Chapter–2

The Concept

Concept is the building blocks for any research construct and process._If concepts move in a wrong direction, every subsequent components go disastrous. So, concept is the protein for creating life in a research process......concepts breed on hypothesis, axioms, methodology and of course, the basic analytical elements of the entire research work...............

2.1: Organic Farming: The Meaning

In today's terminology it is a method of farming system which primarily aims at cultivating the land and raising crops in such a way as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio fertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment.

In another definition FAO suggested that "organic agriculture is a unique production management system which promotes and enhances agro-eco system health, including biodiversity biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs"

ISBN: 978-93-85822-12-4

In philosophical terms organic farming means “farming in spirits of organic relationship.in this system everything is connected with everything else. Since organic farming means placing farming on integral relationship, we should be well aware about the relationship between the soil, water and plants, between soil microbes and waste products, between the vegetable kingdom and the animal kingdom of which the apex animal is the human being, between the agriculture and forestry, between soil, water and atmosphere etc, it is the totality of these relationships that is the bed rock of organic farming.

The most widely recognized alternative farming system. Modern organic farming evolved as an alternative to chemical agriculture in the 1940s, largely in response to the publications of J.I.Rodale in the U.S., lady Eve Balfour in England, and sir Albert howard in India.

In 1980, USDA released a landmark report on organic farming as :

Organic farming is a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives.To the maximum extent feasible ,organic farming system rely upon crop rotation ,crop residues ,animal manures ,off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth ,to supply plant nutrients ,and to control insects ,weeds ,and other pests.

2.2: Organic Farming: The Concept

Organic farming is very much native to this land. Whosoever tries to write a history of organic farming will have to refer India and China. The farmers of these two countries are farmers of 40centuries and it is organic farming that sustained them.

This concept of organic farming is based on following principle-

- Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water
- The entire system is based on intimate understanding of nature's ways. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way for today's needs.
- The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured at all cost
- The total environment of the soil, from soil structure to soil cover is more important.

Organic farming is a form of agriculture that avoids or excludes the use of synthetic fertilizer and pesticides, plant growth regulators and livestock feed additives.Organic farming is also known as ecological farming in many countries.it reflects the reliance on the ecological system management instead of external inputs whether chemical or organic. The role of organic agriculture is to sustain and enhance the health of ecosystem and organism from the smallest soil to human beings.The main aim of organic farming is to enhance the soil health.organic farmer usually use various method of organic farming.this include the crop rotation, crop residues, animal manures, green manures ,cover cropping, application of compost ,mulching and mechanical cultivation.

ISBN: 978-93-85822-12-4

The organic farmer use certain processed fertilizer like seed meal, and various mineral powders such as greensand and rock phosphate.These methods help in maintaining the soil productivity and to supply the plant nutrients and to control weeds ,insects and other pests.

Organic farming is helpful in creating integrated, humane, environmentally and economically sustainable agriculture production systems. The maximum reliance is placed on locally or farm –derived renewable resources and the management of self-regulating ecological and biological processes and interaction to provide the acceptable levels of the crop, livestock, and human nutrition, protection from the pests and diseases, and appropriate return to the human and other resources employed.

Organic pest control involves the cumulative effect of many techniques, including, the allowance for an acceptable level for the crop damage, encouraging or even introducing the beneficial organisms, careful crop selection and crop rotation.These types of techniques provide b benefit in addition to pest control–soil protection and improvement ,pollination, fertilization, season extension, water conservation.

2.3: Principles of Organic Farming

- Organic agriculture based on :
    1. The principle of health.
    2. The principle of ecology.
    3. The principle of fairness.
    4. The principle of care.

ISBN: 978-93-85822-12-4

- Each principle is articulated through a statement followed by an explanation. The principles are to be used as a whole. They are composed as ethical principles to inspire action

2.3a: 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 individuals and communities cannot be separated from the health of ecosystem–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. 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.

2.3b: 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 system.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 animal 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 condition, ecology, culture ,scale.Inputs should be reduce by reuse, recycling ,and efficient management of materials and energy in order to maintain and 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 agricultural diversity.Those that produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water.

2.3c: 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 principles 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.organic agriculture should provide everyone involved with a good quality of life, and contribute to food sovereignty and reduction of poverty.
- It aims to produce a sufficient supply of good quality food and other products
- This principle consists that animals should be provided with the conditions and opportunities of life that accord with their physiology, natural behaviour and well-being.
- Natural and environmental recourses that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations. Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social cost.

2.3d: 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.
- Organic agriculture is a living and dynamic system that responds to internal and external demand and conditions.practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the risk of jeopardizing health and well being.

ISBN: 978-93-85822-12-4

- Consequently, new technologies need to be assessed and existing methods reviewed.given the incomplete understanding of ecosystems and agriculture, care must be taken.
- This principle states that precaution and responsibility 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 offers valid solutions, tested by time. Organic agriculture should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering. Decisions should reflect the values and needs of all who might be affected, through transparent and participatory processes.

2.4: Component of Organic Farming

It involves certain principles and practices of healthy soil, plant and healthful food for human being and feed for animals. In the system, energies from cosmos, mother earth, cow and plants are systematically and synergistically harnessed. It is based on the knowledge at soil, plants, animals and men work together in one agricultural cycle.

2.4.1: Agronomic Practices

2.4.1a: Mulching : Mulching is the use of organic materials e.g. ajilla, grasses, leaf etc. (plastic mulch is expensive and non-biodegradable) to cover the soil, specially around plants to keep down evaporation and water loss, besides adding valuable nutrients to the soil as they decompose. Mulching is a regular process and does require some labour and plenty of organic material, but has excellent effects, including the growth of the soil fauna such as earthworms, preventing soil erosion to some extent and weed control.

2.4.1b: Green Manuring:

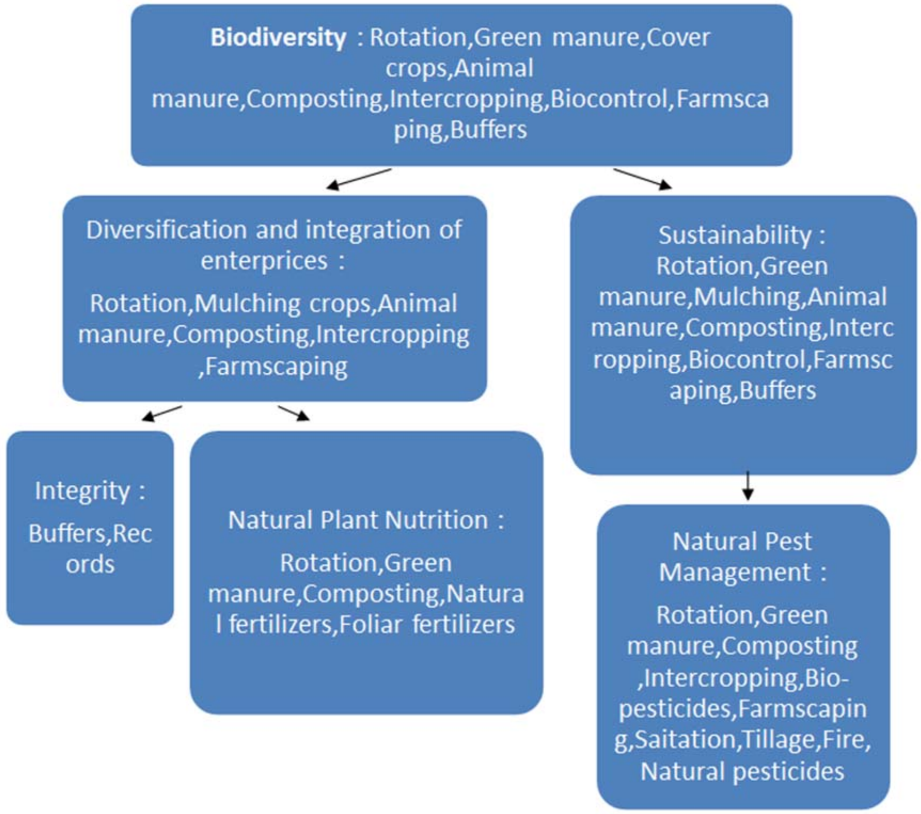
Green manuring is an old age practice prevalent since ancient times. A crop like dhaincha, sun hemp or horse bean is sown (usually) just before the monsoons. Just around flowering (30-40 days after sowing), the crop is cut down and mixed into the soil after which the season's main crop is sown. Green manuring is beneficial in two ways–firstly it fixes nitrogen, and secondly the addition of biomass (around five to ten tons/acre) greatly helps in improving the soil texture and water holding capacity.

Table 2.1: Nutrient potential of green manure crops

Green Manure Crops	Biomass (t/ha.)	N harvest (kg/ha)
Dhaincha (Sesbania aculeata)	22.50	125.0
Dhaincha (Sesbania rostrata)	20.06	146.0
Sunhemp (Crotolaria juncea)	18.40	113.0
Wild Indigo (Tephrosia purpurea)	6.80	6.0
Green gram (Vigna radiata)	6.50	60.2
Black gram (Vigna mungo)	5.12	51.0
Cow pea (Vigna umguiculata)	7.17	63.3

ISBN: 978-93-85822-12-4

Organic Crop Production (Principle and Practices)



2.4.1c: Cover cropping: Cover cropping is normally carried out also with nitrogen fixing crops that grow fast and require little or no inputs like water or additional manuring. While cover crops can yield some returns, they are mostly used for covering the soil in the fallow months, adding nitrogen to the soil, suppressing weeds, preventing soil erosion and latter used as a soil biomass or fodder. Velvet bean is an example, and it finds use as a fodder crop and biomass generator. Another useful cover crop is *Dolichos lablab* which is a source of fodder and food.

