Role of Organic Farming for Sustainable Agriculture

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ABSTRACT

Considering the insufficient usage of natural resources, ecological crisis, rising population and limitations of the traditional food security in the 21st century, it is extremely important to search for methods to achieve sustainable development Indian agriculture. Organic farming is a modern and a sustainable form of agriculture that provides consumers fresh natural farm products. This objective is achieved by using practices to improve soil fertility and soil health (soil physico- chemical and biological properties of soil) without harming the natural environment. Organic forming provides solutions to the problems associated with degradation of soil health and quality production as well as the people who live and work in it. Organic agriculture offers low external inputs, like as different type of manures (farm yard manure (FYM), Vermicompost, green manure, bio- fertilizers, minerals like gypsum, rock phosphate, neem cake, etc.thereby contributing to increased food availability. As compared to conventional agriculture, organic farming produces cost effective food products, free of synthetic fertilizers and pesticides. In addition, organic farming preservation of the health of the nation, environmental protection and natural resources, employment of young people and women in rural areas, positive impact on slowing down migration to urban areas, and strengthening of the competitiveness of national agriculture and economy, enough evidence is available to prove that organic crops are a better source of nutrition than their corresponding conventional forms.

1. INTRODUCTION

There are several definitions of organic farming but the most coherent definition is given by the US Department of Agriculture (USDA). According to it, organic farming is defined as a system that is designed and maintained to produce agricultural products using methods and substances that maintain the integrity of organic agricultural products until they reach to the consumers. Organic farming is a production system which avoids, or largely excludes, the use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives. The objectives of environmental, social, and economic sustainability are the basics of organic farming. **Stockdale *et al,* (2002).** This is accomplished by using substances, to fulfill any specific fluctuation within the system to maintain long term soil biological activity, ensure effective peak management, recycle wastes to return nutrients to the land, provide attentive care for farm animals and handle the agricultural products without the use of extraneous synthetic additives or processing in accordance with the act and the regulations in this part. The origin of organic farming goes 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

possessed a fair knowledge of soil fertility, seed selection, plant protection, sowing seasons, and sustainability of crops in different lands **Sofia *et al* (2006).** The farmers of ancient India adhered to the natural laws and this helped in maintaining the soil fertility over a relatively longer period in its recent history, to 1940s**. Chandra *et al*, (2004).**Organic farming seems to be more appropriate, as it considers the most important aspects like sustainability of natural resources and environmental safety. It is a production system which favor maximum use of organic materials (like crop residue, animal residue, legumes, on and off farm wastages, growth regulators, bio-pesticides) and discourages the use of synthetically produced agro-inputs for maintaining soil productivity, fertility and pest management under conditions of sustainable natural resources and healthy environment. In this study, a review of literatures on organic farming is focused as an alternative for sustainable crop production. The key characteristics include protecting the long-term fertility of soils by maintaining organic matter levels, fostering soil biological activity, careful mechanical intervention, nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, effective recycling of organic materials including crop residues and livestock wastes and weed, and diseases and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, and resistant varieties. A great emphasis is placed to maintain the soil fertility by returning all the wastes to it chiefly through compost to minimize the gap between NPK addition and removal from the soil, **P. K. Chhonkar (2002).**

1.2. Scenario of World and Indian in Organic Farming : Organic agriculture is practiced in 187 countries, and 72.3 million hectares of agricultural land were managed organically by at least 3.1 million farmers. With the most organic agricultural land in Australia (35.69 m hectares) followed by Argentina (3.63 m hectares) and the Spain (2.35 m hectares). There has been an increase in organic agricultural land in all regions. According to the latest FiBL survey on organic agriculture worldwide, organic farmland increased by 1.1 million hectares, and organic retail sales continued to grow. Organic farming is in a nascent stage in India. About 2.30 million hectares of farmland was under organic cultivation as of March 2019. This is two per cent of the 140.1 million ha net sown area in the country. A few states have taken the lead in improving organic farming coverage, as a major part of this area is concentrated only in a handful of states. Madhya Pradesh tops the list with 0.76 million ha of area under organic cultivation — that is over 27 per cent of India's total organic cultivation area. The top three states — Madhya Pradesh, Rajasthan, and Maharashtra — account for about half the area under organic cultivation. The top 10 states account for about 80 per cent of the total area under organic cultivation.

