A Review : Organic Farming Improve Sustainability in Soil and Environmental Health with Era of Climate Change

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ABSTRACT

Organic farming is a modern and sustainable form of agriculture that provides consumers fresh natural farm products. Objective is achieved by using techniques to improve crop yields without harming the natural environment as well as the people who live and work in it. Organic agriculture offers an exclusive combination of environment friendly practices, which require low external inputs, thereby contributing to increased food availability. Organic farming has a very positive influence on soil fertility leads to a stabilization of soil organic matter and a sequestration of carbon dioxide into the soils. Sustainable agriculture can be defined as management practices of crop and animal production that secure long-term ecological productivity without degradation of their natural resource and human health. Sustainable agriculture is the successful management of resources to satisfy the changing human needs while enhancing the quality of environment and conserving natural resources Organic farming has lower global warming potential as a result of global climatic changes and their negative effects on the environment are manifested through soil erosion, water shortages, stalinization, soil contamination, genetic erosion, Organic farming is the best alternative to avoid the ill effects of chemical farming. It also has far more advantages over the conventional and other modern agricultural organic farming and sustainable agriculture. 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.

Key words: Climate change, Sustainable, Contamination.

INTRODUCTION

Organic farming entails holistic production systems that avoid the use of synthetic fertilizers, pesticides, and genetically modified organisms, reducing their negative environmental impact. Organic farming covers 0.03 percent of agricultural land in India and 11.3 percent in Austria. Organic farming is defined by the USDA as a system that is designed and maintained to produce agricultural products using methods and substances that preserve the integrity of organic agricultural products until they reach consumers. This is achieved by using substances to meet any specific fluctuation within the system in order 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 agricultural products in accordance with the act and the regulations in this section. Organic farming has a recent history dating back to the 1940s. Organic agriculture has been shown to contribute to long-term conservation of soil, water, air and the protection of wildlife, their habitats, as well as genetic diversity. However, the prolonged and excessive use of chemicals has resulted in human and soil health risks and cause environmental pollution.

Agriculture is not only affected by climate change, but it also contributes to it. Human food production accounts for ten to twelve percent of global greenhouse gas emissions. Furthermore, intensive agriculture has resulted in deforestation, overgrazing, and the widespread use of pesticides that degrade soil. These changes in land use contribute significantly to global CO2 emissions.They must increase agricultural production's ability to adapt to more unpredictable and extreme weather conditions such as droughts and floods, reduce greenhouse gas emissions in primary food production, and halt or reverse carbon losses in soils. Sustainable agricultural management practices include the preservation of soil organic matter (e.g., conservation tillage and residue management) and the selection of crops that are ecologically adapted to local climate regimes. The enhancement of agro-biodiversity (e.g., intercropping and agro- forestry), and the prevention of soil erosion.

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: ORGANIC FARMING AND SUSTAINABLE AGRICULTURAL DEVELOPMENT

1.1 Organic Sources of Plant Nutrients : Currently, most optimistic projections show that various organic sources can meet roughly 25–30% of Indian agriculture's nutrient needs. The use of FYM to supplement all of the N in the soil increases crop productivity more than the use of conventional N fertilisers. 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.Nutrient concentrations in FYM are usually small and vary greatly depending upon source, conditions, and duration of storage. 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. (**Tandon, 1998)** reported that on an average, well-rotted FYM contains 0.5 per cent N, 0.2 per cent P2O5, and 0.5 per cent K2O. An application of 25 t ha^{-1} of well- rotted FYM can add 112 kg N, 56 kg P2O5, and 112 kg K2O ha^{-1} **(Gaur,1992)**. Several researchers all over the world have shown various benefits of the application of FYM on soil properties and productivity of crops. **(Kalembasa and Deska, 2007**) obtained significantly higher yield of sweet pepper (*Capsicum annum* L. var. grossum) with vermicompost. **(Reddy *et al,* 1998)** recorded maximum plant height at harvest, days to first flowering, and branches plant^{-1} with the application of vermicompost (10 t ha^{-1}). Similarly, (**Tomar *et al.* 1998**) reported that the application of vermicompost significantly increased leaf area in carrot (*Daucus carota* L.) plants.