2.4.1d: Cropping System

- **Crop rotation** is the sequence of cropping where two dissimilar type of crops follow each other- a few examples include cereals and legumes, deep-rooted and short-rooted plants and where the second crop can make use of the manuring or irrigation provided some months earlier to the first crop (e.g. Rice + wheat, Rice + Cotton). The combinations possible are endless and will depend to a great deal on the local situations.
- **Multiple cropping** is the simultaneous cultivation of two crops. In Indian agricultural tradition, farmers have been known to show as many as 15 types of crops combination at one time. An example of multi cropping is Tomatoes + Onion + Marigold (where the marigolds repel some of tomato's pests).
- **Inter-cropping** is the cultivation of another crop in the spaces available between the main crops. A good example is the multi tier system of coconut + banana + pineapple/ ginger/ leguminous fodder / medicinal or aromatic plants. While ensuring bio-diversity within a farm, inter-cropping also allows for maximum use of resources.
- **Use of indigenous seeds**:

Indigenous or traditional seeds are more suitable to a particular region or situation than any hybrid variety because they are hardy, pest-resistant, withstand unfavourable conditions in the area of their origin, require less water and nutritional inputs, fit better in the organic method of farming and may even have special characteristics in term of nutrition, fragrance or colour. Many farmers save seeds selectively after seeing the vigour and growth of individual plants. This is an old tradition and needs to be continued.

- **Reduced tillage / Zero tillage:**

Reduced tillage or conservation tillage is a practice of minimizing soil disturbance and allowing crop residue or stubble to remain on the ground instead of being thrown away or incorporated into the soil. The zero tillage technique is practitioner in India, especially in Punjab, other northern or north-western states for the wheat crop. It is becoming popular because of the direct economic benefits it provides to the farmers. With less tilling, farmers save on machinery use, fuel, labour and time.

2.4.2. Enhancement of Soil Fertility:

2.4.2a: Composting: A huge quantity of crop wastes/residues and animal wastes are always available on a farm. The common practice is to burn plant wastes which, besides being an environmental disaster is also a waste of the huge potential of these residues. Properly recycled, residues from excellent compost in one to six months, depending upon the composting process used.

There are various types of compost viz. vermicompost, vermin -wash, Nadep compost and microbe mediated compost etc. used in organic farming (Pathak and Ram, 2004). Earthworms eat the FYM and break up the organic wastes resulting in a faecal matter known as vermin-compost. There are a no. of earthworms species viz. *Eudrilus eugeniae (Kinberg), Eisenia foetida (Savigny), Perionyx excavates (Periier), P. Sansbaricus, Lampito mauritii*

(Endogenic: Ground pits: TN), Octochaetona philloti (Michelson), O. Rosea (Stephenson) are used in preparation in vermicomposting. 'Nadep compost' is a method of aerobic composting, due to aerobic respiration, composting is fast and nutritional status of the compost is better than the ordinary compost (Pathak and Ram, 2004).

Table 2.2: A comparative account of nutrients and micro flora present in vermicompost and FYM

Parameters	FYM	Vermicompost
N (%)	0.3-0.6	1.8-2.0
P (%)	0.01-0.04	0.6-0.9
K (%)	0.3-0.5	1-1.6
Zn (ppm)	14.5	84.0
Cu (ppm)	42.8	61.5
Mn (ppm)	69.0	509.7
Fe (ppm)	1465.0	1247.3
Beneficial fungi (CFU/g * 105)	5.8	8.4
Beneficial bacteria (CFU/g *105)	0.05	0.25
Actinomycetes (CFU/g*105)	0.21	1.3
Azotobacter (CFU/g * 105)	2.45	10.2

2.4.2b. Microbial bio fertilizers: Microbial bio fertilizers are biologically active (living or temporarily inert) inputs and contain one or more types of beneficial micro-organisms such as bacteria, algae or fungi. Every microorganism having attributed of bio fertilizers has a specific capability and function. There are broadly seven types of bio fertilizers:

- **Rhizobia:** It is a group of bacteria that fixes nitrogen in association with the roots of leguminous crops. Rhizobia can fix 40-120 kg. of nitrogen per acre annually depending upon the crop, rhizobium species and environmental conditions. They help to improve the soil fertility, plant

ISBN: 978-93-85822-12-4

nutrition and plant growth and have no negative effect on soil and the environment. Every leguminous crop requires a specific rhizobium species.

- **Azotobacter:** Azotobacter is also a group of nitrogen fixing bacteria. They are free living nitrogen fixers and can be used for all types of upland crops but cannot survive in wetland conditions. In addition to nitrogen fixation, they also produce beneficial growth substances and beneficial antibiotics that help control root diseases.
- **Azospirillum:** These are live inside plant roots where they fix nitrogen and can be used in wetland conditions. This group of microorganism also produce beneficial substances for plant growth, besides fixing atmospheric nitrogen. Azospirillum does well in soils with high organic matter and high moisture content, and requires p^H 6.0.
- **Blue-green algae:** BGA or cyanobacteria are free living nitrogen fixing photosynthetic algae that are found in wet and marshy conditions. BGA are used only for rice cultivation when the field is flooded and don't survive in acidic soils. The best documented nitrogen fixing heterocyst forms commonly found in rice field are Anabaena, Nostoc, Cylindrospermum, Gloeotrichia, Scytonema, frequently observed particularly in soils fertilised with NPK fertiliser (Kaushik and Prasanna, 1998).
- **Azolla:** Azolla is a free floating water fern that fixes nitrogen in association with the specific species of cyanobacteria. It is a good source of nitrogen and also a source of various micronutrients. Its ability to multiply very fast resulting in reduction of weeds in (flooded) rice

fields. Azolla is also used as a green manure and a high quality feed for cattle and poultry.

- **Mycorrhiza:** Mycorrhiza is a sweeping term for a number of species of fungi which form a symbiotic association with plant root system. Of these, the most important in agriculture is vesicular- arbuscular mycorrhiza or VAM. Plants with VAM colonies are capable of higher uptakes of soil nutrients and water.VAM stand where the plant root system does not reach.
- **Phosphate solubilising microorganisms (PSM):** These are a group of bacteria and fungi capable of breaking down insoluble phosphates to make them available to crops. Field application of Phosphate-solubilising biofertilizer (PSB) alone or in combination with Glomus mosseae and G. fasciculatum increased the plant growth, nutrient uptake and yield in tissue cultured banana plants hardened with the same treatments (Soumya, 2000). In pomegranate, CV 'Ganesh', introduction of PSM increased the plant growth availability of P and fruit yield (Sukhada et al., 2000).
- Non-leguminous vegetable crops like onion, tomato, brinjal, capsicum and chillies have been found to be benefited by the inoculation of PSM (Patil and Madalgeri, 2002; Harikrishna et al. 2002). Tomato growth, yield and quality parameters such as TSS, ascorbic acid and lycopene contents are higher in plants grown with PSB and Azospirillium (Kumaran et al., 1998).

2.5: Status of organic farming

India has converted over 2.5 million hectares including 1.1 million ha of cultivable lands into organic.There has been consistent increase in the number of farmers adopting organic practices in the country every year. According to National Centre for Organic Farming (NCOF)–a body under the union ministry of Agriculture the area under organic cultivation is likely to cross 2 million hectare up to 2012 (Kulkarni 2003). In India, the domestic market for organic products is estimated at Rs 560 corer last year; the exports were in excess of Rs 250 crore.

Mainly three types of farmers are engaged in organic cultivation in India

i. Farmers who grow crops for their own consumption and mostly follow the indigenous knowledge and technologies.

ii. Farmer who cultivate crops to revive Vedic practices, compiled with Ayurvedic tradition of health system with scientific exposition.Some farmers also follow *biodynamic Agriculture*, *Nature farming ,Modern agronomic practices etc.*This categories of farmer export their goods and have market surplus

iii. Farmers who are influenced by the private companies and NGOs in response of market demand and have converted large scale of land under organic production system, such farmers are actively engaged in exports of organic products.

2.6: Aims of organic farming

2.6.1: A System approach: Organic agriculture is a holistic way of farming besides production of goods no high quality, an important aim is the conservation of the natural resources fertile soil, clean water and rich biodiversity. The art of organic farming is to make the best use of ecological principles and processes.

2.6.2: Recycling nutrients: Organic nutrient management is based on biodegradable material, i.e, plant and animal residues. Nutrient cycle are done by the help of composting, mulching, green manuring, crop rotation etc. Farm animals can play an important role in the nutrient cycle their dung is of high value and its use enables nutrients provided with the fodder to be recycled.if and gasification can be reduced to the minimum.this residues the dependency on external inputs and costs of cultivation.

2.6.3: Soil fertility: Soil and its fertility constitute the centre of the natural ecosystem. A more or less permanent soil cover prevents soil erosion and helps build up soil fertility. The continuous supply of organic material feeds a huge number of soil organisms and provides an ideal environment for them.As a result the soil becomes soft capable of nutrient uptake and maintains large quantities of nutrient a d water

2.6.4: Crop diversity: Organic farming increases biodiversity at every level of food chain all the way from bacteria to mammals.organic farm grows different crops including trees either in mixed cropping or in rotation. Animals are an integrated part of the farm system. The diversity of crops not only allows optimum use of the resources but also serves as an economic security in case of pest of disease attack or low market prices for certain crops.

2.6.5: Ecobalance and biocontrol: Organic farming practices keep pests and diseases at a level which does not cause economic damage.beneficial

ISBN: 978-93-85822-12-4

flora and fauna promoted by offering them a habitat and food.if pest increase critical levels, natural enemies and herbal preparation are used.

2.6.6: Back to nature: Organic farming aims at following the laws of nature. Within the organic movement one will find farmers who focus on natural farming and others who take a purely commercial approach. The majority of organic farmers probably lies somewhere in between these two extremes. Most farmers expect sufficient production from the farm for a healthy living.

2.6.7: Sustainability: Organic agriculture claims to be sustainable.in the context of agriculture, sustainability refers to the successful management of resources of agriculture to satisfy human needs while at the same time maintaining and enhance the quality of the environment and conserving natural resources. Sustainability in organic farming must therefore be seen in a holistic sense, which includes ecological, economical and social aspects.

2.6.7a: Ecological sustainability

- Recycling the nutrients instead of applying instead of applying external inputs.
- No chemicals pollution of soil, air and water.
- Promote biological diversity.
- Improve soil fertility and build up humus.
- Prevent soil erosion and compaction.
- Animal friendly husbandry.

