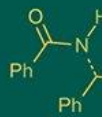


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Anjali Adhikari
School of Agriculture,
Dev Bhoomi Uttarakhand
University, Dehradun,
Uttarakhand, India

Priyanka Kumari
Dhanauri P.G. College,
Dhanauri, Haridwar,
Uttarakhand, India

Shachi Negi
Editor Jagriti Media,
Dehradun, Uttarakhand, India

Kamla Dhyani Jakhmola
Department of Horticulture,
School of Agricultural Sciences,
Shri Guru Ram Rai
University, Dehradun,
Uttarakhand, India

Payal Saha
School of Agriculture,
Dev Bhoomi Uttarakhand
University, Dehradun,
Uttarakhand, India

Preeti Handa Kakkar
School of Agriculture,
Dev Bhoomi Uttarakhand
University, Dehradun,
Uttarakhand, India

Corresponding Author:
Payal Saha
School of Agriculture,
Dev Bhoomi Uttarakhand
University, Dehradun,
Uttarakhand, India

Role of organic farming for sustainable agriculture in rural areas: A review

Anjali Adhikari, Priyanka Kumari, Shachi Negi, Kamla Dhyani Jakhmola, Payal Saha and Preeti Handa Kakkar

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Abstract

Organic farming plays a vital role in promoting sustainable agriculture, especially in rural areas where traditional knowledge and natural resources are deeply rooted in farming practices. This review explores the multifaceted benefits of organic farming in enhancing environmental health, ensuring food safety, and improving the socio-economic conditions of rural communities. By eliminating the use of synthetic inputs and embracing eco-friendly techniques such as composting, crop rotation, and biological pest control, organic farming not only preserves soil fertility and biodiversity but also minimizes environmental degradation. Moreover, it offers rural farmers the opportunity to reduce input costs, access the markets easily and increase resilience against climate variability. The adoption of organic farming can empower rural populations through increased employment, sharing the knowledge amongst the youth and women, and community-driven development for the future achieving goals in the better health and minimization of environmental degradation. This paper highlights the potential of organic farming as a beneficial strategy for achieving long-term agricultural sustainability, food security, and rural empowerment.

Keywords: Sustainability, organic farming, environment degradation, rural farmers, sustainable

Introduction

In an age marked by rising concerns over climate change, soil degradation, and food safety, the quest for sustainable agricultural solutions has never been more urgent. At the heart of this transformation lies organic farming a harmonious blend of traditional wisdom and modern ecological awareness. Rooted in the principles of biodiversity, natural resource conservation, and holistic plant and animal care, organic farming seeks to nurture the earth while feeding its people (Gomiero, T *et al.*, 2011) ^[11] Organic farming, which harmoniously combines old knowledge with contemporary ecological consciousness, is at the center of this change. Organic farming, which is based on the ideas of biodiversity, the preservation of natural resources, and the holistic treatment of plants and animals, aims to feed people while nourishing the planet (Reganold *et al.*, 2016) ^[24].

The integrated use of organic manure and chemical fertilizers improved nutrient availability and soil health thereby, contributing to sustainable wheat production (Sharma *et al.*, 2026) ^[29]. By preserving the environment's natural cycles of recovery, the use of more organic materials in agricultural techniques might lessen negative environmental effects. Organic farming may also improve the quality of the food produced. Chemical fertilizers, insecticides, growth hormones, and feed additives for animal operations may be mostly avoided in organic farming.

The nitrogen cycle, soil erosion, carbon sequestration, and numerous other ecological phenomena are all impacted by contemporary agriculture methods. The study on irrigation and weed management in wheat is highly relevant to sustainable agriculture as it aims to optimize water use and develop eco-friendly weed control strategies. (Kakkar P.H. *et al.*, 2024) ^[13]. One effective strategy to reduce the ecological and environmental effects of sustainable development is organic farming. Agriculture provides a significant proportion of the household economy worldwide. People rely on agriculture to feed their families, earn a living, and start a business, no matter how small (Dorosh and Thurlow, 2016) ^[6] Although it is a less common source of income in wealthy nations, agriculture provides direct and

indirect advantages to all people worldwide. Numerous career opportunities have emerged as a result of the increasing demand for agricultural products worldwide.

Organic Agriculture and Sustainable Development

Environmental health, economic profitability, and social and economic justice are the three main goals of sustainable agriculture. The concept that we must meet present needs without jeopardizing the ability of future generations to meet their own is the cornerstone of sustainability.



Fig 1: Organic Farm of Bergamot Mint (*Mentha citrata*)



Fig 2: Organically grown Turnip

The very basic approach to organic farming for the sustainable environment includes the following

1. Preserve and enhance soil health by promoting organic manures or activity and avoiding pesticide damage.
2. Cutting back on the use of non-renewable energy sources.
3. Recognition of the benefits of the native traditional farming system.
4. Preservation and enhancement of the agro-ecosystem and natural landscape.
5. Preventing excessive use and contamination of natural resources.

