Chapter

# Organic Vegetable Farming; A Valuable Way to Ensure Sustainability and Profitability

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## Abstract

The most pressing concern in the world since independence has been producing enough food to feed an expanding population. The mix of high-yielding production techniques has helped the globe to generate a food surplus while also raising worries about soil health and environmental pollution. Though, scientists and policy makers are rethinking agricultural systems that rely heavily on biological inputs. Organic farming can provide high-quality food without compromising the health of the land or the environment; nevertheless, it is unclear if large-scale organic farming would be able to feed world's vast population. Adoption of this emerging approach "organic vegetable farming" plays a vital role in development of agricultural sustainability through avoiding indiscriminate use of synthetic chemicals. There are numerous organic sources for organic vegetable farming but various type of composts (especially vermi-compost) and biochar are most famous among all other organic sources as they improved soil healthy and vegetables productions through improving soil physico-chemical and biological attributes. In addition, demand and prices of organically produced vegetables are much higher in market and evidence showed that organically grown vegetables are enriched with nutrients and safe for consumption because of their less exposure with residues of in-organic pesticides.

**Keywords:** organic farming, sustainable agriculture, organic vegetables, organic fertilizers, profitability

## 1. Introduction

The world population has been steadily increasing since the end of the Black Death in 1350, when it was estimated to be over 370 million people [1]. Between 1955 and 1975, the world's population grew at its fastest pace of over 1.8% per year, peaking at 2.1% between 1965 and 1970. By 2050, the United Nations Department of Economic and Social Affairs predicts a population of 9 to 10 billion people, with an 80% confidence interval of 10 to 12 billion by the end of the century [2]. Other demographers anticipate that in the second half of the twenty-first century, the

world's population will begin to fall [3]. As of 2012, a typical estimate for the world's sustainable population was 8 billion people. With a global population of 7.8 billion people as of March 2020 and normal population growth predictions, Earth will be overpopulated by 2050 or sooner. So for a higher population, the scientist needs to produce more yields for people.

By 2050, food consumption is predicted to rise anywhere from 59% to 98%. This will have a profound impact on agricultural markets that we have never seen before. Farmers throughout the world will need to boost crop output, either by expanding the quantity of agricultural area available for crop production or by improving productivity on existing agricultural lands with fertilizer and irrigation, as well as embracing innovative technologies like precision farming. Whereas, some crop productivity factors such as diseases, reduced microbial community, use of pesticides, lower or high pH, salinity, and limited nutrient availability affect crop production [4–6]. Furthermore, the use of fertilizers, pesticides, and other synthetic products may be useful to produce more food for hungry people while these conventional methods have various consequences. For example, the total rupees used in the acquisition of pesticides are 8,138 million in Pakistan. It was also projected that the import bill of Rs 8.139 billion for 2003 amounted to Rs 19,612 billion [7]. In most cases, green revolution approaches like increased use of artificial agrochemicals such as fertilizers and insecticides, implementation of mineral-responsive, productive crop genotypes, and improved exploitation of irrigation potentials have increased production output. Changes in soil responses, growth of mineral imbalances/shortage, harm to soil vegetation and animals, reduction in the activity of earthworm, decrease in soil humus/organic matter, and altering atmosphere, reduction in soil productivity ventilation, and water holding capacity are all consequences of the improper way out and incessant use of these intense energy inputs [8]. The research found that over-use of chemical fertilizers and their continuous application is very concerned about the health and environmental risks, and farmers are urged to turn their prevailing farms into organic farming in developed countries.

Organic farming is a food-making strategy that emphasizes the relevance of biodiversity, biodiversity of soil, and biological cycles. It is also a technique of production to prevent or to a significant extent remove the use of synthetic fertilizers [9]. Active degradation of organic manures, comprising various agricultural debris and animal waste, might be achieved by the usage of legumes and biological nitrogen fixation. Organic agricultural systems are typically considered to be even more sustainable over conventional and organically-managed farms globally to about $4.4 \times 10^7$ ha and are predicted to further expand. Increased sustainable agricultural yield may be achieved by the application of organic matter and improvement of land health through the formation of favorable physical soil characteristics [10]. It focuses on creating natural soil fertility so that plants can absorb the nutrients they need for a consistent benefit inside the soil minerals formed in this manner and extracted in accordance with the needs of plants. Disease and weed management are best achieved through the creation of environmental stability within the system and through the utilization of bio-pesticides and several cultural strategies like crop rotation, integrated planting, and farming. Organic farmers also use entire waste and manure inside the farm, but the exportation of produce from the farm outcomes a constant supply of minerals. The water holding capacity of the soil is improved via organic farming. Organic farm produce is generally of healthier size, taste, and quality. Underground water of the area under organic farming is free of toxic chemicals. Maintains the C:N ratio in the soil and improves the fertility and production efficiency of the soil. Mostly, the sources of organic farming now in days are farmyard manure, composting and

biochar that could be used for enhancing the yield, quality, and profitability of various cereal, non-cereal crops as well as vegetables.

