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AI3019

SUSTAINABLE AGRICULTURE AND FOOD SECURITY

UNIT 3
ORGANIC FARMING

Challenges	Sustainable Solutions
Unpredictable rainfall	Rainwater harvesting, soil moisture conservation
Soil degradation	Organic matter addition, cover cropping, agroforestry
Low productivity	Drought-resistant crops, crop diversification
Pest & disease outbreaks	Integrated Pest Management (IPM), biodiversity conservation
Limited farmer knowledge	Training programs, farmer cooperatives

Organic farming:

Organic farming refers to organically grown crops which are not exposed to any chemicals right from the stage of seed treatments to the final post harvest handling and processing.

Importance of Organic Farming

The agriculture today in the country is hampered by erosion of natural resources viz., land, water, biodiversity, fast declining soil fertility and use efficiency of inputs, such as water, fertilizer and energy. Demographic pressure accelerates the former and the faulty agronomic practices account for the latter problems. The modern agriculture with its potential takes the country out of the food trap and to reach an era of self sufficiency in food grain production.

The present day for self sufficiency in food grain production may not last longer unless we develop a sustainable agricultural system which maintains and /or improves soil fertility and productivity with greater acceptance of biological principles so as to assure adequate/more food production in future. Besides plants are more prone to pest and diseases in intensive agriculture, use of chemicals can have residues on the produce, in the soil and in ground water. With more of purchased inputs cost of production is also mounting up. Pesticides use in paddy, cotton and vegetables which occupy less than 30 per cent of total area account for more than 80 per cent of the chemicals used. Organic farming practices that reduces the pressure on land, water and bio-diversity without adverse effects on agricultural production and nutritive value of food comprise, judicious use of organic manure, viz. farm yard manure, compost, crop resides, Vermicompost etc. integrated is an efficient nutrient management practices, cropping systems, conjunctive use of rain, tank and underground water, integrated pest management and

conservation of genetic resources. Among them, soil fertility is give top attention due to its dynamic action with various physical, chemical and biological properties. Besides this, following advantages derived from organic farming.

Advantages of organic farming

1. Organic manures produce optimal conditions in the soil for high yields and good quality crops.

2. They supply all the nutrients required by the plant (NPK, secondary and micronutrients).

3. They improve plant growth and physiological activities of plants.

4. They improve the soil physical properties such as granulation and tilth, giving good aeration, easy root penetration and improved water holding capacity. The fibrous portion of the organic matter with its high carbon content promotes soil aggregation to improve the permeability and aeration of clay soils while its ability to absorb moisture helps in the granulation of sandy soils and improves their water holding capacity. The carbon in the organic matter is the source of energy for microbes which helps in aggregation.

5. They improve the soil chemical properties such as supply and retention of soil nutrients and promote favourable chemical reactions.

6. They reduce the need for purchased inputs.

7. Most of the organic manures are wastes or byproducts which on accumulation may lead to pollution. By way of utilizing them for organic farming, pollution is minimized.

8. Organic fertilizers are considered as complete plant food. Organic matter restores the pH of the soil which may become acidic due to continuous application of chemical fertilizers.

9. Organically grown crops are believed to provide healthier and nutritionally superior food for man and animals than those grown with commercial fertilizers.

10. Organically grown plants are more resistant to disease and insects and hence only a few chemical sprays or other protective treatments are required.

Disadvantages of organic farming.

1. Small holding: The average size of an operational holding is 1.57 ha and further decreasing gradually due to population pressure.

2. Poor infrastructure facilities: i.e. lack of sufficient soil testing laboratories.

3. Lack of technological knowledge, lack of knowledge for use of bio-fertilizers, bio-pesticides, bio control, IPM and INM etc.

4. Organic farming takes four years for a farmer to free his land completely stopping the use of chemical as nutrients & crop savers.

