Chapter 10
Organic Farming: The Return to Nature

Saima Siddique, Madeeha Hamid, Ameema Tariq, and Alvina Gul Kazi

Abstract Organic farming is a modern and a sustainable form of agriculture that provides consumers fresh natural farm products. Organic farming works in synchronization with nature rather than against it. This objective is achieved by using techniques to improve crop yields without harming the natural environment as well as the people who live and work in it. Organic agriculture offers an exclusive amalgamation of environment-friendly practices, which require low external inputs, thereby contributing to increased food availability. Organic farming has a very positive influence especially on birds, insects, weeds, wildlife, and soil flora and fauna. Conventional farming is capital intensive, which requires more manufactured inputs and energy as compared to knowledge- and labor-intensive organic farming. Organic agriculture uses energy more competently than conventional agriculture. As compared to conventional agriculture, organic farming produces cost-effective food products, free of synthetic fertilizers and pesticides. It also provides employment opportunities and economic benefits to local communities. The methods utilized in organic farming are more costly and labor intensive, but prove to be more cost effective in the long run. Since organic agriculture supplies more greenhouse gases in the soil, the farmers across the globe can solve the climate disaster by switching to organic methods. In addition, organic agriculture has the potential to address food security issues. Enough evidence is available to prove that organic crops are a better source of nutrients than their corresponding conventional forms. Organic systems give higher animal immunity and increased disease resistance to plants, with 50 % less mycotoxins in crops and a persistent shelf life. Organic

A. G. Kazi (✉) · S. Siddique · M. Hamid · A. Tariq
Atta-ur-Rahman School of Applied Biosciences, National University of Sciences and Technology, H-12, Islamabad, Pakistan
e-mail: alvina_gul@yahoo.com

S. Siddique
e-mail: symacidiq16@yahoo.com

M. Hamid
e-mail: madeeha@asia.com

A. Tariq
e-mail: ameematariq@hotmail.com

P. Ahmad et al. (eds.), *Improvement of Crops in the Era of Climatic Changes,* Volume 2,
DOI 10.1007/978-1-4614-8824-8_10,

foods have more plant secondary metabolites, higher micronutrient content, and more conjugated fatty acids for better human health, including lower incidences of noncommunicable diseases. Organic agriculture merges modernism, custom, and science to manage the shared surroundings encouraging fair relationship and high quality of life for everyone involved.

Keywords Organic farming · Conventional farming · Climate change · Pesticides · Biofertilizer

1 Introduction

Organic farming has engrossed much attention in current decades as a way to maintain farming production. At the same time, it has played an important role in dealing with the environmental harms rooted in traditional agricultural techniques. Organic farming not only produces fine and healthy food products but also improves the fertility and quality of soil (Isaacs 2012). Funtilana has described organic agriculture as: "Organic Agriculture is giving back to the environment what was taken from it" (Singh et al. 2012). Organic food is grown and processed without using any synthetic fertilizers or pesticides (insecticides, herbicides, and/or fungicides), plant growth regulators, such as hormones, livestock antibiotics and GM organisms, and human sewage sludge (John 2011).

Biological pesticides produced from natural sources can be used in the production of organic food. Some preventative measures have to be applied prior to adopting the latest technologies for organic agriculture due to considerable risks of unpredictable tools such as genetic engineering (Tuomisto et al. 2012). Organic farming is based on ecological cycles, and procedures therefore diminish the use of exterior contributions. This minimizes resource utilization of the farms and restricts nutrient heaps in the system. It lessens the danger of phosphorus and nitrogen eutrophication and evades overfertilization. Organic livestock farming is based on environment-friendly production, maintaining animals in good health, realizing animal benefit values thereby generating yields of high class. Organic livestock farming meets the demands of the rising number of consumers (Sundrum 2012).

Organic agriculture requires low external inputs, thereby contributing to increased food availability. It is a system based on generating food with negligible destruction to ecosystems, humans, or animals. Nevertheless, reviewers argue that organic farming may have lesser yields and would consequently require additional land to generate a similar quantity of food as conventional systems do, resulting in biodiversity loss and extensive deforestation, therefore undermining the ecological benefits of organic procedures (Seufert 2012). The expected boost of human world population, above 2 billion by the middle of the century, spots the requirement of an increase in agriculture to deal with the high demands of feed, food, biofuels, and fiber to meet the needs of the population. It, in addition, plays a decisive role in bringing additional ecosystem services, for instance, those that guard the excellence of the environment. Organic agriculture tackles a lot of traits and makes use of the biological regulation methods to put back external input, protecting biodiversity at the same time.

According to the Codex Alimentarius Commission, "organic agriculture is a holistic production management system that avoids use of synthetic fertilizers, pesticides and genetically modified organisms, minimizes pollution of air, soil and water, and optimizes health and productivity of interdependent communities of plants, animals and people." Organic farming is a production scheme, which mainly prohibits or avoids the utilization of artificial pesticides, fertilizers, livestock feed additives, and growth regulators. The objectives of environmental, financial, and social sustainability are the fundamentals of organic farming. The major features include protecting long-lasting fertility of soil by preserving organic matter level, nitrogen self-sufficiency through the use of biological nitrogen fixation and legumes, careful mechanical intervention, fostering soil biological activity, successful recycling of organic materials including livestock wastes and crop residues, and pest control relying mainly on crop rotation, diversity, natural predators, resistant varieties, and organic manuring. A huge emphasis is made on preserving the soil fertility by returning all the wastes to it primarily through compost to reduce the gap between nitrogen, phosphorous, and potassium (NPK) addition and its removal from the soil.

1.1 Food and Agriculture Organization and Organic Agriculture

As defined by Food and Agriculture Organization (FAO), "Organic farming is environmental friendly ecosystem management in which use of all kinds of synthetic input is eliminated." In March 1999, organic agriculture was officially included into FAO's agenda as a way to support sustainable progress. The interest of FAO in organic agriculture stems from its potential to contribute to rural development and global food security. FAO member countries in the International Conference on Organic Agriculture and Food Security in Rome (2007) emphasized the organic agriculture's capability to create a more stable food supply, increased access to food in rural areas, and maintenance of natural resources (Morgera et al. 2012).

2 Background

Organic farming is a type of agriculture practiced by early farmers for thousands of years. A full organic food production system is one of the most flexible and oldest agroecosystems. Inorganic methods were introduced by Industrial Revolution with severe side effects. An organic revolution was started in Central Europe in the mid-1920s by Rudolf Steiner. He created biodynamic agriculture system, which is considered to be an old version of organic agriculture system. Organic agriculture was developed by Albert Howard in the 1940s in England as an independent field. Though organic farming is primitive in its widest sense, Sir Albert Howard started the post Industrial Revolution organic movement, for which he is known as the "father of organic farming." Since then, the production of organic food has moved from small experimental garden plots to outsized and huge farms with their products sold under a unique organic label. Modern organic farming, from its start until now, has contributed only a small part of the total agricultural output. The increase in ecological knowledge in the general population has altered the former supply-driven movement into a demand-driven movement. Many farm products are produced according to conventional methods in the developing countries, but these methods, although similar to organic farming, are not yet licensed. In some cases, economic reasons have forced the farmers of the developing world to transform (John 2007).

3 Problems Caused by Chemical Agriculture

3.1 Environmental Problems

The current intensive agriculture system causes many problems, including:

- Artificial herbicides and fertilizers are easily washed away from the soil, polluting lakes, rivers, and water courses
- The long-term use of artificial fertilizers results in soils with low organic matter content, which is prone to erosion by rain and wind
- Increased dependency on artificial fertilizers, which are required every year in greater amount to produce the same crop yield
- Artificial chemicals deteriorate the soil microorganisms resulting in poor structure of soil as well as decreased aeration and nutrient availability
- It becomes a great challenge to control pests and diseases as they become resistant to artificial pesticides. The number of natural pests decreases because of pesticide use and habitat loss
- Thinning of eggshells of birds
- Increased extinction of preying birds
- Adverse effects on wildlife
- Environmental imbalance (Deshmukh 2010)

3.2 Effects on Human Health

- Toxic residues cause skin reactions and allergic sensitization
- Unfavorable and adverse effects on nervous system, peripheral neuropathies, and impairment of nervous system
- Disturbance of endocrine system

- Carcinogenicity
- Suppression of immunity
- Prolonged exposure to small amount of pesticides residues in food commodities can lead to:
  i. Spontaneous abortions and increase in miscarriages
  ii. Initiation of early puberty in girls. Undesirable effects on male reproductive system
  iii. Effects on kidney, liver, and brain
  iv. Deformities and abnormalities in newborn babies (Deshmukh 2010).

4 Conventional Farming Versus Organic Farming

Organic agriculture system consists of management practices without using artificial fertilizers and high input of energy. This may affect storage of soil organic material in the long run (Leifeld 2012). Some of the analysis of existing data indicates that overall organic yields are usually less than traditional yields but under certain conditions (better management practices, specific crop types, and growing circumstances), yield of organic farming systems can be increased (Seufert et al. 2012).

