

Organic Farming: A Great Secondary Revolutionary Agriculture In Sustainable Farming

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Abstract

Population is increasing in geometric means, it is expected to reach 9.8 billion by mid-2050, while the food production is increasing in arithmetic means, hence there is more pressure on environment, soil, in order to produce more food to meet the needs of this growing population. Hence in order to reduce the pressure and to conserve the soil and other resources the practice of organic farming is one of the best solutions. The International Federation of Organic Agriculture Movements (IFOAM) is an international organization which put forths the standards of organic farming system, it regulates more than 120 countries. According to IFOAM, "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. This system integrates tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. It aims at promoting the sustainability in agricultural production. Sustainable intensification of this approach supplies safe and healthy food per unit of input utilized.

Introduction

Excessive use of synthetic chemicals in conventional agriculture largely degraded the agroecosystems that constitute approximately 40% of the global terrestrial ecosystems. Moreover, changing climate resulted in a substantial loss in agricultural productivity (both in quantity and in quality) mainly due to diverse abiotic and biotic stresses. This draws public awareness about depleting natural resources, viz., soil, land, and water due to unsustainable agricultural practices and equivalently concerns for food-related animal and human health



risks. Modern organic agriculture has shown positive impacts in terms of food/biomass production, climate resilience, soil health, biodiversity, nutritional security, and good quality of life; and is of prodigious demand for nutrient-rich organic food products. In the ensuing decade, owing to the principal focus for the quality aspects or health benefits of organic agriculture, this review explores how organic interventions affect the nutritional value and yield quality in a production system; enable plants to adapt to adverse futuristic environmental conditions, and address the global food and nutritional security challenges. The chronological emergence, current global status, public perceptions, and key components of organic agriculture with their attached health benefits are inextricably synthesized herein. Fostering the ethos of organic agriculture under the UN Decade on Ecosystem Restoration (2021–2030) is highly imperative for agroecosystem restoration and its sustainable management. Moreover, the multidimensional paybacks of organic agriculture help in attaining important global goals and targets such as the Bonn Challenge and United Nations Sustainable Development Goals (UN-SDGs) by the year 2030. Therefore, invigorating the escalation of organic farming as a concurrent strategy of soil, land, and ecosystem restoration is the need of the hour.

Concept

The USDA defines organic agriculture as "a production system that is managed to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity."

This system promotes the use of on farm organic inputs or resources like crop residues, animal manures, green manures, on and off farm wastes, growth regulators, biofertilizers, biopesticides etc and it avoids the use of synthetic chemicals like chemical fertilizers, pesticides thereby maintaining ecological balance without any negative impact on soil, environment, water resources and the other surrounding biodiversity as it entirely sustains on the ecological processes, biodiversity and the cycles that occur in the environment. It integrates site specific agronomic, biological, and mechanical methods to cater the cycling of resources and enhance agro-ecosystem health. This system works on nature's laws and rules. This system integrates the tradition, innovation and science for the well-being, fair relationship and good quality of life for all linked through this system.

Aims

- Avoidance of agrochemicals.
- Maintains ecological balance
- Production of quality food
- Strengthening rural communities
- Resource conservation
- Improving biodiversity and ecosystem services
- Reducing the use of energy from fossil fuels
- Promoting sustainability

Components of Organic Farming:

