Theory Material

Course no. :Agron.3.3

Course Title:

Principles and Practices of Natural Farming

Course Credit: (1+1=2)

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Principles and Practices of Natural Farming (1+1=2)

Objectives

- To teach students the concept, need and principles of native ecology-based production under natural farming
- To impart practical knowledge of natural farming and related agricultural practices in Indian and
- Global environmental and economic perspectives.

Theory

- Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming;
- Definition; Objective of natural farming, Essential characteristics and Principles of natural farming;
- Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/ schools of natural farming.
- Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services,
- Rearing practices for animals under natural farming**,** Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming;
- Mechanization in natural farming, Processing, labelling, economic considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming produce and products.
- Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture,
- Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.

Practical

- Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm; Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management; On-farm inputs preparation methods and protocols, Studies in green manuring in-situ and green leaf manuring, Studies on different types of

botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient, insect and pest and disease management; Weed management practices in natural farming; Techniques of indigenous seed production, storage and marketing, Partial and complete nutrient and financial budgeting in natural farming; Evaluation of ecosystem services in natural farming (Crop, Field and System).

Suggested Readings

1. Nalini S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
2. Shamasastry R. 1915. Kautilya's Arthashastra.
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9. Hill S.B and Ott. P. (eds.). 1982 Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.
10. Nalini S. 2011. Upavana Vinoda (Woodland Garden for Enjoyment) by Sarangdhara (13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 64p.
11. Boeringa R. (ed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
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13. Fukuoka M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp.
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16. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
17. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities Centre for Science and Environment, New Delhi.
18. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, OtthoHeldringstraat.
19. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016).
20. Plenty For All: Natural Farming A To Z PRAYOG PARIWAR METHODOLOGY by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021).
21. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021).
22. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022).
23. कमलागतप्राकृततककृतत : आचार्यदेवव्रत , pp 1-166.
24. Malhotra R. and S.D. Babaji. 2020. Sanskrit Non Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.
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CONTENT

CHAPTER 1:
INDIAN HERITAGE OF ANCIENT AGRICULTURE, HISTORY OF NATURAL FARMING, IMPORTANCE OF NATURAL FARMING

Indian Heritage of Ancient Agriculture:

Indian agriculture began by 9000 BC as a result of early cultivation of plants and domestication of crops and animals. Settled life soon followed with implements and techniques being developed for agriculture. Double monsoons led to two harvests being reaped in one year. Indian products soon reached the world via existing trading networks and foreign crops were introduced to India. Plants and animals—considered essential to their survival by the Indians—came to be worshiped and venerated. The middle ages saw irrigation channels reach a new level of sophistication in India and Indian crops affecting the economies of other regions of the world under Islamic patronage. Land and water management systems were developed with an aim of providing uniform growth. Despite some stagnation during the later modern era the independent Republic of India was able to develop a comprehensive agricultural program.

Indian Heritage of Natural Farming:

- Krishi-Parashara, Systematically wrote the first textbook on agriculture in the world. It deals with prediction of rainfall models on the basis of movement and position of planets, rainfall and its distribution, indicators of drought, management of farming and cattle, nutrient management, seed collection and preservation, agriculture tools and plough mechanics, other agronomic practices useful in modern agriculture (Nalini, 1999).
- Sitadhyaksha chapter in Kautilya Arthashastra by Acharya Kautilya (321 BC). It addresses the importance of animal husbandry, particularly of cows, measuring rainfall, seed treatment and seed procurement ,cropping pattern and method and timings of harvesting the crop, etc. (Shamasastry, 1915).
- Kashyapiya Krishi Sukti by sage Kashyap (c. 800 CE) deals excellent text on agriculture with details of rice production in irrigated areas of India, cattle management, soil quality, growing pulses on high land as well as vegetables, fruits, spice crops, ornamental plants. The emphasis was given on growing trees, preparing gardens, marketing and mining (Ayachit, 2002).