2.6.7b: Social sustainability :

- Sufficient production for subsistence and sufficient income.
- A safe nutrition for the family with healthy food.
- Good working conditions for both man and woman.
- Build-up a local knowledge and relation.

2.6.7c: Economic sustainability:

- Satisfactory and reliable yields.
- Low cost on external inputs and investment.
- Crop diversification to improve income safety.
- Value addition through quality improvement and on farm processing.
- High efficiency to improve competitiveness.

2.7: Differences Between Chemical Farming and Organic Farming:

2.7.1: Soil Differences

Chemical Farming	Organic Farming
What is it? **Cultivation and production** (Nutrient, pest and disease management) of crops by inorganic chemical inputs.	What is it? **Cultivation and production** (Nutrient, pest and disease management) of crops by biodegradable organic inputs.
Against nature In chemically managed soil the plant nutrients are supplied only through inorganic source, without any organic carbon source to derive food. This ultimately deprives the soil eco-system of the growth medium.	**Harmony with nature** In an organic management, the focus is on food web relations and element cycling aiming o maximize the agro-ecosystem’s stability, sustainability and homeostasis (balanced equilibrium).

Blocks the microbial activity Due to the absence of the carbon source, microbial population trends to be less or sometimes NIL in soil.	**Increases the microbial life** Organics is the main source of nutrients. The soil microbes derive the food from the carboneous source and multiply and make the soil lively, also decompose the complex organic compounds presents in the added organics.
Soil structure is destroyed Non-availability of binding material of the soil particles results in disintegration and reduces the soil granulation. In the long run it may reduce the productive capacity of land to harbour the crops and become unfit for production.	**Soil structure improves** Stable organic resins (humus) results in organic residue decomposition imparts stability to soil aggregates and corrects the permeability i.e. crumb like structure. This structure facilitates the soil aeration, WHC, root penetration, while reducing the soil erosion by the aggregation of soil particles.
Soil becomes dead While chemical farming satisfies the crop nutrient requirements, it is not conducive for biological environment of the soil, finally resulting in a problematic soil loaded with inorganic salts.	**Soil becomes fertile** Here the biological properties of the soil are improved by addition of organic manure. Intensive biological activity promotes better symbiotic relationship between plant and soil focusing on sustainable plant production and nutrient management.
Alters the soil pH Continuous use of inorganic chemicals leads to changes in pH of the soil (either acidic or saline depending on the type of fertilizers used). It unbalances the nutrient availability status and in some cases creates toxicity to the plants.	**Buffering of soils (Enables neutral pH)** Presence of colloidal matter improves the buffering capacity of the soil and CEC. It regulates the nutrient availability due to buffering action, besides checking the toxicity levels to plants and soil microbes.

Nutrients are available only for shorter period Certain fertilizers in the absence of microbes permanently fix on to the soil particles and may not be available for the plant root absorption. In addition, the chemical fertilizers are easily water soluble and this may leads to various types of losses through leaching, evaporation etc.	**Nutrients are available for longer period** Microbes decompose the complex organic compounds to mineral components and CO2. Further mineral elements are converted to available plant nutrients through mineralization process. These ions are held by organic matter and soil colloids and are slowly released as nutrients over a longer period.
Leads to erosion Absence of the binding agents (organic substances) between soil particles makes the soil particles to be easily detached by water and wind. It leads to loss of top fertile soils ultimately making the land barren and unfit for farming/cultivation.	**Prevents the soil erosion** Organic soil management techniques such as organic fertilization, mulching and cover cropping increases aggregation (by organic acid), improves soil structure and therefore increases the soil's water infiltration and retention capacity, sustainability reducing the risk of erosion.
Accumulation of hazardous material in soil Over and abuse of chemical fertilizers (nitrate) and pesticides harm the biological life of the soil. The residues such as heavy metals present in the inorganic soils may pose serious health hazards. Excessive nutrient and salt application such as nitrate, causes ground water pollution, and may be linked to certain diseases in human beings.	**There is no hazardous material in soil** It does not leave any residues/hazardous materials in the soil since all input is biodegradable and non-toxic.

Quick lodging of crop Most of the nutrient is leached beyond the root zone and the crop might lose much of the needed nutrient for better root anchor. Similarly chemically managed soil doesn't provide much of the structure support to the crops. The combination of above leads to lodging of crops.	**Provide good anchorage to the crops** Physical (structure), chemical (nutrient transformation and mineralization) and biological activity (decomposition) favours the crop stand and growth. Liveliness of soil provides a good growth media and support to crop growth.
More chemical residue present in crops For managing fertility, pest and diseases large quantity of synthetic chemicals are used in crops. It does not metabolize properly and leaves residues as such in the end product it will reduce the quality of product and can turn into poison for consumption.	**No chemical residue present in crop** Only decomposable materials (organic manure and bio control agents) are used. It doesn't leave any harmful residue in the crop or the soil environment.
Crops are highly susceptible to pests and diseases Crops are in fleshy condition naturally inviting pest and diseases. A chemically grown crop doesn't have much resistant power against pest and diseases because of less cell wall thickness and low calcium and potassium absorption by plants.	**Protects from pest and diseases** Availability of much of calcium and potassium in organically managed soils improves the uptake in crops. It provides the natural resistance to crops against pest and diseases.
Harvested produce are in low quality The conversion of source to sink, non availability of nutrients especially potassium reduce the quality of the product.	**Premium quality** Nutrient availability in entire crop growth period increases up taking capacity and proper conversion of source to sink improves the keeping quality especially of fruits and vegetables.

2.7.2: Health/Social Differences:

Chemical Farming	Organic Farming
Cause pollution to the environment Chemically managed soils release the residue in soil and water environment leads to pollution. Sometimes it causes toxic effects to human environment.	**Pollution free approach** All practices are interrelated and the end product will be decomposable one, so there is no cause for environmental pollution.
Provide chemical mixed/toxic food to the human life Inorganic fertilizers (nitrogen) and pesticide (synthetic compound) does not decompose properly and leave residue in plant parts, when used as a feed material for animal and food for human beings may create a disease, and malformations.	**Provide nutritive food to the human life** In organic farming, ideal combination of agronomical, physical and biological measures bring down the population harmful microbes and don't release any residues in soil and crop environment. The plant parts from organically managed soils are intuitively rich and safe.
Causes inborn diseases to the human beings Presence of toxic substance in food materials alters the genetic characteristics of human beings. This genetic mutation causes several in borne disease to human beings.	**Provides immune power to the human beings** Crops are grown under balanced nutritive approach. Crops uptake nutrients as and when required in entire growing period and converts the absorbed nutrients properly in to sink. When the food materials from organically managed soil are consumed, natural immunity of the human beings is developed.

ISBN: 978-93-85822-12-4

High investments in inputs Inorganic inputs materials are costly and require much technical knowledge and investment to produce and handle.	**Low investments in inputs materials** Organic input materials are less costly source, readily available at the doorstep and very easy to apply.
Highly fluctuation in yield Fertilizer managed soil doesn't provide nutrient properly during the entire crop duration. The deficiency of one essential nutrient directly effects the growth and metabolism and acts as antagonistic to other nutrient absorption by crop resulting in fluctuation and loss in yield.	**Satisfactory and reliable yield** The nutrients are available in entire crop period in balanced way. It provides optimal environment to the crop growth and taps the full genetic potential of crops to provide satisfactory level yield and quality.
No strands to break competitiveness There is no difference in harvested product among the chemically managed farming; it reduces the offer in the competitive market. Products sold in low rate Chemical farming products are less keeping quality as well as low nutrient status. Therefore it offers low rate in the market.	**High efficiency to improve the competitiveness** The end product is superior in nutritive quality than chemical farming and gets higher offer in the competitive market offered premium price. Where as in organic farming products of potassium improves the keeping quality and also it have more nutritive value in balanced way (it offers much premium price in the market).

2.8: Organic Farming and Countries Food security

The primary concern of all organised communities and civilised societies is to meet the food requirements of its people. the cultivated area, required to maintain the present level of food grain production in India without using fertilizer ,reaches more than the total geographical area of the country.At present, there is a gap of nearly 10 million tonnes between annual addition and removal of nutrients by crops which are met by mining nutrients from

ISBN: 978-93-85822-12-4

soil. A negative balance of about 8 mt of NPK is foreseen in 2020, even if we continue to use chemical fertilizers, maintaining present growth rates of production and consumption.The most optimistic estimates at present shoe that only about 25-30% nutrient needs of Indian agriculture can be met by utilising various organic sources.It vis proved beyond doubt that on long–term basis, conjoint application of organic fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality and soil productivity.The organic sources should be used in integration with chemical fertilizers to narrow down the gap between addition and removal of nutrients by crops as well as to sustain soil quality achieve higher crop productivity. The food security demand of the country requires that inorganic fertilizer s be used in balanced doses.

Redefining the concept of organic farming in Indian context.

- Opportunities and constraints in organic agriculture.
- Organic agriculture perspective and future challenges.
- Soil quality, biodiversity and fertility in organic farming system.
- Standards in organic farming and quality markers for organic produce.
- Setting up of testing units for soil and organic produce for chemical residues.
- Setting up of testing units for soil and organic produce for chemical residues and quality control.
- Market development and assessment of organic produce for export.
- Evaluation of organic /biodynamic farming *vis-a-vis* integrated nutrient and pest management.

ISBN: 978-93-85822-12-4

- Documentation and confirmation of existing Indigenous Technological Knowledge on biodynamic farming.
- Development of bio control measures for various plant diseases and pests.
- Research agenda for comparing organic and conventional agriculture.
- Holistic approaches in organic farming research and development.