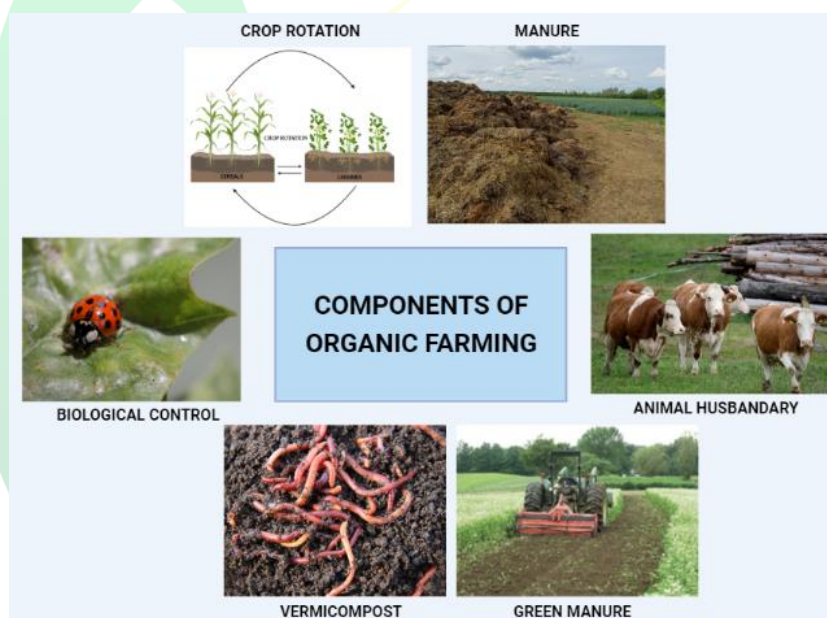


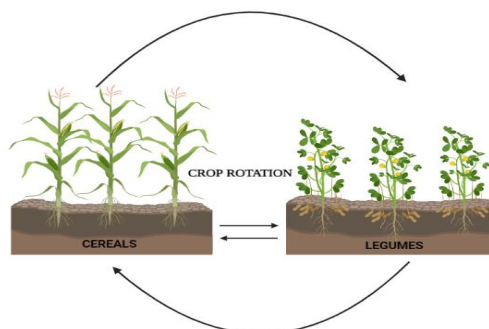
Figure 1 - Components of organic farming

a) Crop And Soil Management

Organic farming mainly aims at improving the soil organic matter thereby maintaining the soil fertility for longer period, in this system this can be achieved by selection of good variety, green manuring, timely sowing, crop rotation, intercropping

• Crop Rotation

It is the systematic arrangement or growing of crops in more or less regular sequence on the same piece of land for a period of two or more year.



This may also include a fallow period within a certain interval of time.

- Adopting this method eradicates pest and weed population
- Protects the soil from depletion and enhances the nutrient uptake mechanism
- Legume should be followed by cereals

Eg - Groundnut-Maize

Green gram-Maize

- Restorative crops should be followed by exhaustive or non-restorative crops

Eg- Sesame-cowpea

Sesame-green gram

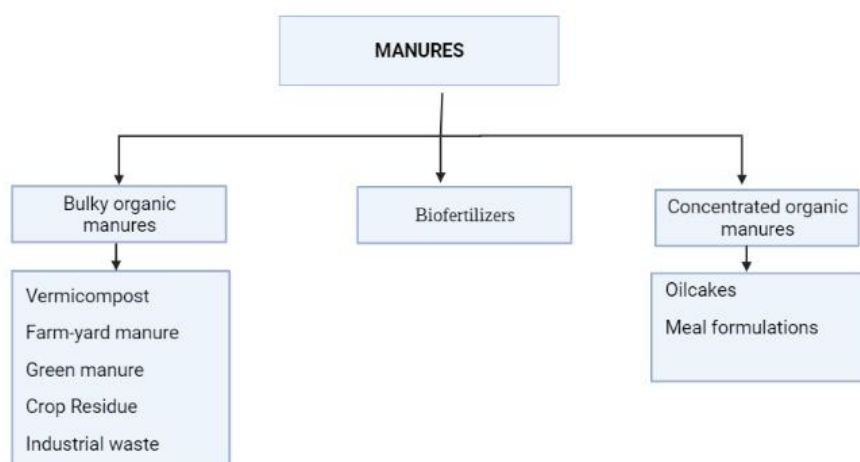
- Deep rooted crops should be followed by shallow rooted crops

Eg- Cotton-potato

Sesame-black gram

b) Nutrient Management

It involves the use of organic inputs like farm-yard manure, vermicompost, biofertilizers, green manures to maintain the soil fertility and to supply needed nutrients to the plants



Bulky organic manures

Organic manures which contain low proportion of major plant nutrients like N, P₂O₅, K₂O.

