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4. Enhancing Agricultural Sustainability: The Significance of Organic Farming and Its Diverse Practices

Bhagyashree Kesherwani

Program Associate, Environmental Sustainability,
Mobius Foundation, Delhi, India.

Anil Kumar

Faculty, Department of Agriculture,
K.P.H.E.I, Jhalwa, Affiliated to Prof. Rajendra Singh,
Rajju Bhaiya University, Prayagraj, Uttar Pradesh, India.

S. Ravichandran

School of Chemical Engineering and Physical Sciences,
Lovely Professional University, Jalandhar, Punjab, India.

4.1 Organic Farming:

Organic farming is a traditional form of agriculture that was initiated 100 centuries ago, when ancient farmers started producing crops relying solely on natural resources. Numerous works of literature from ancient times report evidence of organic inputs in the land for the production of food energy, making traditional agriculture the roots of organic agriculture practices that involve countless villagers and farming communities over the millennia. The term "organic" is derived from the Greek word "Organikos," which relates to the organ of the body, but the word later came to mean characteristics of living organisms in agriculture. Organic inputs contain living organisms like soil minerals, organic matter, microorganisms, insects, plants, animals, and human beings, and do not use any synthetic fertilizers, pesticides, growth regulators, or live seed activities. Currently, organic farming is in trend due to the growing awareness of health and environmental issues in agriculture, increasing the demand for the production of organic food energy. This is moving the population toward the organic farming system, making growing organic crops the first preferable choice in agriculture. The organic farming system moves conventional agriculture farming toward a sustainable method in which different organic inputs are used to protect and conserve the land for future generations without harming natural resources like land, water, plants, animals, and human beings. Many governments and non-government organizations are involved in promoting organic farming to enhance the quality and quantity of agricultural production. **International Federation of Organic Agriculture Movement (IFOAM)** is a high recognized body that promotes the organic farming system taking into account the protection and conservation of the environment socially and economically for the production of food energy and fibers with sustainable approaches. In this system, different methods are used to enhance soil fertility to produce successful production for the population in a sustainable way.

Organic farming means the requirement of sustainable farming without harming natural resources to protect them for future generations. It is directly associated with sustainable and traditional farming, which relied only on nature for food and health. Nature has a feature to manage self-balance of ecologically and biologically processes for a sustained environment. However, after overpopulation, due to the excessive use or exploitation of natural resources, they have been disturbed by anthropogenic activities due to the access use of toxic agrochemical inputs like pesticides, fungicides, herbicides, and fertilizers. In the organic farming system, agrochemical substances are not allowed as inputs, which protect reclaimed and maintain the soil's productivity.

The concept of organic farming is based on some principles. In this system, soil is considered a living entity and the basic medium for the production. It includes a population of microbes and other microorganisms that contribute to maintaining the soil fertility on a sustained way. The system can maintain its balance in our natural process. It is very important to understand the motivation for organic farming, the practices used to protect the soil, and what they want to achieve. The basic principle of organic farming is to fulfill the requirement of food energy to the population with higher quality and quantity with lower prices in a sustainable way. To achieve these principles, we have to focus on health and environment protection, including biosphere natural resources for everyone in equality protection. Different agriculture practices, management, development, technology, practices, experience, experiment, and methods are used to care for soil product activity without having natural resources. The self-regulatory capacity of nature is decreasing day by day, which is why it's important to move towards natural farming or organic farming systems to maintain balance. Organic farming has numerous benefits, including improving food quality, enhancing soil health for the long-term, improving crop production with high-quality and quantity, pest control, providing economic benefits to farmers, creating employment opportunities, appreciation of a new approach to studies, protecting the environment in a sustainable way, conserving natural resources, improving the health of the ecosystem, increasing consumer demand due to improvement in quality with lesser cost of production, higher yield with lesser cost of production, less expense on plant protection, control of soil and water pollution, and increase in soil micro-organism population.