2.9: Fundamentals of organic agriculture

Organic agriculture is the oldest form of agriculture on earth. Farming without the use of petroleum-based chemicals (fertilizers and pesticides) was the sole option for farmers until after World War II. The war brought with it technologies that were useful to agricultural production. For example, ammonium nitrate used for munitions during World War II evolved into ammonium nitrate fertilizer; nerve gas production led to the organophosphate development of powerful insecticides. These technical advances since World War II have resulted in significant economic benefits as well as environmental and social detriments. Organic agriculture seeks to use those advances that consistently yield benefits, such as new varieties of crops, precision agriculture technologies, and more efficient machinery, while discarding those methods that have led to negative impacts on society and the environment, such as pesticide pollution and insect pest resistance. Organic farming is considered a systems approach, where interactions between components (crops, animals, insects, soil) are as important as the whole farm itself. Instead of using synthetic fertilizers, organic farmers use crop rotations, cover crops, and compost to maintain or enhance soil

ISBN: 978-93-85822-12-4

fertility. Also, instead of using synthetic pesticides, organic farmers employ biological, cultural, and physical methods to limit pest expansion and increase populations of beneficial insects. Genetically modified organisms (GMOs), such as herbicide resistant seeds and plants, as well as product ingredients, such as GM-lecithin, are disallowed in organic agriculture because they constitute synthetic inputs and pose unknown risks (see GMO discussion opposite).

The USDA reported on organic production statistics in the United States (USDA-ERS, 2002). This census, conducted in 2002, identified U.S. farmers who reported 2.5 million acres of land dedicated to organic production. This figure probably under-represents current production because many organic farmers produce their products organically, but sell less than $15,000 per year and are exempt from inspection (see "Organic Certification"), or do not label their product as organic and, in general, are direct marketing to a local customer. In 1999, Iowa farmers reported 150,000 acres of organic cropland to the Law Department of Agriculture and Land Stewardship (IDALS) survey. This increase in organic acreage in Iowa represents a doubling from the previous year and a six fold increase since 1996. The U.S. organic industry continues to grow at a rate of 20 percent annually. Industry estimates placed it at $10 billion in 2001. The organic industry is a consumer-driven market. According to industry surveys, the largest purchasers of organic products are young people and college-educated consumers. Today we are faced with the unique opportunity to take advantage of a growing market demand and use the technologies developed over the past 50 years. More and more farmers are interested in the profitability and environmental benefits that organic systems yield. through conservation of food and nesting sites. Others import their fertility and pest management inputs. The philosophy of “input substitution” is discredited by many long time advocates of organic agriculture. A truly sustainable method of organic farming would seek to eliminate, as much as possible, reliance on external inputs.

2.10: Organic Certification—

When Congress passed the Organic Food Production Act (OFPA) in 1990, it was heralded by many as the first U.S. law to regulate a system of farming. This law can be accessed at the Web site http://www.ams.usda.gov/nop/. OFPA requires that anyone selling products as “organic” must follow a set of prescribed practices that includes avoiding synthetic chemicals in crop and livestock production and in the manufacturing of processed products. Organic certification agencies were established in the United States to provide the required third-party certification. Some states, including Iowa, followed suit and established their own organic laws. In 1990 Iowa passed Chapter 190.

2.11: Organic Farming- A modern approach of farming

Organic farming does not mean going ‘back’ to traditional methods. Many of the farming methods used in the past are still useful today. Organic farming takes the best of these and combines them with modern scientific knowledge Organic farmers do not leave their farms to be taken over by nature; they use all the knowledge, techniques and materials available to work with nature. In this way the farmer creates a healthy balance between nature and farming, where crops and animals can grow and thrive. To be a successful organic farmer, the farmer must not see every insect as a pest, every plant out of place as a weed and the solution to every problem in an artificial chemical spray. The aim is not to eradicate all pests and weeds, but to keep them down to an acceptable level and make the most of the benefits that they may provide. Organic farming works in harmony with nature rather than against it. This involves using techniques to achieve good crop yields without harming the natural environment or the people who live and work in it. The methods and materials that organic farmers use are summarised as follows:

- To keep and build good soil structure and fertility.
- To control pests, diseases and weeds.
- Organic farming also involves.

2.12:.The World of Organic Agriculture

- 35 million hectares of agricultural land are managed organically by almost 1.4 million producers.
- The regions with the largest areas of organically managed agricultural land are Oceania (12.1 million hectares), Europe (8.2 million hectares) and Latin America (8.1 million hectares). The countries with the most organic agricultural land are Australia, Argentina and China.
- The highest shares of organically managed agricultural land are in the Falkland Islands (36.9 percent), Liechtenstein (29.8 percent) and Austria (15.9 percent).

- The countries with the highest numbers of producers are India (340’000 producers), Uganda (180’000) and Mexico (130’000). More than one third of organic producers are in Africa.
- On a global level, the organic agricultural land area increased in all regions, in total by almost three million hectares, or nine percent, compared to the data from 2007.
- Twenty-six percent (or 1.65 million hectares) more land under organic management was reported for Latin America, mainly due to strong growth in Argentina. In Europe the organic land increased by more than half a million hectares, in Asia by 0.4 million.
- About one-third of the worlds organically managed agricultural land–12 million hectares is located in developing countries. Most of this land is in Latin America, with Asia and Africa in second and third place. The countries with the largest area under organic management are Argentina, China and Brazil.
- 31 million hectares are organic wild collection areas and land for bee keeping. The majority of this land is in developing countries–in stark contrast to agricultural and, of which two-thirds is in developed countries. Further organic areas include aquaculture areas (0.43 million hectares), forest (0.01 million hectares) and grazed non-agricultural land (0.32 million hectares). Almost two-thirds of the agricultural land under organic management is grassland (22 million hectares). The cropped area (arable land and permanent crops) constitutes 8.2 million hectares, (up 10.4 percent from 2007), which represents a quarter of the organic agricultural land.

2.13: Organic Agriculture in India

- **Emergence**

The growth of organic agriculture in India has three dimensions and is being adopted by farmers for different reasons. First category of organic farmers are those which are situated in no-input or low-input use zones, for them organic is a way of life and they are doing it as a tradition (may be under compulsion in the absence of resources needed for conventional high input intensive agriculture). Second category of farmers are those which have recently adopted the organic in the wake of ill effects of conventional agriculture, may be in the form of reduced soil fertility, food toxicity or increasing cost and diminishing returns. The third category comprised of farmers and enterprises which have systematically adopted the commercial organic agriculture to capture emerging market opportunities and premium prices. While majority of farmers in first category are traditional (or by default) organic they are not certified, second category farmers comprised of both certified and un-certified but majority of third category farmers are certified. These are the third category commercial farmers which are attracting most attention. The entire data available on organic agriculture today, relates to these commercial organic farmers

- **Growing area**

Emerging from 42,000 ha under certified organic farming during 2003-04, the organic agriculture has grown almost 29 fold during the last 5 years. By March 2010 India has brought more than 4.48 million ha area under organic certification process. Out of this cultivated area accounts for 1.08 million ha while remaining 3.4 million ha is wild forest harvest collection area.

2.14: Environmental benefit of organic agriculture

Land management has a significant impact on the environment. Conventional agriculture prioritizes high yields and does little to harmoniously interact with and preserve its immediate environment. These practices can result in widespread environmental degradation, commonly resulting in soil erosion, water, soil and air pollution, biodiversity loss, and desertification. They also contribute to global warming–agriculture today accounts for more than thirteen percent of global anthropogenic greenhouse gas emissions. Conversely, organic agriculture uses an individualized approach to land management that emphasizes preservation of a land's natural ecosystem, while consuming less energy and reducing the risks of pollution common to conventional agriculture. Organic agriculture, therefore, seeks to offer a responsible alternative to conventional practices in the face of ever-growing concerns over climate change and environmental degradation.

Soil erosion is a main cause of loss of yield capacity and fertility. Long term comparisons between conventional and organic farms have found that organic methods improve the fertility and overall health of the soil. Organically managed soils also demonstrate better moisture-retention capacity than those of conventional farms, which is important in arid climates and to reduce the risk of desertification.

Soil conservation is therefore one of the key concepts in organic agriculture. Soil fertility is actually a cornerstone of organic farming by necessity because farmers cannot use synthetic products to restore degraded lands. They rely instead on maintaining and building soil fertility through multi-cropping systems, crop rotations, organic fertilizers, and minimum tillage. Organic farming has the ability to increase organic content in the soil, enhancing its capacity to retain water and circulate pollutants. Organic methods also counter soil erosion because they use natural pesticides and maintain a permanent soil cover, restoring even degraded soils quickly. Although there is little scientific evidence demonstrating that organic agriculture can reverse desertification, there are several practical examples of organic agriculture systems returning degraded lands back to fertility. This suggests that organic farming may prove to be an effective means to counter desertification.

Water pollution in agriculture is also due to soil erosion and nitrate and synthetic products leaking into water supplies. In light of the fact that organic farms do not use synthetic products, the risk of water pollution is greatly diminished. Organically-tended soils also show reduced rates of nitrate pollution in the water supply, as organic farms use fewer nitrates than conventional farms, and organic soils have an increased capacity to retain the organic farms also aim at consuming less energy and being more energy efficient than conventional farms. Studies show that they consume about forty-five to sixty-four percent of the non-renewable energy (fossil fuels) consumed by conventional farms. Depending on the climate and crops studied, organic farms were found to be between twenty-five and eighty-one percent more Energy-efficient.

The environmental benefits of organic agriculture can also extend to climate change. The International Panel on Climate Change has strongly advocated the adoption of sustainable cropping systems such as those used

ISBN: 978-93-85822-12-4

on organic farms to reduce carbon emissions. Organic methods are indeed expected to result in lower emissions–carbon emissions are between forty-eight to sixty-six percent lower than on conventional farms. This is due to the high levels of organic matter found in organic soils, which allow the soil to trap and convert carbon, lowering emissions over time. Organic farms also tend to reduce nitrous dioxide emissions, simply because they use less nitrogen than conventional farms. This is particularly significant in light of the fact that agriculture today is responsible for sixty-five to eighty percent of nitrous dioxide pollution, which contributes to the depletion of the ozone layer.

Organic agriculture is beneficial to nature protection and biodiversity conservation. The use of synthetic products and emphasis on mono-crop specialization and intensive yields that characterizes conventional agriculture has led to a considerable reduction in the number and variety of animals and plants used in agriculture.