5 Principles, Pillars, Components, and Objectives of Organic Farming

5.1 Principles of Organic Farming

The main principles of organic farming are as follows:

- To draw upon local resources and to work as much as possible within a closed system
- To try to preserve the long-term fertility of soil
- To avoid all forms of pollution resulting from different types of agricultural techniques
- To produce food products in sufficient quantity and of high nutritional quality
- To cut down use of fossil energy in agricultural practice
- To allow agricultural workers' to build up their potentialities as human beings and earn a living through their work
- To provide such conditions of life to livestock that fulfill their physiological needs (Deshmukh 2010)

5.2 Pillars of Organic Farming

The organic standards, market network, technology packages, and certification/regulatory mechanism are the four pillars of organic farming (Deshmukh 2010).

5.3 Components of Pure Organic Farming

The components of pure organic farming are:

1. Make use of only organic planting for farming
2. No dependence on artificial inputs
3. Feeding soil, but not the crop plants
4. Implementing food safety practices, i.e., never using GM crops or products
5. Documentation of not only the end product but also the entire procedure and distribution chain, i.e., the process and not the produce is to be certified. The certification should keep in view the export
6. Use of artificial growth promoter and enhancers should be prohibited, even the use of organic fertilizers particularly those having some mutants; cow dung from intensive dairy farms using antibiotics, oil cakes, and bone meal should be strictly restricted (Deshmukh 2010)

5.4 Objectives of Organic Farming

The objectives of organic farming concisely expressed in the standard document of the international federation of organic agriculture (IFOAM) are as follows:

1. To work in collaboration with the natural systems rather than dominating them
2. To enhance the biological cycles contained within the farming system, which involves soil flora and fauna, microorganisms, plants, and animals
3. To preserve and enhance long-term fertility of the soil
4. To use renewable resources as much as possible within locally organized agricultural system
5. To work as much as possible, within a closed system with regard to nutrient elements and organic matter
6. To provide such conditions of life to all livestock to enable to act upon all aspects of their innate behavior
7. To evade all forms of pollution resulting from agricultural techniques
8. To uphold the genetic diversity of agricultural system and its surroundings including protection of wildlife habitats and plants
9. To allow agricultural workers' satisfaction and an adequate return from their work including a safe working environment
10. To consider wider and environmental impacts of the farming system (Deshmukh 2010)

6 Why Organic Farming

Organic farming helps to provide long-term benefits to people as well as the environment. Other environmental advantages of organic farming include supporting local food markets, increased biodiversity, improved soil quality and reduced pesticide pollution and packaging waste, and water usage (Ziesemer 2007). Besides its potential to alleviate poverty and economic gains, organic farming proves to be valuable in a number of ways. Some of its benefits are listed below.

6.1 Environmental Benefits

Organic farming protects the environment from harmful effects, which arise from the use of synthetic inputs, specially pesticides, fertilizers, and hormones (Kotschi and Muller-Samann 2004). Fertilizers and pesticides release dangerous toxic chemicals into soil and water (Theriault 2006). Some pesticides can cause harm to the environment or on direct exposure, they can prove to be toxic and dangerous to human health. Children are at a higher risk than adults to direct exposure, since the toxic effects of pesticides are often more severe in children than adults (Committee on Pesticides in the diets of Infants and Children 1993). Agriculture, without pesticides and chemical fertilizers, might deliver in a number of situations, but outputs would be less than traditional farming. Therefore, generating the massive amount of the worldwide diet will need agricultural methods together with the use of fertilizers (Gilbert 2012). Organic agriculture more or less constantly supports more biodiversity and usually has a positive environmental impact per unit of land. It does not essentially have a positive impact per unit of production. Organic cereals and milk, all produce elevated greenhouse gas (GHG) emissions per unit of product than their traditionally farmed counterparts. On the other hand, organic olives and beef have lower emissions in majority of the cases. On the whole, organic foodstuff requires less energy input, but extra land than the traditional products. Studies show that organic farming system provides greater biodiversity as compared to the traditional farming system due to decreased soil changes and chemical application (Nascimbene et al. 2012).

Organic farming has a positive and favorable influence especially on birds, insects, weeds, wildlife, and soil flora and fauna (Deshmukh 2010). All non-crop species exhibit partiality for organic farming system in terms of both diversity and abundance. An average of 30 % more species reside in organic farms. Butterflies, birds, beetles, spiders, earthworms, mammals, soil microbes, and vegetation are particularly affected (Gabriel et al. 2006). The birds' number and species show higher density in organic farms (Deshmukh 2010).

Agro-biodiversity or agricultural biodiversity is a division of biodiversity, which consists of all shapes of life directly significant to agriculture, and can subsist equally in a farm and crossway farms. Ecologists have disagreed that at the farm level, a boost in on-farm variety and a range of overlying collection of species improve the level of agricultural biodiversity. This amplifies crop resilience and ecological firmness. The farming of a huge number of crops at the farm level, i.e., crop biodiversity, is a component of agricultural biodiversity, and generates differentiation in soil fauna, pests, predators, and weeds at the farm level. More significantly, crop biodiversity has been accounted to raise agricultural output through the control of pest infestation and replacement of agricultural soil, directing to better farm income constancy and security (Nastis 2013). Population density and biodiversity fitness are improved by the lack of pesticides and herbicides (Gabriel et al. 2006). Beneficial insects are attracted by weed species which, in turn, improve forage on weed pests and soil quality (van Elsen 2000). Soil-bound organisms often get a wide range of benefits because of the large number of bacterial organisms produced by natural fertilizers and experience a reduced intake of pesticides and herbicides (Hole et al. 2005). The risk of getting poor yield is reduced to a great extent in organic farming because it promotes biodiversity (Fließbach et al. 2007).

Organic farms are more capable of withstanding harsh weather conditions as compared to the conventional farms. Occasionally in drought conditions, their yield is 70–90 % more than conventional farms (Lotter 2003). Organic farms have been found to be more cost effective in the drier states of the USA because of their better drought performance. In addition, organic farms can endure hurricane damage much better and keep hold of 20–40 % more topsoil, thus incurring smaller economic losses as compared to their neighbors (Holt-Gimenez 2000). Hence, organic farming contributes positively to the reduction in soil, air, and groundwater pollution. Moreover, it is also an excellent solution to nitrate pollution. In addition, it improves soil fertility, structure, and soil fauna (Fan et al. 2005).

The organic matter is globally recognized to enhance soil fertility. In addition, improving the soil's chemical, physical, and organic matter has the prospective to add to climate change alleviation by impounding C from the atmosphere. The basic methods to guard organic elements inflowing the soil against decay are:

a. Selective preservation and production of resistant molecular preparation, structure, and association (biochemical methods)
b. Physical detachment from O_2, enzymes, decomposers, etc., by occlusion in aggregates (physical systems)
c. Chemical diffidence by intimate sorption (association) with mineral exteriors (chemical mechanisms)

An 18-year-long study was conducted on organic methods on nutrient-depleted soil, which showed that conventional methods are better for increasing soil fertility and yield in cold and temperate climates (Kirchmann 2007).

6.2 Economic Benefits and Profitability

Various studies have revealed that organic crops use 97 % less pesticides and yield 95–100 % higher along with 50 % lesser expenditure on energy and fertilizer. Hence, organic agriculture consumes zero pesticides and less energy (Mader et al. 2002). High prices that consumers disburse for organic products along with decreased cost of pesticide inputs and synthetic fertilizers add to increased profits. Organic farms have always been found to be more profitable as compared to the conventional farms (Lotter 2003). According to the FAO, "Organic farming is a pioneer to establish energy reducing practices by using organic principles. Organic principles, which emphasize farm-level self-sufficiency, incorporation of externalities and environmental stewardship, can be improved to form plans for limiting the use of fossil fuel-based energy in organic farming. Especially in the post-production handling sections, advancements done in order to decrease the consumption of energy can affect the traditional parallel sectors." In the majority of cases, 30–50 % less energy is consumed by organic farming as compared to the traditional farming:

- Organic agriculture typically uses energy more competently than conventional agriculture.
- Organic agriculture often needs about one-third additional manual labor hours as a substitution for energy-intensive inputs used in traditional agriculture (Ziesemer 2007). Modern chemical-dependent farming methods:
  - Lessen soil of nutrients
  - Demolish important soil microorganisms
  - Contribute to global climate change and desertification
  - Oversupply farmlands with toxic fertilizers, herbicides and pesticides, which then move into groundwater, rivers, lakes, and oceans

For example, numerous regions of Minnesota, which is the most important farmland, are now facing the problem of increased nitrogen in drinking water. Health risks of nitrogen include a potential correlation with cancer, in addition to reproductive and thyroid problems in both livestock and humans (Mercola 2013).

Organic agriculture is about 30 % more efficient to produce the same amount of food as compared to the traditional farming. Conventional farming is capital intensive, which requires more manufactured inputs and energy as compared to the traditional organic farming which is knowledge and labor intensive (Halberg et al. 2006). The system engages large skilled and semi-skilled/unskilled labor for various tasks to be performed (sowing, planting, cultivating, rearing, maintenance, aftercare, harvesting, cleaning, washing, grading, bar coding, labeling, packing, transporting, and marketing) in order to follow a strict code of "organic farming" (Pimentel 2006). Serious issues are being raised about the energy-intensive nature of these methods and their unpleasant outcomes on soil yield and environmental excellence. Organic agriculture is capable of supporting about three to 4 billion people (Trewavas 2001). In a study of 1,144 organic farms conducted in UK and Republic of Ireland, organic farms engaged more workers as compared to the conventional ones.