4.2 Trending Practices of Organic Farming:

4.2.1 Bulky Organic Farming:

Bulky organic farming refers to the use of large quantities of fertilizers that contain a lower amount of nutrients but fulfill the nutrient needs by applying large quantities. There are several types of bulky organic fertilizers:

- **Farmyard Manure (FYM)**: Farmyard manure is a mixture of dung and urine from farm animals. It is generated as waste and when decomposed, it contains 0.5% Nitrogen, 0.2% Phosphorus, and 0.5% Potassium.
- **Green Leaf Manure**: Green manure is a process of spreading green plants like sunhemp, which is used at the green stage before flowering and merging into the soil. This process enriches soil fertility by turning the fresh plant under the soil, maintaining the nutrients and organic matter of the soil.

- **Compost:** Compost is decayed organic matter from waste, consisting of farm waste like paddy straw, sugarcane trash, weeds, and other organic waste. The average nutrients contained in compost are 0.5% N, 0.15% Phosphorus, and 0.5% Potassium.
- **Crop Residue:** Crop residue is related to straw waste produced from different crops like rice, wheat, Surgam, pearl millet, and maize after harvesting. Crop residue consists of 1.13% nitrogen, 1.41% Phosphorus, and 13.54% potassium, which can be used as compost or formal chain for field land to protect the nutrition by erosion and control the moisture of the soil.

4.2.2 Vermicomposting:

Vermicomposting is the use of earthworms for composting organic material. Earthworms can consume almost any organic matter and can consume as much as their own body weight per day. Earthworm excreta, or "casting," is rich in many nutrients (N, P, K, and Mg) as well as bacterial and actinomycetes populations. Composting has deteriorated organic compost. Its collection of vermicast, and also microbially.

Conditions for Earthworm Production for Vermicomposting: To start producing vermicompost, a satisfactory earthworm population is required, along with their propagation on a large scale. To achieve the goal of economic earthworm multiplying, the following basic conditions must be satisfied:

Selection of Suitable Earthworm Species: Only a few of the 3 thousand earthworm species identified in the world are identified for economic earthworm multiplication for vermicomposting. The species identified for multiplication and vermicomposting are (i) Eisenia foetida, (ii) Eudrilus eugeniae, and (iii) Perionyx excavatus. The first two are exotic, and the third is us. Such species are best suited because they are prolific breeders with a high multiplication rate, have a short life cycle, and are voracious feeders. They are easy to handle, with a lifecycle of 1 to 1.5 years, and they study and survive very well throughout the year in different weather conditions. Such species are both economically feasible and widely available for vermicomposting.

Suitable and Adequate Food: Any well-decomposed food of any organic waste in sufficient quantity with a C/N ratio of 20 to 40 can be used to feed earthworms. It can be used directly as manure if the C/N ratio is less than 20.

Adequate Moisture: Earthworms cannot live without water. One of the most important requirements is water. Earthworms are composed of 85 percent water and thus meet the basic need. Respiration occurs via the body wall, which is kept moist. Urine excretes a large amount of water from the body. Thus, for proper growth, the earthworm feed must contain more than 35% water. Earthworms lack a protective body cover and must keep the body surface moist because the body wall serves as a respiratory organ.

To keep the body moist, they will constantly release mucus through the dorsal pores. As a result, maintaining 60 percent moisture in the medium is critical (one must feel the wetness in the material). Excess moisture or water slowdown creates anaerobic conditions in the medium, which inhibits earthworm growth and the quality of compost.

Suitable Temperature: The temperature range for earthworm feed should be between 20°C and 35°C. Temperatures above 45°C cause desiccation of the body and moisture stress, while temperatures below 0°C halt earthworm activity.

Protection from light is important for earthworms, as they are nocturnal creatures and are most active at night. Exposure to light, especially ultra-violet wavelengths, can harm or even kill them. To increase their activity throughout the day and night, it's best to offer shade for vermicomposting structures. Earthworms stay active at night because they avoid the brightness of the day. Though UV radiation has little effect on the epidemic earthworms due to their pigmentation, the heating element of daylight can cause harm. Therefore, it's crucial to reduce the light intensity in the structure. For effective earthworm reproduction, the pH of the feeding material should be neutral, around 7.0. The earthworm population suffers if the pH of the feed material is between 4 and 9. A pH range of 6.0 to 8.5 in the feed mix is ideal for earthworm activity, though there may be a minor decline in food intake and compost generation at the two stated extremes. To get an optimal pH within this range, it's critical to employ green matter alongside dry biomass and manage the moisture in the medium.