The International Union for Conservation of Nature's (IUCN) Red List of threatened species noted that habitat loss is the main threat to biodiversity, and that agriculture affected seventy percent of all threatened bird species and forty-nine percent of all plant species. Organic farmers, on the other hand, rely on biodiversity for their success. To insure against crop-failure, for example, organic farmers plant genetically diverse crops, thus perpetuating a diverse gene pool while also learning which seeds will be the most resilient and productive in the long term. Organic farmers depend on wildlife for pollination, pest control and maintenance of soil fertility. The absence of synthetic pesticides provides an improved natural habitat for birds, insects and micro-organisms in the soil. As a result of such practices, studies show that bird densities, plant populations, earthworms and insect populations are much higher on organic farms than elsewhere.

Organic agriculture eschews the use of artificial synthetic pesticides, supporting the use of local species and traditional techniques of pest management. These practices are known as **Organic Pest Management (OPM).** OPM requires informed decision-making and careful planning. It includes: promoting populations of natural predators that contribute to controlling weeds, disease and insects; growing the most resistant varieties of crops; improving soil health to resist pathogens; growing plants in the proper seasons, which also contributes to biodiversity; using organic-approved pest-reduction and curative products, such as larvae of pest predators. These are considered effective means of controlling pests, while also promoting a healthy and diverse ecosystem. Furthermore, organic agriculture rejects the use of genetically modified organisms or products, including plants and animals, although the possible risks posed by such products are debated widely (and in some cases such as in the EU and Tunisia, exceptions are provided for some veterinary medical products). This is because organic principles consider that the use of GMOs.

2.13: Social benefit for organic agriculture

Organic agriculture may have a significant social impact on rural communities-

To begin with, organic farming may lead to improved **employment opportunities** in local communities. Organic farming often requires more manual labour to compensate for the loss of synthetic fertilizers and

ISBN: 978-93-85822-12-4

pesticides, and thus generates more jobs in rural communities. The amount of extra labour required varies based on the product and farm in question–figures within Europe alone have been found to vary between countries and even studies. In general, however, the labour needed to manage an organic farm is ten to twenty percent higher than on comparable conventional farms. Organic farmers also diversify their crops and spread their planting schedules throughout the year in order to maintain biodiversity and enhance the health of the soil. This creates opportunities for year-round employment, reduces turnover and may alleviate problems related to migrant labour. Crop diversification also mitigates the effects of crop failure by spreading the risk among a wider variety of crops and products. Greater job opportunities on organic farms contribute to strengthening rural communities as well, by halting exodus to urban areas for jobs.

Organic farming has the effect of **strengthening local communities and supporting rural development**. In order to remain competitive, farmers must adapt to local conditions by managing labour, land and resources in a way that maximizes production and remains sensitive to the environment. Doing so requires constantly experimenting with new techniques and pooling local knowledge to learn best practices. Farmers also rely on their neighbours to maintain certain standards in order to ensure the integrity of their own air, water and soil. Collaboration on these issues strengthens ties within the community, which leads to partnerships and greater organization among organic farmers. Organized groups or cooperatives can thus pool their resources, enjoy greater access to markets, and gain leverage in trade negotiations. There is some evidence that increased co-operation results in more active participation in local government and new businesses among rural communities.

Many organic farms also incorporate fair trade principles with respect to **labour welfare**. Through the implementation of labour rights related to organic agricultural practices, organic producers agree upon minimum social and labour standards. To that end, farmers contribute to providing labourers with liveable wages, safe and healthy working conditions and access to social services. The organic movement believes that these social requirements are important, but recognizes that specific standards can be controversial and difficult to implement across numerous countries.

Consumer protection is another cornerstone of organic agriculture. Consumers prefer organic products to those made on conventional farms because they know that organic products avoid synthetic pesticides and fertilizers, are good for the environment, and are perceived to produce foods that are healthier and taste better. Strong regulatory frameworks, whereby the government verifies organic certifications, are necessary for consumers to trust the products they purchase.

Finally, **organic agriculture** can contribute to food security. Although the global food supply is adequate, 850 million people still go hungry. In addition, the cost of food has risen dramatically in the past decade and there is less genetic diversity in our foods due to conventional agricultural methods. Consequently, large populations are increasingly exposed to the risk of food shortage due to disease and poverty. Organic agriculture may have the potential to meet these challenges.

2.14: Economic benefit for organic farming

Organic agriculture has seen tremendous economic growth in the last decade. This has been mainly demand-driven, as consumers have become increasingly concerned with the safety of conventionally-grown foods and the ethical downfalls of industrial agriculture. Farmers, in turn, have realized that consumers are willing to pay a premium for organically-grown foods. This is particularly attractive to farmers in developing nations, as it is expected to provide access to lucrative and emerging markets. Income constraints currently limit consumer demand mainly to the industrialized world: organic products are generally priced higher than their conventional counterparts both to cover the higher cost of production and processing and to capture unseen savings linked to issues such as environmental protection, animal welfare, and rural development. At present, North America, Japan and the European Union represent the bulk of global sales in organic products. Nevertheless, as more countries develop economically and as their populations become increasingly educated and more affluent, demand for organic products can be expected to rise. Continued growth, however, is dependent on economic swings and food safety concerns. As a result, organic farmers must carefully plan how best to enter such markets and obtain certifications that will be recognized where they wish to sell their products. Governments have also contributed to this growth, by subsidising conversions to organic farming, as they have recognized that organic farming can help them achieve environmental, food security, and rural development goals. Today, organic agriculture is the fastest growing food sector in the world in both land use and market size.

ISBN: 978-93-85822-12-4

2.15: History of organic movement

The values of organic agriculture–no chemical inputs, crop rotations, environmental preservation–have probably been practiced in traditional forms for centuries. Those methods were largely abandoned, however, during the first half of the 20th century with the advent of engine-powered tractors and synthetic farming chemicals. Some, however, remained critical of the trend and potentially harmful effects of such chemicals on food and the environment. Sir Northbourne, an Oxford University agriculturalist, was the first to use the term "organic agriculture" in his 1940 book, *Looking to the Land*, which he wrote in response to the industrialisation of agriculture. Northbourne and others derived their theories from the principles of biodynamic agriculture, first advanced by Rudolf Steiner in 1924. Steiner believed that farmers play an important role in balancing the use of land for agriculture with environmental preservation. The unifying principle between these critics of industrial agriculture was that organic methods led to the long term health of soil, production of higher quality goods and a more sustainable form of land use. These ideas gained popularity in Europe and the United States from the 1940s through 1960s among those concerned about the effects of chemicals and pesticides on their foods, most notably after scientist Rachel Carson's 1962 book, *Silent Spring*, which illustrated the effects of pesticides and other chemicals on food and the environment. Prior to the 1980s, the organic agriculture movement was driven by a collection of grassroots organizations, farmers and traders, who formed national associations to advocate for their cause–Demeter International in Germany; the Soil Association in the United Kingdom; and Rodale Press in the United States, to name a few. Many of these associations banded together in 1972 to form the International Federation of Organic Agriculture Movements (IFOAM), an international umbrella organization for the movement. IFOAM today unites over 750 organizations in 108 different countries. The organic movement was especially concerned with the quality of the food and standards that were needed to create consumer trust and to provide assurance that production processes were similar across different farms. Governments were slow to draft legislation to set these standards, however; the first such legislation appeared in Oregon and California in the United States, in 1974 and 1979 respectively. Consumers created a persistent demand for organic agriculture and beginning in the 1980s, local and national governments responded to it with legislation on organic agriculture. The recognition that organic agriculture could help countries achieve environmental objectives

2.16: Insect Management on Organic Farms

Insect management presents a challenge to organic farmers. Insects are highly mobile and well adapted to farm production systems and pest control tactics. On organic farms, where the focus is on managing insects rather than eliminating them, success depends on learning about three kinds of information(according to (**Linker, H.M; Orr, D.B; Barbercheck, M.E**.) :

- **Biological information**. What the insect needs to survive can be used to determine if pest insects can be deprived of some vital resource.
- **Ecological information.** How the insect interacts with the environment and other species can be used to shape a pest resistant environment.

- **Behavioural information** about both pest and beneficial insects. How the insect goes about collecting the necessities of life can be manipulated to protect crops. This knowledge can be used to craft a management plan that incorporates many different elements to suppress pest insects. No single tactic, employed alone, is likely to give satisfactory control of chronic pest species.

Certified organic farmers can use a wide range of practices to create an integrated pest management approach that complies with the standards of the USDA's National Organic Program (NOP): www.ams.usda. gov/nop/, (202) 720-3252. The standard states that a farmer must use management practices to prevent crop pests, weeds, and diseases,

2.16.1: Cultural practices:

Pest insect problems are influenced by three components of a farming system. Farmers can manipulate all of these components to suppress pest species.

- The *crop species and cultivar* present a set of resources, growth habits, and structure. *Production practices*, such as rotation, timeliness of planting and harvesting, spacing of plants, fertility and water management, tillage, mulching, sanitation, and companion planting.
- *Agro ecosystem structure* includes field borders, natural vegetation, and other crop production areas that resupply fields with pest insects and beneficial species when crops are replanted. Insects require a basic set of resources to live and reproduce. Production practices that deprive a pest species of at least one needed element of life may maintain pest

populations below economically damaging levels for extended periods. It is unlikely, however, that cultural practices will provide permanent control because the most troublesome insect species are those that are well-adapted to the production systems used on a farm. Populations of these pest insects will tend to increase under a particular production system, while populations of less well adapted species will decrease. Pest insects must be very adaptive to succeed because their physical environment changes as production systems change. Insects must deal with many environmental changes, including different tillage practices, fertility regimes, and planting dates. Each individual practice can change pest insect population dynamics. In organic systems, farmers use many different cultural practices and cultivate a wide array of crops. The interactive effect of this array of interacting elements on pests is difficult to predict and usually can be determined only through research and experience. Farmers can use cultural control measures to modify the crop environment enough increase environmental resistance to pest insects. This can involve one or all of the following strategies:

- Reducing initial pest levels by making the crop environment unattractive, unfavourable for pest reproduction and growth, or both.
- Producing favourable conditions for natural enemies.
- Increasing the plants' ability to withstand pest damage. When used together, the cultural practices described on the following pages provide useful tools for reducing or preventing pest problems.