Eg - Farm-yard manure, compost, green manure

▪ Vermicompost

Conversion of bulky complex organic substances to the simpler forms that can be taken up by the plants with the use of earthworms. It has good analytical value.



Figure 4 - Vermicompost

- **Farm-yard manure**

Manures are the animal or plant waste that are used as a source of plant nutrients, the tied-up nutrients are released only after decomposition. Farm-yard manure is a decomposed mixture of dung, urine, bedding material of dairy animals



Figure 5- Farm-yard manure

- **Crop Residue**

The left-over stubbles of previous crop, straw and the by products such as bran, husk, groundnut haulms, cotton stalks can be considered as crop residue. About 50% of them is used for animal feed while the rest can be utilized for enhancing soil fertility and nutrient recycling



Figure 6 - Crop residue

Industrial waste

Industrial wastes such as molasses, bagasse, press mud, spent wash from distillery. These have good analytical value and can be used as potential manure for cro

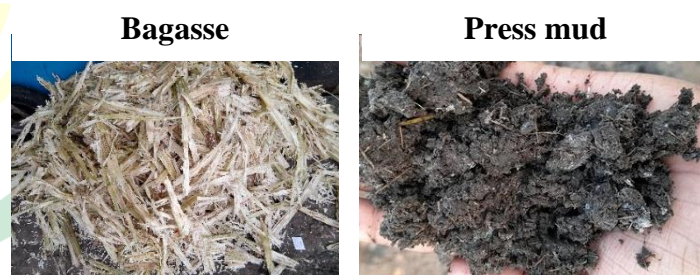


Figure 7- Industrial waste

- **Concentrated organic manures**

Organic manures which contain relatively high proportion of major plant nutrients like N, P₂O₅, K₂O than the bulky organic manures, these are made from raw materials of plants and animals

Eg - Oil cakes, blood meal, bone meal, meat meal, fish meal, hoof and horn meal

- **Oilcakes**

The left-over residue after the extraction of the oil from the oil seeds

Edible oil cakes

These oil cakes are mostly used as animal feed, they can also be used as manure

Eg- Coconut cake, cotton seed cake, groundnut cake, rapeseed cake, sesamum oil cake



Figure 8- Edible oil cake Sesame oil cake

Groundnut oil cake

Non-edible oil cakes

These oilcakes are only used as a manure

Eg- Castor cake, Karanja cake, Mahua cake, Neem cake, Safflower cake



Figure 9- Non-edible oil cakes Castor oil cake

Neem seed oil cake

▪ **Meal formulations**

The blood or bones or meat, hoof or horn, fish are collected from the slaughter house boiled, dried and packed, these can be used as a manure



Blood meal

Bone meal

Meat meal

Fish meal

Large proportion of specific or group of beneficial micro-organisms for enhancing the soil productivity, on inoculating them with their respective crops these living microbial cultures either have the ability to fix atmospheric nitrogen or they mobilize the unavailable

form or solubilize the unavailable form of nutrients into available form so that the plants can take it.

- **Nitrogen fixing biofertilizers**

Symbiotic -Rhizobium, Frankia, *Anabaena azolla*- fixes atmospheric nitrogen in legume crops

Free living-Azotobacter, Azospirillum - fixes atmospheric nitrogen in non-legumes or cereals

Bacillus aspergillus - converts unavailable form of phosphorus to available forms

- **Phosphorus solubilizing biofertilizers**

Bacillus megaterium var. *phosphaticum*, *Bacillus circulans*, *Pseudomonas striata*, *Penicillium digitatum*

- **Phosphorus mobilizing biofertilizers**

VAM -Vascular arbuscular mycorrhiza (glomus), Amani asp., *Rhizoctonia solani*

Green Manure

- **In situ incorporation**

Plants are grown in the field and before flowering the land is ploughed and the entire biomass is incorporated back into the soil, mostly leguminous plants are used for green manuring, they add nitrogen to the soil, improve the nutrient status of the soil and also improve the physical properties of the soil.