Multiplication of earthworms should be done in the shade if possible. Earthworms can be easily replicated in pits and raised beds, as well as on two-story heaps of decayed or partially decomposed organic waste. Any suitable size compost pit can be dug in the backyard, garden, or field. The most practical and controllable pit size is 2m x 1m x 0.45cm. A tank can be made of brick and mortar with adequate water outlets, or a plastic crate 60 cm x 30 cm x 30 cm with holes drilled at the bottom of empty timber crates (drilled wood boxes), or well rings of 75 cm dig and 30 to 45 cm height with modest modifications in the thickness of layers employed.

Vermicompost is handled similarly to conventional manure. Here are the recommended dosages:

- 100 g vermicompost per pot containing 8 to 10 kg soil.
- 1-10 kg vermicompost per tree, depending on size.
- 2000 kg vermicompost per acre of land
- Regular watering and mulching of the land
- No chemicals should be sprayed over the compost pit.
- Sprays of plant extracts are recommended, but only for plant protection.

4.2.3 There are several practices that can be adopted to support agriculture:

Multiple cropping: This is a system in which different varieties of crops are grown simultaneously or on the same land at different time intervals. Mix cropping supports the photosynthesis process and avoids competition between crop nutrients because dissimilar crops required nutrients from a different depth.

Crop rotation: In agriculture, crop rotation is a main practice that can be known as the backbone of an organic farming system. Crop rotation is a sequence of growing crops on the same land in this practice with high nutrients.

Intercropping: This is the practice of growing two or more two crops in the same field. Intercropping ensures better use of land, manures, and fertilizers. Suitable crops for intercropping ensure higher return per unit area, thus meeting the family needs from a smaller area. However, control of disease and pests is difficult in intercropping.

The principles of intercropping are to grow crops maturing at different times and have different growth behavior. Crops having different spread and depths of roots can be grown together, such as tomato and radish or tomato and beet leaf (palak), potato and coriander.

Mulching: Covering the soil with loose extraneous material is termed mulching. There are two types of mulches: organic and inorganic. Organic mulches include grass clippings, straw, husk, crop stumps, bark chips compost, manure, sawdust, wooden pieces, rice husk, onion and garlic scales, and leaf litter. Inorganic mulches include plastic film, metal foil, sand, gravel, and stone.

The use of mulches can provide several benefits, such as

- ✓ Conservation of soil moisture
- ✓ Regulation of soil temperature
- ✓ Suppression of weed growth
- ✓ Prevention of soil erosion
- ✓ Control of pests and diseases

Relay cropping is growing a succeeding crop in the standing crop, without overlapping the growth period of both crops for more than 10-15 days.

Trap cropping involves planting certain crops in the main crop to trap pests and protect the main crop. The trap crop should be sown at an interval of 12-14 rows from the main crop.

For example, planting mustard as a trap crop in cabbage can protect it from the attack of diamond-moth, leaf Webber, aphid, and painted bug. Multiple cropping is growing two or more crops in the field, one after the other, during a fixed period.

Biofertilizers, also known as microbial inoculants, can boost the growth and production of vegetable crops. It is reported that the use of bio-fertilizers increases crop yield from 15-30%. The microbial inoculants fix the atmospheric nitrogen up to 30-50 kg/ha, and enhance the availability of soil nutrients.

Bio-fertilizers are eco-friendly, less expensive, easy to use, and safe for human beings. Symbiotic and non-symbiotic bacteria are both capable of fixing atmospheric nitrogen. A different group of Rhizobium spp. are suitable for legume crops, while Azotobactor spp., Azospirillum spp. and Frankia spp., (Actinomycete) are nitrogen fixers in non-legume crops. Bacteria belonging to Thiobcillus spp. and Bacillus spp. are phosphates solubilizing bacteria, which convert non-available phosphate into insoluble organic phosphates that are easily available to the plant.

