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Organic Farming: Prospects and Constraints: A Review

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Abstract: Exhaustion of the natural resources, destruction of the agrosphere and environmental deterioration resulting from increased man-made environmental modification expressed as climate change, has posed serious threat to existence of humankind. Growing awareness of environmental and health issues associated with the intensive use of chemical inputs has led to interest in alternate forms of agriculture in the world. The best solution to former problem is organic agriculture. Organic farming unites all agricultural systems that maintain ecologically, economically and socially advisable agricultural production. The adverse effects of synthetic chemicals used in agriculture have changed the mindset of some consumers of different countries who are now buying organic with high premium for health. Policy makers are also promoting organic farming for restoration of soil health and generation of rural economy apart from making efforts for creating better environment. Organic farming is being practiced in more than 100 countries of the world. Organic farming through sustainable agriculture meets not only the food requirements of present generation in an eco-friendly way but also the requirements of future generations and maintains our environment. Organic farming, in spite of the reduction in crop productivity provides higher net profit to farmers compared to conventional farming. This was mainly due to the availability of premium price (20–40%) for the certified organic produce and reduction in the cost of cultivation. In view of rising population and demand for food production, conventional farming systems cannot be neglected but organic farming should be certified where it already exists and promoted to the newer areas to the extent possible because it seems safer bet for sustainable agriculture at a time when advanced technologies are still costly and have to be proved safe for long-term development.

Keywords: Organic farming, Sustainable agriculture, Eco-friendly, Conventional farming

Organic agriculture is developing rapidly and today at least 190 countries produces organic food commercially. Organic agriculture is practiced in almost all countries of the world and its share in agricultural land and farms are increasing (FiBL 2022). The market for organic products is increasing at a rapid rate, not only in the major markets like Europe, Japan and North America but also in many other countries including developing countries (Foster and Lampkin 2000, Lin 2003, FAO/ITC/CTA, 2001). The consumer demand for organic products has increased more than three-fold (although from low levels) in the recent past in global sales (Reganold and Wachter 2016). Some countries in Northern Europe are recently observing a rapid increase in the sales of organic foods. Organic food and drink sales reached 97 billion US dollars in 2017 according to Ecovia Intelligence (FiBL2019). In 2022, the countries with the largest organic markets were the United States (49.5 billion euros), Germany (15.0 billion euros), and France (12.7 billion euros). The largest single market was the United States (41 percent of the global market), followed by the European Union (44.8 billion euros, 37 percent), and China (10.2 billion euros, 8.5 percent). The highest per-capita consumption in 2022, with almost 100 euros, was found in Switzerland (418 euros), Denmark (384 euros) and Luxembourg (285 euros). The highest organic market shares were reached in Denmark (13.0 percent), Austria (11.3 percent) and Switzerland (10.8 percent) (FiBL 2022). The world's organic producers are highest in Asia (36%) followed by Africa (29%) and Europe (17%). Organic farming is growing rapidly since last decade on sustainable with annual increase of 20% (Avery 2007 and Lotter 2003).

Generally, man is dependent on plants for basic necessities such as food, fibre, medicine, clothing, shelter etc. The plant growth and yield in all ecosystems depend on the cycling and recycling of nutrients between the plant biomass and the organic and inorganic soil stores. Agriculture, over the years developed as a result of man's quest to feed himself, family and his animals. Through time man discovered that agriculture attracts various input from science, art and also a business of producing plants and animal products for the advantageous use of mankind. Plants are primary producers in agriculture. Plants by the process of photosynthesis, take in carbon dioxide from the air, moisture and nutrients from the soil and traps the energy from sun light thereby converting these simple compounds into complex food materials. Animals are secondary agricultural producers. They eat plants or parts of plants and convert the complex compounds present in plants into animal products

such as eggs, meat, milk, hides and wool. Traditional/primitive agriculture relies on the soil, rainfall and the local species of plants and animals. Any plants and organisms which affect the productivity of useful plants and animals were avoided or controlled. The productivity in such system was quite low and capable of feeding the farmers and his family alone. Due to population pressure and increased urbanization, agricultural practices improved with use of high external inputs such as agro-chemicals for pest and weeds, inorganic fertilizers which in return helped to enhance productivity but with serious adverse effect on environment and making the entire system very unsustainable.

Agricultural production and yields during the last decades have been increasing in the industrialized countries along with global fertilizer and pesticide consumption. The rising global trade with agricultural products and the improved access to fertilizers and pesticides have changed agricultural systems. The rapid development in transportation and communication has enabled farmers to buy their inputs and sell their products further away in larger quantities. These developments resulted in increased food security, whereas a greater variety of food has been offered and diets have changed towards a greater share of meat and dairy products. However, such trend has led to a growing discrepancy among populations and agricultural systems, especially developing countries in Africa have seen very few improvements in production and food security. At the same time, the application of unsuitable farming techniques and the rapid increase of farming inputs use have contributed to the rise of environmental problems due to agricultural activities such as radical decline in biodiversity, pollution of surface and groundwater with pesticides and nitrates, soil degradation and to some extent, global warming (Tilman et al 2002). For further repositioning of agriculture for sustainable consumption and income, the knowledge of what is presently going on is needed to shape what will happen in future.

In the more industrialized countries, the increasing concern from the consumer community and from part of the farmers on the negative environmental consequences of intensive agricultural activity, also coupled with the increased demand for healthy food, have both contributed to develop agricultural systems based on sustainable farming practices, primarily focused to preserve the natural resources while ensuring reliable productivity of food. But unfortunately, global warming seems to be the major threat for food security, especially in tropical countries. It is assumed that global warming will worsen the irregularity of rainfall and the drought intensity in many countries. Meanwhile, intensive agriculture which is dependent on agro-chemicals and non-renewable fossil fuels is being responsible for over 20 % of global anthropogenic greenhouse gas emissions (Scialabba 2003). In Asia, this figure could slightly vary chiefly it may be higher as most of the fertilizers used here are nitrogen-based (Stoll 2002) and the industrial process of manufacturing nitrogen fertilizer emits nitrogen dioxide into the atmosphere which is a strong greenhouse gas. Since green revolution technologies is considered as the major food production system in the world but still there is growing evidence that the green revolution has, at its worst, increased inequality, worsened absolute poverty, and resulted in environmental degradation (IFPRI 2002).

In developing countries, agriculture is the vital sector for the socio-economic development of masses. The trend in agricultural production system from traditional/indigenous to modern agriculture has made the agriculture dynamic and improved overtime. Presently, there is another strategy known as organic agriculture, which is a production system that sustains and maintains the soil health, the ecosystem and the people living in that system and beyond. It is completely dependent on natural processes, biodiversity and cycles adapted that are understood by local agricultural farmers in their conditions but without making the use of external inputs having negative effects. Organic agricultural practices is a combination of innovations, art, science as well as business to promote the environmental gains and ensure fair relationships along with the good quality of life for all involved in it (Ibeawuchi et al 2015). Organic agricultural practices enhance productivity by the slow release of essential nutrients to the plants as well as maintains soil biological stand. This brings about increase in productivity without causing any adverse effect on the environment. Therefore, ensuring food security, mitigating poverty and conserving the essential natural resources is significantly important (Rothschild 1998) and is achieved through organic farming and various other means without deteriorating natural resources.

The major challenge for scientists is that it very difficult to feed the ever increasing population with organic food (Moghtader et al 2011). Safe production and secure food supply is one of the major need of low income countries to restore their reservoirs (Arshad and Shafqat 2012). The concept of food security revolves around the components of agriculture, environment, marketing, employment income, health & nutrition and public policy (Johan 1999). Organic farming with limited or no use of synthetic chemicals has huge potential to minimize these negative impacts on ecosystem. Therefore, organic farming has been considered as a major thrust area for achievement of Millennium Development Goals (MDGs) and to ensure sustainable development. Conversion of chemical based farming

systems to organic farming contributes to diminish the contribution of agriculture to global warming. It therefore, contributes to the stability of the food supply which is threatened by the climate change (Aubert 2007).

Organic and biodynamic agriculture represent some of the various approaches to sustainable agriculture, and several techniques used in such methods (e.g. rotation of crops, inter-cropping, minimum tillage, integration of crops and livestock, mulching) are in fact practiced under various agricultural systems. However, various facts that makes organic and biodynamic agriculture unique, as regulated under various laws and certification programs is that: (i) almost all chemical and synthetic inputs are forbidden, (ii) genetically modified organisms (GMOs) are prohibited and (iii) soil binding crop rotations are mandatory (Anonymous 1999). Organic agriculture unites all agricultural systems that maintain ecologically, economically and socially advisable agricultural production (IFOAM 2002). These agricultural systems utilize the natural potential of plants, animals and landscapes and are aimed at the agricultural practice's harmonization with the environment.