Current Scenario of Organic Farming in India

Organic farming in India has transitioned from niche to mainstream, underpinned by strong policies, science-backed R&D, farmer-led collectives, and emerging market demand. However, to scale sustainably, India must focus on subsidy support, infrastructure, R&D, streamlined certification, and consistent consumer awareness (Kumar *et al.*, 2024) ^[15]. One of the agricultural industries with the quickest rate of

growth is organic farming, which accounts for 1% of all agricultural land worldwide. This agricultural approach emphasizes methods like crop rotation and companion planting and uses organic fertilizers including compost manure, green manure, and bone meal. (Seufert *et al.*, 2017) ^[26]. With about 1.76 million hectares certified and an additional 3.63 million hectares undergoing conversion as of March 2024, India ranks fourth internationally in terms of certified area, making it one of the top countries in the world for organic farming. Even if there are many producers, just 2-4 percent of all cultivated land is made up of organic farmlands. The organic market, which includes fruit, cereals, spices, and dairy products, was valued at approximately USD 5.56 billion in 2024 and is projected to rise to USD 13.48 billion by 2033 at a compound annual growth rate of almost 10.4%. It began in the early 20th century as a response to farming methods that were changing quickly. (Kulasooriya *et al.*, 1994) ^[14].

According to the reports, our findings have come to an analysis that Tripura has 22,000 hectares of organic land, and West Asian importers were drawn to state-level buyer-seller meetings. Organic marketing through cooperatives is supported by Rajasthan's RAJFED Memorandum of Understanding with National Cooperative Organics Ltd. Under the Namami Gange scheme, the Bithoor region of Kanpur introduced the Bithoor Organic brand with over 4,000 farmers. Cotton in the Soyoke region of Madhya Pradesh (Chhindwara) switched from genetically modified to organic with assistance from WWF and Srijan. Zero Budget Natural Farming is expanded in Andhra Pradesh and Karnataka; VP farms are more resilient to climate change.

Benefits of Organic Farming

An eco-friendly and sustainable kind of farming that puts an emphasis on ecological balance, biodiversity, and soil health is organic farming. The dried biomass on the soil is broken down by the microorganisms in cow dung (300-500 crores of beneficial bacteria per gram of cow dung) and turned into nutrients that plants may ingest. (Willer and Lernoud, 2020) ^[30]. Organic farming improves the soil's natural fertility, encourages healthier crop growth, and supports the preservation of important creatures like pollinators and soil bacteria by eschewing synthetic fertilizers, pesticides, and genetically modified organisms. By lowering chemical runoff and water pollution, this technique protects nearby ecosystems and raises groundwater quality.

According to a study conducted by AFSSA (2003) ^[1], foods cultivated organically have more dry matter than foods grown traditionally, particularly green vegetables and tubers. Additionally, organic produce is frequently devoid of toxic residues and higher in specific nutrients, both of which improve consumer health. By supporting local food systems, expanding employment possibilities and encouraging traditional agricultural methods, organic farming may strengthen rural communities in addition to its positive effects on the environment and human health.

Organic vegetables generally have significantly less nitrate content than conventional vegetables. (Woëse *et al.*, 1997) ^[31]. Although nitrates are utilized as soil fertilizer in agriculture, they can quickly change into nitrites, which is concerning for public health. Methemoglobinemia can result from nitrites, which are extremely reactive nitrogen species that can compete with blood oxygen for binding with haemoglobin. Additionally, it forms a strong carcinogen

called nitrosamine by binding to the secondary amine (Lairon, 2010) ^[16]. According to a review by Lairon (2010) ^[16] which was based on the French Agency for food safety (AFSSA) report, dry matter, minerals and antioxidants like salicylic acid and polyphenols are all greater in organic products. Compared to foods cultivated conventionally, 94% to 100% of organic foods are free of pesticide residues.

Recently, the Government of India has introduced a variety of programs and policies for expanding organic farming in the country. Among these the most important schemes include:

Paramparagat Krishi Vikas Yojana, Rashtriya Krishi Vikas Yojana, Organic Value Chain Development in North Eastern Region Scheme, Integrated Development of Horticulture mission, National Programme for Organic Production, National Project on Organic Farming, and National Mission for Sustainable Agriculture (Yadav, 2017) ^[32]. The Government of India has implemented the Rashtriya Krishi Vikas Yojana and Paramparagat Krishi Vikas Yojana since 2015-16 as part of the ZBNF program (Sobhana *et al.*, 2019) ^[27].

Restoring ecosystem health and revitalizing soils through varied, multi-layered agricultural systems while cutting expenses by removing external inputs, Zero Budget Natural Farming (ZBNF) is a farming method that uses only 10% less water and 10% less electricity than chemical and organic farming. ZBNF eliminates the cost of growing and harvesting plants.