6.3 Health Benefits

Food for starving population, fiber for clothing, and feed for animals and even, in a number of cases, fuel for vehicles come from worldwide agriculture. Consequently, in the world's temperate climates, human agriculture has displaced 45 % of temperate forests, 50 % of savannas, and 70 % of grasslands. Agriculture is one of the main sources of GHG emissions; the most important cause of deforestation in the tropics and a recurrent basis of water pollution and nonrenewable groundwater mining. A number of farmers have turned to the organic methods. Such a kind of farming is destined to reduce human health and environmental impacts by evading the use of chemical pesticides, synthetic fertilizers, and antibiotic or hormone treatment for livestock. The use of industrial methods, predominantly synthetic nitrogen fertilizer, has fed the human population during the previous century (Biello 2012). Currently, there is no noticeable evidence of any health benefit of consuming organic over conventionally produced food products (Dangour et al. 2009).

Individual studies have taken into account a variety of potential impacts, including residues of pesticides. Pesticide residues provide a second channel for health effects. The organically produced vegetables and fruits are likely to contain less agrochemical residues than their conventionally grown alternatives (Magkos et al. 2006). Nitrate concentration might be less, but the potential health impact of nitrates is arguable. The users trust that organic products are healthier than traditionally grown products. Research has shown that organic products contain less nitrate content, because larger amount can cause cancer of the alimentary tract and methemoglobinemia in infants (Forman and Silverstein 2012). There is a decreased risk of eczema associated with consumption of organic milk, though no similar evidence was found in case of organic vegetables, fruits, or meat. The higher cost of organic products (ranging from 45–200 %) may limit the intake of the recommended five servings per day of fruits and vegetables, which reduce the risk of cancer and improve health irrespective of their source (Magkos et al. 2006).

The utilization of vegetables and fruits has been linked with lesser risk of chronic human health harms like hypertension, cancer, cardiovascular diseases, and diabetes type II because of their elevated phytochemicals. The health advantages of vegetables and fruits have so far been endorsed to the antioxidant characteristics of phytochemicals. The cell membrane lipid peroxidation (LPO) degree is found to be 60 % higher in organic tomatoes. The superoxide dismutase (SOD) activity is also radically higher in organic fruits. The organic tomato fruits under oxidative stress build up higher content of soluble solids as sugar, vitamin C, and phenolic compounds. These have smaller mass and size than the conventionally grown systems. In addition, they are also rich in soluble solids, phenolic compounds, and phytochemicals including vitamin C. In the past few decades, yield has been of greater importance as compared to micronutritional and gustative quality of plant products. This might be right for staple food, but the micronutritional and gustative qualities of vegetables and fruits hold more significance than the energy supply. Growers should not struggle to decrease stress in order to increase fruit size and yield, but should allow stress to a certain level to enhance product quality. Further research is needed to properly understand the relation between stress and oxidative stress and also between secondary metabolism and oxidative stress. In addition, more studies are required to understand the physiological mechanisms responsible for positive outcomes of organic farming on quality of fruit (Oliveira et al. 2013).

6.4 Social Benefits

Organic farming may have an important social effect on local communities. To start with, organic agriculture may provide employment opportunities to the local people. More manual labor is often required in organic agriculture to compensate for pesticide and synthetic fertilizer loss, thus providing more jobs in local communities. Commonly, the labor required to run an organic farm is 10–20 % higher as compared to the traditional farms. Organic farmers also expand their crops and widen their planting schedules throughout the year in order to enhance soil health and maintain biodiversity. This establishes year-round employment opportunities and may lessen the problems related to migrant labor. More job opportunities will increase the population of local communities and also halt migration to urban areas. Thus, organic agriculture can increase the local communities and support rural development. In order to stay competitive, farmers must adjust to the local conditions by managing land, labor, and resources so that the production can be increased. Farmers also depend on their neighbors to sustain certain principles in order to guarantee the reliability of their own water, soil, and air. Ties within the community are strengthened by association on these issues, leading to greater association among organic farmers and also partnerships. Cooperatives or organized groups can thus gain power in trade negotiations, gather their resources, and enjoy greater access to markets. There is some proof that increased collaboration results in new businesses among local communities and more active participation in local government. Consumer protection is another keystone of organic farming. The well-built regulatory frameworks, whereby the government verifies organic certifications, are essential for consumers to trust the food that they buy (Morgera et al. 2012).

7 Environment-Enhancing Agriculture

In actuality, a conventional farmer needs a farming model that can leave the environment better than before, the forest healthier, the land more diverse, wildlife more prolific, and soil more fertile resulting in clean water, clean air, and healthy animals and plants (Deshmukh 2010).

7.1 IFOAM's Definition of Organic Agriculture

The IFOAM definition of organic agriculture is based on:

1. The principle of health
2. The principle of ecology
3. The principle of fairness
4. The principle of care

a. The Principle of Health Organic agriculture should be able to maintain and improve the health of plant, soil, animal, human, and planet. The principle highlights that the health of individuals and communities is dependent upon the health of ecosystem and soil that produces healthy crops, which in turn foster the health of people and animals. Health is integrity and wholeness of living systems. In farming, processing, distribution, or consumption, the key role of organic agriculture is to sustain and enhance the health of ecosystem from the smallest organisms in the soil to the human beings.

b. The Principle of Ecology Organic agriculture should be based on ecological cycles and systems. It should emulate and help maintain them. The ecological balance is maintained by establishment of habitats, maintenance of agricultural and genetic diversity, and designing of farming system.

c. The Principle of Fairness According to the principle of fairness, organic agriculture should build on associations that assure equality with regard to the common life opportunities and environment. Environmental and natural resources utilized for production and consumption should be supervised in a way that is economically and socially just and held in trust for upcoming generations.

d. The Principle of Care Organic agriculture should be dealt with in a responsible and precautionary manner in order to guard the health of the present and future generations and for the well-being of environment. According to this principle, responsibilities and precautions are key concerns in development, management, and technology choices in organic agriculture. A policy paper has been issued by National Academy of Agriculture Sciences (NAAS), according to which synthetic pesticides can be avoided; however, complete exclusion of fertilizers may not be suitable under all conditions (Deshmukh 2010).

7.2 Environmental Impacts of Conventional and Organic Farming

Organic agriculture attempts to increase water and crop quality by removing external inputs, genetically modified (GM) crops, as well as pesticides and synthetic fertilizers. While there are a number of ways to achieve this outcome, the main point is that pesticides and synthetic fertilizers are not used. The main reason for the difference in global warming potential (GWP) is the manufacturing and transportation of artificial fertilizers. The chemical method to produce the fertilizer (the Haber-Bosch process) releases carbon dioxide as a side product, but organic agriculture uses on-farm compost as its fertilizer. Storing and moving compost still result in CH_3 emission, but the GHG emissions do not even come close to generating off-farm mineral fertilizers. Fossil fuels are usually the source of energy for the manufacturing and shipment of artificial pesticides. As compared to the drawbacks of organic fertilization, the GWP of organic pest control is still less than that of traditional methods (Akeenan 2011).

7.3 Potential of Organic Farming to Alleviate the Impact of Agriculture on Global Warming

One of the major threats for food security especially in the tropical countries is global warming. Rainfall irregularity and drought conditions are expected to get worse in many countries due to global warming. Extenuating the emissions of GHGs is thus an important challenge to improve food security. One way to achieve this is by reducing CO_2 emission due to combustion of fossil fuel, but it can also be done by farming (Moreau 2007). A new study shows that organic agriculture supplies more GHGs in the soil than conventional agriculture. Many farmers across the globe may help to solve the climate disaster by switching to organic methods, along with avoiding the use of pesticides (Isaacs 2012).

The outcome of Gattinger's meta-analysis shows an overall positive worldwide development towards an increase in organic farming (0.9 % of total world agricultural land or 37 million ha). The author's meta-analysis suggests that organic agriculture allows more carbon to be stored in the soil than traditional agriculture. Carbon is stored in the soil instead of heating up the atmosphere, which acts like a carbon sink. The researchers guess that by using a combination of rotating crops (mixed farming) and livestock, more carbon can be stored in organically farmed soil than any other farming system depending on the use of plant protection chemicals and artificial nitrogen fertilizer. Their results show that 0.37 Gt of carbon is being isolated per year globally (0.04 Gt of carbon in the USA, 0.03 Gt of carbon in Europe), thus offsetting 3 % of the existing total GHG emissions (2.3 % for the USA, 2.3 % for Europe), or 25 % of the total existing agricultural emissions (36 % for the USA, 23 % for Europe). The collective alleviation by organic agriculture up to 2030 would contribute 13 % to the collective reduction essential by then to stay on the trail to keep temperatures from rising 2 degrees Celsius above preindustrial levels by 2100. This meta-analysis gives a strong clue in favor of organic agriculture (Isaacs 2012).