5. The neighbouring farmers do not well co-operate regarding use of fertilizer, pesticides, weedicides etc.

6. Decrease in production of high yielding crops like rice, wheat which needs high fertility status to get potential yield.

7. The competitive uses of organic materials such as dung-cakes for domestic cook fuel in villages and bagasse as fuel in sugar factories & villages.

8. Wheat & rice straws are disposed by burning, instead of return to the soil.

9. Dung, slurry & pig manure and other waste used directly in the field (without compositing), which damage the crop & pollute the ground water.

10. Most of organic material is bulky in nature, hence very difficult to store, carry and use.

11. Sewage, sludge contains pathogens and, some of them survive more than six months, which may hazard the human life and prove fatal for the animal .

12. City garbage contains un-decomposed materials such as metal, plastic, glass, stones, needles etc. which causes many problems,

13. Bio control agents are available only for few selected insect pests.

14. Complicated organic certification process and also high cost of certification.

Objectives of Organic Farming

The objectives of organic agriculture have been expressed in the standard document of the International Federation of Organic Agriculture Movement (IFOAM) as follows:

1. To produce food of high nutritional quality in sufficient quantity.

2. To work with natural systems rather than seeking to dominate them.

3. To encourage and enhance the biological cycles within farming system involving microorganisms, soil flora and fauna, plants and animals.

4. To maintain and increase the long term fertility of soils.

5. To use, as far as possible, renewable resources in locally organized agricultural systems.

6. To work as much as possible, within a closed system with regard to organic matter and nutrient elements.

7. To given all livestock, conditions of life that allow them to perform all aspects of their innate behavior.

8. To avoid all forms of pollution that result from agricultural techniques.

9. To maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats.

10. To allow agricultural producers for adequate return and satisfaction from their work including a safe working environment.

Principles and practices of Organic Farming

The International Federation for Organic Agriculture Movement's (IFOAM) definition of organic farming is based on:

1. The Principle of Health.

2. The Principle of Ecology.

3. The Principle of Fairness.

4. The Principle of Care.

The principle of health

Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. This principle points out that the health of indivisibles and communities cannot be separated from the health of ecosystems – healthy soils produce healthy crops that foster the health of animals and people. Health is the wholeness and integrity of living systems. It is not simply the absence of illness, but the maintenance of physical, mental,

social and ecological well-being. Immunity, resilience and regeneration are key characteristics of health. 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.

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 farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature. These cycles are universal but their operation is site-specific. Organic management must be adapted to local conditions, ecology, culture and scale. Inputs should be reduced by reuse, recycling and efficient management of materials and energy in order to maintain or improve environmental quality and conserve resources. Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and agriculture diversity. Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, bio-diversity, air and water.

The principle of fairness

Organic agriculture should build up relationship that ensures 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.

The principle of care

This principle states that precaution and responsibilities are the key concerns in management, development and technology choices in organic agriculture. Science is necessary to ensure that organic agriculture is healthy, safe and ecologically sound. However, scientific knowledge

alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions, tested by time.

Practices of Organic farming:

1. Crop Rotation

Crop rotation is a system of growing different kinds of crops in recurrent succession on the same land.

2. Green Manures and Cover Crops

Green manures and cover crops are grown primarily for reasons other than short-term economic gain. In other words, they are not produced for sale, but rather for the benefits they provide to the production of subsequent cash crops. Cover crops are so-called because they protect otherwise bare soil against erosion; green manures improve soil fertility. Because a cover crop is inevitably added to the soil, it becomes a green manure, so the terms are reasonably interchangeable.

3. Manuring and Composting

Manure and compost not only supply many nutrients for crop production, including micronutrients, but they are also valuable sources of organic matter.

4. Intercropping and Companion Planting

Intercropping is the growing of two or more crops in close proximity to promote beneficial interactions. Companion planting refers to the establishment of two or more species in close proximity so that some cultural benefit, such as pest control or increased yield, may be achieved between them.