Table 4.1: List of Microbial Inoculant

Saprophytes	**Trichoderma viz**
Legume inoculant	Rhizobium
Plant associated	Azosprillum
Free-living organism	Azotobactor
Blue-green algae	Nastac, Anabaena
Free water fern	Azolla
Phosphorous solubilizer	Pseudomonas, Aspergillus, Bacillus Penicillium
Ecotrophic mycorrhizae	Basidiomycetes
Endotrophic	Glomus, Gigaspore

4.3 Traditional Farming Techniques: Modern Organic Methods:

Rishi Krishi Method: In India, farmers have mastered the **Rishi Krishi** method of natural farming. This method involves using all on-farm nutrient sources, such as composts, cattle dung manure, green leaf manure, and crop biomass for mulching. The soil is enriched using a Rishi Krishi formulation known as Amritpani and virgin soil. This solution is used for seed treatment, soil enrichment, and plant foliar spray. It must be applied as fertigation through irrigation water for soil treatment. The system has been demonstrated on a wide range of crops, including fruits and vegetables, cereals, pulses, oilseeds, sugarcane, and cotton.

Table 4.2: Composition of Rishi Krishi

Ghee	250 g
Cow dung	10 Kg
Honey	500 g
Water	200 lit

Natural farming method: Natural farming is a method that focuses on maximizing the soil's biological activity. It achieves this by making optimal use of on-farm biological resources and enriching the soil with Jivamruta. The package outlined above includes two important components that are crucial to natural farming. The first component is Bijamruta, which is used for treating seed and planting material. The second component is Jivamruta, which is used for soil treatment and foliar spray. Jivamruta is rich in various helpful microorganisms, as confirmed by tests conducted by Bio Centre Bangalore.

Table 4.3: Bacteria used in making natural farming.

Azospirillum	$2x10^6$
PSM	$2x\ 10^6$
Pseudomonas	$2x\ 10^2$

Trichoderma	2×10^6
Yeasts and moulds	2×10^7

For the application of one acre, 200 liters of jivamruta are required. It can be applied by drenching mulches spread over the field or under the tree basin with irrigation water, whether by flow, drip, or sprinkler.

Natueco Farming system: Natueco Farming is a farming system that adheres to the principles of natural eco-system networking. It goes beyond the broader concepts of organic or natural farming and provides an alternative to modern farming's commercial and heavily chemicalized methods. The focus is on the simple harvesting of sunlight through the critical application of scientific examination, experiments, and methods based on local resources. It is dependent on gaining a thorough understanding of plant physiology, growth geometry, fertility, and biochemistry. This is easily accomplished by understanding Natueco Farming Science.

Natueco farming methods are different from natural farming and organic farming. Natural farming is done by trusting nature through empirical wisdom accumulated over time. Natueco methods, on the other hand, emphasize farming by learning more about nature through critical scientific inquiries and experiments. It is an ever-expanding, novel, one-of-a-kind, participatory tryst between man and nature. Natueco Farming has nothing to do with current commercial farming techniques. It has a new vision of infinite resource potentials in Nature and sunlight, and it promises plenty for all by increasing human activity and harvesting all available resources. This is dependent on a critical understanding of greening and recycling of biomass within the neighborhood to systematically enrich the structure and fertility of the soil. It guarantees record yields with mathematical precision by understanding plant geometry, growth cycles, and canopy (leaf area) management with little or no external inputs and ensuring optimal sunlight harvesting. It depicts how, in the near future, the current money market system will have to give way to a new eco-economic system of Nature, namely the energy market system.

Natueco Farming emphasizes "Neighborhood Resource Enrichment" through "Additive Regeneration" rather than reliance on external, commercial inputs. It has three important aspects: (a) Soil-enrichment through biomass recycling via an appropriate energy chain, (b) Roots-Establishment, and maintenance of white feeder root zones for efficient nutrient absorption, and (c) Canopy-Using proper canopy management to harvest the sun for efficient photosynthesis.