Organic farming is an integrated production management system which promotes and enhances agro-ecosystem health including biodiversity, biological cycles and soil biological activity. It focus on the usage of management practices such as the use of off –farm inputs, taking into account that regional conditions require locally adapted systems. This is achieved by using agronomic, mechanical and biological methods where possible, without using any synthetic materials, to accomplish any specific function within the system (FAO 2002). Organic farming predominantly restricts the usage of external production factors (resources) by putting a limitation to the use of chemically-obtained fertilizers, pesticides and pharmaceutical preparations. Instead, in order to enhance the yield and protect the crops, organic farming involves other agro-technical methods and several natural factors. Organic farming is a type of agriculture that rely on various techniques such as green manuring, crop rotation, vermicomposting, biofertilizers, animal husbandry and biological pest control. Thus, organic farming involves cultivation of crop/plant by using organic manures that are environment friendly and supports the life of soil and other beneficial organisms in the soil. Organic farming is becoming popular in developing countries, where farmers make use of animals for tilling the land and manures prepared from dung and other waste material of animals. Thereby, organic farming supports the quality of production and crop yield (Auobamiri and Ahmad 2014). Most of the developed countries utilize synthetic chemicals to protect plants/crops from insects, pests attack and other plant diseases. The usage of synthetic chemicals may give high yield for some period of time and protects the plants but the continuous usage of such chemical in farming may result in inactivation of some useful organisms in soil; in addition to this, certain insects or pests and other diseases develop resistance to these chemicals and later the chemical may not show its effect on the insects, pests and other harmful organisms to the crops. Organic farming in some developing countries like India is not new approach and is being followed from ancient days. Bio fertilizers are prepared with beneficial microbes which release essential nutrients to soil and promote the crop growth and product yield without any environmental degradation (Rao et al 2014). Organic agriculture developed as a response to the industrialization of agriculture and its associated environmental and social problems. Since organic agriculture actually delivers overall advantages over conventional agriculture is however controversial. Some claim that organic agriculture are more profitable and eco-friendly (Reganold and Wachter 2016), while others question the role of organic agriculture in future sustainable food systems (Connor and Minguez 2012).

Organic agriculture adheres to the principles that have been developed by the specific local, climatic, economic, social, cultural and historical features. Organic agriculture is mainly based on four basic principles namely health, ecology, fairness and care (Juma 2007) and are key for sustainability in agriculture. Organic production systems can provide major contributions to farmer livelihoods and food supply stability by improving fertility of the soil, providing diversity and therefore, ensuring flexibility to food production systems in accordance to many causalities of climate change. Usually, a local marketing initiative's set up in organic farming and operating strategy should match its scope. The appropriate option thus, chosen will depend on the country, the location, nature and availability of product range, scale of planned operation and existing sector/market conditions (Wai 2000). The impact of organic agriculture in comparison to conventional agriculture has not been extensively studied including various economic and social aspects. Therefore, it is vital that every country should practice organic farming and should minimize the usage of synthetic chemicals, but the green revolution had brought enormous change in food production systems and now it requires organic form of green revolution by meeting the food requirement and to safeguard the soil life and the ecosystem (Sudadi and Sumarno 2014). The fertility of soil is declining with increase use of synthetic chemicals and the harmful organisms are developing resistance towards synthetic chemicals and these chemicals are dangerous to the ecosystem and the animals. Many

countries export and import different food products like crops, fruits, seeds etc. but from these, some of the food products are banned to import due to high chemical content which would be detrimental for human health, if consumed (Ul-Haq et al 2014).

In India, the organic movement has its origin in the work of Howard (Howard, 1940) who devised and conceptualized most of the views which were later acknowledged by those people who became active in this movement. The objectives of environmental and socio-economic sustainability are the fundamentals of organic farming (Stockdale et al 2001). The key features comprises of safeguarding the long-term soil fertility by maintaining sufficiency through the use of legumes and biological nitrogen fixation, efficient recycling of organic materials inclusive of livestock wastes and crop residues and weed, diseases and pest control focusing primarily on crop rotations, natural predators, organic manuring and resistant varieties. The immense importance is laid on maintaining the fertility of the soil by returning all the wastes back to the soil primarily through compost to reduce the gap between NPK addition and removal from the soil (Chhonkar 2002). Today, the rapidly increasing population pressure has compelled many countries to use synthetic fertilizers and chemicals to enhance the productivity of farm for meeting their growing food requirements. The continuous and over usage of synthetic chemicals has, however, resulted in deteriorating the soil and human health along with environmental pollution. Therefore, in developed countries farmers are encouraged to convert their existing farms into organic farm.

The key factors influencing consumer demand for organic food is the health awareness and the willingness of the masses to pay for the organic high-priced produce. Generally, consumers of organic products are affluent, health conscious and educated group pushed by strong consumer demand, liberal price premium and concerns about the environment. Because of these unseen advantages, conventional growers are switching to organic farming. Agricultural practices of India date back to more than 4000 years and organic farming is very much native to this country. As mentioned in Arthashastra, farmers in the Vedic period had a fair knowledge regarding seed selection, soil fertility, sowing seasons, plant protection and crop sustainability in different lands (Sofia et al 2006). The farmers of ancient India followed the natural laws and this helped in maintaining the soil fertility over a considerably longer period of time (Chandra and Chauhan 2004). The modern studies concluded that instead of integration of the two forms (organic & inorganic inputs) so as to achieve better crop yields, the application of only organic inputs alone can fulfill the nutritional requirements of the crop. The interaction between organic and inorganic matter may result in either increase or decrease soil nutrients, depending on the planting and nutrient material in question (Frankenberger and Abdelmagid 1985).

Historical background and emergence of organic farming: Although the term 'organic farming' is gaining popularity in current era, but it was initiated in 10000 years back when ancient farmers started cultivation depending on natural sources only. There is short reference of several organic inputs in our ancient literatures like Arthashastra, Kautilya, Mahabharata, Ramayana, Rigveda etc. In fact, organic agriculture has descended from traditional agricultural practices that were being practiced in countless villages and farming communities. The major milestones in the area of organic farming are presented in Tables 1 and 2.

Stage of emergence (1924-1970): The commencement of organic farming could mark out back to 1924 in Germany with Rudolf Steiner's course on Social scientific basis of agricultural development and in his theory he considered the human being as part and parcel of a cosmic equilibrium that she/he must under and in order to live in harmony with the environment. Therefore, a balance must be maintained between the materialistic and spiritual phase of life (Herrmann and Plakolm 1991). These theories were applied to agriculture and laid the foundation of biodynamic agriculture (Kahnt 1986). It was developed at the end of the 1920s in Denmark, England, Germany, the Netherlands and Switzerland (Herrmann and Plakolm 1991, Kahnt 1986, Diercks 1986). In 1930, politician Hans Mueler gave momentum to organic-biological agriculture in Switzerland. His goals were at once economic, political and social as they anticipated on the ability of the farmer and a much more direct and less cluttered association between the production and consumption stages (Herrmann and Plakolm 1991, Niggli and Lockeretz 1996). Maria Mueler applied these theories to orchard production (Niggli and Lockeretz 1996). Hans Peter Rush, the Austrian doctor adapted these ideas and included them in developing a method for the greatest utilization of renewable resources (Gliessman 1990). Hans Peter Rush and Hans Mueler laid the hypothetical foundation for the organic-biological agriculture and its expansion in the Germanic speaking regions and countries (Niggli and Lockeretz 1996, Rigby et al 2001). Sir Albert Howard was the creator of the organic farming movement. His book 'An Agricultural Testament' summarized his research works at Indore in India of 25 years, where he developed the famed Indore composting process, which utilize the primordial art of composting on the scientific basis and explained the relationship between the health of the soil, plants and the animals (Du and Wang 2001). J.I. Rodale started his

research and practice on organic farming in the United States of America. His main objective was to build up and revealed the practical methods of rebuilding natural soil fertility. By 1942, he published the magazine 'Organic gardening' (Coleman 1989). Lady Eve Balfour started her first study known as the Haughley experiment in which she compared the natural and conventional farming methods. Her ideas encouraged the development of the soil association that was founded in England in 1946. The main objective of the soil association was to return humus and soil fertility to their basic place in the biological balance. It was set up on the basis of theories given by Sir Albert Howard in his agricultural testament of 1940 (Soil association 2001). During 1950-1960s, organic farming (lemaire-boucher) began to embrace in France due to the awareness of doctors and consumers with regard to food and its effect on health (SOEL 2002). Later, Nature and progress association was founded. Mokichi Okada started natural agriculture in Japan in 1935. His major goals were to respect and focus on the function of soil and nature in the agricultural production, and to harmonize the relationship between nature and humans by enhancing soil humus so to have higher yields without the use of fertilizers and agricultural chemicals. The health and environmental issues became a concern in the 1950s-1960s of the last centuries in Japan and thus, it facilitated the development of natural agriculture. The fundamentals of natural agriculture became the essential contents of Japanese agricultural, standard of organic agricultural products (Sheng et al 1995, Yu and Dai 1995).

Stage of expansion (1970- 1990): The research and development programs for organic agriculture extended worldwide after the 1960s, especially, the expansion and dual polarity of organic agriculture started in 1973 with the oil crisis and the growing environmental issues. So, this was the right time for the new ideas, protest movements, appropriate sociological transformations and the proliferation of alternative life styles. The new thoughts comprises of rational use of natural resources, safeguarding the environment, realizing low input and high efficiency, ensuring food security and sustainable development of agriculture such as organic, organic-biological, bio-dynamic, ecological and natural agriculture were remarkably developed in their concepts, research and practical activities (Herrmann and Plakolin 1991, Rigbyet al 2001, Du and Wang 2001, May 2001, Pacini et al 2002, Conacher and Conacher 1998). In 1970, William Albrecht defines the ecological agriculture as the agriculture

Table 1. Historical perspective of organic farming

Ancient period	
Oldest practice	10000 years old, dating back to Neolithic age, practiced by ancient civilization like Mesopotamia, Hwang Ho basin etc.
Ramayana	All dead things - rotting corpse or stinking garbage returned to earth are transformed into wholesome things that nourish life. Such is the alchemy of mother earth – as interpreted by C. Rajagopalachari.
Mahabharata (5500 BC)	Mention of Kamadhenu, the celestial cow and its role on human life and soil fertility.
Kautilya Arthashastra (300 BC)	Mentioned several manures like oil cake, excreta of animals.
Brihad- Sanhita (by Varahmihir)	Described how to choose manures for different crops and the methods of manuring.
Rig Veda (2500- 1500 BC)	Mention of organic manure in Ria Veda 1, 161, 10,2500-1500 BC, is Green Manure in Atharva Veda II 8.3, (1000 BC). In Sukra (IV, V, 94, 107 112) it is stated that to cause healthy growth the plant should be nourished by dungs of goat, sheep, cow, water as well as meat. A reference of manure is also made in Vrksayurveda by surpala (manuscript, oxford, No 324 B, Six, 107-164).
Holy Quran (590 AD)	At least one third of what you take out from soils must be returned to it implying recycling or post-harvest residue.