5. Biological Pest Control

Biological pest control is the use of one or more beneficial organisms, usually called natural enemies, to reduce the numbers of another type of organism, the pest.

6. Sanitation

Sanitation can take on many forms including removal, burning, or deep plowing of crop residues that could carry plant disease or insect pest agents, the destruction of nearby weedy

habitats that shelter pests, cleaning accumulated weed seeds from farm equipment before entering a new, and sterilizing pruning tools.

7.Conservational Tillage

Merely maintaining soil organic matter levels is difficult if soil is intensively tilled (such as with annual use of a moldboard plow.) Reducing tillage means leaving more residue, and tilling less often and less intensively than conventional tillage. No-till is the most extreme version of reduced tillage, but is not desirable on some soils and is not the only way to conserve soil organic matter.

8.Mulching

Organic mulches, such as straw or spoiled hay, can reduce the need for cultivation, protect soil from erosion and crusting, and replenish organic matter.

9. Supplemental Fertilization

Organic farming management relies on developing biological diversity in the field to disrupt habitat for pest organisms, and the purposeful maintenance and replenishment of soil fertility. Organic farmers are not allowed to use synthetic pesticides or fertilizers.

Role of different sources for biological INM

ORGANIC MANURES

Term 'manure' was used originally for denoting materials like cattle manure and other bulky natural substances that were applied to land, with the object of increasing the production of crops. Therefore, manures are defined as the plant and animal wastes which are used as sources of plant nutrients.

Urine is normally low in phosphorus and high in potash, where as about equal parts of nitrogen may be excreted in faeces and urine of the cattle. Hence the manure in which the proportion of the urine was allowed to drain away would be relatively low in N and K. Poultry manure is very important for organic farming due to there will be no loss of urine, since both liquid & solid portions are excreted together.

Fresh poultry manure creates local alkalinity, it may hamper the standing crop. Therefore, it is recommended to preserve the excreta at least for six months with suitable amendments and appropriate microbes.

ADVANTAGES OF MANURING

- Manures supply plant nutrients including micro nutrients
- They improve soil physical properties
- Increase nutrient availability
- Provide food for soil micro organisms
- Provide buffering action in soil reaction
- Improve soil tilth, aeration and WHC of the soil

On the basis of concentration of nutrients, manures can be grouped into two categories-

(A) Bulky organic manures

Contain small percentage of nutrients and they applied in large quantities like FYM, compost, green manure, biogas slurry, night soil, sewage and sludge, poultry manure, sheep & goat manure, animal waste, crop residue etc.

A.1 FARM YARD MANURE (FYM)

Most commonly used organic manure in India. It refers to the decomposed mixture of dung and urine of farm animals along with litter and left over materials from roughages or fodder

fed to the animals. It contains 0.5% N, 0.2% P2O5 and 0.5% K2O. Urine contains 1% N and 1.35% K2O. Litter is the straw, peat, sawdust and dry leaves used as bedding material for farm animals and birds. The N present in urine is mostly in the form of urea which is subjected to volatilization losses. Chemical preservatives are used to reduce losses and enrich FYM e.g. gypsum, kainite and super phosphate.

These preservatives absorb urine and prevent volatilization loss of urea and also add nutrients.

A.2 COMPOST

Compost means 'a product obtained by the controlled decomposition of organic wastes (composting), finally used as organic manure'. Composting is the process of reducing animal and vegetable refuse (except dung) to a quickly utilizable condition for improving and maintaining soil fertility. The final well decomposed manure having lower C: N ratio is termed as 'compost'. The recycling of organic materials by biological decomposition as manure is very important for organic farming as it kills weed seeds, pathogenic organisms, and dispose off agricultural / industrial wastes to produce a uniform, slow release organic fertilizer which stimulates soils life, improve soil structure and control insect pests and diseases. Compost contains 0.5-0.15-0.5 N,P,K, respectively.