Vegetable growing is a key source of funding for farmers in the whole world, including organic agriculture. Overall, vegetable crops make for around 7% of the overall farmland and in developed countries, this figure is generally higher [11]. Vegetables are very adaptive and valuable to farmers in their use of organic sources of nutrients. Organic sources such as vermicompost, biochar and farmyard manure, etc. could be beneficial for vegetable growing. Rekha, [12] found that applied vermicompost enhanced the number of branches and fruits of Capsicum annum (Linn.) Hepper. Vermicomposting has a beneficial influence on crop efficiency [13]. Similarly, a high yield could be obtained of brinjal a crop cultivated with vermicompost, and a significant increase in production in the instance of sweet pepper [14]. Yadav and Vijayakumari [15], reported quality enhancement of various vegetables after the addition of organic sources.

## 1.1 Importance of organic farming

Organic agriculture is an environmentally friendly production option available. It is necessary for guaranteeing food supply, relieving impoverishment, and protecting dynamic mineral deposits on which current and future generations will be completely reliant for their persistence and security. Over 90% of developing countries, particularly in Asia, would be in towns, which will adopt the green revolution approach to an ever-greater level [16]. Organic farming contributes to the protection of the environment and aids to consolidate environmental problems such as soil management and organic farming by creating a crop cycle to supplement the soil with a natural nutrient reservoir. Because of its friendly approach, it helps to reduce pollution of the earth, water, and air. Thus, it serves as a natural means for conservation of the environment and maintainable development [17]. Organic farmers must go along with the procedures established by regional organic farming organizations and are not permitted to grow genetically modified (GM) crops [18].

## 1.2 Sustainability of agriculture

Agricultural researchers and experts are well aware of the importance of sustainable agriculture and the necessity to put it into practice, i.e., developing appropriate ways to assess the farming system's sustainability [19]. Organic agriculture raises concerns about the negative consequences of cropping and agricultural systems such as water pollution from nitrates and pesticides and emissions of gasses from inputs of nitrogen; it is conventional agriculture that raises the most issues. But addressing the negative repercussions of productivism is not enough to ensure long-term viability. Other variables outside of the traditional system can contribute to a lack of long-term viability. As a result, the long-term viability of organic agricultural systems must be recognized. In reality, the long-term viability of organic farming is assessed using the same set of indicators to compare conventional, integrated, and organic farming systems [20].

### *1.2.1 Emerging approaches in organic farming*

Organic amendments are being used as an alternative to inorganic fertilizers; currently, these amendments are an emerging approach [21]. Organic farming methods accord with the four basic principles that reveal their essence: health, ecology, fairness, and care. Various other approaches include, crop rotation, cover crop, green manures, animal manures, and integrated pest and weed management. Among

the researchers, organic amendments such as biochar and compost have growing interests. Many studies have been done on exploring their role in the enhancement of plant nutrition, quality, yield of crops, soil fertility protection, and ensuring the sustainability of the environment [22, 23]. There are different factors that are responsible for the special effects when they are added into the soil, for example, properties of feedstock, processing methods, rate of application, type of soil, species of crop, and environmental conditions [24, 25].

### 1.3 Manures

Different types of manure and certain manure-derived compost, which contain larger levels of nutrients, are applied to soils to increase vegetable output and meet the rising demand for their consumption [26]. By providing necessary nutrients through substrate and decomposition to generate organic matter, the farmyard manure plays a critical role in the productivity of a variety of agricultural systems. By adding farmyard manure [27], soil microbial activity is enhanced, which may increase the rate of organic matter breakdown. Organic matter significantly enhances soil physical properties such as soil hydraulic conductivity, soil porosity, and soil water-holding capacity, all of which are important components of soil quality [5, 28]. It was noticed that the incorporation of organic manures (farmyard manure, poultry manure) to the soil resulted in remarkable improvement of physiological attributes in various vegetables [29]. When biochar and poultry manure were applied to the soil alone or in combination, they improved the physical properties of soil significantly as compared to control. They decreased soil bulk density and improved soil moisture content and soil porosity [30]. Application of manure improved the properties of soil that increased cucumber yield. Higher rates of manure application resulted in a higher yield of cucumber [31]. Miaha et al. [32], also observed similar results and said that yield of cucumber was increased by increasing higher rates of organic fertilizer. Njoku et al. [33], observed that plots that were amended with manure produced a higher cucumber yield. Another study said that the production of vegetable "cauliflower" was increased when organic manure was application and time of application was also a considerable factor in increasing crop production. Thus, while considering the productivity of the crop and the economic return of the vegetable crop, the application of organic manure as well as certain other aspects such as application timing may be significant for better as well as higher quality production of cauliflower [34].