Source: Bhattacharya and Chakraborty 2005

Table 2. Key milestones on organic farming

Sir Albert Howard (1900-1947)	Father of modern organic Agriculture, developed organic composting process (mycorrhizal fungi) at Pusa, Samastipur, India and published document"An Agriculture Testament".
Rudolph Steiner (1922)	A German spiritual Philosopher built biodynamic farm in Germany.
J.I. Rodel (1950), USA	Popularized the term sustainable agriculture and method of organic growing.
IFOAM	Establishment of "International Federation of Organic Agriculture Movement", in 1972
One Straw Revolution	Release of the book by Masanobu Fukoka (1975), an eminent microbiologist in Japan.
EU Regulation	EU Regulation on Organic Food, 1991
Codex	Codex guideline on organic standard, 1999.

Source: Bhattacharyya and Chakraborty 2005

The development of the organic farming worldwide had gone through three stages namely emergence, expansion, and growth in chronological sequence

system in which the ecological principles were introduced to the production system of organic agriculture (Coleman 1989). In England, the soil association developed the logo in addition to the legally formulated specifications and quality controls that ensures legal guarantee for the consumers (Yussefi and Willer 2003; Soil Association 2001). The largest non-governmental organization of organic agriculture in the world is IFOAM (International Federation of Organic Agriculture Movements) was founded in1972 (Niggli and Lockeretz 1996). The main organic agriculture associations and research institutions in the world such as FNAB (Federation Nationaled' Agriculteurs Biologiques), FiBL (Forschungsinstitutfuer Biologischen Landbau), which is currently the largest organicresearch institute worldwide, were founded in 1970s-1980s (FA0 2002, Greene 2001). These organizations played the major role in standardization of the produce and market of organic products and support research and consumer's awareness. The governmental action on organic farming gradually began in the different regions and countries as the guidelines for organic farming. In the United States, the regulation on organic farming was implemented in 1974 in Oregon and in California in1979 respectively (Greene 2001). The United States Department of Agriculture (USDA) initiated the research program on organic farming on the large scale on 69 organic farms of 23 states and published the report and recommendations on organic farming explaining the development status and potential remained as issues and the research directions. In this report the guidelines and definition for the organic farming was specified, and an action plan for the development of organic farming was called for. The publication of the report and development of organic farming in the United States was a milestone in legislation (USDA 1980). In France, the organic farming regulation was put into practice in 1985 (Graf and Willer 2001, Dai 1999).

Stage of growth (since 1990): The organic farming altogether goes through a new stage of growth worldwide in the 1990s. The trade organizations for organic products were founded, organic farming regulations were implemented, and organic farming movement was promoted by both the governmental and non-governmental organizations. The first BioFach Fair was emerged in Germany in 1990 which is currently the largest fair for organic products worldwide (ITC 1999). The federal government of the United States published the regulation for organic food products in 1990 (Greene 2001). The European Commission adopted EU regulation 2092/91 on organic agriculture in 1991. Since 1994, this regulation became a law and was granted in almost all European Union countries (IFOAM and FA0 2002). Simultaneously, the North America, Australia and Japan, the major markets for organic products, published and implemented organic regulations in succession (Yussefi and Willer 2003, Niggli and Lockeretz 1996). Both, the International Federation of Organic Agriculture Movements (IFOAM) and the Food and Agriculture Organization of the United Nations (FAO) set out guidelines for the production, processing, labeling and marketing of organic produced foods in 1999. These guidelines were of prime importance for international harmonization of the organic farming standards (FAO and WHO 2001). Organic farming had rapidly developed worldwide during this stage. The main drivers of steady market and production growth were the commitment of many retail chains as well as favorable policy conditions. Together these conditions have provided an opportunity for harmonious increase in supply and demand. The legal framework and state support for organic farming research and development was relatively gaining importance since the end of the 1990s.Therefore, organic agriculture is the holistic production management systems which promotes and enhances agro-ecosystem health including biodiversity, biological cycles and soil biological activity. It laid emphasizes on the use of management practices particularly the usage of off farm inputs, taking into account that regional conditions require locally adapted systems. This is achieved by using, where possible, cultural, biological and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system (FAO and WHO 2001). Terms such as organic, biological, biodynamic and ecological are recognized as organic farming in the EU regulations (Yussefi and Willer 2003, FAO 2002, FAO and WHO 2001).

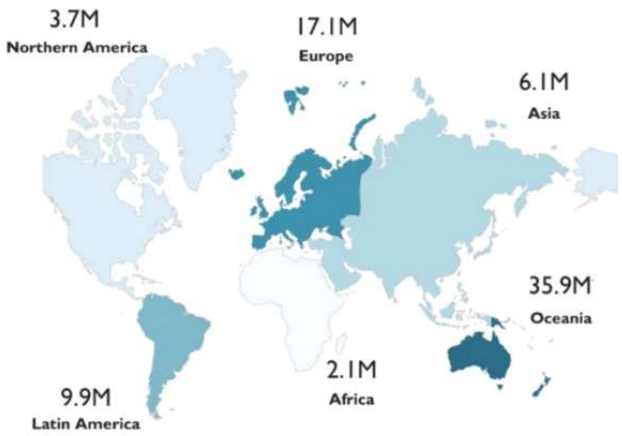
Organic agriculture worldwide: Approximately, organic farming is being practiced in 190 countries of the world and the area under organic agriculture is continuously growing (FiBL 2022). The total organically managed area is 74.9 million hectares (including conversion areas) in 2022 which is around 1.47 million hectares more than in 2016. About 1.1 percent of the agricultural land is organic. In 11 countries, 10 percent or more of the farmland is organic (FiBL 2019). The major part of the global organic land area is located in Oceania, Europe and Latin America (Yussefi and Willer 2003, FiBL 2022).

Europe: As of the end of 2020, 17.1 million hectares were managed organically by more than 420,000 farms in Europe. In the European Union, 14.9 million hectares were under organic management with almost 350,000 organic farms (FiBL 2022). 3.4 percent of the European agricultural area and 9.2 percent of the agricultural area in the European Union is organic. Organic farmland has increased by over 0.7 million hectares compared to 2019. The countries with the

largest organic agricultural areas were France (2.5 million hectares), Spain (2.4 million hectares) and Italy (2.1 million hectares). In 15 countries, at least 10 percent of the farmland was organic: Liechtenstein had the lead (41.6 percent), followed by Austria (26.5 percent) and Estonia (22.4 percent). Retail sales of organic products totalled 52 billion euros in 2020 (European Union: 44.8 billion euros), an increase of 15 percent since 2019. The largest market for organic products in 2020 was Germany, with retail sales of 15.0 billion euros, followed by France (12.7 billion euros) and Italy (3.9 billion euros). In Europe, 46 countries have legislation on organic agriculture (FiBL 2022). The legal protection, grants under rural development programs, and a European as well as several national action plans were the major support for the development of organic farming in the European Union and neighboring countries. One of the chief instruments of the European Action Plan on organic food and farming was an information campaign which was launched during 2008 with the objective of enhancing awareness of organic farming throughout the European Union.

North America: In Northern America, over 3.7 million hectares of farmland were managed organically in 2020. Of these, 2.3 million were in the United States and 1.4 million in Canada, representing 0.8 percent of the total agricultural area in the region. US organic food sales soared to a new high in 2020, jumping to 56.5 billion US dollars (49.5 billion euros). The Canadian organic sector experienced disruptions in 2020 as the growing season's beginning collided with the national lockdown, causing global disruptions. Despite the obstacles, organic acreage increased by 19 percent to more than 3.5 million acres or almost 1.5 million hectares. Organic food and beverage sales in 2020 topped 6.5 billion Canadian dollars (4.3 billion euros), about 33 percent higher than in 2017. Canada continues to be a net importer of organics globally, but exports have stagnated in recent years, with 2020 data showing organic exports at more than 600 million Canadian dollars. Organic equivalency arrangements continue to provide market access for importers and exporters (FiBL 2022).

Latin America and the caribbean: In Latin America, over 270'000 producers managed over 9.9 million hectares of agricultural land organically in 2020. This constituted 13.3 percent of the world's organic land and 1.4 percent of the region's agricultural land. The leading countries were Argentina (4.4 million hectares), Uruguay (2.7 million hectares) and Brazil (1.3 million hectares). The highest organic shares of total agricultural land were in Uruguay (19.6 percent), French Guiana (11.3 percent) and the Dominican Republic (4.8 percent). Many Latin American countries remain important exporters of organic products



Source: (FiBL Survey, 2022)

Fig. 1. Organic agricultural land in hectares (M=millions)

such as coffee, cocoa and bananas. In Argentina and Uruguay, temperate fruit and meat are key export commodities (FiBL 2022).

Asia: The total area dedicated to organic agriculture in Asia was more than 6.1 million hectares in 2020. There were nearly two million producers, most of whom were in India. The leading countries by area were India (2.7 million hectares) and China (over 2.4 million hectares). Twenty countries in the region have legislation on organic agriculture, and six countries are drafting legislation (FiBL 2022). Organic wild collection areas play a vital role in China and India, while aquaculture is significant in Bangladesh, China and Thailand. Even though most of the production is for export purposes but still markets continue to provide domestic growth support in the region. Mixtures of regulatory frameworks co-exist in the region. The government standard-setting bodies have set voluntary organic standards in Malaysia, Nepal, Laos, Thailand, the United Arab Emirates and Vietnam. The policy makers have recognized the positive impacts of organic agriculture on economy and local communities, climate change and the carbon footprint of agriculture so they began to integrate organic agriculture into sustainable agriculture development initiatives (FiBL 2019).