A.3 BIOGAS SLURRY

Instead of directly using the animal dung for composting it can be used for production of biogas by feeding through Biogas Plants. It contains (1–1.8% N, 0.4–0.9% P2O5 and 0.6-1% K2O) due to low volatilization losses of ammonia.

A.4 NIGHT SOIL (Poudrette)

Night soil is human excreta, both solid and liquid. It contains 5.5% N, 4% P2O5 and 2% K2O. The dehydration of night soil, as such or after admixture with absorbing materials like soil, ash, charcoal and sawdust produces a poudrette that can be used easily as manure. Poudrette contains about 1.32% N, 2.8% P2O5 and 4.1% K2O.

A.5 SEWAGE AND SLUDGE

1.1.1 The solid portion in the sewage (human excreta + water) is called sludge and liquid portion is sewage water. It can be recycled for crop fertilization, irrigation to the crop, aquaculture production, application to forest land, biogas production and land reclamation. It was estimated that total waste generated by 217 million people in urban areas is 39 mt/ year

(2001). The total NPK content of this would be 2.5 lac tone of N, 2.6 lac tone of P and 2.6 lac tone of K. Both the components are separated and are given a preliminary fermentation and oxidation treatments to reduce bacterial contamination and offensive smell, otherwise soil quickly becomes "sewage sick" owing to the mechanical clogging by colloidal matter in the sewage and the development of anaerobic organisms which not only reduce the nitrate already present in the soil but also produce alkalinity. These defects can be removed by thoroughly aerating the sewage in the settling tank by blowing air through it. The sludge that settles at the bottom in this process is called "activated sludge" (3.6% N, 2% P2O5 & 1% K2O).

A.6 SHEEP & GOAT MANURE

The droppings of sheep and goat contain higher nutrients than FYM and compost. On an average, the manure contains 3% N, 1% P2O5 & 2%K2O). It is applied to the field in two ways- i) Sweeping of sheep and goat sheds are placed in pits for decomposition and it is applied later to the field. ii) Sheep penning- wherein sheep and goats are allowed to stay over night in the field and urine and faecal matter is added to soil.

A.7 POULTRY MANURE

Poultry manure can supply higher N and P to the soil than other bulky organic manures. The average nutrient content is 2.87% N, 2.93% P2O5 & 2.35% K2O.

A.8 GREEN MANURING

Green un-decomposed plant material used as manure is called green manure. By growing green

manure crops (usually leguminous crops) are grown in the field and incorporating it in its green stage in the same field is called green manuring. It adds organic matter and nitrogen to the soil. On an average green manuring gives 60-80 kg N/ha.

(B) Concentrated organic manures

These have required in small quantities and contain higher nutrients as compared to bulky organic manures. The most commonly used are oil cakes, fish meal, meat meal, blood meal, horn & hoof meal, bird guano, raw bone meal etc. which act a good source of organic manures for organic farming system.

B.1 OIL CAKES

Oil cakes are generally grouped into two groups, viz., edible oil cakes suitable for feeding the cattle and other domestic animals and non-edible oil cakes exclusively used as manure due to their higher content of plant nutrients. It has been estimated that India produced about 2.5 million tones of oil cakes annually.

Non-edible oil cakes are used as manure especially for horticultural crops. Nutrient present in oil cakes, after mineralization, are made available to crops 7-10 days after application. Oil seed cakes need to be well powdered before application for even distribution and quicker decomposition. Neem cake acts as Nitrification Inhibitor.