Organic Farming Practices in the Global Agriculture

Organic Farming refers to “a system which usually excludes the use of harmful and artificial chemical use (like: chemical fertilizers, pesticides, plant hormones, additives etc.) (Tiwari *et al.*, 2022) ^[25]. Organic farming depends upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral-grade rock additives, and biological systems of nutrient mobilization, ensuring plant protection optimally. "Organic agriculture is a production method that preserves the health of soils, people, and ecosystems. It relies on biological processes, biodiversity, and cycles that are adapted to local conditions rather than employing inputs that have detrimental effects. (IFOAM, 2015) ^[12]. With at least 3.1 million farmers managing 72.3 million hectares of farmland organically, organic farming is implemented in 187 countries (Willer *et al.*, 2020) ^[30].

While the benefits of organic farming in improving soil health, environmental sustainability, and consumer well-being are well established, one major gap lies in the lack of localized studies to identify suitable crops and organic products that align with both regional agro-climatic conditions and global market demands. (Mishra *et al.*, 2023) ^[20] The current body of research does not adequately address how organic farming systems can be tailored to the socio-economic realities of different regions-especially those struggling with food and nutritional security or where conventional farming remains the primary livelihood (Sahu *et al.*, 2024) ^[25]. There is also insufficient data on the transitional challenges faced by farmers shifting from conventional to organic methods, including economic viability, yield stability, and policy support (Ravisankar *et al.*, 2024) ^[23]. Moreover, despite the growing consumer demand for organic food, there is limited analysis on market accessibility, value chain integration, and certification mechanisms for small-scale rural producers (Ashoka

garage *et al.* 2023) ^[3]. Addressing these gaps is essential to ensure that organic farming not only contributes to environmental sustainability but also enhances rural employment, income generation, and national food security without compromising productivity or equity.

Scope of Organic Farming

In recent decades, the global agriculture sector has become increasingly dependent on synthetic inputs such as chemical fertilizers, pesticides, and genetically modified organisms (GMOs). High yields and food security have been facilitated by these traditional practices, but they have also resulted in a number of socioeconomic, health, and environmental problems. Given this, organic farming has become a viable substitute, providing a comprehensive strategy that prioritizes biodiversity, soil fertility, environmental health, and the production of safe food (Reganold *et al.*, 2016) ^[24]. The common problem nowadays is degradation of the environment from conventional farming which includes air pollution, water contamination, biodiversity loss, and soil degradation have all resulted from the overuse of agrochemicals. Climate change is exacerbated by greenhouse gas emissions from synthetic pesticides and fertilizers (Menegat *et al.*, 2022) ^[19]. Apart from that the second major problem that we face is the soil fertility and soil health. In order to enhance soil structure, microbial diversity, and long-term fertility, organic farming emphasizes replenishing the soil with compost, green manures, and crop rotations as it stops the salinization and soil erosion brought on by intensive chemical-based farming. India is somehow lucky in the availability of food grains in comparison to some other countries which cannot afford even a one time meal but if we talk about the Food safety and health, we are still facing many major and minor diseases due to the excessive amount of the harmful chemicals use in the production of the agricultural produce in higher amount or let's just say for getting higher output production in a very less amount of time by implementing very less inputs for the production. (for eg: Plant hormones, pesticides, insecticides, and other harmful chemical fertilizers) (Amarendra Reddy *et al.*, 2024) ^[2]. Reducing or eliminating synthetic fertilizers, increasing agricultural yields and productivity, promoting biodiversity, conserving water, and retaining carbon in the soil are the objectives of the program. It is often linked to organic farming practices (Pretty *et al.*, 2018) ^[21].

A survey led by researchers at the University of California, Davis, revealed that food produced by organic methods contains up to 58% more polyphenolics (an antioxidant) than conventionally grown food (Fell, 2003; Faller, 2010) ^[10, 9]. Many health problems have been connected to residual pesticides and chemicals in food that is farmed traditionally. Due to its perceived nutritional worth and health benefits, organic food is becoming more and more popular. It is also free of artificial additives. Now comes the most interesting yet so concerning topic that is “Sustainability and Climate Resilience,” by improving soil moisture retention and lowering reliance on external inputs, organic farming techniques increase cropping systems' resistance to drought and climate stress. The foundation of agricultural sustainability is the notion that we must satisfy present demands without endangering the capacity of future generations to satisfy their own. Sustainability has several applications in agriculture. (Malik *et al.*, 2020) ^[17]. It also

helps with energy conservation and carbon sequestration. Agriculture has a significant impact on the environment, both generating and being influenced by environmental changes. It contributes to water scarcity, pollution, climate change, land degradation, deforestation, and other processes. (Mateo-Sagasta *et al.*, 2017) ^[18].

Conclusion

Although organic farming can provide high-quality food without negatively impacting the environment or the health of the soil, it is necessary to choose appropriate crops and products on a regional basis for organic agriculture according to the environmental conditions of that particular region that has international market demands too because of its promises to ensure food and nutritional security as well as their source of income, some areas might not be able to afford to switch to organic at this time. In addition to bringing prosperity and tranquility to the area, this will offer plenty of job opportunities. Organic agriculture promotes the health of consumers, the state of a country's ecology and its overall economic development through income generating. Given that India currently produces more organic food than any other country in the world, we can draw the conclusion that promoting organic farming there will help create a country that is economically, environmentally, and nutritionally sound in the near future.

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