At least 30 % of global warming is due to agriculture. Three gases are responsible for this, namely CH_4 (methane), N_2O (nitrous oxide), and CO_2 (carbon dioxide). Fertilizer industry mainly emits CO_2 from the machines used on the farm. A significant contributor for CO_2 emission by agriculture is deforestation. CH_4 emissions from livestock are mostly from enteric fermentation, but also from rice fields and manure. Soil (denitrification) is a major source of N_2O, and a minor one is fertilizer from animals.

a. ***CO_2 Emissions***

About half of the energy used in agriculture in developed countries is in the manufacturing of fertilizers (mostly nitrogen fertilizers). However, there is an increased amount of energy utilized by the fertilizers due to minor mechanization and less efficient use of fertilizer plants. Since organic agriculture does not use artificial nitrogen fertilizer, less energy is consumed than conventional agriculture, and therefore less CO_2 is emitted. In Europe, it has been evaluated that for key crops, organic farming uses per acre about half the energy used in traditional agriculture systems. Despite lower yield in organic agriculture, the amount of crops produced remains a significant factor. In European livestock production, the energy consumed in the production of 1 liter of organic milk is 25 % of conventional milk production. This is because organic cows are mainly grazing, whereas the feed of conventional ones is based on grain and soybean cake (Moreau 2007).

d. ***Carbon Sequestration***

It has been noted that the organic content in many areas of the world has decreased progressively due to the increase in agriculture based on deep plowing and artificial fertilizers. About 50 % of soil organic carbon has been degraded over the past 50–100 years of cultivation in the Great Plains of North America. About 7 million ha have less than 2 % organic content in France. Deforestation in tropical countries has led to a faster decline in the organic content. As proved by repeated and long-term trials, the organic matter increases (carbon content of soil increases) and is maintained by organic agriculture. This ability to impound carbon contributes to alleviate the contribution of agriculture to the greenhouse effect (Moreau 2007).

e. ***Nitrous Oxide (N_2O) Emissions***

Soil mainly emits nitrous oxide. The Intergovernmental Panel on Climate Change (IPCC) has evaluated that about 1.25 % of the amount of nitrogen applied as fertilizer is represented by these emissions. However, many factors are responsible for this percentage. As compared to conventional farming, data for emission of N_2O are less for organic farming. The amount of nitrogen applied normally is lower in organic than conventional agriculture. Likewise, emissions of N_2O increase radically when nitrogen fertilization exceeds the needs of the crop, which happens habitually in conventional farming. It can therefore be concluded that organic farming emits less N_2O than conventional agriculture (Moreau 2007).

f. ***Methane (CH_4) Emissions***

After N_2O emission, methane emission is the main contributor of global warming. There are three main origins of methane from agriculture: anaerobic fermentation of flooded crops (rice), fermentation of animal dejections, and enteric fermentation of ruminants. The production of methane per animal is about the same in conventional and organic breeding. But, the emission per kilo of meat or milk is more in intensive production. This increase is, at least moderately, compensated by better endurance of organic cows. In intensive systems, particularly in milk production, cows have a very short life, generally up to 5 years. Methane emission by fermentation of compost is less in organic than conventional breeding, because composting is aerobic, whereas storing compost (heaps or slurry) is mainly anaerobic.

In short, it can be said that organic farming has decreased the contribution of agriculture to global warming. It, therefore, leads to a stable food supply, which is threatened by the climate change. On the other hand, more research is required in order to estimate the extent of this alleviation and identify what improvements can be done in organic farming to increase it. Another important way to reduce the contribution of food production to global warming is to alter our eating habits, especially in the developed countries by reducing consumption of red meat (Moreau 2007).

8 Organic Foods

Some studies have revealed and also some consumers think that organic products are rich in flavor and nutrients. The organic products are sold at high prices as compared to the conventional food products. Since organic foods are grown via more labor-intensive production methods, they are sold at high prices.

8.1 Organic Certification

Organic certification is a certification procedure for manufacturers of organic products. In common, a few trades in food manufacture are certified including farmers, retailers, food processors, seed suppliers, and restaurants (Organic Certification 2013). Organic farmers are qualified to assure that their agricultural techniques comply with principles of organic manufacture to reassure consumers, retailers, and wholesalers that their products are really organic (Department of Agriculture and Food 2010). Necessities differ from country to country and normally engage a set of manufacturing principles for raising, storage, packaging, processing, and delivery that comprise:

- Human manure sludge fertilizers are not employed in feed of animals or development of plants
- Prohibition of artificial chemical inputs not on the National List of Allowed and Prohibited Substances (e.g., pesticides, food additives, antibiotics, fertilizer etc.), irradiation, GM organisms and the use of sewage mud
- A complete written record of manufacturing and sales proceedings (audit trail) should be kept

- Firm substantial separation of organic goods from noncertified goods
- Carrying out periodic on-site assessment

Organic certification deals with increasing international demand for organic food substances as well as guaranteeing quality, avoiding deception and supporting commerce of food. Such an official recognition was not compulsory in the early days of the organic association. With the passage of time, as organics have developed fame, the small-scale producers trade their goods straight to farmers' marketplace. Mostly customers are buying organic products through established channels, for example, supermarkets.

8.2 Hazard Analysis

A number of significant food safety hazards to consider in an organic farm may comprise:

1. Microbiological contagion from fish emulsion fertilizers or compost
2. Quality of water used for washing or processing the produce
3. Pest control methods
4. Contamination from exterior sources, for instance transport suppliers
5. Clean-down measures (Department of Agriculture and Food 2010)

9 Organic Agriculture and Food Security

Organic farming can add to food security. Eight hundred and 50 million people still starve for food, even though the worldwide food supply is sufficient. Additionally, the price of food has increased noticeably in the past 10 years, and there is less genetic assortment in our food because of traditional agricultural techniques. As a result, populations are more exposed to the threat of food scarcity. Organic farming has the ability to meet up these confronts. Organic farming involves access to food by dropping threats of disease, raising productivity and biodiversity over the lasting period, and giving means for limited manufacture and access to food. Sponsors for traditional agriculture disagree that organic agriculture reduces yield. Organic advocates, on the other hand, think that yield is identical to traditional farms over the extended period of time (Morgera et al. 2012). Organic agriculture has the following roles in food security:

- Mitigates acute starvation during food emergency situations through increased ecosystem stability and diversification
- Improves domestic nutrient intake and capability to buy food via sustainable growth and commercialization of small-scale agriculture
- Develops self-reliant food systems, especially at the domestic level

- Plays a role in intake of micronutrient and improved diets by the diversification of production and reintroduction of underutilized varieties

For poverty mitigation, organic agriculture:

- Contributes to sustainable rural livelihood, as it gives a better return on labor
- Offers employment opportunities, as it requires 30 % more labor input per hectare
- Contributes to more common well-being, through nonexploitive work and fair salary that develop control on income
- Contributes to development of rural areas, as rural economies are revived

For environmental sustainability, organic farming:

- Avoids harm by increasing energy and nutrient recycling and efficiency of resource use
- Is a low-energy track food system, as it forbids the use of nitrogen fertilizers
- Decreases transaction and transport costs via community-supported food short-supply series
- Restores biodiversity and conserves ecological values (International Conference on Organic Agriculture and Food Security 2007)

For food sourcing, organic agriculture:

- Allows smallholders to compete with specialty foods and quality products
- Offers higher farm-gate prices that are a reflection of environmental stewardship and real production costs
- Helps re-localize food systems where the poor and hungry live
- Develops effervescent local food supplies that reduce import surges and food-import reliance

There are many links with organic agriculture practices, including issues such as legal protection, authority in the food supply chain, economic development opportunities, avoidance of noncompetitive practices, inexpensive technology, protection of consumers, expansion of local and regional markets, small producer's integration into markets, protection of agro-biodiversity and drinking-water quality, maintenance of ecosystem carrying capability for present and future generations, promotion of gardens at both home and schools, availability of nutritious and diverse food, and support of traditions on food-related matters.

It is emphasized particularly that production in agriculture should (in order of priority):

- Allow import not only for locally grown items
- Target local food needs in local markets
- Export high cost products

9.1 Organic Agriculture and Food Availability

There are many factors that affect food availability including fossil fuel crisis and water scarcity, globalization that threatens smallholder viability, and urbanization and loss of farms and farmers. The role of organic agriculture in food availability considers these issues, in terms of both food import capacity and agricultural output.

By converting global agriculture to organic without the use of nitrogen fertilizers and conversion of wildland to agriculture would lead to global agricultural supply of 2,640–4,380 kcal/person/day. Sustainable growth in developing countries through the practice of organic agriculture would lead to an increase in the production by 56 %. Organic and conventional yields are comparable on average, although yields increase when converting from low-input systems and decline when converting from high-input systems. A case study in Tigray, Ethiopia, reported double yields due to organic soil management. The main challenges in semiarid environments are soil management practices and livestock production, whereas in tropical humid ecosystems, it is crop diversification. Through an efficient use of natural resources locally, input availability is increased in organic systems. Organic farms utilize 33–56 % less energy per hectare. They also improve economic competence through savings on inputs, but are laborious. Nutrient use is increased through minimizing losses and recycling, but phosphorus is not easily accessible.