Africa: There were more than 2 million hectares of certified organic agricultural land in Africa in 2020. Africa reported 149´000 hectares more than in 2019, a 7.7 percent increase, and nearly 834´000 producers. Tunisia was the country with the largest organic area (more than 290´000 hectares in 2020), and Ethiopia had the largest number of organic producers (almost 220´000). The country with the highest percentage of land devoted to organic farming in the region was the island state of Sao Tome and Principe, with 20.7 percent of its agricultural area dedicated to organic crops.

The majority of certified organic products in Africa are destined for export markets. Key crops are nuts, olives, coffee, cocoa, oilseeds and cotton (FiBL 2022). The majority of certified organic production is in Africa and is mainly meant for export markets. The European Union, as the major recipient of these exports, is Africa's largest market for agricultural produce. In 2011, considerable achievements were reached especially the African Union's (AU) decision to support organic farming and their subsequent leadership in promoting and further developing strategies for organic farming policies such as the African Ecological Organic Agriculture Initiative and the IFOAM-African Union Conference that took place in November 2011 in Nairobi (FiBL 2019).

Oceania: This region includes Australia, New Zealand and the Pacific Islands states. Altogether, there were over 16'000 producers on 35.9 million hectares, constituting 9.7 percent of the region's agricultural land and half the world's organic land. More than 99 percent of the organic land in the region is in Australia (35.7 million hectares, mostly extensive grazing land), followed by New Zealand (over 79'000 hectares) and Papua New Guinea (over 72'000 hectares). The highest organic shares of all national agricultural land were in Samoa (14.5 percent), followed by Australia (9.9 percent), Papua New Guinea (6.1 percent), Fiji (4.5 percent), French Polynesia (3.4 percent) and Tonga (3.2 percent). Four countries in Oceania have legislation on organic agriculture, and twelve countries have a national standard but no organic legislation (FiBL 2022).

Standards, Legislation, Policy Support

According to the FiBL survey on standards and legislation, 93 countries had organic standards in 2018, and 16 countries were in the process of drafting legislation. At least29 countries in Africa, Asia, and Oceania, have adopted national or regional standards for organic agriculture. The European Union (EU) adopted the basic act of its new organic regulation, which will come into force in 2021. In 2019 and 2020, the secondary legislation – the delegated and implementing acts for production, controls, and trade – will be drafted and adopted. In Russia, the law on organic production was signed, which will come into force in 2020. In Ukraine, the Organic Law was adopted in August 2018, and it came into force in August 2019. Although organic farming as a concept has existed for almost 100 years, it has onlygarnered significant attention from consumers, environmentalists, farmers and ultimately policy-makers worldwide since the mid-1980s. Initially set by private scheme owners, mainly organic farmers' organizations, in the 1980s, organic standards started to become part of a legislative process that brought the enforcement of national and regional organic regulations to help facilitate international trading. At the same time, an increasing number of governments began supporting organic agriculture beyond regulation, and there is a growing number of government policies and programs that support organic agriculture development, such as subsidy schemes, market development support, capacity building, and research investment. A recent trend is that municipalities and cities play an increasing role in supporting the development of the organic sector while legislating on broader objectives related to sustainable growth and development of urban areas.

Table 3. Percentage of area under organic farming among different countries in the world

Country	Percentage area under organic farming
USA	0.6
UK	2.7
Germany	10.2
Argentina	3.0
Austria	26.5
Australia	9.9
Japan	0.3
Switzerland	19.6
South Africa	0.04
Italy	16.0
India	1.5
Pakistan	0.08
Sri Lanka	2.6

Source: FiBL 2022

Participatory guarantee systems (PGS): PGS are locally focused quality assurance systems. PGS have proven to be an affordable alternative to third-party certification, an effective tool to develop local markets for organic produce and are particularly appropriate for small-scale farmers. Based on the data collected through the Global PGS Survey 2017 conducted by IFOAM – Organics International, PGS initiatives are established in 66 countries, with at least 311,449 farmers involved in PGS initiatives worldwide. This includes mostly small farmers and small processors. It is estimated that there are currently at least 241 PGS initiatives, of which 127 are fully operational.

Need for organic agriculture: In current scenario, the European Union has banned Indian contingent of mangoes on account of high pesticidal residues. The Indian chillies undergo the same treatment in Saudi Arabia, which happens to be the fifth-largest importer of vegetables from India. Even in India, the most commonly and intensively used pesticide such as endosulphan has been completely banned from its usage in many crops including fruits and vegetables. All

these are signals that the concern regarding food safety is getting prominent in both developing and developed economies. Since extensive use of synthetic inputs resulted in various issues such as over-exploitation of the groundwater resources, depletion of fertility of soil and higher susceptibility of crops to various insect-pests attack and diseases, (Sidhu 2002) organic agriculture is being seen as an alternative in some quarters. But it has to be well understood that organic agriculture aims at optimization rather than maximization. It has been estimated that ushering in organic cultivation in about 10 million hectares by 2020 could save Rs. 10,000 crores of government exchequer with the reduction of fertilizer subsidies (Pratap 2006).

Scope and mode to promote organic agriculture: India is one of the leading fruit producing countries in the world, producing about 10% of the world's fruit production (Indian Horticulture Database 2014). Agriculture is the backbone of the Indian economy as nearly 67% of population and 55% of the total work force is dependent on agriculture and other allied activities. Thereby, agriculture sector has the remarkable potential to grow and satisfies the ever increasing demands Indian population. It has been assumed that Indian agricultural should have the growth rate of 4% or more so as to achieve a double digit GDP growth rate (Chandrashekar 2010). The scope and prospects of potential organic agriculture in India is evident by the fact that the farm sector has plentiful organic resources like crop residue, water, livestock, aquatic weeds, forest litter, rural & urban solid wastes and agro- industries, bio-products (Bhattacharya and Chakraborty 2005). The adherence of huge population of the farmer to the natural law in ancient India has played a vital role in maintaining the fertility of soil over a longer period of time (Chandra and Chauhan 2004). The inbuilt advantages such as its diverse agro-climatic regions, local self-sustaining agri-systems, substantial number of progressive farmers and ready availability of inexpensive manpower translate into the potential to cultivate organically a vast basket of products (Munda 2006). More than 65% of the country's cultivated area is rainfed on crop rotation, crop residues, legumes, animal manure and biological pest control. Majority of the farms are of subsistence type in remote and marginal areas. Organic farming is gaining much importance among Indian farmers and entrepreneurs, especially in rain-fed zones, low productivity areas, hilly areas and the north-eastern states where fertilizer consumption is less than 25 kg/ha/year (Mitra and Devi 2016). In fact, North Eastern Region (NER) is considered as home to some niche crops such as Assam lemon, Joha rice, medicinal rice and passion fruits which has high market demands and accounts for 45 per cent of total pineapple production in India (Munda et al 2007). Viewing the benefits of organic agriculture, Uttaranchal and Northeast states have declared themselves as organic-farming states while Mizoram and Sikkim have declared their intentions to shift to total organic farming (Mitra and Devi 2016).Sikkim, by practicing organic farming on approximately 75,000 ha of agricultural land has become India's first fully organic state. Nagaland has 3000 ha area under organic farming whereas Meghalaya has committed to certifying 200,000hectares of land as organic by 2020 (Hill 2016). These regions receive very high rainfall (2000 mm to11000 mm per annum) resulting to the massive production of biomass including weeds, herbs and shrubs (Munda 2006) when a large part of the land falls under forests, pastures, wastelands etc. Lotter et a l(2003) estimated that organic farming performed better in area shaving extreme rainfall because of the less run-off and higher absorption of water in the field. The encouragement for organic agriculture initiated first in the rain-fed areas especially in the hilly areas where there is little or no use of chemical fertilizers and other agro-chemicals due to poor resources with smallholder farmers (nearly 60% of farms in India are less than one ha). Jammu & Kashmir mostly have a hilly topography. Thereby, majority of its area suffers from run-off and soil erosion losses. Besides, more than 70per cent of the arable land is un-irrigated where cultivation of crops alone is very risky (Gupta et al 2005 and Chandra 2014). The varied agro-climatic zones with potential of diversification makes possible to convert at least these areas into organic farming easily (Wani et al 2013). With the success of organic farming, some awakening has initiated in the western and southern states like Karnataka and Maharashtra (Khanna 2012).

Organic farming v/s conventional/modern farming: The organic agriculture differs from conventional agriculture not only gradually but fundamentally. The continuous practice of organic methods thus, seems to provide a new quality in how the agro-ecosystem works. This functioning cannot be explained by summing up single ecological measures. Organic farming tends to improve fertility of the soil in a way and to an extent which cannot be achieved by conventional farming even if the later constantly respects some ecologically principles. Organic agriculture is one of several to sustainable agriculture and many of the methods used (e.g. rotation of crops, inter-cropping, mulching, double digging, integration of crops and livestock) are practiced under various agricultural systems. In organic agriculture almost all synthetic inputs are prohibited and soil building crop rotations are mandated, it is this fact that makes organic agriculture unique. The fundamental rules of organic production are that natural inputs are accepted and synthetic

inputs are prohibited, but there are exceptions in both cases. On other hand, today's modern chemical farms have little use for the skilled husbandry which was once the guiding principle of working the land. The main focus today is primarily on productivity -high input in exchange for high returns and productivity (mostly diminishing now however for farmers worldwide). Four important considerations namely what happens to the land, the food it produces, the people who eat it and the communities which lose out are mostly overlooked. The various drawbacks/hazards of modern chemical farming are summarized in Table 4.