1. 3 Principles of Organic Farming

The main principles of organic farming are as follows **(Chandrashekar, 2010):**

- To work within a closed system and draw upon local resources as much as possible
- To maintain long-term fertility of soils
- To avoid all forms of pollution that may result from agricultural techniques
- To produce foodstuffs in sufficient quantity and having high nutritional quality
- To minimize the use of fossil energy in agricultural practices
- To give livestock conditions of life that confirm to their physiological needs
- To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human being.

1.4 The main pillars of organic farming are:

- Organic threshold standards
- Reliable mechanisms regarding certification and regulatory affairs

- Technology packages
- Efficient and feasible market network

2. MAJOR PILLARS OF ORGANIC FARMING-BASED AGRICULTURE

There are four major pillars of organic agriculture and they are as follows (IFOAM, 2010):

2.1 Principle of Health : Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. This principle points out that the health of individuals and communities cannot be separated from the health of ecosystems-healthy soils produce healthy crops that foster the health of animals and people. Health is the wholeness and integrity of living systems. It is not simply the absence of illness, but also the maintenance of physical, mental, social and ecological well-being. The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems from the smallest organisms in the soil to the human beings.

2.2. Principle of Ecology : Organic agriculture should be based on living ecological systems and cycles, work, emulate and help to sustain them. This principle roots organic agriculture within living ecological systems. It states that production is to be based on ecological processes and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment. For example, in case of crops this is the living soil; for animals it is the farm ecosystem; for fish and marine organisms it is the aquatic environment. Organic farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature. These cycles are universal but their operation is site-specific. Organic management must be adapted to local conditions, ecology, culture and scale. Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity.

2.3. Principle of Fairness : Organic agriculture should be built on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings. This principle emphasizes that those involved in organic agriculture should conduct human relationships in a manner that ensures fairness at all levels and to all parties-farmers, workers, processors, distributors, traders and consumers. Organic agriculture aims at providing a good quality of life to everyone involved with it and contribute to food sovereignty and reduction of poverty. It aims to produce a sufficient supply of good quality food and other products. Natural environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations.

2.4. Principle of Care : Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations as well as the environment. Organic agriculture is a living and dynamic system that responds to internal and external demands and conditions. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and well-being. The incomplete understanding of ecosystems and agriculture should be taken care of. This principle states that precaution and responsibility are the key concerns in management, development and technology choices in organic agriculture. Science is necessary to ensure that organic agriculture is healthy, safe and ecologically sound. Organic agriculture should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering etc.

Table 1. Conventional farming Vs Organic farming

Conventional farming	Organic farming
• It is based on economical orientation ,heavy mechanization, specialization and misappropriates development of enterprises with unstable market-oriented programme • Supplementing nutrients through fertilizers, weed control by herbicides, plant protection measures by chemicals and rarely combination with livestock • Based on philosophy of to feed the crop/ plants. production is not integrated into environment but extract more through technical manipulation, excessive fertilization, and no correction balances • Low input: output ratio with considerable pollution • Economic motivation of natural resources with out considering principles of natural up gradation.	• It is based on ecological orientation, efficient input use efficiency, diversification and balanced enterprise combination with stability • Cycle of nutrient within the farm, weed control by crop rotation and cultural practices, plant protection by non-polluting substances and better combination of livestock. • Feed the soil to the plant is the watch word and slogan of organic farming • production is integrated into environment balanced conditions for plants and animals and deficiencies need to be corrected • high input: output ratio with no pollution • Maximum consideration of all natural resources through adopting holistic approaches

3. COMPONENTS OF ORGANIC FARMING

There are assumptions throughout the organic literature of differences between organic and conventional systems with respect to their effects on soil physical properties, soil insect fauna and nutrient flow within the soil, crop health and nutritional value of the harvested crop. Different components of organic farming are as follows.

3.1. Crop and Soil Management : Organic farming system encourages the use of rotations and measures to maintain soil fertility. Carefully managed soil with a high production of humus offers essential advantages with respect to the water retention capacity, ion exchange, soil erosion and animal life in the soil. Green manuring and inter-cropping of legumes is another important aspect for biological farming systems. It not only helps in controlling weeds but also in improving its chemical and physical properties by reducing the leaching of nutrients and reducing soil erosion. Depending on the green manure mixture or the legumes used for under sowing, there may be an increase in soil organic matter, soil N2 as well as increase in other nutrient level. Researches have shown that yields of maize improve in rotation system with soybeans, often by as much as 80% **(Carscy *et al*, 1997).**

3.2. On-farm Waste Recycling : Increase in price of chemical fertilizers has enabled organic wastes to regain an important role in the fertilizer practices on the farm. Good manure management means improved fertilizers value of manure and slurry and less nutrient losses. Composting of all organic wastes in general and Farm Yard Manure (FYM) or feedlot manure in particular is important in organic farming.