Organic urban gardens enhance the urban food supplies through short supply chains between consumers and growers. At community and household level, organic rural and urban markets and networks play an important role in improving food quality, quantity, and diversifying food availability. It is seen that organic agriculture is emerging robustly in domestic markets of some developing countries, such as Brazil, India, and China. The role played by the developed country consumers in triggering organic production in developing countries is known, but the ability of the poor to feed themselves is still an interrogation.

A challenge related to international markets is to create participatory networks, to bring the producers together, and to develop value chains based on reasonable trade and informed choices. The significance of food traceability is stressed to authorize consumers and producers, especially as organic farming is stepping into the mainstream. Nature and More are the examples of the commercially efficient systems which internalizes social and environmental costs in food prices. It is made clear that organic markets are not for an economic influence, but for an "aware elite" prepared to pay elevated prices provided the label is reliable.

There is a requirement for better agroecological science as well as need to understand factors that play an important role in risk alleviation. The complex environment–livestock interactions have been highlighted as an area for further research and improvement of organic principles. The importance of participatory guarantee systems is considered important to reduce the costs and authorize farming communities to distinguish their organic products in sale.

There is a need to assess organic foods and farms fundamentally as a whole, with multiple measurements on both efficiency and productivity. For comparing organic systems with other food systems, the adequate methodology must consider total agricultural outputs of multiple cropping systems, including yields and secondary goods such as straw, environmental services, such as carbon sequestration, total energy efficiency from the farm to postharvest handling and distribution, water saving, and soil fertility, and nonfood benefits derived from agricultural systems such as social equity and disease reduction (International Conference on Organic Agriculture and Food Security 2007).

9.2 Organic Agriculture and Access to Food

Organic agriculture system improves food access by increasing output, variety, and conservation of natural resources, by raising salaries and by decreasing risks for farmers. Enhancement also results by sharing knowledge among farmers. These benefits lead to poverty alleviation and a turnaround of migration from rural to urban areas. Policy requirements to advance food access include expanding fair-trade systems along the full value chain, increasing farmer's rights to local varieties, seeds, and biodiversity, strengthening the rights of indigenous farmers, and evaluating current emergency aid and procurement plans.

The investigation of several case studies on organic agriculture system in Africa, Asia, and Latin America suggests that the economic effects of converting to organic agriculture depend on the previous farming system. When converting from traditional extensive farming to organic farming, input cost reduces, while yield and income are likely to increase. On the other hand, when converting from intensive farming, yield and income tend to reduce. In both cases, input costs reduce and labor costs increase. However, there are other advantages of organic agriculture beyond the purely financial ones, such as conservation of natural resources, health protection, risk reduction, increased flexibility to adverse weather, and farmer authority through the attainment of knowledge and higher dependence on limited inputs. It is thought that policies aiming at facilitating the import of cheap foods and providing subsidies to farmers in developed countries have unfavorable effects on farmers in developing countries. On the other hand, in rural areas, access to food is enhanced by organic agriculture system. Organic agriculture system also tends to reorganize gender roles, with women participating more in homegrown foods, but care should be taken in the sharing of workload.

It is being noted that the conventional food prices are frequently altered by subsidies and do not reflect the full cost to society as a whole or the environment. The higher production does not necessarily translate into higher local access to food, but food must also be ethnically appropriate. The superior farm-gate food prices are needed for livelihood security, but market intelligence is needed to sustain benefits from improved income generation. Six thousand farmers are improving their income by 10–20 % from organic cotton in Madhya Pradesh, India, just due to market knowledge: a business model that builds networks and partnerships among retailers, spinning and processing companies, and farmers. As knowledge is very crucial in organic agriculture, farmer organizations have a significant role to play in training, extension, and technical assistance. A participatory internal control system can be established to reduce the cost of certification and group marketing.

The private sector should be the engine of growth for the organic supply system, whereas the governments can be more influential in building capacity and supporting research and providing legal and institutional environment. Extended political dedication by governments is deemed essential for the sustainable development of organic agriculture (International Conference on Organic Agriculture and Food Security 2007).

9.3 Organic Agriculture and Stability of Food Supply

The strength of food supply is challenged by climate change and interannual variability, trade reform impacts on commodity prices, and the erosion of natural resources and environmental services. Organic agriculture system is analyzed through the environmental constancy of organic agroecosystems. Preventive measures are mainly emphasized by organic agriculture system that results in an overall stability of the agroecosystem, especially of soils that have high levels of microbial biomass and increased soil organic matter. Organic soil structure results in better percolation and water drainage, and improves water retention (20–40 % more), thus decreasing the requirement of irrigation and increasing crop yield in drought periods. Mandatory crop rotation is a road to better ecological balance through rehabilitation of functional biodiversity and the use of adapted seeds/breeds.

9.4 Organic Agriculture and Food Utilization

The utilization of food is challenged by dietary problems, health concerns and rapid urbanization, global trans-boundary diseases and higher occurrence of contamination, food consumer demands for quality food, and changing trade patterns. The role of organic agriculture system is analyzed in terms of consumer health, food quality, postharvest handling, and food security. Numerous benefits of organic agriculture system depend on the establishment of an ecological balance among the soil, plants, and animals, not just on substituting synthetic pesticides and fertilizers with organic ones. This primary difference is particularly significant for farmers with little knowledge of organic agriculture.

It is expected by the consumers that the organic food must be safe and should be equal to or better than the conventional foods. Organic foods should have more plant secondary metabolites, higher micronutrient content, and more conjugated fatty acids to contribute to better human health, including lower incidences of non-communicable diseases. Organic systems provide higher animal immunity and increased disease resistance of plants, with 50 % less mycotoxins in crops and a persistent shelf life. The restriction on synthetic input use has led to safer drinking water, due to reduced amount of phosphates and nitrates being leached and pesticide poisoning is also avoided (about 20,000 deaths per year are caused by conventional agriculture chemicals).

Rural environmental pollution in China has led to the need for health and environmental protection among consumers. Organic land has increased from 342,000 ha in 2003 (0.28 % of total land) to 978,000 ha in 2005, while increasing the yearly income of local farmers by nine times. The example of China is very inspirational because it provides three distinct organic supply models. The first is commercially successful and involves suburban or semi-urban areas close to large rich cities in the Eastern provinces. These organic gardens, which give jobs to needy workers, sell to both domestic supermarkets (owned by big entrepreneurs) and international market. In the second model, usually the most successful, domestic farmers take the entire risk and are in charge of group training and certification. The third model, more insecure, involves poor farmers living in remote locations, encouraged by local research institutions or local environment defense boards.

The benefits of higher yields can be less than the cost of illness. More knowledge is required to understand the cost of organic agriculture on the nutritional quality of diet, both in developed and in developing countries. It is decided that organic foods should not only be evaluated in terms of "harmless," but also in terms of other life quality and fitness values. The significance of food cultures is considered important, including knowledge systems for food harvest, storage and preservation. The revival of indigenous knowledge and local system adaptation is highlighted for the pattern shift towards food security. For the revival of local food systems, governments should facilitate homegrown policies. A holistic view of food systems, ahead of productivity to include social, environmental, and health impacts, could solve the current irony in farming (International Conference on Organic Agriculture and Food Security 2007).

10 Organic Farming Methods

The overarching objective of organic farming as defined by IFOAM is as follows: Organic agriculture is a manufacture system that maintains the health of soil and people. It depends on biodiversity, ecological procedures, and cycles modified to confined circumstances. Organic agriculture merges modernism, custom, and science to do well to the shared surrounding and encourages just relationships and a high quality of life for each and every one involved (International Federation of Organic Agriculture Movement 2008). Miscellaneous "organic fertilizers," e.g., cattle dung compost, farmyard manure, MSW compost, sewage sludge, poultry droppings, plants bio-fertilizers, microbial inoculants, and earthworm vermicastings, are used for agriculture all over the world where farmers are unable to afford expensive chemical manures (Sinha and Herat 2012). Most studies reflect that organic farming could increase the quantity and variety of total fungi and total bacteria in soil (Wang et al. 2012).

10.1 Chemical Control

The pest problem cannot be solved by the pesticides. Insecticide use has amplified tenfold, whereas crop fatalities from pest spoil have doubled in the past 50 years. Three significant causes of why natural power is preferable to pesticide use are given below:

10.1.1 Safety For People

Synthetic pesticides can rapidly discover their mean into watercourses and food chains. This can generate health risks for humans. Human health can also be debilitated by population consuming food (especially vegetables and fruit) holding remains of pesticides sprayed on the produce. Around the world, there are an estimated 1 million cases of poisoning by pesticides each year. Approximately 20,000 of these result in death. The majority of the deaths occur in tropical countries, where chemical pesticides prohibited in the USA or Europe are still available.

10.1.2 Cost

As natural techniques do not involve purchasing matter from the exterior, using natural disease and pest control is frequently cheaper than applying chemical pesticides.