ISBN: 978-93-85822-12-4

2.16.1a: Crop Cultivar

Plant breeders traditionally have placed more focus on creating disease-resistant varieties than on creating insect-resistant varieties. Where they are available, however, insect resistant varieties can be an effective defence. It is important to find out about the mechanism of insect resistance in a crop variety because genetically modified crops (GMOs, transgenic crops) are not allowed in organic production systems. Even when insect-resistant cultivars are not available, some varieties may be less attractive to pest species or tolerate more damage than others. Plant size, shape, coloration, leaf hairs, and natural chemicals—both attractants and repellents—all affect the outcome of insect crop colonization. Note that changing cultivars to reduce pests can also reduce beneficial insects either directly (characteristics that affect pest abundance may also influence beneficial insects) or indirectly (through providing less prey). Although resistant varieties and natural controls generally work together to suppress pests, some exceptions have been documented. If difficult, persistent pest problems occur, selection of a resistant or more tolerant cultivar is an option that should be tested. Most land-grant universities have official variety tests that may include observations or screening on insect resistance. Often, however, farmers must depend upon observation, experience, and exchanging information with other farmers.

2.16.1b: Crop Rotation

Crop rotation or sequence is designed to present a non-host crop to pest insects. Realistically, rotations are likely to have little effect on highly

ISBN: 978-93-85822-12-4

mobile foliar insects. Less mobile foliar pests—such as the Colorado potato beetle (CPB), subterranean pests, or pests with one generation a year—may be substantially suppressed with proper rotation.The distances required, however, may exceed the space available on small-scale operations.

For example, to reduce insecticide applications for CPB by 50 percent, potatoes have to be moved 1/4- to 1/2-mile away from previous potato crops (Weiss et al. 1994). To be most effective, rotations between susceptible crops should be three to seven years.

2.16.1c: Planting Date and Method

The stage of crop development can have a profound effect on a crop's attractiveness to pest insects. For some pests and crops, stage of development dictates whether or not a pest is a problem. If very few crops are available when insects emerge in the spring, pest insects may concentrate on a few early planted fields. Conversely, if many crop and non-crop host plants are available in early spring, then pests may disperse widely and not concentrate in any one crop. Thrips, for example, often infest early planted crops in high numbers. But they cause fewer problems on later planted crops. For some pest insects, planting a crop early so that it reaches a less susceptible physiological stage can be a practical solution to a pest problem. For example, corn earworm causes fewer problems in early planted sweet corn. Additionally, aphid-transmitted plant viruses may be minimized in early planted crops. Vigorous crop growth is also important. Seeds should be sown when temperatures will allow them to emerge and grow quickly. Using seedlings or transplants instead of seeds can also speed crop development. Plants struggling to survive or plants under stress will be more attractive to pest insects and more affected by damage. Most of the time, planting date and method are dictated by markets, weather, labour availability, and other factors. But if a pest insect presents an especially difficult problem, manipulating the planting date and method may be one option to explore.

2.16.1d: Harvest Date

The shorter the time a crop is in the field, the less time pest insects have to damage it. Combining early planting with early maturing varieties may allow a crop to mature before pest insects reach damaging levels. This can also be effective for minimizing insect transmitted plant diseases. For example, cucurbit crops may have fewer virus problems with early harvest. Other factors, however, such as markets and weather, may dictate longer seasons. This must be weighed against insect pest losses.

2.16.1e: Crop Population Density —Row Spacing & Seeding Rate

Decisions about crop population densities are dictated more by the growing characteristics of the crop, weed management, and harvest requirements than by pest insect management. In general, if increasing the population density of a crop increases beneficial insects, it can lead to a decrease in pest insects. In some crops, close row spacing increases control by beneficial insects. More ground shading will usually increase ground dwelling predators, such as ground beetles. Some species of ground beetles also consume weed seeds on the soil surface.

ISBN: 978-93-85822-12-4

2.16.1f: Fertility Management—Nutrition, Vigour, and Soil pH

Proper nutrient management is an important component of IPM in organic systems. Organic production does not allow synthetic fertilizers or sewage sludge. Check with your certifier if you are in doubt about your fertility management materials. Although crop plants must grow vigorously to withstand pest damage, overly lush plants often attract more pest insects and experience more damage than other plants. Over fertilized plants may give visual clues to insects and become targets of attack. Survival of immature insects may also be better on over fertilized plants. Nutrient stress from insufficient plant nutrients can also cause plants to be more attractive to insect pests or more susceptible to damage by insect pests. Consequently, the careful planning and execution of soil fertility programs (including pH) is an important component of pest insect management.

2.16.1g: Tillage

Tillage practices affect both subterranean and foliar insect pests. Infrequent disturbance of soils in natural systems preserves food webs and diversity of organisms and habitats. The regular disturbance of agricultural soils disrupts ecological linkages and allows adapted pest species to increase without the dampening effects of natural controls. Nevertheless, tillage can also destroy insects overwintering in the soil as eggs, pupae, or adults, and reduce pest problems. Organic producers usually rely on tillage to control weeds and to prepare the soil for planting. Research is being conducted on methods and equipment that may allow for the reduction of tillage in organic systems. Some practices to reduce tillage in organic systems include zone tillage, ridge tillage, and including a perennial or sod-producing crop in the rotation. Reduction of tillage alters pest insect dynamics considerably. Thrips cause fewer problems in reduced-till systems. Ground-dwelling predators, such as ground beetles that prey on pest insects, can increase. However, cutworm and slug problems can also increase where tillage is reduced. The degree of pest population shifts between a tilled and reduced-tillage system cannot be reliably predicted. Species shifts will occur and should be carefully monitored.

2.16.1h: Trap Crops

Trap crops attract pest species away from the cash crop to be protected and into a specific area where they can be destroyed. Depending on the target pest and the cash crop, trap crops can be planted with or around the perimeter of the cash crop field. This approach is an appealing idea, and it has proven useful in some situations. Implementation of trap cropping takes careful management. Knowledge of the biology and ecology of the target pest species is critical when considering trap cropping. Species that are weak fliers or pests that are blown into a crop (such as aphids) or are dispersed in the wind (such as spider mites) are not good candidates. Good target pests show a strong preference for a particular type, variety, or physiological stage of the crop. The size and configuration of the trap-crop area usually is not based on the size of the cash-crop area but on the number of pests expected. A small trap-crop area that is quickly destroyed will not give satisfactory results. If enough land is available, it is better to have a trap-crop area that is too large rather than one that is too small. Some trap crops are planted within the field of the cash crop. Another approach, called

ISBN: 978-93-85822-12-4

perimeter trap cropping, involves planting at least two rows of the trap crop around the entire perimeter of the cash crop. An approach to trap cropping that improves efficacy is to combine it with other tactics. For example, with a ***push-pull approach***, a trap crop is used to pull the pest species away while the protected cash crop is intercropped with a plant that repels pests.

2.16.1i: Pheromones and other attractants

Insects are very small creatures in a very large world. They have evolved many different ways of finding each other to mate. Some insects can make a sound as loud as a chainsaw; others have striking colours. Many insects find each other over long distances by emitting chemical signals or ***pheromones*** to attract individuals of the same species into an area so they can find each other to mate. Once the individuals get close together, visual cues—such as colour, shape, and behaviour— become more important. Entomologists have determined the chemical structure of pheromones for many pest species and duplicated them synthetically. Insects also use other chemical messages. Chemical cues to the location of food can draw insects into a particular area where, once they get close enough, visual and tactile cues lead them to food sources. Pheromones and other chemical attractants can be used in several different ways: to monitor pests, disrupt mating, capture a large number of adults (called *mass trapping*), distribute an insect pathogen or or lure pests to consume poisoned bait. Any trap baited with an attractant must be used carefully. Some research has demonstrated that a trap can bring more pests into an agro ecosystem than it kills.

2.16.2: BIOLOGICAL CONTROL USING INSECT

2.16.2a: Pathogens

Insects have many types of natural enemies. As with other organisms, insects can become infected with disease-causing organisms called ***pathogens***. Soil serves as a natural home and reservoir for many kinds of insect pathogens, including viruses, bacteria, protozoa, fungi, and nematodes. Pest control products based on insect pathogens are available commercially, and some products are allowed in organic production. As with all pest control products, it is critical to determine if the specific insect-pathogen based product that you want to use is allowed by your certifier.

2.16.2b: Insect-Parasitic Nematodes

Traditionally, soil-inhabiting insect pests have been managed by the application of pesticides to the soil. Interest in biological control to manage crop pests has increased because of concerns about the economic, environmental, and health costs of chemical crop protection and because of the need to develop production systems that are environmentally and economically sustainable. Insect-parasitic nematodes show promise as biological control agents for soil pests. Nematodes are microscopic, whitish to transparent, unsegmented round worms. Nematodes in the family’s Steinernematidae and Heterorhabditdae have been studied extensively as biological control agents for soil-dwelling insects. These nematodes occur naturally in soil and possess a durable and motile infective stage that can actively seek out and infect a broad range of insects. They do not infect birds or mammals. Because of these attributes, as well as their ease of mass

ISBN: 978-93-85822-12-4

production and exemption from EPA registration, a number of commercial enterprises produce insect-parasitic nematodes as biological "insecticides."

2.16.2c: Insect-Parasitic Fungi

Fungi are a diverse group of organisms with close ties to agriculture. Some fungi are used successfully to protect crops from a variety of insect pests. Most fungi can cause natural outbreaks when environmental conditions are favourable. Several species have been developed as commercial products because of their ability to be mass-produced. Specific fungal strains in commercial products target thrips, whiteflies, aphids, caterpillars, weevils, grasshoppers, ants, Colorado potato beetles, and mealybugs. Currently (2008), allowable products containing the fungus *Beauveria bassiana* that are commercially available include Mycotrol O (Emerald BioAgriculture), Naturalis H&G, and Naturalis L (Troy BioSciences Inc.). Before applying any pest control product, make sure that it is currently allowable by the NOP and your certifier.