Homa Farming method: Homa Farming is a farming system with roots in the Vedas. It is based on the principle that if you heal the atmosphere, the atmosphere will heal you. Homa farming practitioners and propagators refer to it as a "revealed science" because it is an entirely spiritual practice that dates back to the Vedic period. The chanting of Sanskrit mantras (Agnihotra puja) at specific times of the day before a holy fire is the foundation of Homa farming. The importance of timing cannot be overstated. Homa farming is not associated with any specific agricultural practice. It energizes and awakens the farm and household where it is practiced. The puja ash is used to energize composts, plants, and animals, among other things. Homa Organic Farming is a holistic agriculture healing system

that can be used in conjunction with any good organic farming system. It is extremely inexpensive and simple to implement, but it requires discipline and consistency. The fundamental Homa fire technique, Agnihotra, is based on the bio-rhythm of sunrise and sunset and can be found in the ancient Vedic sciences. Agnihotra has been simplified and modernized so that it may be performed by anyone. During Agnihotra, a particular mantra (word-tone combination) is recited as dried cow dung, ghee (clarified butter), and brown rice are burned in an inverted, pyramid-shaped copper vessel. It is widely thought that burning organic materials in a pyramid-shaped copper kettle produces valuable purifying and balancing energies. These are released into the atmosphere and are also found in the ash that remains. This highly electrified ash can be utilized as an organic fertilizer in organic gardening with great effectiveness.

Farmers use various methods to prepare liquid manure for disease control and treatment. Here are some key points:

Sanjivak: Combine 100 kilograms of cow dung, 100 kilograms of cow urine, and 500 grams of jaggery in a 500-liter closed barrel. Let it ferment for 10 days. Dilute the mixture with water 20 times and apply it to one acre as a soil spray or with irrigation water.

Jivamrut: Combine 180 kilograms of cow dung, 5 liters of cow urine, 1 kilogram of jaggery, 1 kilogram of any pulse grain flour, and 200 grams of forest soil. Let it ferment for 5-7 days. After 3 days of irrigation, use 1 quintal of prepared jivamrut for one acre.

Figure 4.1: Composition of Jivamrut Composition: cow dung 180 kg+ cow urine 5 lit + Jiggery 1 kg + pulse grain flour 1 kg +forest soil 200 gm.

Amrit Pani: Combine 10 kg cow dung and 500 g honey in a mixing bowl and thoroughly combine to produce a creamy paste. Mix in 250 g of cow desi ghee at high speed. 200 lit water to dilute Sprinkle one acre of this suspension over soil or with irrigation water. Apply the second dose after 30 days in between the rows of plants or through irrigation water.

Bijamrut: To extract the soluble elements of dung, place 5 kg of fresh cow dung in a cloth bag and suspend it in a container filled with water. Separately, dissolve 50 g lime in 1 lit water. Squeeze the bag to collect the extract after 12-16 hours and add 5 lit cow urine. Lime water, 50 g virgin forest soil, 20 lit water. Incubate for 8-12 hours. Filter the contents. The filtrate is used to treatment for seeds.

Dashparni extract:

Table 4.4: Formation of dashparni extract

Crush the following plant parts in a 500-lit drum	
Neem Leave	5 Kg
Vitex negundo ieave	2 Kg
Aristolocnia Leav	2 Kg
Papaya (carica Fapaya	2 Kg
Tinospora cordifoila leaves	2 Kg
Annona squamosa (Custard apple) leaves	2 Kg
Nerium Indicum	2 Kg
Calotropis Procera leaves	2 Kg
Green Chili paste	2 Kg
Garlic pastes	250 gm
Cow dung	3 Kg
Cow Urine Water	5 lit 200lit

Panchgavya: 5 kg cow dung, 3 lit cow pee, 2 lit cow milk, 2 lit curd, 1 kg cow butter oil Combine all ingredients thoroughly and ferment for 7 days, stirring twice daily. Spray 3 litres of Panchgavya with 100 litres of water over the soil. For soil application, 20 lit panchgavya and irrigation water are required per acre. Seed treatment can also be done with Panchgavya. Before sowing, soak the seeds for 20 minutes. Panchgavya is produced at a cost of around Rs. 25-35 per lit. Panchgavya contains a wide range of beneficial microorganisms, including fungus, bacteria, actinomycetes, and micronutrients. The mixture acts as a tonic, enriching the soil and encouraging plant vitality and high-quality produce. The strength of various microorganisms detected in panchgavya are as follows:

Table 4.5: Composition of panchgavya

Panchgavya	
Cow dung slurry	5 kg
Fresh cow dung9	1 kg
Cow Urine	3 lit
Cow milk	2 lit
Curd	2 lit
Cow deshi ghee	1 kg

Table 4.6: Microorganism used.