Methods of Organic Farming

Soil management/ maintenance of soil fertility: Soil is the foundation of terrestrial life. Specific soil management practices are required to safeguard and conserve the soil resources (Ghorab and Khalil 2016). Improvement and preservation of soil fertility is the major issue during introduction of organic farming technology. Studies reveals that organic farming conserves fertility of the soil and improves system stability better than conventional farming (Stolze et al 2000, Shepherd et al 2003). A study of cotton production under organic conditions in India showed similar

Table 4. Effects of modern farming system

Land exhaustion	The constant use of artificial fertilizer, together with a lack of crop rotation, reduces the soil's fertility year by year.
Fertilizers	High yield levels are produced by applying large quantities of artificial fertilizers, instead of by maintaining the natural fertility of the soil.
Nitrate run-off	About half of the nitrate in the artificial fertilizer used on crops is dissolved by rain. The dissolved nitrate runs off the fields to contaminate water courses.
Soil erosion	Where repeated deep ploughing is used to turn over the ground, heavy rains can carry away the topsoil and leave the ground useless for cultivation.
Soil compaction	Damage to the structure of soil by compression is a serious problem in areas that are intensively farmed. Conventional tillage may involve a tractor passing over the land six or seven times, and the wheelings can cover up to 90 per cent of a field. Even a single tractor pass can compress the surface enough to reduce the porosity of the soil by 70 per cent, increasing surface run-off and, therefore, water erosion. In the worst cases, the surface run-off may approach 100 percent -none of the water penetrates the surface.
Agricultural fuel	As crop yields grow, so does the amount of fuel needed to produce them. European farmers now use an average of 12 tons of fuel to farm a square kilometer of land; American farmers use about 5 tons (1987 figures).
Biocide sprays	The only controls used against weeds and pests are chemical ones. Most crops receive many doses of different chemicals before they are harvested.
Cruelty to animals	On most modernfarms, all animals are crowded together indoors. Complex systems of machinery are needed to feed them, while constant medication is needed to prevent disease. The cruelty involved in managing, breeding, growing and slaughtering farm animals today is unimaginably repulsive and horrifying.
Animal Slurry	With so many animals packed together in indoor pens, their manure accumulates at great speed. It is often poured into lagoons which leak into local watercourses, contaminating them with disease-causing organisms and contributing to algae blooms.
Imported animal feed	Many farms are not self-sufficient in animal feed; instead they rely on feed brought into the farm. This often comes from countries which can ill afford to part with it.
Stubble burning	In countries where stubble is burned, large amounts of potentially useful organic matter disappear into the sky in clouds of polluting smoke.
Loss of cultivated biodiversity	Large and other chemical farms tend to be monocultures growing the same crop and crop variety
Threat to indigenous seeds and animal breeds and species	Native cultivars and animal breeds lose out to exotic species and hybrids. Many native animal breeds are today threatened with extinction. The same holds true for many indigenous plant varieties which have disappeared within the space of one generation.
Habitat destruction	Agribusiness farming demands that anything which stands in the way of crop production is uprooted and destroyed. The wild animals and plants which were once a common sight around farms are deprived of their natural habitat and die out.
Contaminated food	Food, both plant and animal products, leaves the farm contaminated with the chemicals that were used to produce it.
Destruction of traditional knowledge systems and traditions	Rural indigenous knowledge and traditions, both agricultural and non-agricultural, is invariably connected to agriculture and agricultural systems.
Control of agricultural inputs and food distribution channel	The supply and trading in agricultural inputs and produce is in the hands of a few large corporations. This threatens food security, reducing the leverage and importance of the first and the last part of the supply chain - the farmer and the consumer.
Threat to individual farmers	Chemical agriculture is a threat to their livelihoods and changes their lifestyles, unfortunately not for the better.

Source: www.localfoodworks.org

yield levels as in modern cultivation techniques, but the quality of the soil showed advantages for the organic system as indicated by soil organic matter, water stable aggregates and mean weight diameter (Blaise 2006). The fertility of the soil is maintained by several ways under organic farming (Partap 2010) such as optimization of agricultural crop within each farm; optimum and efficient use of available organic fertilizing resources (humus, turf, turf-and-humus composts, putrid mud, organic wastes of agricultural production and others); taking the advantages of diversification by increasing areas under perennial grasses, application of bacterial substances and expanding the areas under green fodder; recommencement of planned chemical land reclamation, which would make use of local deposits of limestone and chalk; use of local raw material resources for enhancement of soil fertility (defecate, glauconites, phosphorites, phosphate slag, sapropels, zeolites and others); limiting the expansion of areas under harmful crops, which can further worsen the phytosanitary state of the soil; introduction of minimum tillage & widecut tillage methods and direct sowing technology; application of contour structural arrangement of the territory in land use, which presumes optimization of the state of natural environment within the territory of watersheds or ravine and gully systems; developing field-protecting and water-protecting measures.

Ecological benefits: The ever rising concern about environmental degradation, declining natural resources and urgency to meet the food requirements of the increasing population are forcing farm scientist and policy makers to critically examine and provide an alternative to chemical agriculture. Nemecek et al (2005) found greenhouse warming potential in organic systems 29 to 32 percent lower on per ha basis than in a mineral fertilizer system and 35 to 37 percent lower than in the conventional manure-based system. The economic returns from the ecological farming system are really significant, if one gets a premium price for the organically grown rice. The declines in productivity or no effect on yields is over looked by the higher prices that farmers get for their organic produce (Rao et al 2006). Various studies have confirmed that organic agriculture is productive and sustainable (Mader et al 2002).

Efficient energy utilization: The requirement of energy for organic farms in the production process as measured per rupees of produce is only one third of what it is required for their conventional counterparts. This is because N fertilizer and pesticides are not used by organic farmers and the comparison of total energy input/ha with total energy output favors organic farming systems. In one study it was revealed that the soil organic matter was relatively higher inorganically managed soil in comparison to conventional soil despite of similar contents of organic carbon (Marinari et al 2007). The nitrate leaching can only be reduced by carefully managing crop rotations including catch and cover crops (Thorup-Kristensen et al 2003). Meanwhile, a study conducted by Hoeppner et al (2006) on the impact of organic versus conventional management on energy use, energy output and energy-use efficiency revealed that a) the energy consumption was 50% lower with organic as compared to conventional management b) energy output was 30% lower with organic in comparison to conventional management c) the efficiency of energy (output energy/input energy) was highest in the organic management.

Superior food quality: Nowadays, food quality is one of the main concerns of scientists as well as consumers. Nitrates in water and farm produce, pesticides residues, desirable components, keeping quality and physiological imbalances are some of the important characteristics of food quality. It is most often ignored fact that by applying integrated methods, differences resulting from cultivation methods are mostly in favor of the organic variants (Velimirov 2006). The synthetic toxicants are considerably reduced in organic foods, if not completely avoided (Baker et al 2002, Mahnke-Plesker et al 2005). Population belonging to higher and middle economic status are more concerned about the food quality and therefore are willing to pay higher prices for organic food products.

Waste utilization: The ever growing prices of chemical fertilizers have facilitated the usage of organic wastes in the fertilizer practices on the farm. Good manure management implies improved fertilizers value of manure and slurry and fewer nutrient losses. Composting of all organic wastes in general and of Farm Yard Manure (FYM) or feedlot manure in particular is important in organic farming. The self-sufficiency of nitrogen in organic systems is a major advantage in times of shortage of fossil energy (Cormack 2000). Sewage and sludge use for crop production can form an important component of organic farming, if treatment and application methods are improved further. Lotter et al (2003) found that water holding capacity in organic plots was approximately 100 percent higher than in conventional plots during torrential rains.

Use of traditional knowledge: Most countries have utilized different kinds of traditional organic materials to improve or enhance the productivity and fertility of their agricultural soils. However, several years ago, organic recycling practices in some countries were mainly replaced with chemical fertilizer which were applied to high yielding cereal crops that responded to a high level of fertility and adequate moisture including irrigation. Consequently, the importance of organic matter to crop production and its proper use in soil

management is often overlooked or sometimes forgotten. Due to these changes and the failure to implement effective soil conservation practices, the agricultural soils in a number of developing and developed countries have suffered from serious degradation and decrease in productivity because of nutrient run-off, excessive soil erosion and decreased soil organic matter levels. Therefore, in order to achieve self-sufficiency in utilization of organic materials such as usage of agricultural residues and urban wastes to protect agricultural soils from water and wind erosion and to prevent nutrient losses through run-off and leaching, organic farming has been looked as the most reliable method of agricultural production.

Integrated Intensive Farming System (IIFS) or Intensive use of resources: IIFS comprises the intensive utilization of farm resources. In order to ensure environment sustainability, such intensification should be based on techniques which are knowledge intensive and which replaces market purchased chemical inputs with farm grown organic/biological inputs. It is concluded that organic agriculture encourage more species and have more abundance of organism groups than conventional farming that ensures better utilization of wide variety of resources (Bengtsson et al 2005). Pretty et al (2006) suggested several ways to improve water use efficiency in organic agriculture such as reducing evaporation through minimum tillage, using more water-efficient varieties and inducing microclimatic changes to reduce crop water requirements.

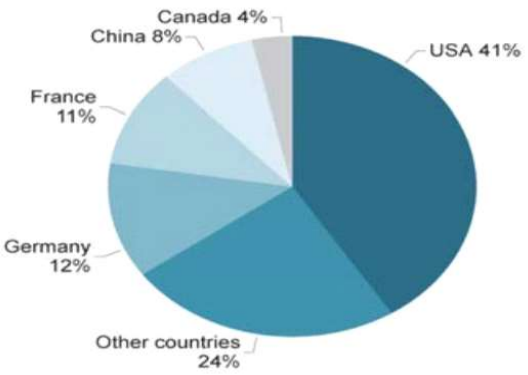
Economic Benefits: Partap (2006) in his recent study of Indian market observed that nowadays there are adequate numbers of people who are willing to pay more for safe food supplies from organic market. Some main findings from research on yields suggested that yield equivalent to or better than conventional agriculture can be achieved under organic systems, although often they are not and yields decrease during conversion period but then improve afterwards (Wynen 1994, Stonehouse et al 2001, Mendoza 2002). The estimates made by the International Fund for Agricultural Development (IFAD) reported that the income of associated small farmers in organic farming can increase substantially (Giovannucci 2005) and Partap and Vaidya (2009).

