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Organic Agriculture – A Conceptual Approach for Sustainable Environment : A Review

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Abstract: Today, the burgeoning population pressure has forced many countries to use chemicals and fertilizers to increase the farm productivity for meeting their ever-increasing food requirements. The prolonged and over usage of chemicals has, however, resulted in human and soil health hazards along with environmental pollution. Farmers in the developed countries are, therefore, being encouraged to convert their existing farms into organic farm.we focuson future of organic agriculture and challenges specially in India.

Keywords: Organic farming, principles,standards, method, challenges.

Introduction

The organic movement in India has its origin in the work of Howard[1] who formulated and conceptualized most of the views which were later accepted by those people who became active in this movement. 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 [2]. 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 [3].

Acid rain, deforestation, depletion, smog due to automobiles and discharge of industrial pollution, soil degradation, depletion of ozone layer and discharge of toxic wastage by industrial units into rivers and oceans are some environmental problematic issues. Intensive use of inorganic fertilizers and pesticides has been an important tool in the drive for increased crop production. In fact more fertilizers consumption is a good indication of agricultural productivity but depletion of soil fertility is commonly observed in soils. Due to heavy use of chemical herbicides, pesticides and intensification of agricultural production during the past few decades has led to other harmful effects like nitrate in the ground water, contamination of fooding materials, eutrophication, stratospheric changes etc. High agricultural inputs are unlikely to be sustainable for very long unless the inputs are correctly judged in terms of both their quality and quantity[4].

Definition of organic agriculture

Organics or ‘o word’ as Mark Lipson (1997) has wryly called organic agriculture in recognition of the ambiguous nature of the word, is a problematic label that can be interpreted to mean a wide range of things. The term ‘organic’ was first used in relation to farming by Northbourne (1940) in the book Look to the land ‘the farm itself must have a biological completeness’, it must be living entity, it must be a unit which has within itself a balanced organic life. The use of ‘organic’ in reference to agricultural production and food is legally constrained in many countries, and some certification agencies have more stringent compliance requirements than other. However, it is useful to provide a general definition of organic agriculture to indicate briefly what the production systems are designed to achieve[5].

The international food standars, Codex Alimentarius, states :

'Organic agriculture is a holistic management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agromic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system. (FAO 1999)

Methods

Organic farming methods combine scientific knowledge of ecology and modern technology with traditional farming practices based on naturally occurring biological processes. Organic farming methods are studied in the field of agroecology.[36] While conventional agriculture uses synthetic pesticides and water-soluble synthetically purified fertilizers, organic farmers are restricted by regulations to using natural pesticides and fertilizers. An example of a natural pesticide is pyrethrin, which is found naturally in the Chrysanthemum flower. The principal methods of organic farming include crop rotation, green manures and compost, biological pest control, and mechanical cultivation. These measures use the natural environment to enhance agricultural productivity: legumes are planted to fix nitrogen into the soil, natural insect predators are encouraged, crops are rotated to confuse pests and renew soil, and natural materials such as potassium bicarbonate [24] and mulches are used to control disease and weeds. Hardier plants are generated through plant breeding rather than genetic engineering[7].

While organic is fundamentally different from conventional because of the use of carbon based fertilizers compared with highly soluble synthetic based fertilizers and biological pest control instead of synthetic pesticides, organic farming and large-scale conventional farming are not entirely mutually exclusive. Many of the methods developed for organic agriculture have been borrowed by more conventional agriculture. For example, Integrated Pest Management is a multifaceted strategy that uses various organic methods of pest control whenever possible, but in conventional farming could include synthetic pesticides only as a last resort[23] .

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. Application of organic sources encouraged the growth and activity of mycorrhizae and other beneficial organisms in the soil and is also helpful in alleviating the increasing incidence or deficiency of secondary and micronutrients and is capable of sustaining high crop productivity and soil health [6]. 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.) [7] due to their heavy demands in domestic, national, and international markets.

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 [8, 9]. Tandon [10] reported that on an average, well-rotted FYM contains 0.5 per cent N, 0.2 per cent P_2O_5, and 0.5 per cent K_2O. Gaur [11] stated that an application of 25 t ha^{-1} of well-rotted FYM can add 112 kg N, 56 kg P_2O_5, and 112 kg K_2O ha^{-1}. The composted manure is applied either immediately or stored until the next crop season depending upon farmer's socioeconomic conditions. 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 [13]. Organic farmers also use animal manure, certain processed fertilizers such as seed meal and various mineral powders such as rock phosphate and green sand, a naturally occurring form of potash which provides potassium. Together these methods help to control erosion. In some cases pH may need to be amended. Natural pH amendments include lime and sulfur, but in the U.S. some compounds such as iron sulfate, aluminum sulfate, magnesium sulfate, and soluble boron products are allowed in organic farming.