10.1.3 Safety for the Environment

Chemical pesticides can have a number of harmful effects on the environment. They are:

- Useful insects can be killed by chemical pesticides. The equilibrium between pests and helpful predators can be disturbed by only one spray.
- Artificial chemicals can reside in the bodies of animals and in the environment causing troubles for several years.
- Insect pests can rapidly turn out to be resistant to synthetic products and are no longer restricted over a small number of breeding cycles. This means that stronger chemicals or enlarged quantity are subsequently required, generating more environmental, health, and economic problems.

10.2 Natural Control

The organic farmer can manage pests and diseases in a number of ways by:

- Raising vigorous crops that experience fewer harm from pests and diseases
- Selecting crops with an innate resistance to particular pests and diseases. Local varieties are superior in resisting diseases and local pests as compared to introduced varieties

- Avoiding the phase when the pest does the majority harm by timely planting of crops
- Companion sowing with other crops (garlic, onion) to keep the pests away
- Picking or trapping pests from the crop
- Recognizing diseases and pests properly. This will stop the farmer from unintentionally eradicating helpful insects or wasting time. It is hence useful to know preferred host plants, breeding habits, predators of pests, and life cycles
- Using crop rotation to check a carryover of pests to the subsequent period and breaking pest cycles
- Providing a natural environment to promote natural predators that manage pests

10.3 Weed Management

Weed management in organic farming is not a simple job, mainly in regions where labor for hand weeding is not reasonably priced or is scarce. On the other hand, the standard must be similar as in any traditional cropping scheme, i.e., weed competition desires to be prohibited in turn to attain the highest crop yields. This essentially involves weeding with nonchemical substances, however, this has to be done accurately at the precise time to get rid of weeds during the supposed significant phase of weed competition. Organic schemes also need the use of precautionary techniques prior to raising the crop and to set up a sensible crop rotation. Decayed seedbed preparation to kill the weeds manually or mechanically is an extremely fine choice to hold up the launch of weed competition. The use of green manure and cover crops, as well as mounting soil fertility, may possibly assist to manage a number of weed varieties. The common techniques used to put off weed competition in organically raised crops are elevated seeding rates and companion cropping with small-seeded legumes and narrow seed spacing/cross seeding (Food and Agriculture Organization of United States 2013).

Organic weed management encourages weed inhibition, to a certain extent, by promoting phytotoxic effects on weeds and crop competition. Organic farmers integrate biological, cultural, chemical, physical, and mechanical strategy to control weeds without artificial herbicides. Organic principles say that a single crop cannot be raised in a similar place without a different, dominant crop. Thus, organic standards need rotation of annual crops. Crops with different life cycles depress weeds linked with a particular crop. The weed-suppressive cover crops are repeatedly incorporated in organic crop rotation. Organic farmers struggle to amplify soil organic material content, which can hold up microorganisms to demolish ordinary weed seeds.

Additional cultural procedures used to improve crop competitiveness and lessen weed force include high-density planting, tight row spacing, choice of viable crop ranges, and delayed planting into lukewarm soil to promote quick crop germination. Physical and mechanical weed control procedures used on organic farms can be generally classified as (Schonbeck 2010):

- Tillage—rotating the soil between crops to integrate crop remains and soil alterations; eliminate accessible weed development and set up a seedbed for planting
- Cultivation—upsetting the soil after seeding
- Cutting and Mowing—eliminating apex enlargement of weeds
- Thermal weeding and flame weeding—using heat to kill weeds
- Mulching—jamming weed appearance with plastic films, landscape fabric, or organic materials (Szykitka 2004)

For herbicidal use, a few naturally supplied chemicals are acceptable. These include corn gluten meal, certain formulations of acetic acid (concentrated vinegar), and essential oils. A small number of choosy bioherbicides based on fungal pathogens have also been built up (Schonbeck 2010).

10.4 Crop Rotation

Crop rotations are at the heart of organic agriculture and aid organic methods to shield our surrounding. They engage in altering the form of crop developed in one area on a usual basis. Organic farmers sow alternating groups of plants (brassica, cereals, roots, and legumes) to put in fertility and stop diseases and pests from strengthening. A few plants, like clover, provide nutrients to the soil, whereas potatoes and wheat consume nutrients. Rotations frequently comprise of a "rest" phase for individual plots or fields, where "green manure" or grass such as clover is grown for a season or further to add fertility. This is known as planting "ley." Although using crop rotation may sound old fashioned, it is a more effective and sophisticated method than chemicals. Using chemicals to fertilize the soil frequently merely supplies crops with three basic elements (nitrogen, potassium, and phosphorous) that they require to grow before supplying them with each and every nutrient that they require.

In addition to making sure that soil nutrients do not get exhausted, crop rotations check the buildup of diseases and pests, which assist organic producers to prevent the use of pesticides. When a farmer grows the similar crop in one field year after year (known as monoculture), the pests and diseases that attack the crop set up and get enlarged in number with time. Nonorganic producers rely on pesticides to deal with the pest and disease. On the contrary, organic farmers stay away from this by growing discontinuous crops that are susceptible to different diseases and pests every year, stopping several from getting established in the similar location.

Crop rotations have a lot of significant functions:

1. They assist to manage diseases and pests.
2. They help to preserve soil fertility.
3. They help out to maintain soil structure and soil organic matter levels.
4. They make certain that sufficient nutrients are accessible to different crops each year.

In general, organic farming decreases environmental pollution and liberate GHGs from food manufacture.

10.5 Soil Management

Plants require potassium, phosphorus, and nitrogen, in addition to micronutrients. Green manure and crop rotation facilitate to give nitrogen through legumes (the Fabaceae family), which fix nitrogen from the atmosphere through symbiosis with rhizobial bacteria. Intercropping, which is occasionally used for disease and insect management, can add soil nutrients, but the rivalry among the crop and the legume can be challenging, and a greater gapping among crop lines is necessary (Watson et al. 2002). Organic farmers use animal manure and developed fertilizers such as a variety of mineral powders like greensand, rock phosphate, and seed meal. Collectively, these techniques assist to manage erosion. In a number of cases, pH might have to be altered. Except in the USA, few compounds such as magnesium sulfate, aluminum sulfate, soluble boron products, and iron sulfate are permitted in organic farming.

Diverse farms with both crops and livestock can function as lay farms, whereby the land collects soil fertility through increasing nitrogen-fixing grasses such as *alfalfa* or white clover and raise cereals or cash crops as soon as soil fertility is established. Farms exclusive of livestock may discover it more complicated to preserve fertility and could depend on peripheral contributions, such as grain legumes and green manures. Horticultural farms raising vegetables and fruits, which function in confined circumstances, are frequently more dependent upon exterior inputs (Watson et al. 2002).

10.6 Controlling Other Organisms

Nematodes, arthropods (e.g., mites, insects), bacteria, and fungi are organisms other than weeds, which form the basis of problems on organic farms. A broad range of integrated pest management techniques are used by organic farmers to avoid diseases and pests. These comprise, however, are not restricted to, nutrient management and crop rotation, providing environment for advantageous organisms, sanitation to eradicate pest territory, crop protection using physical obstacles, crop diversification by companion planting or founding of polycultures, and collection of pest-resistant crops and animals. Organic farmers frequently rely on the use of advantageous organisms to diminish pest populations (biological pest control). Examples of advantageous insects include big-eyed bugs, minute pirate bugs, and ladybugs (which are likely to fly away).

Natural insecticides permitted to use on organic farms include *Pyrethrum* (a chrysanthemum extract), *Bacillus thuringiensis* (a bacterial toxin), *rotenone* (a legume root extract), *neem* (a tree extract), and *spinosad* (a bacterial metabolite). These pesticides are used by less than 10 % of organic farmers regularly (Lotter 2003). These are, at times, called green pesticides, since they are usually considered to be environment-friendly and safer. *Pyrethrum* and *rotenone* are mostly controversial, since they perform by affecting the nervous system just like the majority of traditional insecticides (Pottorff 2010). Rotenone is awfully toxic to fish and is able to provoke symptoms similar to Parkinson's disease in mammals (Sheer et al. 2003). Naturally resulting fungicides acceptable for use on organic farms include the fungus *Trichoderma harzianum* and bacteria *B. pumilus* and *B. subtilis*. These are chiefly successful for diseases attacking roots.

10.7 Genetic Modification

A key feature of organic agriculture is the refusal of genetically engineered animals and plants. Though resistance to the utilization of every transgenic technology in organic agriculture is powerful, some agricultural researchers persist to support incorporation of transgenic technologies into organic agriculture as the most favorable way to sustainable farming, predominantly in the developing countries (Herrera-Estrella and Alvarez-Morales 2001). In the same way, a few organic growers question the justification behind prohibiting the use of genetically engineered seeds as they view this sort of biotechnology to be steady with organic standards.

11 Production of Inputs for Organic Farming

11.1 Composting

11.1.1 Production of Compost

Compost production is the major sustaining factor of organic farming. It is done by the interaction of biological materials and the microorganisms. It is a decomposition method that produces a stable product from the organic matter. A large amount of organic matter from the farms or kitchens can be recycled back to the soil as compost. The level of organic matter can be increased by the addition of compost with many beneficial effects, such as water retention capacity improvement in humus content, absorption capability, etc. Compost can also be used for bedding.