Biodiversity conservation: The number of species is more in organic grasslands as compared to conventional grasslands, as a result of which the plant communities are richer in species and structure (Frieben 1997). In European organic farming systems, many researchers have found greater diversity and abundance of soil and surface-living arthropods such as beetles, parasitic flies, spiders and wasps as well as non-pest butterflies and many other invertebrate species in comparison to conventional farming systems (Feber et al 1997, Stolze et al 2000, Tybrik et al 2004). Organic farming systems are the most convenient tool used by the planners to balance production and conservation (Hole et al 2005). Therefore, many projects and schemes worldwide working to conserve indigenous varieties and seed banks are linked to organic agriculture projects (Stolton 2002).

Role of organic farming in sustainable agriculture: In India, about 1.5 million hectare area is under organic farming (this includes certified and area under organic conversion) with 835,000 number of certified organic producers. This accounts for about 2.59% of total agricultural land (Ramesh et al 2010). The majority of small farmers utilize locally available resources in India. As such in many marginal areas of India, organic farming is present not by choice but by default. In organic animal husbandry, integration of livestock with cropping or integrating more than one livestock species can be the basis of a sustainable and balanced farming system, allowing effective resource use and nutrient recycling (Subrahmanyeswari and Chander 2008). The future of organic livestock farming appears to be bright as compared to intensive livestock production especially in dry land areas of India (Chander et al 2007). In rainfed areas, livestock is the major source of occupation for the millions of Indian small scale farmers because crops may fail but livestock sustain the life of poor farmers. The maintenance cost of these livestock is very low in comparison to the crossbreds. This type of mixed farming system is common in India. The farmers have little knowledge about the systematic and scientific approach of organic agriculture management of farm (Tewari and Tewari 2007). However, it is mandatory to provide resources/inputs to the organic farmers in the form of technical knowledge so as to enable their livestock systems to be modified and certified which is essential in organic production systems (Subrahmanyeswari and Chander 2008).

Global market for organic food: The organic food market continues its positive trajectory, with global sales reaching 97 billion US dollars in 2017. Organic crops are now grown in almost every country, however demand remains concentrated. The Figure below shows that North America and Europe comprise almost 90 percent of global revenues. These two regions account for just one quarter of the organic land area. Although internal markets are now developing, much of the organic crops grown in Asia, Africa and Latin America are destined for export markets.

North America: North America remains in the pole position, with the region's organic food market valued at 48.7 billion US dollars in 2017. The US has the largest market for organic foods in the world, worth 45.2 billion US dollars. The North



Source: FiBL-AMI survey, 2022, based on retail sales with organic food

Fig. 2. Global market for organic foods: Distribution of retail sales by country 2020

American organic food market is characterized by mergers, acquisitions and investments. Such activity has led to large operators, which operate at every level of the supply chain. White wave Foods, a leading organic food enterprise, was set up by the purchase and merger of several organic food entities. The French multinational Danone acquired White wave Foods for 12.5 billion US dollars in July 2016. General Mills, a large American food company, bought Annie's in 2014. It also owns a brace of other organic food brands. UNFI, a leading wholesaler and distributor of organic foods, acquired Supervalu in July 2018. Supervalu is a conventional supermarket chain, with about 3000 American stores. At the retail side, Whole Foods Market became the world's largest natural and organic food retailer by buying rivals in USA, Canada and the UK. It was bought by Amazon for 13.7 billion US dollars in June 2017. Amazon is now actively promoting the Whole Foods Market 365 and related private labels on its online platform.

Europe: Valued at 39.6 billion US dollars, the European market for organic foods is the second largest in the world. Healthy growth continued in most country markets in 2017, with some countries (such as France and Denmark) reporting exceptional growth. Europe has the largest concentration of organic food retailers in the world. Most are located in Germany, France, and Italy. Much of the growth however is coming from mass market retailers, such as supermarkets, hypermarkets, and discounters. Almost all leading food retailers are marketing organic foods under their private labels. In countries like Switzerland and Denmark, retailer private labels generate the most sales for many organic product categories. Central & Eastern European (CEE) countries, such as Poland, Hungary, and Romania, have traditionally been important growers and exporters of organic crops. However, internal markets are slowly developing in these countries.

Other regions: The combined value of the organic food market in other regions (Asia, Australia, Latin America, and Africa) totaled 8.7 billion US dollars in 2017. Asia has the third largest market for organic products. Historically, the most important consumer markets were in Japan and South Korea; most developments are now occurring in the Chinese and Indian market. A number of organic food enterprises are being set up to cater for the local market. For instance, over ten organic dairy companies have been set up in China in the last decade to cater for the domestic market. In Asia, a transition is taking place whereby countries are moving from an export to domestic focus. Organic foods are in demand as a growing middle class seeks food products that are better for their health and avoid contentious agricultural chemicals.

China has a large market for organic products partly because the country has experienced a number of food scandals; these include selling rotten meat, sewage oil in food products, contaminated pork and beef, as well as numerous incidents of adulteration and counterfeiting. Brazil has the largest market for organic products in Latin America. Similar to Asia, demand is coming from a growing middle class that is seeking healthy nutritious foods. Conventional food retailers comprise most organic food sales. Farmer markets are also important in Brazil, with many producers selling direct to consumers. Other Latin American countries, such as Argentina, Peru, Chile, and Colombia, have export oriented organic food markets. Australia and New Zealand also have important markets for organic products. Both countries are established as leading exporters; organic products include beef, lamb, kiwi fruit, apples, pears, onions, wine, and dairy products.

Current scenario of organic farming in India: The 'Sevagram Declaration' played a vital role for promotion of organic agriculture in India since January 1994. Organic farming has grown many folds with the passage of time due to number of initiatives at government and non-government level. The National Programme on Organic Production (NPOP) defined its regulatory framework while the National Project on Organic Farming (NPOF) has represented the promotion strategy and provided necessary support for area expansion under certified organic farming. Before the implementation of NPOP during 2001 and introduction of accreditation process for certification agencies, there was no institutional arrangement for estimation of organically certified area. Initial estimates during 2003-04 suggested that approximately 42,000 ha of cultivated land were certified organic. By 2009 India had brought more than 9.2 million ha of land under certification and it has been increased further. According to the International Fund for Agriculture and Development (IFAD) about 2.5 million hectares of land was

under organic farming in India in 2004. Further, there are over 15,000 certified organic farms in India. India therefore is one of the chief suppliers of organic food to the developed countries. No doubt, the organic movement has again started in India. Organic food and farming systems are a promising and innovative means of handling the challenges faced by the world in the area of agriculture and food production. Organic production has encouraged dynamic market growth, contributed to farm incomes and created employment for more than three decades now. At the same time, it delivers public goods in terms of animal welfare, rural development and environmental protection. In addition to this, the development generated by the organic sector have played a vital role in pushing agriculture and food productions generally towards sustainability, quality and low risk technologies. The various advantages of organic farming for small farmers all over the world include low capital investment, high income, ability to achieve higher premium in the market and the ability to use traditional knowledge. According to a research conducted by the Office of Evaluation and Studies (OE), International Fund for Agriculture Development (IFAD), small farmers in China, Latin America and India can benefit significantly from organic farming and will help in mitigating poverty in these countries. Organic farming tends to minimize modern farmers struggles which involves various debts and farmland mortgages. Organic farming refers to means of farming that does not involve usage synthetic inputs such as chemical fertilizers and chemical pesticides. Numerous small farmers have been practicing organic farming, since they are unaware of the market opportunities they are notable to reap the benefits of organic farming.

Table 5. Indian states and agricultural products involved in organic farming

Indian states involved in organic farming	Main organic agricultural products of India
Gujarat	Bajra-mustard-wheat
Kerala	Chilly
Karnataka	Cereals-cereals
Uttaranchal	Cereals-pulses
Sikkim	Kholar
Rajasthan	Maize Ginger
Maharashtra	Soybean
Tamil Nadu	Large cardamom
Madhya Pradesh	Passion fruit
Himachal Pradesh	Bhilwara Urd
	Bharatpur Bajra and wheat
	Alwar Wheat and bajra
	Cotton grass
	Dungarpur pulses-cereals
	Bajra
	Mustard
	Til
	Wheat
	Nagour Guar-cumin
	Moong
	Ganganagar cotton
	Jaisalmer bajra
	Jhunjhunu pulses and wheat
	Banswara maize
	Jaipur Guar