2.16.2d: Insect-Parasitic Viruses

Insect viruses are obligate disease-causing organisms that can only reproduce within a host insect. They can provide safe, effective, and sustainable control of a variety of insect pests, although they are most effective as part of a diverse IPM program. Some viruses are produced as commercial products, most notably for fruit pests, but many others are naturally occurring and can initiate outbreaks without additional inputs. Commercially available insect viruses that are allowed in organic production can be found at the National Organic Program's Web site (see the list of online references on page x). All are highly specific in their host range, usually limited to a single type of insect.

2.16.2e: Insect-Pathogenic Bacteria

Many insect diseases are caused by bacteria. The most commonly used bacterial product available to organic growers is *Bacillus thuringiensis* (Bt). This bacterium produces an insecticidal protein that provides effective control for many pest insects and has very little effect on non-target insects and natural enemies. Because Bt products are applied like insecticides, it will be discussed in the section on insecticides in this publication. Not all formulations of Bt are allowable in organic production, so it is important to check with your certifier before purchasing or using Bt.

2.17: ORGANIC PESTICIDES

An organic insecticide is a pesticide that uses only natural components to kill bugs. In many cases, organic materials used to repel insects are also called organic insecticides. This is not a true insecticide, but rather a repellent. Organic insecticides can be made from a number of different materials, but what many people most appreciate about them is that they are a relatively safe form of pest control in most cases.

It is possible to make an organic insecticide from a number of different substances. It is also possible to buy them commercially. It should be noted that many organic insecticides are meant to only target a certain species or a few different species. Therefore, those who have a variety of insect species they wish to treat will likely need more than one type of organic insecticide.

One common type of organic insecticide uses **garlic**. Garlic oil, if sprayed on a pond, can kill mosquito larvae. Garlic is also a popular product use to repel a number of harmful insects, such as chiggers, borers and other types of pests that can cause substantial damage to garden plants and fruit trees. This just is one example where common household food items or other natural products can be used in the fight against insects.

The benefits of organic insecticide products are: the ability to repel different harmful insects but not repel or kill beneficial ones, the ability to manufacture varieties at home and its safety around children and animals. Most synthetic pesticides work by affecting the central nervous system of the insect. In certain amounts, this can affect humans and other animals as well.

❖ **Some name and preparation of organic pesticides**

2.17.1: Amritapani- Ingredients used:

a. Leguminous leaf (2 kg).

b. Soft tender leaf (2 kg).

c. Cow dung (10 kg).

d. Molasses (2 kg).

e. Ripe banana (10 pc).

f. 15 days old organic soil (1 kg).

g. Besan (2 kg).

It is prepared by mixing all the ingredients properly and kept it for 10-12 days. After that leaker water is extracted from the mixture and applied to the standing crop @ 100 kg/ bigha.

2.17.2: Neem water- It is prepared by mixing the neem leaf and water, after that boiling of the mixture is done about 1-2 hr. Then the boil neem water is mix in the tank (16 lit) @ 2 gm/ lit and applied in the field.

2.17.3: Ginger and Garlic paste- It is prepared by mixing the garlic and ginger paste and mix with water in 10:1 ration. After that it mix in the tank (16ltr) 160 gm / 16 lit + 2 gm surf. Then the solution is ready for spraying in the field which repel the attack of insect and pest. Here, surf is use as because it is use as a sticker i.e., when applied in the field it sticks to the leaf and repel the insects and pests.

2.17.4: Neem paste-It is prepared by mixing the neem leaf paste with the water in 10:1 ratio. After that it mix in the tank (16ltr) 160 gm / 16 lit + 2 gm surf. Then the solution is ready for spraying in the field which repel the attack of insect and pest. Here, surf is use as because it is use as a sticker i.e., when applied in the field it sticks to the leaf and repel the insects and pests.

2.17.5: Another type of organic pesticides is prepared by taking some leaves of bad odour and paste it. And mix it with water and 2 gm surf. After that the solution is kept it for 12 days. The product so obtained is mix in the water tank (16 lit) and spray in the field @10 ml/bigha.

2.17.6: Another type of organic pesticides is prepared by mixing 200 gm organic soil with some amount of cow urine + 5 kg cow dung + 250 gm besan and 500 gm molasses. After proper mixing, 2 lit water is added to it and kept it for 15 days in a shady place. And then it applied to the basal portion of the plant/ crop.

ISBN: 978-93-85822-12-4

2.18: Ecology of organic farming

The roots of ecological justice are in the concept of environmental justice that arose from grass-root resistance movements in the United States in the 1980's–in particular the antitoxic movement, which focused on environmental health threats from waste dumps and pollution in local communities, and the movement against environmental racism, which focused on the disproportionate environ- mental risks to poor and coloured communities (Schlosberg, 2003; Byrne, et al., 2002b). Environmental justice is mainly concerned with the fair distribution of environmental ills among human communities. Since then, these concepts have been treated theoretically by several authors in relation to environmental politics, justice and ethics (Low and Gleeson, 1998; Baxter, 1999, 2005; Shrader-Frechette, 2002; Bell, 2003, 2004; Schlosberg, 2003). Low & Gleeson (1998: 2) coined the term "ecological justice" which broadens the scope of environmental justice to include the justice of the relations between humans and the rest of the natural world and between present and future generations.

2.18.1: General relationships between Organic Farming and Agro-Ecology

Some commonalities appear between Organic farming and Agro-ecology. Both promote a “closed system” approach, use multiple and diverse crops or animals, rely on biological processes for building soil fertility and controlling pests and diseases, support transition pathways towards ecologically-based agricultural systems (Abreu et al., 2009). They are also

ISBN: 978-93-85822-12-4

both a suited way to introduce practical systems research into academia. Some differences can however be identified

Table 2.3: Comparative analysis of central attributes in Organic farming and Agro-ecology

Item	Organic farming	Agro-ecology
Defination	System of farm management and food production	Various e.g. Interdisciplinary study and design of agricultural and food systems (Gliessman, 2007
Intial paradigm	Soil fertility (and soil sciences)	Ecology (and entomology)
Key concept	Farming system ; Value chain	Agroecosystem; Food sovereignty
Reference model	Mixed livestock-cropping	Traditional multistratified systems
Agricultural form associated	Biological, Biodynamic, Organic	Alternative, Sustainable agriculture, Integrated Pest Management
Key factors	Farmers, processors, consumers	Diversified small farmers
Technologies	Use of natural substances and processes; no GMOs	Nutrient cycling; biological crop protection; possibly chemical inputs
Food	Quality, content, health	Agri-food systems, sovereignty

2.19: Cost of cultivation of some crops

Table 2.4: Aman paddy and Boro Paddy

Sl. No	Items	Amount/bigha
1	Seed	100
2	Plough	400
3	Labour	1500
4	Organic manure	1000
5	Irrigation	1000
	Total	4000

Boro Paddy		
Sl. No	**Items**	**Amount/bigha**
1	Seed	100
2	Plough	400
3	Labour	2000
4	Organic manure	2500
5	Irrigation	1500
	Total	6500

30. Benefits of organic agriculture

- Soil conservation and maintenance of soil fertility.
- Less pollution of water (ground water, rivers, and lakes).

- Protection of wildlife (birds, frogs, insects etc).
- Higher biodiversity, more diverse landscape.
- Better treatment of farm animals.
- Less pesticide residues in food.
- Better product quality (taste, storage properties).
- Most cost: benefit ratio.

PARADIGM OF ORGANIC FARMING

PARADIGM - 1

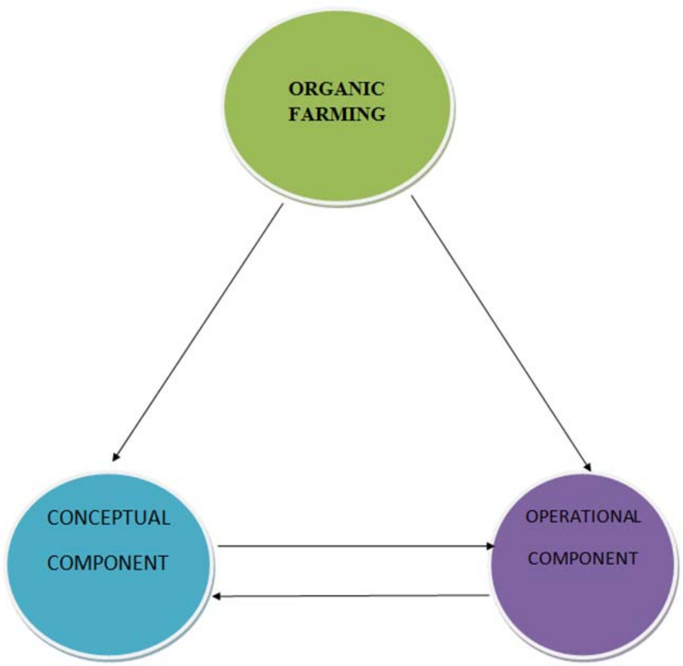


Fig: Components of Organic Farming

- The diagram represents that organic farming has got both operational and conceptual components and there has been subtle differences in between as well.