3.3. Non-chemical Weed Management : Weed Management is one of the main concerns in organic agriculture. Generally, all aspects of arable crop production play an important role in a system approaching to problems. The elements to consider in preventing weed problems are crop rotation, green manuring,

manure management and tillage. Mulching on a large scale by using manure spreaders may also be useful in weed control.

3.4. Domestic and Industrial Waste : Recycling Use of sewage and sludge for crop production can form an important component of organic farming if treatment and application methods are improved further.

3.5. Energy Use : The energy required for production, measured per rupees of produce for organic farms is only one third compared to their conventional counterparts. Because N_2fertilizer and pesticides are not used by biological farmers, the comparison of total energy input/ha with total energy output favors biological farming systems.

3.6. Food Quality : Food quality is one of the main issues, which concerns both scientists and consumers. Nitrates in water and farm produce, desirable components, pesticides residues, keeping quality and physiological imbalances are some of the important aspects of food quality.

3.7. Ecological Agriculture : The growing concern about environmental degradation, dwindling natural resources and urgency to meet the food needs of the increasing population are compelling farm scientist and policy makers to seriously examine alternatives to chemical agriculture. Integrated Intensive Farming System (IIFS) IIFS involves intensive use of farm resources. To be ecologically sustainable, such intensification should be based on techniques which are knowledge intensive and which replace to the extent possible, market purchased chemical inputs with farm grown biological inputs.

4. ORGANIC SOURCES FOR SUSTAINABLE AGRICULTURE

4.1 Organic Sources of Plant Nutrients : At present, most optimistic estimates show that about 25–30 percent of nutrient needs of Indian agriculture can be met by various organic sources. Supplementation of entire N through FYM sustains crop productivity at more than use of conventional N fertilizers. Since the estimates of NPK availability from organic sources are based on total nutrient content, efficiency of these sources to meet the nutrient requirement of crops is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality, and productivity on long-term basis [3]. These organic sources besides supplying N, P, and K also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients, and decomposed plant residues into an available form to facilitate the plants to absorb the nutrients. The N, P, and K contents of fresh FYM range widely from 0.01 to 1.9 percent on dry weight basis due to variable nature of manure production and storage **(Inoko and Zhu, *et al* (1984).** The farmers can in turn, get good remuneration from organically produced crops and if included in high value crop rotations, that is, aromatic rice (Oryza sativa L.), table pea (Pisum sativum L.), and onion **(Allium cepa L.)** due to their heavy demands in domestic, national, and international markets. In particular, soil, water, and nutrient management strategies, such as reduced tillage and use of raised beds, that avoid the deleterious effects of puddling on soil structure and fertility, improve water- and nutrient-use efficiencies, and increase crop productivity, may be appropriate **J. Timsina *et al* (2001)**

4.2 Effect of Organic Nutrition on Crop Productivity : Addition of organic matter in the soil is a well-known practice to increase crop yields. Sharma and Mitra [14] reported that the application of organic materials increased grain and straw yield of rice. **Ranganathan and Selvaseelan (1997)**. Found that application of spent mushroom and rice straw compost though comparable with FYM increased rice grain yields by 20 per cent over NPK fertilizer. Singh et al. [16] reported that the application of 7.5 t FYM ha^{-1}

produced significantly more grain, and straw yields over unfertilized fields. All of the yield attributing characters of rice increased with increasing rates of FYM. Vermicompost provided macroelements such as N, P, K, Ca, and Mg and microelements such as Fe, Mo, Zn, and Cu [20]. The vermicompost contained 0.74, 0.97, and 0.45 per cent nitrogen, phosphorus, and potassium, respectively **Pal, (2002).** In low-input agriculture, the crop productivity under organic farming is comparable to that under conventional farming. Agroeconomic study of practices of growing maize with compost and liquid manure top dressing in low-potential areas showed significantly better performance than those of current conventional farmer practices of a combined application of manure and mineral fertilizers. Maize grain yields were 11–17 per cent higher than those obtained with conventional practices **Onduru *et al* (2002).**