Eg - Sun hemp - *Crotalaria juncea*

Dhaincha - *Sesbania aculeata*

Berseem - *Trifolium alexandrinum*

- **Green leaf manuring**

The green leaves, twigs and other biomass are collected from the trees grown on the wastelands, roadsides or the field boundaries, they are added to the soil and incorporated into the soil

Eg-Pongam - *Pongamia pinnata*

Neem - *Azadiracta indica*



Figure 11- In-situ green manuring



Figure 12- Green leaf manure

Wild indigo - *Tephrosia purpurea*

c) PLANT PROTECTION

In this system the Insects, pathogens, and other pests are controlled by either cultural, physical, biological control methods such as growing trap crops, crop rotations, predators, resistant varieties, botanicals

Bio-Pesticide

Biopesticides are certain types of pesticides derived from natural materials as animals, plants, bacteria, or secondary metabolites such as terpenoids, phenolics, alkaloids. In this system insect pest and diseases are controlled by the use of cultural, physical and biological control methods

Eg-*Trichoderma viridae*, *trigogramma* sp., egg parasitoids, larval parasitoids, pupal parasitoids, white and green muscadine, trap crops, crop rotation, Bordeaux mixture, neem oil, NSKE (Neem seed kernel extract), sticky traps, pheromone trap

d) Livestock Management

Livestock are reared based on their evolutionary adaptations, behavioural needs, and welfare issues with respect to nutrition, shelter, breeding, there is no use of synthetic chemicals as food additives, growth boosting drugs, hormones, antibiotics, non- organic forages, GMO's, clones

e) Soil And Water Conservation

Apart from using the resources for cultivation this system also emphasizes on the protection and conservation of resources as well. The soil erosion and runoff can be prevented by contour cultivation, contour bunding, terracing, grassing. the waterways, water conservation through broad bed and furrow system, ridge and furrow system, inter-row water harvesting, inter-plot water harvesting, scooping, for protecting the soil the erosion permitting crops like cereals should be followed by erosion resistant crops like cowpea, this will also help in recycling of nutrients

Principles of Organic Agriculture:



Figure 13- Principles of organic farming

The Principle of Health

Organic farming should sustain and improve the soil, plant, animal, human and planet health as one and in divisible as healthy soils can produce healthy crop that maintains good health of animals and humans

The Principle of Ecology

Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. In this system ecological balance is maintained through the design of farming systems, establishment of habitats and maintenance of genetic and agricultural diversity.

The Principle of Fairness

Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is relished by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings.

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.

Importance of Organic Farming

Day to day the challenges in the agriculture are increasing like increase in cost of cultivation, low water availability, labour problem, in these cases if we practice conventional farming system then this may alleviate the problems and may cause ecological damage and affect the socio-economic condition, this shows that there is a strong need for use to shift towards the holistic farming system that can have overall Improvement in the ecosystem, hence organic farming is one such system

Any activity that causes deterioration of environment and the surrounding ecosystem, will definitely impact productivity of crops and health of humans. Low use of non-renewable energy helps in reduced emission of greenhouse gases (GHGs). Nitrate leaching is considerably low in organic system; thus, groundwater pollution is prevented. The biological activity of soil is improved with the use of organic inputs, and this will also help in sustaining soil fertility for longer time. This system reduces the reliance of the farmer on external inputs, thereby production cost is also reduced. The risk and uncertainty of main crop failure is reduced by diversification, agroforestry, crop rotation, and intercropping and other aspects of this system. Farmers get high price of organic products, and get access to organic markets. The purchasing power and the standard of living of the farmer is improved. In organic farming, farmers as well as the food products are not exposed to harmful chemicals. Organic foods are nutritious, tasty, and fresh, the organic products are higher in vitamin C, antioxidant, etc. content. They are known for their quality and safety issues. The living standard of living the farmer is enhanced with the practice of organic farming