Source: Chandrashekar 2010

Strategies to increase yields in organic farming: Recent meta-analyses revealed that globally the yield of organic crops are on average 80% (de Ponti et al 2012), 66–95% (Seufert et al 2012) or 81% (Ponisio et al 2015) of conventional yields. Yield differences vary considerably with crop types (with legumes showing a considerably smaller yield gap than cereals or tubers) growing conditions and management practices. The two most important yield limiting factors in organic crop production are supply of nitrogen (N) and control of perennial (Askegaard et al 2011). These two factors are closely linked as sufficient N is available for rapid early establishment and growth of crops which play a strong role on reducing weed infestation by inducing greater weed suppression ability of the crop (Olesen et al 2007). The most commonly used organic fertilizers such as compost, manure, green manure and organic wastes are quite low in plant available N and this in combination with slow N mineralization in the spring due to low temperatures limits yield in organic crops, especially in the Nordic countries (Dahlin et al 2005). Yield losses due to the insect-pest attack and diseases also affect the organic-conventional yield gap. The number of crop protection products permitted for organic farming is very limited (EU 2014) although they constitute an important input for decreasing crop losses, especially in some horticultural crops (Letourneau and van Bruggen 2006). The limitation of crop protection products or other effective crop protection measures restricts organic yields. It should be here noticed that copper-based products are most commonly used in European organic farming for crop protection products especially for controlling fungus attacks in vines, fruit crops and potatoes (Niggli et al 2016) but copper fungicides are banned in Scandinavian countries by national legislation. Therefore, organic farmers often has to rely on plant varieties bred for high-input conventional systems i.e. high-yielding varieties with poor weed competitive abilities and shallower

rooting depth (Lammerts van Bueren et al 2011) whereas in conventional production systems, these deficits are corrected by the use of herbicides and inorganic nutrients. To overcome these limiting factors, a wide range of strategies are available. Niggli et al (2016) describe such strategies as summarized in Table 7 for arable crops that are applicable to Northern Europe. Some of the strategies comprise of execution of well-known best practices. The use of appropriate crop rotation design to control weed infestation, disease and pest outbreaks particularly for horticultural crops, which are susceptible to many pests and pathogens (Letourneau and van Brugge 2006). The new crop protection strategies in combination with the development and increased use of a variety of biological control agents (e.g. bacteria, fungi and predatory arthropods) (van Lenteren2012) will be chiefly important to minimize the yield gap. Increased use of resistant varieties is also critical, but these varieties are however not fully resistant, implying that direct crop protection measures will be especially important to secure high yields and product quality in high value crops (Speiser et al 2006).

Quality of produce in organic farming: Nowadays, the chief concern for the agricultural scientists and policy makers is environmental hazards and to develop farming methods which are useful to produce quality food. In order to accomplish this goal, the first step is to search for alternate fertilizers which can replace the inorganic source of fertilizers. Several organic materials have been used as fertilizers in organic crop production. But, use of these materials (animal waste and urban sewage waste) in modern agriculture invites pollutions such as heavy metals, chemical residues and parasites (McCalla et al 1986). To overcome this problem, farmers have adopted a kind of biological fertilizer called Bokashi in Japanese, an aerobically fermented using oil seed sludge, rice bran and fish processing byproduct as materials. A microbial inoculate, including lactic acid bacteria, yeast and actinomycetes, is usually inoculated to materials before fermented. This kind of organic fertilizer is easily stored for long time without bite smell. However, the major problem observed is the low nutrient availability at the early stage of crop growth even if the nutrient availability is hold longer than chemical fertilizers (Xu 2000). However, the researchers counter the same problem that it is difficult to obtain same yield in organic farming as in conventional farming. Two leafy vegetables were grown under greenhouse conditions and the dynamics

Table 6. Strategies to increase yields in organic arable crops

Area of intervention	Important for	Strategies to increase yields
Soil fertility	All crops, but especially on stockless farms	• Crop rotation design and management including optimal management of legume pre-crop effects and green manure crops • Increased crop diversity • Intercropping • New technologies for reduced tillage • Increased cooperation between livestock farms and stockless farms • Adding/promoting supportive microorganisms and fungi in soil
Plant nutrients	All crops (except nitrogen for legumes)	• Optimal use of legumes in rotations • Effective use of manures • Increased recycling and use of nutrients from society • Novel treatments of organic food wastes to produce high quality composts • Technological solutions for safe sewage sludge treatments and recycling
Crop-weed competition	All crops, but especially in stockless systems without perennial leys	• Crop rotation design and management • New physical weed control strategies and techniques including cover crop management • Use of the false seedbed technique • Precision farming and robots
Control of diseases	All crops, but especially potatoes and legumes	• Use of tolerant or resistant crop varieties • Crop rotation design and management • Preventative strategies like intercropping, deep ploughing, optimal planting date etc. • New techniques and products for preventing fungal infections, physical methods and bio-control organisms • Replace copper that is currently used • Use of certified and dressed seeds
Control of pests	All crops, several pests in oilseed rape and potatoes	• Crop rotation design • Habitat manipulation (hedgerows, wild flower strips etc.) to strengthen functional biodiversity (e.g. natural enemies) • Physical/biological methods like nets, traps and repellents • Selective pest control products with low negative side-effects

Source: Niggli et al 2016

of both the plant growth and the organic fertilizer were examined to enlighten the plant limiting factors and benefits of this organic fertilizer. Leaf-picking or leaf-peeling harvest method was adopted to prolong the growth and harvestable period. It has been proved that quality of crop particularly the vegetables and fruits is improved by the application of organic fertilizers (Larson et al 2000). The nutritional profile of leafy vegetables was studied including sugar contents, vitamin C and the ionic-nitrate and for the analysis, the organic and inorganic grown vegetables were compared. From results, it was observed that the concentration of sugars and vitamin C were significantly higher but nitrate was lower in organically grown vegetables than chemically fertilized vegetables (Maynard and Barker 1979). In case of chilies, it was noticed that the chilies grown on vermin composted vegetable waste showed higher carbohydrate and protein concentration (Yadav and Vijayakumari 2004). Organic potato tubers farming may be expected to have significantly higher dry matter contents (19%) that are considered good for processing into French fries without deteriorating the texture of the fries when concentrations exceed 23 per cent (Haase et al 2007). Similarly, application of FYM at 10 t /ha alone increased the economic yield and quality parameters like protein and amylose content, hulling percentage and milling percentage of rice (Dixit and Gupta 2000). It is observed that organically grown potato showed 66% higher yield than the conventional crop (Mourao et al 2008). The quality analysis given in Table 11 clearly revealed that acidity, ascorbic acid and total soluble sugars were maximum in organic farming was closely followed by integrated nutrition with a slight edge over the chemical farming. The amount of total solids in all the organic farming treatments was in the range of 22.41 to 25.43 per cent as compared to chemical farming treatment (20.50 %). Similarly, in onion the total solids, ascorbic acid and reducing sugars were more in organic onion as compared to chemical farmed onion (Table 12). The quality of produce can be improved through organic farming (Kaur et al 2006 and Walia and Kler 2007a).

Export Pattern of Organic Products from India

The export of organic food from India is increasing as more farmers are shifting to organic farming. Since the domestic consumption of organic food is quite low in India, so the main market for Indian organic food industry lies in the Europe and US. India has now become a principal supplier of organic basmati rice, organic herbs, organic spices etc. About 53% of the organic food produced is exported from India. This is significantly higher in comparison to the percentage of agricultural products exported. In 2003, only 6-7% of the total agricultural produce was exported from India (Food Processing Market in India 2005).

The upliftment in the demand for organic food products in the developed countries and extensive support provided by the Indian government so as to enhance the agri-exports, are the major reasons for growth of the Indian organic food industry. The prices of organic food products in India are relatively 20 -30% higher than non-organic food products. This is a very high premium for most of the Indian population where the per capita income is merely USD 800. Though the per capita income in India is rising swiftly but the domestic market is not adequate to consume the entire organic food produced in the country. As a result, exports of organic food are the principal aim of organic farmers as well as the government. The Indian government is dedicated towards promoting organic food production in the country. During the Tenth Five Year Plan, the Indian government has allocated Rs.100 crore or USD 22.2 million for promoting sustainable agriculture. APEDA (Agricultural and Processed Food Export Development Authority) manages the export of organic food (and other food products) in India. The National Programme

Table 7. Quality characters of potato in maize-potato-onion cropping system

Treatments	TSS (%)	Acidity (%)	Ascorbic acid mg/100 g	Moisture (%)	Total solids (%)
50 % rec. NPK + 50 % N as FYM	5.75	0.209	3.2	74.99	25.01
1/3 N FYM + 1/3 N Vermi-compost + 1/3 N non-edible cake(T2)	6.00	0.212	3.4	74.57	25.43
100 % NPK + sec. & micro nutrient	4.50	0.218	2.8	79.50	20.50

Table 8. Quality characters of onion in maize-potato-onion cropping system

Treatments	TSS (%)	Ascorbic acid mg/100 g	Reducing sugars (%)	Total solids (%)	Moisture (%)
50 % rec. NPK + 50 % N as FYM	10.80	7.07	3.50	12.50	87.50
1/3 N FYM + 1/3 N Vermi-compost + 1/3 N non-edible cake	11.20	7.11	3.64	12.80	87.20
100 % NPK + sec. & micro nutrient	9.80	3.56	2.43	10.80	89.20

for Organic Production in India was initiated by the ministry of commerce. The programme provides standard for the organic food industry in the country. Since these standards have been developed taking into consideration international organic production standards such as IFOAM and CODEX, as a result, Indian organic food products are being accepted in the US and European markets. APEDA also provides a list of organic food exporters in India and is presented in Table 8. The country wise export pattern for organic products from India is given in Table 9.

Since organic farming is labour intensive and labour is quite expensive in developed countries so organic food production costs are higher in these countries. However, in a country like India, where availability of labour is quite high and relatively cheap, organic agriculture is view as a good cost effective solution to the increasing costs involved in chemical farming. Currently most of the organic farmers in India are still in the evolution phase and hence their costs are still high. As these farmers are expected to adopt the organic farming, the production costs are likely to reduce, thus, making India as one of the significant producers of organic food.

Risks Involved in Organic Farming

However, there are both risks and opportunities associated with strategies to increase yields in organic production. The final outcome largely depends on management, i.e. how strategies are managed and worked out to increase the yield of crop. The various risks involved in organic farming are presented in Table 10.