Average nutrient content of different oil cakes

Oil cakes	**Per cent composition**		
	N%	**P%**	**K%**
Edible oil cakes (feed for livestock)			
Safflower (decorticated)	7.9	2.2	1.9
Groundnut	7.3	1.5	1.3
Cotton seed (decorticated)	6.5	2.9	2.2
Non-edible oil cakes (not fed to livestock)			
Safflower (un-decorticated)	4.9	1.4	1.2
Cotton seed (un-decorticated)	3.9	1.8	1.6
Caster	4.3	1.8	1.3
Neem	5.2	1.0	1.4

B.2 FISH MEAL

Sea food canning industries are present in almost all coastal states of India, Fishes which is not preferred for table purposes due to their small size, bonny nature and poor taste can be converted into very good organic manure. The fish is dried, powdered and filled in bags. It contains average nutrients are 4-10, 3-9 & 0.3-1.5 NPK. These manures are highly suitable for fruit orchards and plantation crops.

B.3 MEAT MEAL

An adult animal can provide 35 to 45 kg of meat after slaughter or death. It contains 8-9% N and 7% P2O5.

B.4 BLOOD MEAL

Blood manure contain about 13-20%N, rich in Iron and its application gives a deep rich colour to foliage,.

B.5 HORN & HOOF MEAL

A healthy animal can give about 3 to 4 kg of horn and hoof. These materials are dried, powdered, bagged and marketed as manure. It contains 13% N.

B.6 GUANO (Bird / Fish)

The excreta and dead remains of the bird is called bird guano (11-14% N & 2-3% P2O5) and the refuse left over after the extraction of oil from the fish in factories, dried in cemented yards and used as manure is called as fish guano (7% N & 8% P2O5).

B.7 RAW BONE MEAL

An excellent source of organic phosphorus. It contains 3 to 4% N and 20 to 25% P2O5.

VERMICOMPOSTING

Definition: The process of composting organic wastes through domesticated earthworms under

controlled conditions is vermicomposting. arthworms have tremendous ability to compost all biodegradable materials. Waste subjected to earthworm consumption decompose 2 to 5 times faster than in conventional composting. During composting the wastes are deodorized, pathogenic micro-organisms are destroyed and 40 to 60 % volume reduction in organic wastes take place. It is estimated that the earthworms feed about 4 to 5 time their own weight of material daily.

Earthworms bears both male and female reproductive organs. However, two worms are needed for successful copulation. The self fertilization does not occur generally in the earthworms. Fertilization take place in the egg case or cocoon.

Earthworm species such as *Eisenia foetida, Eudrilus eugeniae, Lumbricus rubellus, L. mauritee* and

Perionix excavatus have been recommended for vermiculture technology. Vermicompost is the compost which is prepared by earthworms. It is a mixture of worm casting (faecal excretions) organic materials including humus, live earthworms, their cocoons and other micro organisms.

Vermiculture : It is the process of rearing and breeding of earthworms in controlled condition and presently it is known as earthworm biotechnology. It is estimated that 1800 worms which is an ideal population for one sq. meter can feed on 80 tonnes of humus per year. Faecal matter or excretions of earthworms is known as vermin cast. Vermi wash is a liquid fertilizer collected after the passage of water through a column of worm activation, which is useful for foliar spray. It may be diluted with water before use. It can also be diluted with 10% urine of cow. The average nutrient content of vermicompost is about 0.5 to 0.9- 0.1 to 0.2- 0.67 % N,P,K respectively.

VERMIWASH – A liquid manure: It is a transparent pale yellow coloured fluid collected after the passage of water through a column of worm action or it a collection of excretory products and mucus secretions of earthworm along with nutrients from the soil organic molecules. It is very useful as a foliar spray to enhance the plant growth and yield and to check development of diseases.

BENEFITS OF VERMICOMPOST

1. When added to clay soil, loosens the soil and provides the passage for the entry of air.

2. The mucus associated with it being hygroscopic, absorbs water and prevents water logging and improves water holding capacity.

3. In the vermicompost, some of the secretions of worms and the associated microbes act as growth promoter along with other nutrients.

4. It improves physical, chemecal and biological properties of soil in the long run on repeated application

5. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb these nutrients.

6. The multifarious effects of vermicompost influence the growth and yield of crops.