1.2 Effect of Organic Nutrition on Crop Productivity : Increasing crop yields by adding organic matter to the soil is a well-known practice and using organic materials boosted rice grain and straw output **(Sharma and Mitra ,1990)**, **(Ranganathan and Selvaseelan,1997**) reported that using them boosted rice grain yields by 20% over using NPK fertiliser. **(Singh.*et al.* 1998)** found that applying 7.5 t FYM ha^{-1} to unfertilized fields resulted in significantly higher grain and straw yields. With rising rates of FYM, all of the rice yield contributing features rose. Rice and chickpea grain yields increased significantly when organic farming with dhaincha (*Sesbania aculeata* L.) was used. 2001, **(Stockdale *et al,* 2001)** narrated the benefits of organic farming to developed nations (environmental protection, biodiversity enhancement, and reduced energy use and CO2 emissions) and to developing countries (sustainable resources use, increased crop yield without over reliance on costly inputs, and environmental and biodiversity protection).

Many researchers reported that in an organically managed field activity of earth worm is higher than in inorganic agriculture. In the biodegradation process earthworms and microbes work together and produce vermicompost, which is the worm faecal matter with worm casts. Vermicompost provided macro elements such as N, P, K, Ca, and Mg and microelements such as Fe, Mo, Zn, and Cu. The vermicompost contained 0.74, 0.97, and 0.45 per cent nitrogen, phosphorus, and potassium, respectively. In low-input agriculture, the crop productivity under organic farming is comparable to that under conventional farming. **(Tamaki *et al,* 2002)** reported that the growth of rice was better under continuous organic farming than with conventional farming. Agro-economic 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

1.3 Effect of Organic Nutrition on Soil Fertility : The organic matter after decomposition release macro and micronutrients to the soil solution which becomes available to the plants resulting in higher uptake of nutrients **(Minhas and Sood, 1994)**. Organic farming is capable of sustaining higher crop productivity and improving soil quality 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 also the reserve pool of stored nutrients and maintained relativity stable EC level Normal composting takes a long time leading to considerable loss of organic materials as CO2 or does not contribute to the organic pool **(Bulluck *et al* 2002)** reported that the use of compost raised soil pH from 6.0 without compost to 6.5 with compost and reduced the broadleaf weed population by 29 per cent and grassy weed population by 78 per cent. Degradation of soil organic matter reduced nutrient supplying capacity, especially, on soils with high initial soil organic matter content in rice-wheat cropping system. Organic farming improved organic matter content and labile status of nutrients and also soil physicochemical properties. Addition of carbonaceous materials such as straw, wood, bark, sawdust, or corn cobs helped the composting characteristics of a manure. These 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

1.4 Effect of Organic Nutrition on Soil Biological Properties : Compost contains bacteria, actinomycetes, and fungi besides, play 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, pesticides and limits degradation as well as transport in soil. **(Singh and Bohra, 2009)** reported that rice-pea- black gram (*Vigna mungo* L.) cropping system recorded higher population of bacteria, actinomycetes, and fungi than rice-wheat cropping system. Field experiment conducted with P solubilizers like *Aspergillus awamori, Pseudomonas stria*ta, and Bacillus polymyxa significantly increased the yield of various crop yield like wheat, rice and cowpea in presence of rock phosphate and saved 30 Kg P_2O_5 ha^{-1} with the use of phosphate solubilizing microorganisms. Vegetable crops responded better to *Azotobacter* inoculation than other field crops. Nevertheless, yield increase in case of wheat, maize, jowar cotton and mustard crop using *Azotobacter chrooccocum* culture was 0–31 per cent higher than control.

2. AGRICULTURE AS CAUSE AND VICTIM OF CLIMATE CHANGE

The current change in global climate is a phenomenon that is largely due to the burning of fossil energy (coal, oil, natural gas) and to the mineralization of organic matter as a result of land use. These processes have been caused by mankind's exploitation of fossil resources, clearing of natural vegetation and use of these soils for arable cropping. Of these emissions, methane accounts for 3.3 Gt equivalents and nitrous oxide for 2.8 Gt CO_2 equivalents annually, while net emissions of CO_2 at only 0.04 Gt CO_2 equivalents per year, are small.