Environmental deterioration and human health: At

Table 9. Organic food products exported from India

Category	Organic products
Organic cereals	Wheat, rice, maize or corn
Organic pulses	Red gram, black gram
Organic fruits	Banana, mango, orange, pineapple, passion fruit, cashew nut, walnut
Organic oil seeds and oils	Soybean, sunflower, mustard, cotton seed, groundnut, castor
Organic vegetables	Brinjal, garlic, potato, tomato, onion
Organic herbs and species	Chilly, peppermint, cardamom, turmeric, black pepper, white pepper, amla, tamarind, ginger, vanilla, clove, cinnamon, nutmeg, mace
Others	Jaggery, sugar, tea, coffee, cotton, textiles

Source: Chandrashekar 2010

Table 10. Country wise export of organic food products from India (2013-14)

Country	Export volume (Metric tons)	Percentage share	Export value (Rs. crore)	Percentage share
Australia	749.95	0.42	14.58	1.10
Canada	38545.57	21.68	182.41	13.73
China	76.35	0.04	1.57	0.12
European Union	56946.72	32.03	553.85	41.69
Iran	38.00	0.02	1.21	0.09
Israel	312.93	0.18	3.72	0.28
Japan	309.07	0.17	16.12	1.21
Korea Republic	143.48	0.08	2.33	0.18
Malaysia	43.44	0.02	0.91	0.07
New Zealand	599.79	0.34	4.23	0.32
Philippines	110.11	0.06	1.88	0.14
Singapore	73.02	0.04	0.97	0.07
Sri Lanka	78.51	0.04	2.45	0.18
Switzerland	4306.56	2.45	33.89	2.55
USA	74942.72	42.16	498.83	37.55
Others	489.04	0.28	9.65	0.73
Total	177765.26	100.00	1328.60	100.00

Source: Deshmukh and Babar 2015

present, concerns are voiced both in respect of environment and health quality. Eutrophication of water bodies due to high nitrate and phosphate concentration, increasing levels of nitrates in drinking water sources, accumulation of heavy metals such as lead, chromium and cadmium in soil and water resources are the principal causes of environmental deterioration due to agriculture. Dhaliwal et al (2000) reported high concentration of NO_3 (mg/litre) at different locations in Punjab, Haryana and UP which was much higher than the safe limit of 45 mg NO_3/litre. Nitrate in drinking water is the main reason of blue baby syndrome. Likewise, pesticide contamination of food and feed in Punjab were studied by Dhaliwal et al (2000) and sizeable amount of contamination was found in grains, vegetables, feed and milk (Table 2). The average dietary intake of pesticide residues (Table 3) by vegetarian Indian is 362.5 mg/day and non-vegetarian Indian is 356.3 mg/day as against developed countries varying from 7.6 to 149.0mg/day (Ghosh 2000). The heavy metals and other potentially toxic elements are the most serious soil pollutants. Amines produced from the nitrogenous fertilizers cause cancer in human beings. Herbicide residues affect the central nervous system, respiratory system and gastro-intestinal system of human beings. These chemical residues also cause depression, insomnia, oral automatism, myoclous and hyper-reflexia of man (Ghosh 2000). Such harmful effects are now being focused at various forums on account of alarming health hazard situations. To negate such harmful effects organic farming is one of the important options for adoption (Walia and Kler 2007a).

Table 11. Risks associated in organic farming

Business risks						
	Agricultural/ Technological		Communication risks	Non- agricultural		
	Production risks			Managerial risks	Social risks	Profit risks
Yield risks	Specific primary production risks			Institutional and regulatory risks	Informational risks- information shortage, misinformation etc.	
	Climatic risks	Environmental risks and disasters -weather conditions -temperature, rain, sun etc. and climate change -extreme weather events such as frost, droughts, floods, storms etc.		Management and organization risks- including human resources risks	Seasonality risks	
					Research, development and knowledge transfer risks	
	Sanitary risks	Ecological risks -pests, diseases and weeds risks -epidemic diseases -GMO risks -pollution risks (land, water etc.)		Market and marketing risks including price risks- inputs and outputs	Society risks	
		Input risks including supply risks		Administrative risks	Local development risks	
	Post- harvest production risks	Processing risks		Financial and investments (land, facilities, equipment, technology and other) risks	Life standards and purchasing power risks	
		Storage risks				
		Sorting and packaging risks		Unfair competition risks	Intentional or non-intentional violations risks- including theft, warfare, terrorism etc.	
		Transport and distribution risks				
Price risks						

Source: Terziev et al 2015

Table 12. Pesticide contamination of food and feed in Punjab

Commodity	Number of samples	
	Analysed	Contaminated
Cereals	30	30
Rice grain	99	99
Vegetable	96	64
Animal feed	15	15
Animal feed + fodder	105	105
Milk	24	23

Source: Dhaliwal et al (2000)

Table 13. Average dietary intake of pesticide residues (mg/day/person)

Country	Average dietary intake
Australia	20.0
Canada	13.3
Germany	149.0
United kingdom	12.0
United States of America	7.6
India	
-Vegetarians	362.5
-Non vegetarians	356.3

Source: Ghosh (2000)

Controversies and constraints: Export of organic produce to western markets has lucrative appearance as it is widely publicized advantage of high income. Market of indigenous organic food market is infancy and may remain as such in future. There is remote possibility of a poor farmer of remote area to get premium price for his organic produce after successfully overcoming all the steps and formalities beginning from farm certification to final export. The demands of families of such farmers might force them to dispose off their organic produce in local market without any premium. In a section of pro-change farmers of agriculturally important areas currently engaged in food grain production began to convert their farms to organic with the intention of getting premium price, there will be no option left for country other than importing food grains as it has practiced a few decades back was warned by Chhonkar and Dwivedi (2004). The main end product of organic decomposition is nitrate. Nitrate, from organic matter under decomposition is continuously released. Release of nitrate is not synchronized with either crop demand or its uptake, it tends to accumulate in excess in soil and pose environmental risk. Irrespective of the origin of ions weather organic or inorganic, they will behave similarly. The nitrate ions from organic sources are less mobile and have lower denitrification potential than from inorganic fertilizers is without evidence. The trace elements and heavy metals vary widely in animal manures and sometimes their concentration exceeds than inorganic fertilizers. Application of these organic manures in large quantities in the agricultural fields may pollute the soil and there will be every chance to enter into the food chain and create health hazard. The biggest myth about organic farming as indicated by Chhonkar and Dwivedi (2004) is that our country has enough organics available to replace chemical fertilizers to sustain the present level of crop production. All tappable nutrients from organic sources will be barely able to meet the deficit nutrients in soil after crop removal at present level of production. To maintain the present level of food grain production in India without use of inorganic fertilizers, the net additional area to be brought under cultivation will be more than the total geographical area of the country. There are contentions that organic farming is unsustainable. The comparatively lower yields and dependence of manure from low yield cattle has prompted criticism that organic farming is environmentally unsound and incapable of feeding the world's population. Norman Borlaug, father of the “Green revolution” asserts that organic farming practices can at most feed 4 billion people, after expanding cropland dramatically and destroying ecosystems in the process (Mahapatra et al 2009). Some Other constraints of organic farming are practicability of green manuring crop is limited due to high cropping intensity; incorporation cost is involved; non-availability of seeds of green manuring crops; use of undecomposed FYM; organic manures are bulky and transportation cost is involved; limited availability of FYM; most of cow dung is used for making cow dung cakes used for fuel purposes; fewer recommendations on bio-pesticides; labour cost are high for controlling weeds manually; yields are low in organic farming during the initial 2-3 years, marketing problems; cumbersome certification process; regulation problems; risky method especially in insect and disease prone crop.

CONCLUSION

The farmers of India had been practicing environment friendly agriculture for centuries till the introduction of the so-called 'green revolution' which was based on the conventional farming methods came into existence in the western countries. Still many resource-poor, marginal and small farmers, have not fully adopted the conventional farming and they follow more or less the traditional eco-friendly agriculture systems. They use local or own farm derived renewable resources and manage self-regulated ecological and biological processes. This has become vital to cultivate the acceptable levels of crop, livestock and human nutrition products and above all to safeguard both the crops and humans from pests and diseases through the use of

locally available low-cost inputs. Such a situation is suitable for making the farming community aware of the organic farming methods to make the switch over less troublesome. A country like India can enjoy a number of benefits from the adoption of organic farming. The price premiums for the products, conservation of the natural resources in terms of improved soil fertility and water quality, prevention of soil erosion, preservation of natural and agro-biodiversity are major benefits of organic farming. Economic and social benefits like generation of rural employment, lower urban migration, improved household nutrition, local food security and reduced dependence on external inputs will be large gains in the Indian conditions. The control of environment pollution and the consequent increase in the quality of human life will be other contributions of organic farming. There is a good demand for organic products in the domestic and export market. The main rules and regulations for accreditation and certification of organic products are in place in India. Considering the above, it may be concluded that organic farming will progress tremendously in India.

The organic production is coming farmer's movement and consumer choice which cannot be ignored. All facilities should be necessarily provided to organic farmersin the form of appropriate package of practice, voluminous amounts of organic inputs and good domestic as well as export market. Organic farming should not be discouraged under any circumstances. The immediate task is to arrange availability of organic inputs and low-cost certification process.

Therefore, it is recommended that Governments should develop appropriate policies for extensive adoption of organic agriculture by millions of individual farmer households. Specifically, Governments should encourage farmers to establish effective organizations to promote organic agriculture. In addition to this, they should support the development of alternatives to chemical pest control and chemical fertilizers. Meanwhile, local NGOs and all other related sectors should assist farmers to minimize the use of synthetic chemicals in farming. Actions should be taken to increase consumers' awareness of organic consumption. For this massive extension works and support from state government for capacity building of local NGO's are needed. More research need to be conducted on markets for organic products and operational mechanism for risk insurance should be secured through financial support during the conversion period and provision of incentives or subsidies for organic agricultural production.

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