4.3 Effect of Organic Nutrition on Quality Parameters of Crops : Yadav and Vijayakumari (2004).carried out an experiment to assess the effect of vermicomposted vegetable waste on the biochemical characters of chilli and found that the protein was higher at 60 (113 mg g”1) and 90 DAS (79 mg g”1). The carbohydrate content was higher in vermicomposted treatment at 60 DAS (15.34 mg g”1). Chlorophyll (2.61 mg g”1) and total chlorophyll (3.62 mg g”1) contents were observed at 60 DAS, while chlorophyll a (1.01 mg g”1) was higher at 90 DAS as compared to inorganic fertilizers. In another experiment, **Haase *et al* (2007)**. suggested that tubers from organic potato cropping may be expected to have sufficiently high tuber dry matter concentrations (19 per cent) for processing into French fries without impairing the texture of the fries when concentrations exceed 23 per cent.

4.4 Effect of Organic Nutrition on Soil Fertility : Minhas and Sood (1994) also reported that the organic matter after decomposition release macro- and micronutrients to the soil solution, which becomes available to the plants, resulting in higher uptake. Organic farming could sustain higher crop productivity and improving soil quality and productivity by manipulating the soil properties on long term basis. It was reported that organic and low-input farming practices after 4 years led to an increase in the organic carbon, soluble phosphorus, exchangeable potassium, and pH and the reserve pool of stored nutrients and maintained relativity stable EC level **Clark *et al* (1998) and Gaur *et al* (2002).** Organic farming improved organic matter content and labile status of nutrients [71] and soil physicochemical properties. The materials reduced water content and raised the C: N ratio. However, under Indian conditions, joint composting of the manure slurries with plant residues was more viable and profitable than its separate composting. Use of FYM and green manure maintained high levels of Zn, Fe, Cu, and Mn in rice-wheat rotation.

4.5 Effect of Organic Nutrition on Soil Biological Properties : Compost contains bacterial, actinomycetes, and fungi; hence, a fresh supply of humic material not only added microorganisms but also stimulated them **Balasubramanian (1972) Gaur *et al* (1973).** Besides, compost played an important role in control of plant nematodes and in mitigating the effect of pesticides through sorption. Sorption is the most important interaction between soil/organic matter and pesticides and limits degradation as well as transport in soil. Pesticides bound to soil organic matter or clay particles are less mobile, bio available but also less accessible to microbial degradation and thus more persistent **Prasad *et al* (1972)** and **Gaur *et al* (1975).** reported that organic fertility amendments enhanced beneficial soil microorganisms, reduced pathogen population, total carbon, and cation exchange capacity, and lowered down bulk densities, thus improved soil quality Field experiment conducted with P solubilizers like Aspergillus awamori, Pseudomonas striata, and Bacillus polymyxa significantly increased the yield of various crops like wheat, rice, cowpea (Vigna sinensis

L.), and so forth in presence of rock phosphate and saved 30 Kg P_2O_5 ha^{-1} with the use of phosphate solubilizing microorganisms. Vegetable crops, in general, responded better to Azotobacter inoculation than other field crops.

5. ADVERSE EFFECT INDIAN FARMING FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT.

The extensive use of agro chemicals in modern farming by the developed and under developed countries, cause various adverse effect on soil, water, food and atmospheric environment which are reviewed below.

5.1. Fertilizer Pollution : In the developed countries, there has been intensive use of fertilizers since the last four decades. The polluting effects of fertilizers are being observed now; similar problems in the developing countries should be expected soon. Some important problems associated with fertilizers pollution are Nitrate Pollution Application of N_2 fertilizers such as urea and ammonium sulphate to soils produces acid by two processes. Firstly, the natural process of oxidation of ammonium ions to nitrate ions release acid. Part of acid produced is neutralized by alkaline ions released by plants during the subsequent uptake of the nitrate ions. Secondly, since nitrate ions are not strongly absorbed by the soil they are liable to leach or move down through the soil. The negatively charged nitrate ions carry positively charged basic cataions such as Ca, K, Mg and Na in order to maintain the electric charge on the soil particles. A high nitrate concentration indicates the likely presence of harmful bacteria as well. In condition, to high enrichment, NO_3 may produce a state known as methemoglobinemia (blue babies) which generally affect the infants under six months of age. Repeated heavy dose of nitrate on ingestion may likely cause carcinogenic diseases. Consumption of high dose of NO_3 may develop symptoms of dizziness, abdominal cramps, vomiting, weakness, convulsion, mental impairment and even nitrosamine which causes stomach cancer. Apart from this, overuse of N_2 fertilizers leads to swindling of earthworms from the particular area. Earthworms have always been considered a farmer's friend and their absence means loss to the soil fertility.