11.1.2 Classification of Composing

a. Aerobic Composting: Aerobic composting involves aerobic conditions necessary for the composting of large-scale agricultural and municipal wastes. Aerobic microbes control aerobic composting. Therefore, oxygen is crucial for this decomposition process. It is characterized by the absence of foul odors, short stabilization, and high temperature. The high temperature helps in destroying the pathogenic organism and the weed seeds.

b. Anaerobic Composting: It is controlled by anaerobic bacteria, which work in the absence of atmospheric oxygen. The method works at lower temperature characterized by longer stabilization time and production of foul odors. The major benefit of anaerobic composting is that minimum attention is required for the process and once the compost bed is established, little or no energy is needed.

11.1.3 Vermi Compost

Earthworms set up compost from livestock and farm wastes. Earthworms constantly nourish upon the organic residues and manufacture casts. Vermi compost is a term normally given to the casts produced by earthworm. Casts of earthworms function as a good quality supply of manure for rising crops because they are typically wealthy in organic matter and nutrients. Earthworms, which are exclusively appropriate for the preparation of vermi compost are *Eudrilus eugeniae, Eisenia fetida,* and *Perionyx excavatus*.

11.1.4 Merits of Vermi Compost

1. Helps in improving the pH of soil, i.e., salinity and alkalinity of the soil
2. Helps in removing some of the toxic components from the soil
3. Helps in providing macroelements and small dose of essential elements
4. Helps in reducing the translocation of chemical fertilizers especially nitrogenous fertilizers
5. Helps in increasing the fertility of soil
6. Helps in increasing the water absorption capacity of the loose soil and penetration in compact soil
7. Assists in dropping soil influx by nematodes
8. Vermi compost is also full of enzymes responsible for general growth of plants, hormones such as auxins and cytokinins, and microorganisms for raising the proportion of nitrogen
9. Helps out in dropping the infestation of termites

11.2 Green Manure

For growing crops, numerous green manure crops give adequate nitrogen and organic matter. In a time range between 45 and 60 days, these can supply 60–90 kg nitrogen. Green manuring moreover aids to accelerate the nutrient cycling process and put together accessible nutrients to the crops by supplying large amount of easily decomposable organic matter to the soil.

11.2.1 Benefits of Using Green Manure

1. With modest additional labor, a low-cost method of improving crop is presented by green manuring.
2. Green manures are particularly significant where not enough animal manure is obtainable, e.g., on farms.
3. They aid in increasing the soil fertility.
4. Green manures add on different nutrients.
5. By improving drainage and letting additional air into the soil, they advance soil structure.
6. Green manures facilitate sandy soil not to drain so quickly by assisting soil to grasp added water.
7. Since the roots go through deep in the soil and grasp the plant in position, green manures furthermore help out to prevent the soil from being carried away by wind (Deshmukh 2010).

Inorganic fertilizers used in traditional methods might not protect soil structure, but may cause large fluctuation in the ion concentration and pH of the soil solution. These can considerably decrease a number of soil faunal populations, particularly earthworms. Organic manuring applications tend to preserve soil structure and are not disrupting to the soil chemical surrounding. It contributes to manage microbial pathogens and supports populations of valuable soil fauna. Where inorganic fertilization procedures stop working to preserve soil organic substance intensity, and consequently soil structure, they restrain crop rooting and decrease the water preservation capability of the soil. The accessibility of micronutrients and retention of macronutrients are improved by organic manuring procedures. The use of extremely soluble inorganic fertilizers usually results in greater losses of macronutrients, which can injure crop roots and interrupt crop uptake of all nutrients. It may be due to nutrient imbalance.

Inorganic fertilization procedures, which harm soil structure, may limit the cycling of a number of crop nutrients, and speed up the loss of others. Nutrient cycling effectiveness in farming systems has significant implications for water resources. Adding up of phosphorus to surface water results in eutrophication. Phosphorus losses are likely to be higher for traditional than organic farms. This is due to soil erosion and removal or unintentional loss of livestock wastes. Contamination of groundwater with nitrates in a lot of areas is strongly associated with agricultural practices, but the comparative impacts of organic and conventional structures are hard to estimate (Hodges 2012).

12 Implications of Organic Farming

IFOAM has outlined some principles for organic farming which state the maintenance of ecology and also the avoidance of all pollution spreading practices. Production values and economic feasibilities are also incorporated as key points (Deshmukh 2010).

12.1 Soil Health

Soil is given more care by organic farming. Organic farming enhances the status of micronutrients. Green manuring, in addition to rock phosphate and vesicular-arbuscular mycorrhiza (VAM) fungi, enhances the uptake of macronutrients such as phosphorus and nitrogen *(mycorrhizal associations produced by Glomeromycotan fungi are known as arbuscular mycorrhizas or vesicular-arbuscular mycorrhizas)*. An increase in the organic matter of soil occurs, pH of soil becomes stable, and organic carbon enhances, which are important for good biological environment of soil. Organic manure speeds up the nutrition transformation processes. The enhancement of soil's physical properties occurs in terms of aggregation stability, porosity, nutrient retention, soil aeration, and water-holding ability (Deshmukh 2010).

12.2 Water Pollution

Water contamination can be eliminated by prohibiting the use of synthetic peptides in organic farming as compared to conventional farming. No use of antibiotic and food additives in livestock production may decrease the risk factors involved in conventional livestock (Deshmukh 2010). Factors related to losses in nitrate leaching are nitrate load in the soil, different activities of crop production, and the type of crop harvested. It is also determined by inclusion of organic matter and nitrogen demand by crops. The nitrogenous humus being incorporated in the soil must be equal to the demand of nitrogen by the crop. Water pollution can only be caused by mishandling, otherwise organic farming has very low risk factors (Deshmukh 2010).

12.3 Air Pollution

Air pollution in organic farming is less than that in the conventional farming due to the following reasons:

- Excess of nitrogen is less in organic system and is likely to emit little amount of gaseous nitrogen. Losses of ammonia can occur through management and spreading of farmyard manure (FYM).
- Organic farming forbids the use of many wastes, which may result in water, soil, and air pollution.

In organic farming, emission of carbon dioxide is lower due to prohibition of use of chemicals (Deshmukh 2010).

13 Present Status of Organic Farming

The requirement of safe and sound food, in competition to improved environmental consciousness, has resulted in a rising demand for organic stuff. In developed countries, there is a steadily growing market for organic products, driven by rising consumer awareness for health and environment, which offers farmers a chance to produce for the best price markets and hence an opportunity to augment their farm profitability and improve their livelihoods. Organic agriculture is seen as a sustainable method of attaining social, environmental, and economic goals by producing above-average income in contrast to similar conventional farm sizes, new job opportunities due to comparatively elevated labor inputs, and improved habitat circumstances as synthetic fertilizers and pesticides are not applied.

14 Causes of Low Adoption of Organic Farming

In organic farming, the foremost challenges are management of nutrients and increase of yield (Toumisto et al. 2012). Although adaptation to organic agriculture often comes with a decrease in crop yield, proponents of organic agriculture highlight the sustainability mainly due to improvement in organic material-associated soil excellence. Based on current research on methods driving soil organic material turnover, though, it somewhat comes into view that low-input agroecosystems may convert to lesser competence in terms of substrate use by heterotrophs which might have an effect on soil organic material storage space in the long run. A collection of field statistics verifies lower use competence in some organic soils and thus questions the claim of a largely sustainable use of the soil reserve in organic agricultural methods (Leifeld 2012).

15 Conclusion and Future Perspectives

Organic farmers depend greatly on versatile understanding of soil science and ecology. Modern organic farming methods are used to guarantee fertility and pest/weed control with conventional techniques of crop rotation. Organic farming has to be implicated as a feasible option compared to conventional approaches in agriculture. Thousands of farmers have transformed to this method as a result of a higher demand for organically developed foodstuff. Organic farming also involves access to food by dropping threats of disease, raising productivity and biodiversity over the lasting period, and giving means for limited manufacture and access to food. Other advantages of organic agriculture beyond the purely financial ones include conservation of natural resources, health protection, risk reduction, increased flexibility to adverse weather, and farmer authority through the attainment of knowledge and higher dependence on limited inputs. Sustainable earnings in organic farming would not only include safe food production but also shielding of natural environment and maintenance of limited assets. Today, the organic agriculture sector is one of the fastest growing food segments, thrust to which is provided by many factors like introduction of policies that prove to be encouraging for organic agriculture, taking away of government funding on agricultural inputs, controversial debate on genetic modification related to food safety and crisis aggravated by foot and mouth and mad cow diseases and dioxin-contaminated food. On the demand side, forceful marketing and promotion strategies of supermarkets and retailers have produced new marketing prospects in northern countries. Food retailing chains have played a significant role in promoting the market growth for organic food products.