Standards

The organic standards generally prohibit products of genetic engineering and animal cloning, synthetic pesticides, synthetic fertilizers, sewage sludge, synthetic drugs, synthetic food processing aids and ingredients, and ionizing radiation. Prohibited products and practices must not be used on certified organic farms for at least three years prior to harvest of the certified organic products. Livestock must be raised organically and fed 100 per cent organic feed ingredients.[2] Organic farming presents many challenges. Some crops are more challenging than others to grow organically; however, nearly every commodity can be produced organically.

Standards regulate production methods and in some cases final output for organic agriculture. Standards may be voluntary or legislated. As early as the 1970s private associations certified organic producers[9]. In the 1980s, governments began to produce organic production guidelines. In the 1990s, a trend toward legislated standards began, most notably with the 1991 EU-Eco-regulation developed for European Union, which set standards for 12 countries, and a 1993 UK program. The EU's program was followed by a Japanese program in 2001, and in 2002 the U.S. created the National Organic Program (NOP). As of 2007 over 60 countries regulate organic farming (IFOAM 2007:11). In 2005 IFOAM created the Principles of Organic Agriculture, an international guideline for certification criteria[21]. Typically the agencies accredit certification groups rather than individual farms.

Principles of organic agriculture-

The four principles of organic agriculture are as follows:

- **The Principle of Health**

  Organic agriculture should sustain and enhance the health of soil, plant, animal and human 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. The role of Organic Agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings. In particular, organic agriculture is intended to produce high quality, nutritious food that contributes to preventive health care and well-being. In view of this it should avoid the use of fertilizers, pesticides, animal drugs and food additives that may have adverse health effects[36].

- **The Principle of Ecology**

  Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help 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 the case of crops this is the living soil; for animals it is the farm ecosystem; for fish and marine organisms, the aquatic environment. Organic Agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity. Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water[36].

- **The Principle of Fairness**

  Organic agriculture should build 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 [36].

- **The 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 and the environment. This principle states that precaution and responsibility are the key concerns in management, development and technology choices in Organic Agriculture. Practitioners of Organic Agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and well-being. Consequently, new technologies need to be assessed and existing methods reviewed. Given the incomplete understanding of ecosystems and agriculture, care must be taken [IFOAM wikipidia].

Tools

Organic farming promotes the use of crop rotations and cover crops, and encourages balanced host/predator relationships. Organic residues and nutrients produced on the farm are recycled back to the soil. Cover crops and composted manure are used to maintain soil organic matter and fertility. Preventative insect and disease control methods are practiced, including crop rotation, improved genetics and resistant varieties. Integrated pest and weed management, and soil conservation systems are valuable tools on an organic farm.[18] Organically approved pesticides include "natural" or other pest management products included in the Permitted Substances List (PSL) of the organic standards. The Permitted Substances List identifies substances permitted for use as a pesticides in organic agriculture. All grains, forages and protein supplements fed to livestock must be organically grown[2].

Organic Certification

When considering organic certification, know the requirements and accreditation(s) needed in the marketplace where your products will be sold. When comparing certification bodies, make sure they have the certification requirements and accreditations needed to meet market requirements. As a minimum certification bodies should be accredited under the Canadian Organic Products Regulations[11.] Some markets may require accreditation or equivalency agreements with countries in the European Union, or with the Japanese Agricultural Standard (JAS), Bio-Swisse or other international organic certification systems. As Canada develops international equivalency agreements the need for the certification body to have these international accreditations will diminish.

"Certified organic" is a term given to products produced according to organic standards as certified by one of the certifying bodies. There are several certification bodies operating in Ontario. A grower wishing to be certified organic must apply to a certification body requesting an independent inspection of their farm to verify that the farm meets the organic standards.[30] Farmers, processors and traders are each required to maintain the organic integrity of the product and to maintain a document trail for audit purposes. Products from certified organic farms are labelled and promoted as "certified organic"[36].

Crop diversity

Crop diversity is a distinctive characteristic of organic farming. Conventional farming focuses on mass production of one crop in one location, a practice called monoculture. The science of agroecology has revealed the benefits of polyculture (multiple crops in the same space), which is often employed in organic farming.[26] Planting a variety of vegetable crops supports a wider range of beneficial insects, soil microorganisms, and other factors that add up to overall farm health. Crop diversity helps environments thrive and protect species from going extinct [27].

