

AGRICULTURE FORUM FOR TECHNICAL EDUCATION OF FARMING SOCIETY

Kota, Rajasthan



Organic and Regenerative Farming Practices for Sustainable Agricultural Development

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INTRODUCTION

Agriculture forms the backbone of the global food system, providing food, fiber, and raw materials for billions of people. However, the rapid intensification of agriculture over the past few decades has resulted in several environmental challenges, including soil degradation, biodiversity loss, water pollution, greenhouse gas emissions, and declining soil fertility. Excessive use of synthetic fertilizers, pesticides, and intensive tillage has increased crop yields in the short term but has also threatened the long-term sustainability of agricultural ecosystems.

Globally, governments, researchers, and farmers are increasingly recognising the importance of these approaches in achieving the **United Nations Sustainable Development Goals (SDGs)**, particularly those related to zero hunger, climate action, responsible consumption and production, life on land, and sustainable communities. In India, initiatives such as the **Paramparagat Krishi Vikas Yojana (PKVY)**, **National Programme for Organic Production (NPOP)**, and **Bharatiya Prakritik Krishi Paddhati (BPKP)** have encouraged farmers to adopt sustainable farming methods. Organic and regenerative agriculture not only improves environmental health but also contributes to food security, rural livelihoods, and long-term agricultural productivity.

Concept of Organic Farming

Organic farming is a holistic agricultural production system that relies on ecological processes, biodiversity, and biological cycles while minimising the use of external synthetic inputs. It avoids the use of chemical fertilisers, synthetic pesticides, genetically modified organisms (GMOs), growth hormones, and antibiotics. Instead, it emphasises

natural nutrient cycling, composting, crop rotation, biological pest control, and organic manures.

The primary objective of organic farming is to produce safe and nutritious food while conserving natural resources and maintaining ecological balance. It promotes healthy soil, clean water, biodiversity, and sustainable livelihoods for farming communities.

Principles of Organic Farming

Organic farming is guided by four internationally recognized principles:

- **Principle of Health:** Maintaining the health of soil, plants, animals, humans, and ecosystems.
- **Principle of Ecology:** Working in harmony with natural ecological cycles.
- **Principle of Fairness:** Promoting equity, respect, and social justice in agricultural production.
- **Principle of Care:** Adopting precautionary approaches to protect future generations and the environment.

Table: Key Facts and Statistics on Organic and Regenerative Agriculture in India

Indicator	Latest Data (Approx.)	Significance
Total Area under Organic Certification	Over 4.4 million hectares	Reflects India's growing commitment to sustainable agriculture.
Number of Organic Producers	More than 2.4 million	India has one of the largest numbers of organic producers globally.
Share of Small and	Over 86% of total farmers	Sustainable farming practices help improve

Marginal Farmers		productivity and reduce input costs for smallholders.
Average Operational Landholding	About 1.08 hectares	Small farm sizes make resource-efficient and regenerative practices particularly valuable.
Major Government Schemes	PKVY, BPKP, NPOP, MOVCNDR	Promote organic farming, natural farming, certification, and market access.
Common Organic Nutrient Sources	FYM, compost, vermicompost, green manure, biofertilizers	Improve soil fertility and reduce dependence on chemical fertilizers.
Major Regenerative Practices	Crop rotation, cover cropping, conservation tillage, agroforestry, mulching	Enhance soil health, biodiversity, water conservation, and carbon sequestration.
Major Benefits	Improved soil fertility, reduced pollution, enhanced biodiversity, climate resilience	Supports long-term agricultural sustainability and food security.

Concept of Regenerative Farming

Regenerative farming is an ecosystem-based agricultural approach that aims not only to sustain but also to restore and enhance the natural resources used in farming. It focuses on rebuilding soil organic matter, improving soil structure, increasing

biodiversity, conserving water, and capturing atmospheric carbon through biological processes. Unlike conventional agriculture, which often depletes soil resources, regenerative agriculture seeks to regenerate degraded landscapes by improving soil fertility and ecosystem functions. Healthy soils store more carbon, retain more water, support beneficial microorganisms, and produce healthier crops.

The major goals of regenerative farming include:

- Restoring soil fertility.
- Increasing soil organic carbon.
- Enhancing biodiversity.
- Improving water infiltration and retention.
- Reducing greenhouse gas emissions.
- Building climate-resilient farming systems.

Organic and Regenerative Farming Practices

1. Crop Rotation

Crop rotation involves growing different crops in a planned sequence on the same field over successive seasons. Rotating cereals with legumes, oilseeds, vegetables, and fodder crops helps maintain soil fertility, break pest and disease cycles, and improve nutrient availability. For example, rotating wheat with pulses enriches soil nitrogen through biological nitrogen fixation, reducing dependence on synthetic fertilizers.

2. Cover Cropping

Cover crops such as legumes, clover, mustard, and grasses are grown primarily to protect and improve the soil rather than for harvest.

Benefits include: Prevention of soil erosion, improvement in soil organic matter, enhanced microbial activity, weed suppression, moisture conservation and nitrogen fixation.

Cover crops play a central role in regenerative agriculture by continuously feeding soil microorganisms.

3. Conservation Tillage

Excessive tillage disturbs soil structure and accelerates the decomposition of organic matter. Conservation tillage minimises soil disturbance, helping retain soil carbon and moisture while protecting beneficial organisms.

Major benefits include: Reduced soil erosion, improved water infiltration, increased carbon sequestration, lower fuel consumption and better soil structure.

4. Organic Nutrient Management

Organic farming relies on natural nutrient sources rather than synthetic fertilizers.

