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Organic farming practices for sustainable horticultural development: A review

Abhijit Debnah and Prahlad Deb

Abstract
Due to their potential to promote horticultural sustainability, organic farming methods have attracted a lot of attention recently. Crop rotation, cover crops, and integrated pest control are essential practices for preserving ecosystem health, soil fertility, and biodiversity. These procedures ensure the long-term sustainability of horticulture production systems by reducing soil erosion, improving water retention, and mitigating environmental pollution. Market demand for organic produce drives up prices, and lower input costs help businesses become more profitable and economic. Additionally, organic farming improves rural livelihoods, supports regional economies, and opens up employment prospects.

Keywords: Organic, soil fertility, biodiversity, economic, livelihood

Introduction
At least 170 nations already produce commercially viable organic food since organic agriculture is expanding quickly. In India, there were 2 million organic farmers working on 43.1 million hectares of land, including areas undergoing conversion. Asia (36% of the world's producers are organic), followed by Africa (29%) and Europe (17%).
This work attempts to bring together different issues in light of recent developments in organic farming. It recounts the development of organic farming and examines the current state of organic farming in India and the rest of the world. The literature analysis identified several significant difficulties in organic farming, including yield reduction while switching to organic farming, improving soil fertility, integrating livestock, certification, ecology, marketing, and legislative support. Agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity, is promoted and enhanced by organic farming, a comprehensive production management approach. It emphasizes the use of management practices above the usage of off-farm inputs while taking into account the need for regionally adapted systems according to regional conditions. To achieve this, specific system functions are filled using agronomic, biological, and mechanical techniques whenever possible rather than synthetic materials [7].
Certainly, its emergence into the world of policymaking, its presence in the anonymous global market, and the conversion of organic products into commodities present significant challenges today. The worldwide community has become significantly more aware of the need to protect the environment and ensure the quality of food during the past two decades. Organic farming is finally being embraced by the general public after almost a century of development and holds immense promise from a commercial, social, and environmental standpoint. Although there is a progression of ideas from the past to the present, the contemporary organic movement is very different from its initial shape. In addition to the founders' concerns for healthy soil, healthy food, and healthy people, environmental sustainability is now at the center of the organization.

Definitions
According to the definition of organic farming provided by the USDA study team, "organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilisers, pesticides, hormones, feed additives, etc.) and to the maximum extent practicable relies upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives, and biological system of nutrient mobilisation and plant protection.

"According to a different definition offered by FAO, "Organic agriculture is a unique production management system that promotes and enhances agroecosystem health, including biodiversity, biological cycles, and soil biological activity and this is accomplished by using on-farm agronomic, biological, and mechanical methods in exclusion of all synthetic off-farm inputs."

Organic agriculture in India: Since the "Sevagram Declaration" in January 1994, which aimed to promote organic farming in India, the industry has multiplied, and several initiatives at both the government and non-government levels have given it a clear course.
The National Project on Organic Farming (NPOF) has defined the promotion strategy and given the required assistance for the area expansion under certified organic farming while the National Programme on Organic Production (NPOP) outlined its regulatory framework. Growing certified area had no institutional framework for assessment prior to the implementation of NPOP in 2001 and the development of the accreditation process for certification organisations [8]. About 42,000 acres of farmed land were first estimated in 2003–2004 to be certified organic. India certified more than 11.2 million acres of land by the year 2012 [3, 4]. While only around 1.4 million ha of this was suitable for cultivation, the remaining 8 million ha were forests suitable for wild animal grazing. The total certified area has increased dramatically over the past five years as a result of rising public awareness, rising consumer demand, rising farmer propensity to switch to organic farming practises, and rising institutional support. India is now the largest country in the world in terms of the total area used for certified organic wild harvesting. India had become the greatest producer of organic cotton in the world a year prior, accounting for more than 50% of all organic cotton produced globally, with a production of more than 77,000 MT of organic cotton lint.
Agriculture plays a vital role in a developing country like India. Apart from fulfilling the food requirement of the growing Indian population, it also plays a role in improving economy of the country. The Green Revolution technology adoption between 1960 to 2000 has increased wide varieties of agricultural crop yield per hectare which increased 12-13% food supply in developing countries [15]. Inputs like fertilizers, pesticides helped a lot in this regard. But in spite of this fact, food insecurity and poverty still prevails prominently in our country. Uses of chemical biopesticides and fertilizers have caused negative impact on environment and increasing the health problems and many more. India has been traditionally practicing organic agriculture but modern agriculture practices have pushed it to walls. Vermicomposting have positive impacts on plant growth and health and treats organic waste in an environment friendly way [9].