Characteristics of Organic Farming

- Use of organic inputs provides the insoluble nutrients, which are available to the plants only after the action of microbes
- There is a practice of reduce, reuse and recycling of the organic inputs through crop rotation, biological nitrogen fixation, green manuring, thereby reducing the dependency of farmer of the external inputs
- Insect pest, weeds and diseases are controlled by the natural ways like by using pheromone, sticky traps, crop rotation, trap crop, use of natural formulations like neem oil, without the use of chemical inputs



- Rearing of the livestock by considering their evolutionary adaptations, behavioural needs, and welfare issues with respect to nutrition, shelter, breeding
- Apart from intensively reaping the benefits from the crop, this system also emphasises on protecting and conserving the environment and the surrounding biodiversity

Key Indicators of Organic Farming: World & India

In India organic farming is in nascent stage. 2.78 million hectares of land was under the organic farming as of March 2020, as per the Union Ministry of Agriculture and Farmers Welfare. This accounts to about 2% of the net sown area in the country (140.1 million ha). Madhya Pradesh is the top most state in area under organic farming with about 0.76 million ha that is 27% of India's total organic cultivation area, this is followed by Rajasthan and Maharashtra which accounts to about half the area under organic cultivation. The top 10 states occupy about 80 % of total area under the organic cultivation. Though India is small in area under organic farming, but in terms of number of organic farmers it ranks 1st. In India there are 1.9 million farmers as of March 2020, which accounts to 1.3% of 146 million agricultural land holders. Sikkim is India's first fully organic state. Organic agriculture is practised in 187 countries, and 72.3 million hectares of agricultural land were managed organically by 3.1 million farmers. The global sales of organic food and drink reached more than 106 billion euros in 2019. In 2018 there was increase in 2.0 million hectares of area under organic farming and organic retail sales also continued to grow. There were 2.8 million organic producers across the globe, from this India (1,149,000) has highest number of organic producers followed by Uganda (210,000) and Ethiopia (204,000) (2018). By the end of 2018 71.5 million hectares were under organic farming there was increase in 2 million hectares of area which accounts to 2% then compared to 2017. Australia stands first in area under organic farming (35.7 million hectares), followed by 35.7 million hectares

Organic Farming in Indian Economy

Due to the burning issue of climate change, we have been experiencing uncertainties in rainfall and fluctuations in temperature, hence organic farming serves as a key to all these problems. Sikkim is India's first fully organic state. Now-a-days most people are shifting towards the organic farming from the conventional agriculture this is due to its potential capability of this system to bring in higher profitability which aids in sustainable

development. This system can improve the standard of living of farmers. India is dominated by small and marginal farmers, they gain the most economic advantage over others because they do not have proper access to resources, could not invest high cost in buying external inputs hence its easy for them to substitute these with locally available on farm organic inputs. Apart from this they can also fetch relatively higher amount with the sale of the organic produce, the income incurred by the farmers also increases with this system. When there is any weather vulnerabilities crop diversification, intercropping, crop rotation, and agro-forestry and other allied aspects assures income to the farmer against the failure of the main crop.

Various edible organic products like basmati rice, cereals, pulses, oilseeds, fruits, tea, coffee, spices, honey, herbal medicines, and their value-added products, some other non-edible products such as cotton, garments, cosmetics, body care products etcare being produced in India. These organic products are having high demand and value in India an also has good export potential abroad.