Common nutrient sources include: Farmyard manure (FYM), vermicompost, compost, green manure, biofertilizers, crop residues and animal manure. Organic nutrient management improves soil fertility, microbial diversity, and long-term productivity.

5. Integrated Pest Management (IPM)

Organic farming emphasises environmentally friendly pest management techniques.

These include: Biological control agents, botanical pesticides such as neem extracts, pest-resistant crop varieties, crop rotation, trap crops and mechanical pest removal. Integrated Pest Management reduces pesticide residues while protecting beneficial insects such as bees and ladybird beetles.

6. Agroforestry

Agroforestry combines trees, crops, and livestock on the same land.

Its benefits include: Improved biodiversity, reduced soil erosion, carbon sequestration, diversified farm income, better nutrient cycling and improved

microclimate. Trees also serve as windbreaks and increase water conservation.

7. Composting and Vermicomposting

Organic wastes are converted into nutrient-rich compost using microorganisms and earthworms.

Advantages include: Recycling agricultural waste, improving soil structure, increasing microbial populations, enhancing nutrient availability and reducing environmental pollution.

8. Water Conservation Practices

Water management is essential for sustainable agriculture.

Organic and regenerative farming promotes: Rainwater harvesting, drip irrigation, mulching, farm ponds, laser land levelling and moisture conservation techniques. Efficient water use becomes increasingly important under changing climatic conditions.

9. Livestock Integration

Livestock are integrated with crop production to create circular farming systems.

Animals contribute: Organic manure, farm power, additional income, nutrient recycling. Integrated farming reduces waste while improving overall farm sustainability.

10. Carbon Sequestration

One of the most significant features of regenerative farming is carbon sequestration. Healthy soils capture atmospheric carbon dioxide and store it as soil organic carbon.

This contributes to: Climate change mitigation, improved soil fertility, better water retention and increased crop resilience.

Benefits of Organic and Regenerative Farming

Organic and regenerative agriculture provide multiple environmental, economic, and social benefits.

Environmental Benefits

- Improved soil fertility.
- Increased biodiversity.
- Reduced chemical pollution.
- Enhanced groundwater quality.
- Lower greenhouse gas emissions.
- Greater carbon storage.
- Improved ecosystem resilience.

Economic Benefits

- Reduced expenditure on synthetic fertilizers and pesticides.
- Premium prices for certified organic products.
- Diversified farm income.
- Long-term productivity.
- Improved resilience against climate-related risks.

Social Benefits

- Improved food safety.
- Better human health.
- Increased rural employment.
- Empowerment of small farmers.
- Preservation of indigenous agricultural knowledge.

Organic and Regenerative Farming in India

India has become one of the leading countries promoting sustainable agriculture. According to the **National Programme for Organic Production (NPOP)** and the **Agricultural and Processed Food Products Export Development Authority (APEDA)**, India has **over 4.4 million hectares** under organic certification and is among the world's largest producers of organic products by number of producers.

Several government initiatives support sustainable agriculture:

1. Paramparagat Krishi Vikas Yojana (PKVY)

PKVY encourages cluster-based organic farming through financial assistance, farmer training, certification, and market support.

2. Bharatiya Prakritik Krishi Paddhati (BPKP)

This programme promotes natural farming methods that minimize external inputs while improving soil health.

3. National Programme for Organic Production (NPOP)

NPOP establishes standards for organic production, certification, and export of organic agricultural products.

4. Mission Organic Value Chain Development for North Eastern Region (MOVCDNER)

The programme promotes certified organic farming, processing, and value-chain development in the North-Eastern states of India.

These initiatives aim to improve farmers' income while promoting environmentally sustainable agriculture.

Challenges of Organic and Regenerative Farming

Despite numerous benefits, several challenges hinder large-scale adoption.

1. Lower Initial Yields

Crop yields may decline during the transition period from conventional to organic farming.

2. Certification Costs

Obtaining organic certification can be expensive and time-consuming for small farmers.

3. Limited Market Access

Many farmers lack direct access to premium organic markets.

4. Knowledge Gap

Adoption requires specialized knowledge regarding composting, biological pest management, and soil management.

5. Labour Requirements

Organic farming often requires more manual labour than conventional farming.

6. Policy and Infrastructure Constraints

Insufficient storage, processing facilities, and marketing infrastructure continue to limit expansion.

Future Prospects

The future of organic and regenerative farming is promising due to increasing consumer awareness regarding food safety, environmental conservation, and climate change. Advances in digital agriculture, remote sensing, precision farming, and artificial intelligence can complement sustainable farming practices by improving resource-use efficiency and decision-making. Growing demand for organic food in domestic and international markets offers significant income opportunities for farmers. Climate-resilient agriculture, carbon credit mechanisms, ecosystem restoration programmes, and sustainable supply chains are expected to further encourage the adoption of regenerative farming. Strengthening farmer training, certification systems, research, and market infrastructure will be essential for scaling these practices.

CONCLUSION

Organic and regenerative farming represent transformative approaches to achieving sustainable agricultural development. By emphasising ecological balance, soil regeneration, biodiversity conservation, and responsible resource use, these systems address many of the environmental and economic challenges

associated with conventional agriculture. Organic farming ensures the production of safe and healthy food through natural methods, while regenerative farming restores degraded ecosystems and enhances long-term agricultural resilience. In India, government initiatives such as PKVY, BPKP, NPOP, and MOVCDNER have accelerated the adoption of sustainable farming practices, benefiting both farmers and consumers. Although challenges related to certification, market access, and knowledge remain, continued investment in research, extension services, and farmer support can significantly expand the adoption of these practices. Ultimately, organic and regenerative farming offer a sustainable pathway toward improved food security, environmental protection, climate resilience, and inclusive rural development.