Effect of Organic Nutrition on Quality Parameters of Crops

Yadav and Vijayakumari [22] 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. [13]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. Similarly, application of FYM at 10 t ha−1 alone increased the economic yield and quality parameters like hulling percentage, milling percentage, and protein and amylose content of rice cv. Saket-4. Mourao et al. found that organically grown potatocv. Virgo yielded 66 per cent of the conventional crop, whereas Raja yielded 47 per cent. The nitrogen uptake of organic crop (tubers and foliage) was 37.0 kg/ha for Raja and 50.5 kg/ha for Virgo, respectively, 21 and 28 per cent of nitrogen uptake by same cultivars grown with mineral fertilizer. Although foliage nitrogen content was increased for the conventional crops, difference between N content of organic and conventional tubers were not significant, as well as for K, Ca, and Mg. Maheswari et al. studied the effect of foliar organic fertilizers on the quality and economics of chilli and observed the highest ascorbic acid content (175.23 mg/100 g) with vermiwash : water at 1 : 5 ratio [11].

Growth

As of 2001, the estimated market value of certified organic products was estimated to be $20 billion. By 2002 this was $23 billion and by 2007 more than $46 billion.[16] By 2012 the market had reached $63 billion worldwide.[5] The Canadian Organic Farmers reported 669 certified organic farms in Ontario in 2007 with over 100,000 certified organic acres of crops and pasture land. This is an annual increase of approximately 10 per cent per year in recent years. About 48 per cent of the organic cropland is seeded to grains, 40 per cent produces hay and pasture and about five per cent for certified organic fruits and vegetables. Livestock production (meat, dairy and eggs) has also been steadily increasing in recent years.

Europe (2011: 10.6 million hectares, which is 5.4 percent of Europe's farmland and an increase of 6% from the prior year; Europe has 29% of the world’s organic agricultural land) and North America (2011: 2.8 million hectares, 7.5% of the world’s organic agricultural land) have experienced strong growth in organic farmland.[5]In the EU it grew by 21% in the period 2005 to 2008.[17] However, this growth has occurred under different conditions. While the European Union shifted agricultural subsidies to organic farmers due to perceived environmental benefits in the early 2000s, the United States did not, continuing to subsidize some but not all traditional commercial crops, such as corn and sugar [18].

As of 2012 the country with the most organic land was Australia (12 million hectares), followed by Argentina (3.8 million hectares), and the United States (1.9 million hectares).

The Transition Period

The first few years of organic production are the hardest. Organic standards require that organic lands must be managed using organic practices for 36 months prior to harvest of the first certified organic crop. This is called the “transition period” when both the soil and the manager adjust to the new system. Insect and weed populations also adjust during this time [25].

Cash flow can be a problem due to the unstable nature of the yields and the fact that price premiums are frequently not available during the transition since products do not qualify as “certified organic.” For this reason, some farmers choose to convert to organic production in stages. Crops with a low cost of production are commonly grown during the transition period to help manage this risk [3].

Carefully prepare a plan for conversion. Try 10 per cent to 20 per cent the first year. Pick one of the best fields to start with and expand organic acreage as knowledge and confidence are gained. It may take five to 10 years to become totally organic, but a long term approach is often more successful than a rapid conversion, especially when financial constraints are considered. Parallel production (producing both organic and conventional versions of the same crop or livestock product) is not allowed. Use good sanitation, visually different varieties, individual animal identification and other systems to maintain separation and integrity of the organic and conventional products. Good records are essential [28].

Successful Organic Farming

In organic production, farmers choose not to use some of the convenient chemical tools available to other farmers. Design and management of the production system are critical to the success of the farm. Select enterprises that complement each other and choose crop rotation and tillage practices to avoid or reduce crop problems. Yields of each organic crop vary, depending on the success of the manager. During the transition from conventional to organic, production yields are lower than conventional levels, but after a three to five year transition period the organic yields typically increase [1].

Cereal and forage crops can be grown organically relatively easily to due to relatively low pest pressures and nutrient requirements. Soybeans also perform well but weeds can be a challenge. Corn is being grown more frequently on organic farms but careful management of weed control and fertility is needed. Meeting nitrogen requirements is particularly challenging. Corn can be successfully grown after forage legumes or if manure has been applied. Markets for organic feed grains have been strong in recent years [5].