In Organic farming works in integrally with the natural ecosystem and cycles, it encourages and promotes indigenous technical knowledge and transfers valuable knowledge from generation to generation. It also plays an important role in conserving cultural practices and crop cultivars, with the adoption of organic farming soil health is improved which gives healthy food therefore the health of the farmers as well as the other people in the ecosystem will be protected

Benefits of Organic Farming

- Reduction in production cost
- Increase in income levels of farmers
- Standard of living and purchasing power of the farmer is improved
- Farmers will get access to the markets and they can get higher price for their produce
- High export potential
- Higher bargaining power
- Provides financial security to farmers because of diversification by reducing the risk
- Supplies healthy, nutritious food which is free from harmful chemical residue
- Conservation of resources
- Enhancement of input use efficiency

- This system is eco-friendly as it will not have any harmful impact on environment and surrounding biodiversity
- Enhances the nutrient status of the soil and also improves the physical properties of the soil
- Use and promotion of indigenous knowledge
- The products have longer shelf life
- Access to diverse food
- Climate resilient agriculture

Limitations Of Organic Farming

- Tedious process
- Initially the yield is low
- Organic inputs are not easily available as that of chemical inputs

Organizations and Government Schemes/ Initiatives Promoting Organic Farming

- **National Centre of Organic Farming**

This centrally run institute, located in Ghaziabad, Uttar Pradesh, it has six Regional Centres at Bangalore, Bhubaneswar, Panchkula, Imphal, Jabalpur, and Nagpur. This has been established for implementing Centrally Sponsored Scheme (CSS), i.e., National Project on Organic Farming. NPOP scheme, which started in 2001, it covers about 70 % of the organic area of the country of which 30 % is under conversion, during 2015-16 to 2018-19, around 96 % of total certified organic food production was under NPOP certification. Madhya Pradesh has about 90% of area under NPOP and the three states namely Madhya Pradesh, Maharashtra and Rajasthan together collectively have over 80 % of their organic area under NPOP.

- **National Organic Farming Research Institute**

This is a research institute recently established in Gangtok, Sikkim for promoting research and educating and giving trainings on organic production systems, especially in the North East Hills Region of India.

- **Participatory Guarantee System (PGS)**

A participatory approach for the stakeholders (producers, consumers, retailers, traders and others such as NGOs, Societies/Gram panchayats/ State/Central Government organizations/agencies/farmers, etc.) to assess, inspect, and verify the production practices of



each other and take decisions on organic certification (PGS-Green and PGS Organic). This system focuses on assurance of quality at local levels, and is a platform for the participators to build trust, social networks, and exchange knowledge to continue the integrity and movement of organic. During 2015-16 to 2018-19, around 4% was under Participatory Guarantee System (PGS) of certification.

- **Paramparagat Krishi Vikas Yojana**

This is an expanded component of Soil Health Management (SHM) of a major CSS, National Mission of Sustainable Agriculture (NMSA), launched in 2015. The latest technologies of organic farming are disseminated in villages among youths and farmers by cluster method and PGS certification. PKVY and MOVCNDR schemes started in 2015-16 and cover 21.5 % and 2.6 % of the total organic area in the country. In states like Andhra Pradesh, Uttarakhand, Telangana and Bihar covered more by PKVY.

Organic Farming: Myth and Reality

Can organic farming feed the World population?

The responsibility of organic farming in food security is an arguable issue considering the crop productivity loss and increasing cost of production. Hypothetically, organic farming is the paramount to attain ecologically and economically sustainable crop production and several scientific studies have also been supporting the facts with encouraging consequences in contrast to conventional farming. Conversely, technological breakthrough to practically demonstrate large extent economically sustainable organic production without time loss is still at large

Does organic means free of pesticide/chemical residues?

Studies carried out by various certification agencies indicate either no or very low levels (below detectable limits) of pesticides and other contaminants in organic food product. Residue found in organic products are mainly due to drift of chemicals from conventional farms. According to an USDA survey, about 21% of the organic samples had detectable residues. Organic food products are definitely safer in terms of toxic residue, though there are few incidents of malpractice and violation, which need to be checked regularly.

Do organic products increase the risk of food poisoning?

It was reported that organic cultivation largely depends on higher use of organic manures. Thus, it is assumed that they pose higher risk of contamination. Though, majority of the



experimental results conclude that there is no threat of any food poisoning or bacterial infection through organic products. They are as safe as any other products produced by any other system

Do organic products taste better than conventional products?