References

Akeenan (2011) Can organic farming really reduce GHG level. www.verus-co2.com/blog/?cat=27. Accessed 25 July 2013 (Versus Carbon Neutral)

Biello D (2012) Will organic food fail to feed the world? www.scientificamerican.com/article.cfm?id=organic-farming-yields-and-feeding-the-world-under-climate-change. Accessed 25 July 2013 (Scientific American)

Committee on Pesticides in the Diets of Infants and Children (1993) Pesticides in the diets of infants and children. Committee on Life Sciences, National Research Council, National Academy Press, Washington DC. www.nap.edu/openbook.php?isbn=0309048753. Accessed 25 May 2013

Dangour DA, Aikenhead MA, Hayter MA, Allen DE, Lock DK, Uauy PR (2009) Comparison of putative health effects of organically and conventionally produced foodstuffs: a systematic review. Nutrition and Public Health Intervention Research Unit. London School of Hygiene and Tropical Medicine. www.food.gov.uk/multimedia/pdfs/organicreviewappendices.pdf. Accessed 25 May 2013

Department of Agriculture and Food, Australia (2010) www.agric.wa.gov.au/PC_94253.html. Accessed 25 May 2013

Deshmukh SM (2010) Organic farming: principles, prospects and problems. www.charoka.com/Organic-Farming-Principles-Prospects-and-Problems/b/60009. Accessed 25 April 2013

Fan T, Stewart B, Payne W, Yong W, Luo J (2005) Long-term fertilizer and water availability effects on cereal yield and soil chemical properties in northwest China. Soil Sci Soc America J 69:842–855

Fließbach A, Oberholzer HR, Gunst L, Mader P (2007) Soil organic matter and biological soil quality indicators after 21 years of organic and conventional farming. Ecosyst Environ 118:273–284

Food and Agriculture Organization of United States (2013) AGP—What is integrated weed management. www.cgiar.org/wp-content/uploads/2013/04/eco-efficiency_book.pdf. Accessed 27 July 2013

Forman J, Silverstein J (2012) Organic foods: health and environmental advantages and disadvantages. Pediatrics 130(5):25–79

Gabriel D, Roschewitz I, Tscharntke T, Thies C (2006) Beta diversity at different spatial scales: plant communities in organic and conventional agriculture. Ecol Appl 16(5):2011–2021

Gilbert N (2012) Organic farming is rarely enough. Nature.com. www.nature.com/news/organic-farming-is-rarely-enough-1.10519. Accessed 26 May 2013

Halberg N, Alroe H, Knudsen M (2006) Global development of organic agriculture: challenges and prospects. www.cabi.org/CABeBooks/default.aspx?site=107&page=45&LoadModule=PDFHier&BookID=282. Accessed 26 May 2013

Herrera-Estrella L, Alvarez-Morales A (2001) GM crops: hope for developing countries? EMBO Rep. 2001 April 15; 2(4):258–258. www.ncbi.nlm.nih.gov/pmc/articles/PMC1083872. Accessed 26 May 2013

Hole D, Perkins A, Wilson J, Alexander I, Grice P, Evans A (2005) Does organic farming benefit biodiversity? Biol Conserv 122:113–130

Holt-Gimenez E (2000) Hurricane mitch reveals benefits of sustainable farming techniques. http://www.panna.org/legacy/gpc/gpc_200012.10.3.02.dv.html. Accessed 26 May 2013 (PANNA)

International Conference on Organic Agriculture and Food Security (2007) 3–5 May, 2007, Rome, Italy. ftp://ftp.fao.org/docrep/fao/meeting/012/j9918e.pdf. Accessed 4 July 2014

International Federation of Organic Agriculture Movements (2008) Classic.ifaom.org/press/press/2008/20090915_IFAOM_Annual_Report_2008.php. Accessed 26 May 2013

Isaacs JR (2012) Organic farming keeps carbon out of the atmosphere. http://news.mongabay.com/2012/1128-isaacs-organic-carbon. Accessed 26 May 2013

John P (2007) China's organic revolution. J Org Syst 2(1):1–11. http://orgprints.org/10949/01/10949.pdf. Accessed 26 May 2013

John P (2011) Nanomaterials in food and agriculture: the big issue of small matter for organic food and farming. Proceedings of the third scientific conference of ISOFAR (International Society of Organic Agriculture Research), pp 96–99

Kirchmann H (2007) Comparison of long-term organic and conventional crop-livestock systems on a previously nutrient-depleted soil in Sweden. Agron J 99:960–972

Kotschi J, Muller-Samann K (2004) The role of organic agriculture in mitigating climate change: a scoping study. International Federation of Organic Agriculture Movements, Bonn. www.shop.ifaom.org/bookstore/download-preview/ClimateStudy_intro.pdf. Accessed 26 May 2013

Leifeld J (2012) How sustainable is organic farming. Agric Ecosyst Environ 150:121–122

Lotter DW (2003) Organic agriculture. J Sustain Agric 21(4). http://donlotter.net/lotter-organicag.pdf. Accessed 26 May 2013

Mader P, Fliessbach A, Dubois D, Gunst L, Fried P, Niggli U (2002) Soil fertility and biodiversity in organic farming. Science 296:1694–1697

Magkos F, Arvaniti F, Zampelas A (2006) Organic food: buying more safety or just peace of mind? A critical review of the literature. Crit Rev Food Sci Nutr 46(1):23–56. doi:10.1080/10408690490911846.PMID16403682

Mercola D (2013) How organic farming could release us from the curse of fertilizer. Healthimpactnews.com/2013/how-organic-farming-could-release-us-from-the-curse-of-fertilizer/. Accessed 14 May 2012

Moreau TL (2007) International conference on organic agriculture and food security. Rome, Italy, 3–5 May 2007

Morgera E, Caro CB, Duran GM (2012) Organic agriculture and the law. FAO, Rome

Nascimbene J, Marini L, Paoletti M (2012) Organic farming benefits local plant diversity in vine yard farms located in intensive agricultural landscapes. Environ Manage 49:1054–1060

Nastis SA (2013) Crop biodiversity repercussions of subsidized organic farming. Land Use Policy 32:1–380

Oliveira A, Moura C, Enéas GF, Claudia AM, Laurent U, Maria Raquel AM (2013) The impact of organic farming on quality of tomatoes is associated to increased oxidative stress during fruit development. PLoS ONE 8(2):e56354. doi:10.1371/journal.pone.0056354

Organic Certification (2013) www.michiganorganic.msu.edu/michiganorganic/organic-certification. Accessed 14 May 2012

Pimentel D (2006) Impacts of organic farming on the efficiency of energy use in agriculture. The Organic Center, Cornell University, Ithaca

Pottorff L (2010) Some pesticides permitted in organic gardening. Denver. www.colostate.edu/Depts/CoopExt/4DMG/VegFruit/organic.htm. Accessed 14 May 2013

Schonbeck M (2010) An organic weed control toolbox. Virginia Association for Biological Farming

Seufert V, Ramankutty N, Foley JA (2012) Comparing the yields of organic and conventional agriculture. Nature 485:229–232

Sheer TB, Betarbet R, Testa CM, Seo BB, Richardson JR, Kim JH et al (2003) Mechanism of toxicity in rotenone models of Parkinson's disease. J Neurosci 23(34):10756–10764

Singh S, George R, Prafull B (2012) Organic farming practices of plains and hills farmers and their extent of compliance with National Program for Organic Production (NPOP) guidelines. J Agric Sci 3:55–62
Sinha R, Herat S (2012) Organic farming: producing chemical-free, nutritive and protective food for the society while also protecting the farm soil by earthworms and vermicompost—reviving the dreams of sir Charles Darwin. Agric Sci Res J 2:217–239
Sundrum A (2012) Organic livestock farming: a critical review. Livest Prod Sci 67(3):207–215
Szykitka W (2004) The big book of self-reliant living: advice and information on just about everything you need to know to live on planet earth. The Lyons Press, Guilford
Theriault M (2006) Growing demand for organic produce helps young farmers. The Bellingham Herald. www.truth-out.org/archive/item/60536:growign-demand-for-organic-produce-helps-young-farmers. Accessed 14 May 2012
Toumisto H, Hodge I, Riordan P, Macdonald D (2012) Does organic farming reduce environmental impacts—A meta analysis of European research. J Environ Manage 112:309–320
Trewavas A (2001) Urban myths of organic farming. Nature 410:409–410
van Elsen T (2000) Species diversity as a task for organic agriculture in Europe. Agric Ecosyst Environ 77:101–109
Wang S, Li Z, Fan G (2012) Soil quality and microbes in organic and conventional farming systems. Afr J Microbiol Res 6:5077–5085
Watson CA, Atkinson D, Gosling P, Jackson LR, Rayn FW (2002) Managing soil fertility in organic farming systems. Soil Use Manage 18:239–247. doi:10.1111/j.1475-2743.2002.tb00265.x. http://orgprints.org/8060/. Accessed 14 May 2012
Yadav SK, Babu S, Yadav MK, Singh K, Yadav GS, Pal S (2013) A review of organic farming for sustainable agriculture in Northern India. Int J Agron. http://dx.doi.org/10.1155/2013/718145. Accessed 14 May 2012
Ziesemer J (2007) Energy use in organic food systems. Natural Resources Management and Environment Department, Food and Agriculture Organization of the United Nations, Rome