### 1.4 Biochar

Biochar is porous in nature, rich in carbon contents, and is an alkaline solid product. It is prepared by pyrolysis of waste biomass [35]. Biochar has the ability to increase soil organic carbon, organic matter, and/or soil humus contents. It improves the nutrient and water holding capacity of soil [36]. It has a high cation exchange and adsorption capacity. Biochar has ability to delay fertilizer release in soil and it improves the rate of utilization of fertilizer nutrients. As the structure of biochar is porous with higher water and nutrients adsorption ability, it provides suitable habitat to the soil microorganisms thus promotes activities and propagation of beneficial soil microorganisms. Application of PAD (peanut-shell biochar-based amendment) at the optimal concentrations i.e., 1.5–3% enhanced yield of vegetable. This was mainly due to improved soil qualities and increased contents of available nutrients. Another study was carried out and results showed that application of rice husk biochar and rice straw biochar increased the yield of spring onion by 22% and 35% as compared to raw rice husk that is a current practice followed by farmers

practice [37]. Nobil, [38] indicated that incorporation of biochar having low density and higher porosity leads to the higher production of basil and lettuce biomass. It is mostly related to biochar beneficial effects on the availability of water. Another study said that the addition of biochar increased potassium availability and its uptake in soil and it is primarily responsible for higher root growth in ginger [39]. Biochar application to tomatoes in the field resulted in taller tomatoes plants; it increased root growth and biomass [40].

### 1.5 Vermicompost

In near future "sustainable agriculture" can be ensured through the system of organic farming that includes different biological processes like the application of compost and vermicompost. Many forms of organic material can be used to prepare vermicompost, it includes manure of animals, wastes of manufacturing industries like paper waste, sugar waste of cane or the cotton residues, kitchen waste, agricultural wastes, and the municipal wastes having an organic origin [41]. Higher concentrations of vermicast and the vermitea improves the heath of the plant, provide protection, improve growth, and also provide optimum production of eggplant [42]. According to [43], the application of vermicompost effectively reduced the continuous cropping obstacles in the soil and improved crop growth, its productivity and quality through improving the soil physical, chemical, and biological properties alone and combined application of biochar and the vermicompost improved properties of soil, quality, and yield of cucumber. According to [44], the effect of vermi & parthenium compost on the growth of brinjal seedlings was observed. Growth parameters i.e. the height of plants, the number of plant leaves, area of the leaf, length of root, the number of flowers per plant, and the number of fruits per plant were increased in the parthenium compost as compared to vermicompost and control. [32], said that more nutrients were available to the okra plants when they were mixed as compared to alone organic materials. Growth and yield of vegetable crop okra was highest when it received integrated nutrient management treatment with the lowest rates of vermicompost. But when Vermicompost was mixed with farmyard manure, it gave better results as compared to their individual application. Similar results were found that said combined application of inorganic fertilizer, organic fertilizer, and bio-fertilizers improved okra fruit quality and health of the soil. It was also said that it can produce more yield with better growth of okra vegetative [45].

## 2. Profitability of organic farming

Organic agriculture is significantly more profitable (22–35% greater net present values) and had higher benefit/cost ratios (20–24%) than conventional agriculture under actual conditions with price premiums. When organic premiums are removed, net present values (27–23%) and benefit/cost ratios (8–7%) of organic agriculture were significantly higher. Even though premiums were 29–32%, the breakeven premiums required for organic earnings to meet conventional profits were just 5–7%, despite organic yields being 10–18% lower. While total expenses were similar, labor costs were substantially higher (7–13%) with organic agricultural techniques. Organic farming has space to expand: by 2050, it may account for 10–20% of farmland, up from 1% now [46]. Organic farming has been demonstrated to provide abundant and inexpensive food while also safeguarding the environment, assisting farm finances, and adding to the well-being of farmers and farm employees, according to research. Organic and alternatively produced foods are becoming increasingly popular in grocery shops and farmers' markets [47].

## 3. Conclusion

Organic and organic agriculture are terms that almost everyone has heard of these days. Organic farming is an agricultural method that adheres to the principles of sustainable development. It's an agricultural production management method that does not utilize pesticides, chemical fertilizers, industrial synthetic products, or genetically modified organisms. Organic agriculture contributes to long-term development in society (health, employment, etc.), the environment (methane emissions, water resources, etc.), and the economy (source of wealth, etc.). To promote the adoption of more organic and other novel farming systems, incentives for suitable markets, reform of farm-related laws, and reorientation of publically supported agricultural science are required. Lower yields are less of a concern if society learns to value the other three characteristics of organic and other creative agricultural systems: improved economic, social, and environmental sustainability.

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## Conflict of interest

All the authors declared no conflict of interest.

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