Quality parameters like flavouring ingredients, oils and other taste giving components have been found to be higher in organic products.

As per report, high yields achieved today in some fruit and vegetable crops with higher chemical fertilizers and other inputs under conventional farming have likely come at the expense of crop nutritional and organoleptic quality

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Do organic products contain more nutrition?

There is a scientific contest concerning the nutrition quality of organic food in contrast to conventionally grown food. Based on the analysis made it indicated that organic food was having higher nutrients in 43% cases, equal in 45% cases and lower nutrients in 11% cases compared to conventionally grown foods. In India, it was also observed that relatively higher vitamin C and polyphenol content in the organically grown potato and tea, respectively.

Can organic sources meet entirely nutrient requirements of crops?

The fundamental prerequisite in organic farming is to enhance input use efficiency at each corner of the farm operations. This is accomplished partly through reducing losses and adoption of new technologies for enrichment of nutrient content in manure as well as enhancing nutrient uptake and utilization efficiency of plant with scientific plant management practice. According to a conservative estimate, if we convert major part of the bio-waste generated in India to organic manure; the manure produced would be about 440 million tonnes per year. Tapping these resources and converting it to organic manure with technological advances, and step wise planning for resource regeneration will aid in self-dependency in organic nutrient management.

Is it possible to manage pests and diseases in organic farming?

Pest management in organic agriculture can be effectively attempted only through improvement of plant health. A healthy plant is less prone to pest and disease infestation. Therefore, a most important aim for the organic farmer is to make conditions which keep the plant healthy. Stress weakens the defence mechanisms of plants and makes them easy targets for pests and diseases. Focusing on plant management towards enhancement of its physiological activities also helps to reactivate plant's inherent quality of self-nourishment and self-protection, which in turn helps to minimize the incident of pest/disease infestation and thereby effective control utilizing organic pest control alternatives

Are there any significant environmental benefits of organic farming?

The environmental costs of conventional agriculture are ample, and the support for important environmental amelioration through switch to organic agriculture is awesome. An evaluation of over 300 published reports showed that out of 18 environmental impacts, organic farming systems performed significantly better in 12 and performed worse in none. But the biggest impact is minimization of pesticide and heavy metal residues in food chain which threaten the human health aspects.

Is organic agriculture economically feasible?

Replacement of external inputs by farm-derived resources should lead to reduction in variable input costs under organic management. However, in most cases outsourcing of bulky organic inputs, ineffective pest control and huge production loss increases the cost of production. Also, higher requirement of man-days under organic practice adds up the cultivation cost. Technological advances that can permit enough and timely on-farm resource generation and sustain crop productivity can only cut down the production cost.

CONCLUSION

In addition, there are farmers who are not certified and hence not counted, especially by-default organic farmers in hilly, tribal and rain-fed regions. Organic farming is the best solution to solve the burning issues faced in agriculture. Organic farming is the system that uses natural off farm inputs to produce the products which are natural, nutritious, free from chemical residue. Most of the farmers do not want to adopt this system because of low economic returns in the initial stage of adoption, this shows that there is lack of correct knowledge among the farmers about the long-term benefits of organic farming practices.



Trainings and result demonstrations should be organized in order to fill the gap. Method demonstrations should be conducted for demonstrating the procedures for preparation of organic inputs on farm thereby training them to utilize the resources efficiently. The main thing that should be brought to their view is that to reduce, reuse and recycle the organic inputs. More entrepreneurs should come into this field and put on their start-ups in preparation and sale of organic inputs so that even organic inputs are readily available for the farmers to use same as the synthetic chemical inputs. In India there are greater number of farmers who are practicing the organic farming then compared to the area under cultivation hence several state and central level schemes on organic farming, FPO and cooperative farming approach should be brought up to the view of farmers this will help them in certification of the produce and also improve their standard of living. Another reason for more number of organic farmers but less area under the organic farming is because many farmers who are not certified and hence are not counted, like organic farmers in hilly, tribal and rain-fed regions.