficient technologies.
6. **PM-KUSUM** – Promotes the use of solar-powered irrigation

Role of Technology and Innovation

Technology can be a game-changer for sustainable agriculture. Precision farming, use of AI and IoT for crop monitoring, mobile apps for market access and weather alerts, and satellite imagery for land management are transforming traditional farming systems into more efficient and sustainable models.

Suggestions:

- **Policy Reforms:** Incentivize sustainable practices through subsidies and market support.
- **Farmer Education:** Increase awareness and training on sustainable farming techniques.
- **Research and Development:** Promote innovation in climate-resilient crops and eco-friendly farming tools.
- **Public-Private Partnerships:** Leverage the strengths of both sectors to scale up sustainable models.

Few Practical Examples of Sustainable Agriculture:

Few practical examples of sustainable agriculture practices being implemented around the world

1. **Agroforestry in Africa**
Farmers in countries like Kenya and Senegal practice agroforestry, where trees such as acacia or moringa are integrated into croplands. Benefits include enhanced soil fertility, biodiversity, and shade for crops, along with additional income from tree products like fruit or timber.
2. **Drip Irrigation in India**
Many farmers in India use drip irrigation systems to deliver water directly to plant roots. This saves water, increases efficiency, and improves crop yields in arid regions such as Rajasthan.
3. **Rice-Fish Farming in Asia**
In countries like China and Indonesia, farmers practice rice-fish farming: raising fish in flooded rice paddies. Fish help control pests and provide natural fertilizer, while farmers benefit from additional food and income.
4. **Zero Budget Natural Farming (ZBNF) in India**
Farmers in states like Andhra Pradesh follow ZBNF, which eliminates chemical inputs and focuses on using farm-produced resources like manure and bio-stimulants. This approach improves soil health and reduces production costs.
5. **Organic Farming in Europe**
Countries like Denmark and Austria lead in large-scale organic farming, avoiding synthetic pesticides and fertilizers and promoting soil health through natural methods. This practice supports ecosystems and provides consumers with chemical-free produce.
6. **Rotational Grazing in Australia**
Livestock farmers in Australia use rotational grazing, moving animals between pastures to prevent overgrazing and allow vegetation to recover. This improves soil carbon storage and reduces erosion.
7. **Precision Farming in the United States**
Many farms use satellite imagery, sensors, and GPS technology to monitor crop health and optimize resource use.

Precision farming reduces input waste, improves yields, and minimizes environmental impact.

8. **Composting in Urban Agriculture**
Urban farms and community gardens around the world recycle organic waste into compost, which enriches soil and reduces landfill waste.

Grassroots Initiatives & Success Stories

1. **Green Cotton in Madhya Pradesh** – Farmers in Chhindwara have transitioned from GMO cotton to organic practices, improving soil health and biodiversity
2. **Natural Farming in Andhra Pradesh** – The state has adopted natural farming methods, utilizing organic materials to enhance soil water retention and resilience against extreme weather events.
3. **Revival of Native Cotton Varieties** – Initiatives like Khamir in Kutch and Saheli Women in Rajasthan are working to revive indigenous cotton strains, promoting sustainable and ethical fashion supply chains.

Conclusion:

Sustainability in the agriculture sector is no longer optional; it is a necessity for the survival of future generations. By adopting sustainable practices, fostering innovation and driving policy reforms, we can create an agricultural system that not only meets global food demands but also protects the planet and uplifts farming communities.

A collective effort from stakeholders: farmers, governments, consumers, and industries is highly essential for building a resilient and sustainable future.

The future of Indian agriculture lies in integrating traditional wisdom with modern innovation. Collaboration between farmers, policymakers, researchers, and agribusinesses is vital to ensuring food security while preserving the environment. By embracing sustainable practices, India can create a resilient and prosperous agricultural ecosystem for generations to come.

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Dr. Bhakti Mahindrakar as the author declares that there are no conflicts of interest regarding the publication of this paper.

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