ISBN: 978-93-85822-12-4

PARADIGM - 2

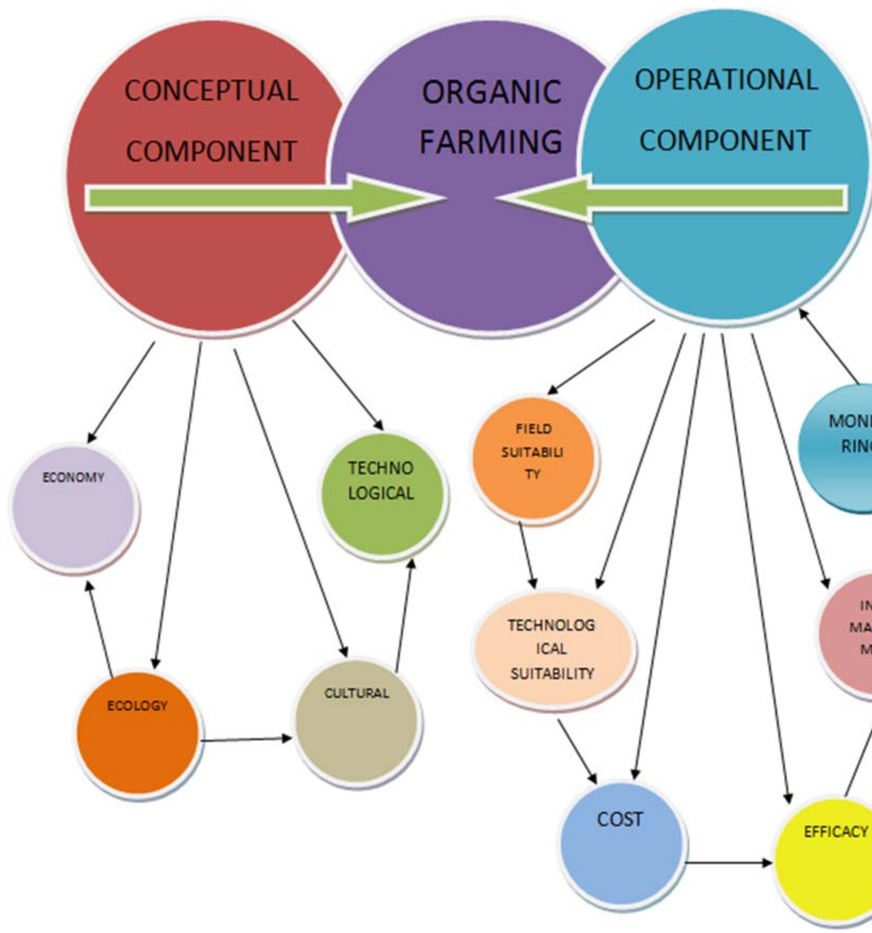


Fig: Components and sub-components of organic farming.

- The diagram represents the components generating from concept and operation are in constant process- osmosis.

PARADIGM – 3

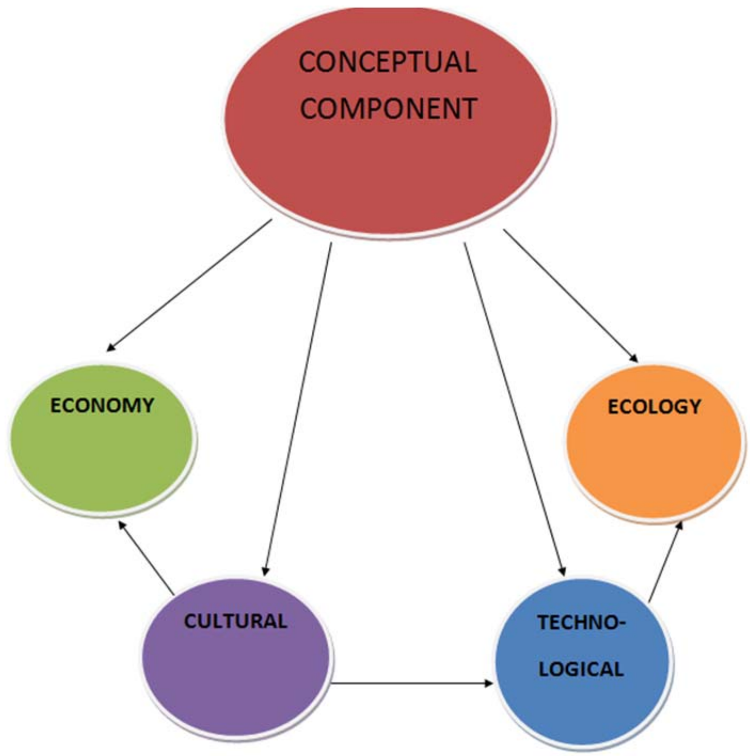


Fig: Conceptual Component

- The diagram represents the conceptual components of organic farming includes economy, cultural, technology and ecology.

PARADIGM - 4

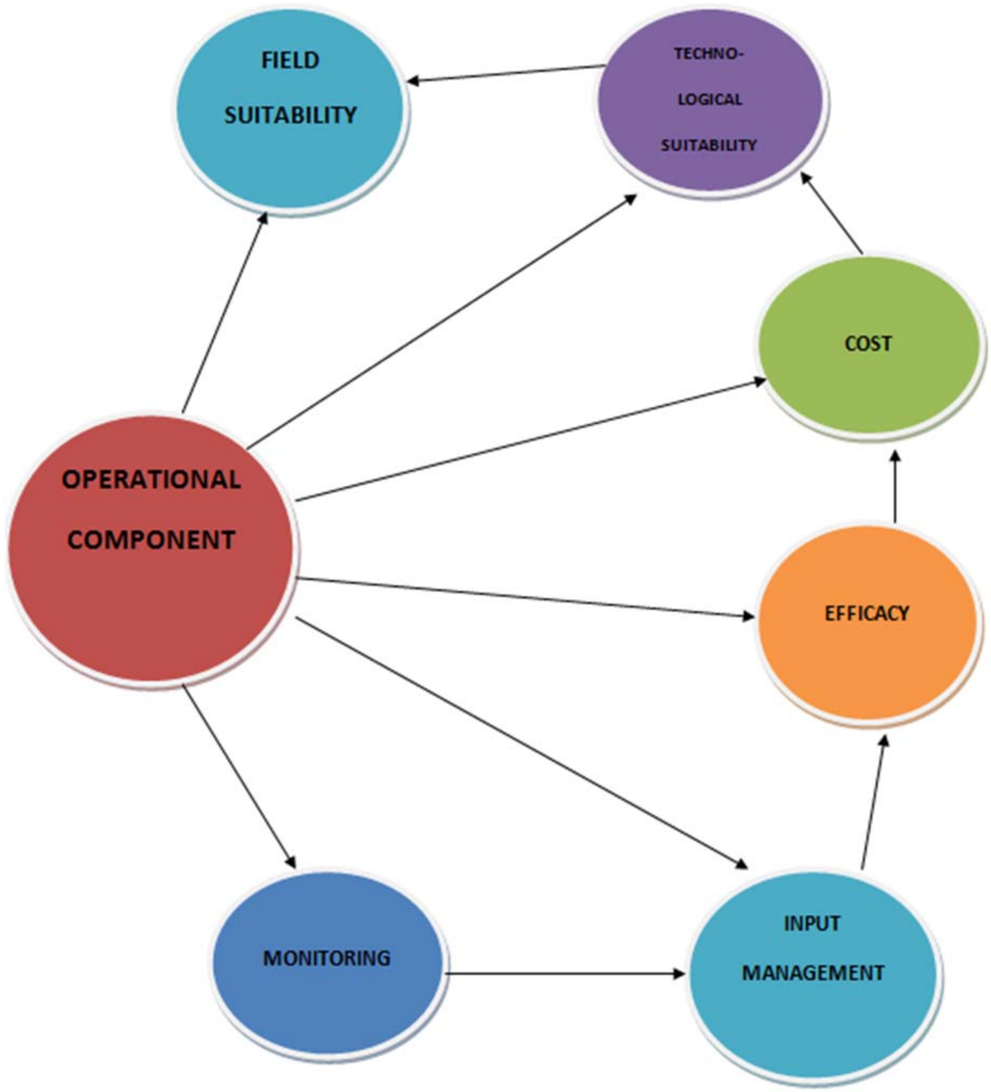


Fig: Operational Component

- The diagram represents the operational component do form the chain of constant interaction.

ISBN: 978-93-85822-12-4

PARADIGM - 5

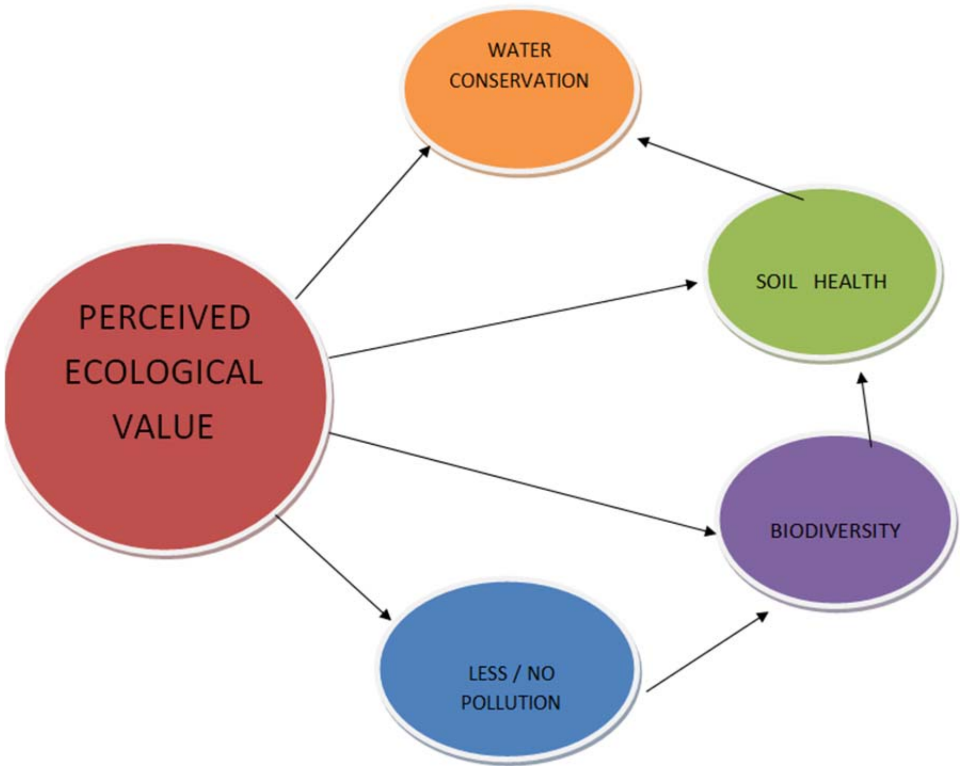


Fig: Perceived Ecological Values

- ❖ The diagram represents the farmer's perception on ecological properties of organic farming encompass a plethora of areas.