Total fungi	38,800/ml
Total bacteria	1,880,000/ml
Lactobacillus	2,260,000/ml
Total anaerobes	10,000/ml
Acid formers	360/ml
Methanogens	250/ml

- **Neemastra:**

✓ Crush 5 kg neem leaves in water
✓ Add 5 lit cow urine and 2 kg cow dung
✓ Ferment for 24 hrs with intermittent stirring
✓ Filter squeeze the extract and dilute to 100 lit
✓ Use as foliar spray over one acre
✓ Useful against sucking pests and mealy bugs

Figure 4.2: Material used in neemastra

- **Brahmastra:**

✓ Crush 3 kg neem leaves in 10 lit cow urine
✓ Crush 2 kg custard apple leat, 2 kg papaya leaf, 2kg pomegranate leaves, 2 Kg guava leaves in water.
✓ Mix the two and boil 5 times at some interval till it becomes halt
✓ Keep for 24 hrs, then filter and squeeze the extract. This can be stored in bottles for 6 months
✓ Useful against sucking pests, pod/fruit borers.
✓ Dilute 2-2.5 lit of this extract to 100 it for 1 acre.

Figure 4.3: Ingredients used in Brahmastra

- **Agneyastra:**

✓ Crush 1 kg lpomea (besaram) leaves, 500 gm hot chilli, 500 gm garlic and 5 Kg neem leaves in 10 lit cow urine.
✓ Boil the suspension 5 times till it becomes half.
✓ Filter squeezes the extract.
✓ Store in glass or plastic bottles
✓ Useful against leaf roller, stem/fruit/pod borer
✓ 2-3 lit extract diluted to 100 lit is used for one acre.

4.4 Present Status of Organic Farming in India:

Present data reveal that India secure 8th in world for organic land and secure 1st rank for total organic production. (Source: FIBL & IFOAM book published in 2020).

Data is available for organic farming, organic production state, organic product and export of organic position in India.

Organic certified area under NPOP in India	**Organic status**
Total Organic certified cover area Cultivated certified area Wild certified area	4339184.93 ha (2020-21) 265788.33ha 1681295.61 ha
Highest organic certified producer State	Madhya Pradesh followed by Rajasthan, Maharashtra, Chhattisgarh, Himachal Pradesh, Jammu & Kashmir and Karnataka.

Organic certified area under NPOP in India	Organic status
	In 2016 Sikkim also achieved 75000 ha area under certified organic cultivation land.
Total Organic production	Approximate 3496801.34 MT (2020-21)
Highest Product produce under certified organic	Sugarcane, fiber, Tea, coffee, cotton fiber, millets, cereal, pulses, fruits, spices, oil seeds, fodder & fiber crops, dry fruits, medicinal and aromatic crops.
Total quantity export of Organic product from India	888178.60 MT (2020-21)
Total gross received by export of Organic product	707849.52 Lakhs
Organic products are export to countries	USA, Israel, Switzerland, Great Britain, Korea Republic, Australia etc.

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4.5 India's Certification Agencies:

A. Governmental Organizations:

- Coffee Board
- Tea Board

- Spices Board
- Coconut Board
- Cocoa & Cashewnut Development Board

B. Private Agencies:

- ECOCERT: International (Based in France and Germany branch office in Aurangabad, Maharashtra).
- IMO Control Pvt. Ltd. -Institute for Market ology (based in Switzerland, office in Bengaluru, Karnataka).
- LACON Gmbh (based in Germany, office in Aluva, Kerala).
- SGS India Pvt. Ltd. (based in Switzerland, office in Delhi and other cities).
- BIOINSPECTA (based in Switzerland, branch office in Cochin, Kerala) SGS India Pvt. Ltd. (based in India, office in Bengaluru).
- APOF Organic Certification Agency (AOCA) (based in India, office in Gurgaon, Haryana) SKAL International (based in Netherlands, branch office in Mumbai).
- INDOCERT (based in India, office in Aluva, Kerala) India Society for certification (ISCOP) (based in India, office in Coimbatore).
- All the above certification bodies are accredited under NPOP.

4.6 Future Prospectuses:

According to the calculation in upcoming years organic product feeding more than 1.5 billion people by 2030.

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