Table 1: Major organic crops exported form India

S. No	Type of Commodity	Products
I	Spices	Cardamom, black pepper, Ginger, turmeric, nutmug, chilli, clove and vanilla
2	Plantation	Tea, coffee, cocoa
3	Pulses	Red gram, black gram
4	Fruits	Mango, banana, pine apple, passion fruit, orange, cashew
5	Nut	Walnut
6	Vegetables	Okra, brinjal, onion, tomato, potato
7	Oil seeds	Sesame, castor, sunflower
8	Others	Cotton, herbal extracts

***Source*:** (APEDA)

Methodology

Components of organic farming

Important components of organic farming are biological nitrogen fixation, crop rotation, residues of crops, biopesticides, biogas slurry etc. Vermicomposting has emerged as a major component in organic farming which is very effective in enhancing soil fertility and growth of crops in a sustainable way.

The various components of organic farming are

1. **Crop rotation:** For practicing sustainable agriculture there should be rotation of crops on the same land over a period of two years or more for maintaining soil fertility and control of insects, weed and diseases. For example use of legumes in rotation improves soil fertility.
2. **Crop Residue:** India has great potential of using residues of crops and straw of cereals and pulses in recycling of nutrients during organic farming. Crop residues when inoculated with fungal species improve physico-chemical properties of soil and crop yields.
3. **Organic manure:** The organic manure is obtained from biological sources (plant, animal and human residues). Organic manure helps in increasing crop growth directly by improving the uptake of humic substances and indirectly promoting soil productivity by increasing availability of major and minor plant nutrients through soil microorganisms.
4. **Bulky organic manure:** Bulky organic manure includes compost, FYM and green manure having less nutrients in comparison to concentrated organic manure.

FYM: Farm Yard Manure (FYM) refers to the well decomposed combination of dung, urine, farm litter and leftover materials (roughages or fodder).

Compost: Large quantities of waste material (vegetable refuse, weeds, stubble, Bhusa, sugarcane trash, Sewage sludge, animal waste, human and industrial refuse) can be converted into compost manure by anaerobic decomposition. Compost is used in the same way as FYM and is good for application to different type of soils and crops.

Green manuring: Green manuring is practice of adding organic matter to the soil by ploughing and adding into the soil undecomposed green plant tissues for improving physical structure and fertility of the soil. The green manure crop (legume crop) supplies organic matter and additional nitrogen. Commonly used green manure crops are such as Sun hemp

(*Crotalaria juncea*), Dhaincha (*Sesbania aculeata*), Cowpea, Cluster Bean, Senji (*Melilotus parviflora, Vigna sinensis*), Berseem (*Trifolium alexandrinum*) etc.

5. Concentrated Organic Manure:
Oilcakes, blood meal, fishmeal, meat meal and horn and hoof meal (Concentrated organic manures) that are organic in nature made from raw materials of animal or plant origin and contain higher percentage of vital plant nutrients such as nitrogen, phosphorous and potash, as compared to bulky organic manures.

6. Waste
- **Industrial waste:** Industrial by products such as spent wash & coir waste can be used as manure.
- **Municipal and Sewage waste:** It is an important component of organic waste.

7. Biofertilizers
Biofertilizers; are microorganisms that have the capability of increasing the fertility of soil for example by fixing atmospheric nitrogen and through mycorrhizal fungi and phosphate solubilisers; These are ecofriendly and sustainable way of achieving soil fertility. Biofertilizers have biological nitrogen fixing organism which help them in establishment and growth of crop plants and trees, enhance biomass production and grain yields.

Types of Biofertilizers
There are two types of bio-fertilizers.

Symbiotic Nitrogen-fixation
Rhizobium: Rhizobium Bacteria fixes atmospheric nitrogen in roots of leguminous plants, form tumours like growth known as root nodules. It is widely used biofertilizer which can fix around 100-300 kg N/ha in one crop season.

Asymbiotic N-fixation: Blue Green Algae, Azolla, Azotobacter, Mycorrhizae and *Azospirillum* grow on decomposing soil organic matter and fixes atmospheric nitrogen in suitable soil medium.
- **Azotobacter:** Azotobactor has beneficial effect on vegetables, millets, cereals, sugarcane and cotton. Organism is capable of producing nitrogen as well as antifungal, antibacterial compounds, siderophores and harmones.
- ***Azospirillum*:** *Azospirillum* has beneficial effect on oats, barley, maize, sorghum, forage crop and pearl millet. It fixes nitrogen by colonising root zones.
- **Blue Green Algae:** Blue-green algae reduce soil alkalinity and it is good for rice cultivation and bio-reclamation of land.
- **Azolla:** Small floating fern, *Azollaharbours* blue-green algae, anabaena, commonly seen in shallow fresh water bodies and in low land fields. They fix nitrogen in association.
- **Mycorrhizae:** Mycorrhizae is symbiotic association of fungi with roots of Vascular plants. This helps in increasing phosphorous uptake and improve the growth of plants.