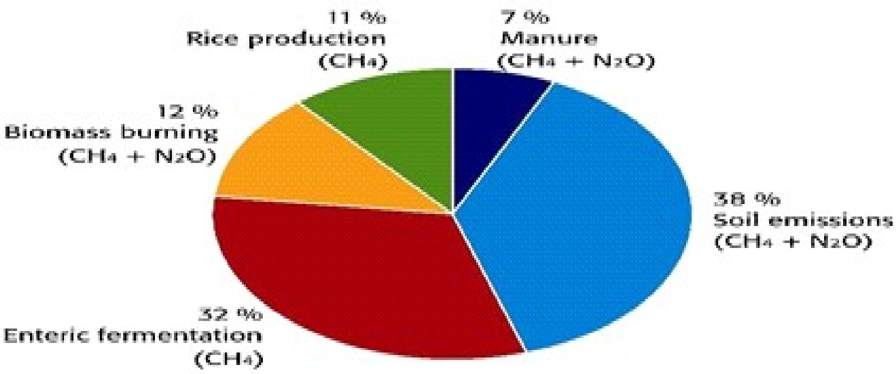

Fig: Main sources of greenhouse gas emissions in the agricultural sector in 2005 (Smith *et al*,2007)

2.1 Further increase in emissions expected unless agricultural practices change : Predictions concerning the future global trends for greenhouse gas emissions from agriculture largely depend on physical and economic parameters that have a strong influence on total emissions.These parameters include: cost of fuel, economic development, evolution of livestock numbers, increase in productivity, new technology, availability of water, deforestation, and consumer attitudes and diet (**Smith *et al,* 2007**).According to current projections, total greenhouse gas emissions from agriculture are expected to reach 8.3 Gt CO_2 equivalents per year in 2030, compared to the current level of approximately 6 Gt CO_2 equivalents annually **(Smith *et al.* 2007).**

2:2 Higher risks due to more unpredictable weather : Current scientific models predict substantial environmental changes caused by increased emission of greenhouse gases. These changes will affect agriculture both in positive and negative ways. The forecast increase in global temperature of between 1.4º C and 5.8º C will result in alterations in precipitation patterns **(Smith *et al.* 2007).** Extreme weather events (droughts, floods) are expected to occur more frequently. Seasonal variations in weather events may pose risks to traditional methods of crop production either due to water constraints or surplus of water and erosion. Soil stability will become crucial in order to store water in the soil profile, to resist severe weather events and minimize soil losses. Vulnerable regions such as tropical and subtropical areas and high mountain regions are expected to suffer most from climate change. 1.4 Measures proposed by IPCC to mitigate the global warming impact of agriculture

3. THE POTENTIAL OF ORGANIC FARMING TO MITIGATE CLIMATE CHANGE

Reduction of greenhouse gas emissions. Organic farming has lower global warming potentiall.The global warming potential (GWP) of agricultural activities can be defined as greenhouse gas (GHG) emissions in CO_2 equivalents per unit land area or per unit product. The global warming potential of organic farming systems is considerably smaller than that of conventional or integrated systems when calculated per land area. This difference declines, however, when calculated per product unit, as conventional yields are higher than organic yields in temperate climates **(Badgley *et al.* 2007).** When losses and gains of soil carbon stocks (mineralization or sequestration) are considered in the calculations, the global warming potential is considerably reduced for organic agriculture as shown in recent studies.

- Scheyern experimental farm: decrease of 80% **(Küstermann *et al,*2007).**
- Bavarian survey of 18 commercial farms: 26% **(Küstermann *et al,* 2007).**
- Station experiment in Michigan: 64% **(Robertson *et al.,* 2000).**

CONCLUSIONS

- Enhanced soil fertility leads to a stabilization of soil organic matter and sequestration of carbon dioxide into the soils.
- Increases the soil's water retention capacity, thus contributing to better adaptation of organic agriculture under unpredictable climatic conditions with higher temperatures and uncertain precipitation levels.
- Organic Farming accept climatic challenges particularly in those countries which most susceptible to change climatic condition and reduced soil erosion that important source of CO_2 losses.
- Organic systems are highly adaptive to climate change due to the application of traditional skills and farmers knowledge, soil fertility-building techniques and a high degree of diversity.

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