5.1.2. Accumulation of Heavy Metals : Contamination of soil by heavy metal through fertilizers such as cadmium from phosphate fertilizers is catching the increasing attention of environmentalists (**Kostial, 1977).** Health hazards associated with heavy metals entering the food chain through soil is demanding attention. Fertilizers contain heavy metals as impurities. The application of rock phosphate or its produce to soil always implies the addition of significant amount of lead and cadmium into the soil. Analysis of several commercial fertilizers commonly used revealed that a combination of low analysis and straight fertilizers can add more lead and cadmium to soil than high analysis and mixed fertilizers **(Arora et al., 1995).**

5.2. Pesticide Pollution : The use of different types of poisonous substances as pesticides, contribute towards imbalances in the ecosystem and polluting the environment. Pesticides are extremely used nowadays to control various pests which are harmful to the crops raised by man for food, feed and fiber production. However, most of the chlorinated pesticides are non-biodegradable and leave residue which are detrimental to human beings, animals and the environment.

5.3. Insecticide Pollution : The presence of residues of insecticides in food commodities and other components of the environment is a matter of serious concern. Even small quantities of the residues ingested daily along with food can build up to high levels of body fat **(Dhaliwal and Koul, 2010).** During the 1900's, there was little information available on the bad impose of pesticide on soil and water quality. Organochlorine insecticides such as chlorine, dieldrin, DDT and heptachlor were widely used in agriculture to control insect/

pests in different countries. Since 1960's, the organochlorine use was progressively restricted and is finally banded now. Nevertheless, their residues are still found in soil and continue to cause problems of food and food contamination.

5.4 Herbicide Pollution : The use of chemicals for controlling weeds started with the introduction of 2,4-D in 1940's. The usage of herbicide is higher than any agro-chemicals. Farming has now realized the importance of herbicide usage for harvesting higher crop yields.

5.**4.1. Negative Effect on Soil Ecosystem :** Herbicide plays an important role in the disturbance of soil ecosystem where soil micro-flora and fauna lies in the breaking down of organic matter, incorporating it into the soil and releasing nutrients for plant growth. The herbicide can have direct effect upon decomposing micro-organisms, rhizosphere micro-organisms, root pathogens and disease antagonists such as parasites and predators as well as organisms pathogenic to invertebrates.

5.4.2. Bad Effect in Farmer's Health : The increased uses of herbicides in recent years have caused more concern due to their effect on farmer's health. While herbicide technology has made remarkable progress in terms of developing sage herbicides that are less toxic to human beings, many farmers still suffer from chemical poisoning after applying herbicides.

5.4.3. Soil, Water and Environment : Effect We can probably assume that herbicides applied over many years are always going to have some adverse impact on the environment. They not only affect many species of plants and animals in and around farmland but also cause pollution of underground as well as surface water. New ecotypes of weed which are resistant to herbicides have developed.

CONCLUSION

This chapter has focused on organic agricultural sustainability, and its relationship to various alternative agricultural approaches. organic farming is suited to improve soil fertility and nutrient management markedly on the farm level. With reference to biodiversity, organic agriculture is committed to conservation of biodiversity within agricultural systems. The organic agriculture movement had its roots in a philosophy of life and not in the agricultural science **(Kirchmann, 1994**). In any case, one fundamental reason for increasing interests in organic agriculture is due to the requirements and attention of health, environmental protection, and food safety. Agriculture remains the key sector for the economic development of most developing countries, because for development, any country should be self-sufficient for food shelter and cotton. To make a country self-sufficient, there has been intensive use of fertilizer for the last four decades, which has created several problems linking excessive fertilizer use with environment. Increased amount of nitrate in drinking water is due to excessive and improper use of nitrogen fertilizers, which is most important fertilizer related pollution issues. Agriculture is not sustainable if its resource base declines, or if it has an adverse impact on the environment or leads to economic hardship for farmers especially for farmers with limited resources and landless tenant cultivators. To overcome such problems, organic farming receives the top priority in sustainable agriculture. Experiments conducted on different legume crops grown under varying agro-ecological conditions proved the potentiality of bio-fertilizer and organic wastes as important source of plant nutrients. So, from the different reviewed study, organic farming is practical proposition for sustainable agriculture if adequate attention is paid to this issue. There is urgent need to involve more and more scientists to identify the thrust area of research for the development of eco-friendly production technology.

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