Bio-pesticide
Biopesticides are of plant origin and include plant products like alkaloids, phenolics, terpenoids and some secondary chemicals. They are biologically active against insects, fungi, nematodes affecting their behaviour and physiology. Commonly known insecticides are Pyrethrum, Nicotine, Neem, Margosa, Rotenone etc.

Vermicompost
Vermicompost is organic manure or compost produced by the use of earthworms that generally live in soil, eat organic matter and excrete it in digested form. These are rich in macro and micronutrients, vitamins, growth hormones and immobilized microflora essential for plant growth [10].

Effect of inorganic fertilizers and other agro-chemicals on soil and plants
Modern agriculture involving use of agrochemicals like fertilizers causes:
- Depletion in soil fertility and pollution problems in ground as well as surface water bodies.
- A portion of the nutrients added through fertilizers does not become available to plants and remain in soil which may result in Eutrophication in water bodies like lakes or increase in nitrate concentration in ground water more than the permissible limit of 10 ppm causing Blue baby Syndrome [14].
- Increases the soil acidity with nitrification.
- Denitrification results in formation of methane, ammonia, elemental nitrogen and nitrous oxide.
- Depletion of micronutrients like sulphur& zinc.
- Increased risk of humus depletion and decline in crop production through large doses of N-fertilizers [11].
- Trace metal contamination (Fluoride, Arsenic & cadmium) in soils and plants due to large and regular use of phosphatic fertilizers.
- Trace toxic metal contaminants can cause problem when they reach human body through food chain.

Benefits of organic farming
The benefits provided by organic farming are:
- It maintains health of environment by reducing pollution.
- It helps in increasing agricultural production in a sustainable way.
- It helps in improving the soil health.
- Agriculture products obtained from organic farming are better in quality. (Bigger in size, flavor, size & aroma)
- Water holding capacity of the soil is increased through organic farming.
- It improves the availability of nutrients required and essential for plants. (Macro nutrients & Micro-nutrients)
- Organic farm products are usually of better size, flavor, aroma (Quality)
- Underground water of the area under organic farming is free of toxic chemicals.
- Vermicomposting brings down waste bulk density.
- Vermicomposting has hormone like substance auxins which increases plant growth.
- Maintains C:N ratio in the soil and increases the fertility and productivity of the soil.
- Increase in biological activity makes lower depth nutrients availability possible.
- Increases water holding capacity of the soil.
- Improves texture & structure of soil

Market for organically grown food
Consumers concern over high levels of saturated fats,

sugarcane, salt in foods as well as the risks from additives and pesticide residues, has stimulated the demand for health foods particularly organic foods. Furthermore, there is an increasing awareness of the environmental damage associated with the use of modern agricultural techniques, especially agrochemicals. At the same time, food surpluses especially in Europe have resulted in encouraging organic farming where in the yield levels are low resulting in reducing the supply. Even though the above factors have contributed to the growth of market for organic food, it is interesting to note that there have been no major promotion campaigns in catering organic food[13]. However, the media has been relatively sympathetic to organic farming, which has compensated largely for the lack of product promotion through commercial advertising channels. In this context, marketing concepts needs to be prominent but cannot dominate totally. Thus, close attention to marketing is an integral part of successful organic farming.

Major problems in marketing Indian organic products

- Price expectations are too high in relation to quality.
- Low consistency of quality.
- Slow shipment, restrictions for importing Indian organic products.
- Time consuming and complicated paper work while dealing with export authorities.
- The poor customer service from the Indian traders after sales is the major problem in export marketing.
- Lack of proper marketing network a marketing implementation.
- Less effort to develop domestic markets.

Scope and modes to promote organic farming

As the demand for organic products is increasing over years with people becoming more conscious about the quality of the food stuffs and awareness about the environmental effects due to overuse of chemicals in agriculture. They also opined that if the organic products have a well-defined marketing channel and ensured premium price the likeliness to increases the area under organic farming is wider. When asked for the modes in which organic farming could be promoted the following measures were recommended:

- Improve the marketing channels Ensure premium price for the organic products
- Ensure regular supply of organic manurg Establish organizations to promote organic farming
- Educate people about the benefits of organic farming
- Branding of organic products

Conclusions

Organic farming is the system of farming that promotes environmentally, socially and economically sound products of food and fibers. As the awareness about the harmful effect of chemicals on health, soil, environment etc., is increasing; that's why inorganic farming is shifting its way towards organic farming. India with diverse agro climatic conditions has great potential for organic farming and many products are produced organically in India. High price for organic products and lack of proper marketing functions within domestic markets are the major constraints in organic farming in India.

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