The adoption of genetically engineered (GMO) corn and canola varieties on conventional farms has created the issue of buffer zones or isolation distance for organic corn and canola crops. Farmers producing corn and canola organically are required to manage the risks of GMO contamination in order to produce a "GMO-free" product. The main strategy to manage this risk is through appropriate buffer distances between organic and genetically engineered crops. Cross-pollinated crops such as corn and canola require much greater isolation distance than self-pollinated crops such as soybeans or cereals [36].

Fruit and vegetable crops present greater challenges depending on the crop. Some managers have been very successful, while other farms with the same crop have had significant problems. Certain insect or disease pests are more serious in some regions than in others. Some pest problems are difficult to manage with organic methods. This is less of an issue as more organically approved biopesticides become available. Marketable yields of organic horticultural crops are usually below non-organic crop yields. The yield reduction varies by crop and farm. Some organic producers have added value to their products with on-farm processing. An example is to make jams, jellies, juice, etc. using products that do not meet fresh market standards [30].

Organic produce can usually qualify for higher prices than non-organic products. These premiums vary with the crop and may depend on whether you are dealing with a processor, wholesaler, retailer or directly with the consumer. Prices and premiums are negotiated between buyer and seller and will fluctuate with local and global supply and demand [24].

Higher prices offset the higher production costs (per unit of production) of management, labour, and for lower farm yields. These differences vary with commodity. Some experienced field crop producers, particularly of cereals and forages, report very little change in yield while in some horticultural crops such as tree fruits, significant differences in marketable yield have been observed. There may also be higher marketing costs to develop markets where there is less infrastructure than for conventional commodities. Currently, demand is greater than supply for most organic products [7].

Pure Organic Farming

This does not include the use of biological pest control methods and inorganic manures. The entire requirement of NPK is to be provided in the form of organic elements like either as farm or the town compost or even the green manure. Organic manure is required in large quantities. But, huge potential of organic resources continues to remain untapped across the country. Almost 250 millions tons varieties of yielding crop, 750 million tons of cow dung, hybrid and the mechanization of labor retention is needed. Still, much higher efficiency on the usage of all of these inputs is attained to minimize the damages on the environment, as well as human health [11].

Integrated Farming System (IFS)

It is the organic farming of low input. In this, the farmers need to depend on the crop residues, recycling agricultural wastes and local resources, as well as the ecological process [8].

The Trivedi Effect®

Energy Transmission is the core of development; conventional or contemporary. The ethics and principle associated with Human Wellness are lot more dependent on Energy Transmission than what we think of. The Trivedi Effect® is a concept developed by Mahendra Trivedi, its founder, believing in generating better results through the maximum utilization of available resources; living or non-living. The Trivedi Effect® has a remarkable contribution in the modern science pertaining to physical, sexual, mental, financial, social as well as spiritual betterment. It is possible to achieve greater levels of leverages and goals through emotions, mental peace, eternal happiness, meditation and much more [9].

Challenges for organic agriculture

While organic agriculture aims to be environmentally sustainable, it has not yet reached its goals and there are issues that still need to be addressed. A common question asked of the organic movement relates to its yields. Can organic agriculture feed the world? Like questions about sustainability, productivity also depends on many factors including the farmers background, the farm's resourcefulness and local and national support mechanisms. The appropriate answer may be : does conventional agriculture successfully feed the world now ? high input yielding systemsare currently failing to feed the world, not because of problems with productivity, but because of problems with food distribution and social organization, andserious concern such proverty, racism and gender imbalance (Woodword 1996).

Comparison of organic and conventional farming have been a common feature of the organic literature since the 1980s. The researchers have looked at a wide rande of measures including yield, economics, resource us, efficiency, environmental impact and social factors on a diverse rangeof farm type such as dairies, orchards and mixed cropping farms [35].

The challenges for organic agriculture will depend in part on the location and commodities being produced , but some concern will affect organic farmers worldwide. Agronomic constraints including weeds, animal health and soil fertility continue to concern farmers. Inadequacies in regulatory and marketing structures frustrate farmers, processors and consumers alike. [34]With limited government support, the lack of large commercial supporters and the inability of smaller commercial operations to fund research and development , extensionists and researchers are less able to attract funding. Maintaining a commitment to the principles of organic agriculture will also be a challenge. After almost a century of development, organic agriculture has been embraced by the main stream and shows great promise commercially, socially and environmentally. Behind the billion dollar markets and the million hectare farms, there are many organic growers and consumer who are deliberately opting fot cleaner and safer goods that are produced with regard for the welfare of people and animals involved in production and with minimum impact on environment [36].

Proponents of organic farming

"Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved..."

International Federation of Organic Agriculture Movements

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