- Vrikshayurveda by Vaidya Surapala is a repository of agricultural knowledge which includes information on garden construction, importance of plants, details of plantation near buildings, procurement of seeds and plantation material, testing, treatment, preparation of pits for planting, selection of land, methods of irrigation, nutrition, manures, etc. Surapala has described a unique fermented liquid fertiliser-cum-plant protection material called Kunapajala, which happens to be the first fermented natural liquid manure in the world. Further, important information is given about plant nutrition, plant diseases, plant protection with natural products/formulations, construction of gardens, miracles related to agriculture and horticulture, use of plant species as an indicator of crops and animal production and description of religious plants (Nalini. 1996).
- Upavanavinod have information on benefits and losses from trees near the house, soil, planting of trees, sowing of seeds, pits, distance between trees, auspicious and inauspicious plants, irrigation (watering), garden construction, digging wells, kunap (liquid manure), miracle of plants (amazing plants), natural signs for growth of cereal crops, natural signs of animals and signs of reproduction of animals, etc. (Nalini, 2011).
- Vishwavallabha by Chakrapani Mishra (1577 CE), an eminent manuscript describing various aspects of agriculture keeping in mind the Asian Agri History Foundation(AAHF) Classic Bulletin deals, Mewar region includes information on groundwater detection, soil testing, plantation, water management, nutrition, disease and treatment, miracles of plant and seeds etc. in dry, semi-arid and moist areas and hills (Nalini, 2004).
- Brihat Samhita by Varahamihir((600 AD), deals with widely ranging subjects as astronomy, physics, geology, horticulture, archaeology, etc including Vrikshayurveda as one of the major subjects (Bhat, 1992)
- Lokopakara 1000-year-old manuscript which deals with methods and criteria for water divining, Vrikshayurveda and methods for insect control, Perfumery, Veterinary medicine (Sreenivasa, 2006)
- Nuskha Dar Fanni-Falahat (The Art of Agriculture) by Prince Dara Shikoh (1650 CE)(9) AAHF Classic Bulletin, A text on synthesis of farm technologies of West Asia and India, grafting unrelated rees,introduced water-dripping system of irrigation, useful in modern agriculture (Akbar, 2000).

- Krishi Gita (Agricultural Versus), (15th century by Vidwan C Govinda Warriar), includes useful crops on the coasts of India, large numbers of rice varieties (124) for different areas described, and many other crops with their varieties are described (Kumar, 2008).

It is well documented in literature that Indian agricultural history was rich, diverse and high yielding before the advent of the Green Revolution, through the ages.

Examples of these are -

- 10^{th}-13^{th} Century - Inscriptions in Chola Temple in Ramnad (Tamil Nadu) indicate rice yields of 6.6 MT/Ha (Scott, 2016). Great biodiversity in cultivation from millets, paddy, lentils, vegetables and fruits have been reported (Srinivasan, 2016).
- 16^{th} Century - Abul Fazl mentions in Ain-i-Akbari that the yield of non-irrigated wheat was 1.28 MT/Ha (Dharampal, 1999).
- 19^{th} century - Edinburgh review reported land productivity in India was 3 times that of England (George, 1889).
- 1807 - Revenue records of Madras Presidency Coimbatore report rice yields of 6 MT/Ha. Bengal gram production was recorded at 1104 kg/ha in Gujarat (George , 1889).
- 1890 - Dictionary of Economic Product of India (British India) reported the native variety cotton yield to be substantially higher in various parts of India as compared to the national average in 2017-18 as 505 Kg/Ha (George, 1889).

Additional references to the knowledge on plant-human interface is evidenced in the various texts over the millenia and recent history are -

- In Rigveda (c. 8000 BC) there is a reference of the profession of farming, farming operations.
- Lord Rama (c. 5000 BC) enquired from Bharat that all those engaged in agriculture, animal husbandry receive special care.
- Tiruvallur (70 BC) author of the Tamil classic, Thirukural or the Maxima of Tiruvalluvar in which there is evidence that Indian civilization considered farming to be the most noble profession to which even royalty bowed.
- Kautilya's Arthasastra describes the technique for measuring rainfall and method of seed treatment.
- From ancient times till pre-British era farming as a community was a special tradition and enjoyed a respected and dignified status in society. Wealth was measured in natural resources. 'Gau-dhan' (Cows), 'Ashwa-dhan' (Horses), 'Gaj-dhan' (Elephants) etc. were all

different forms of wealth. 'Vidya-dhan' was also a wealth as was raw material of the artisans. Among all these popular wealth forms, the most important one was 'dhanya' or rice/crops. Most of the transactions in the society were done through 'dhanya (Gupta and Gupta, 2019).

- There is also a broad tradition of ‘natural farming’, propounded by advocates such as Narayana Reddy (in Karnataka), Shripad Dabholkar (Maharashtra), G Nammalvar (Tamil Nadu), Partap C Aggarwal (Madhya Pradesh) and Bhaskar save (popularly referred to as the ‘Gandhi of Natural Farming’, working in Gujarat) (Bharucha et. al., 2020).
- Natural farming is a system developed in the 1980s by Indian farmer, agricultural scientist and extension agent Subhash Palekar who established Zero budget natural farming (ZBNF) after a period of self- study of vedas, organic farming and conventional agricultural science, testing methods on his own farm (Khadse et al., 2017)
- The credit of the Shaping ‘natural farming’ movement in the country goes to former Governor of Himachal Pradesh Shri Acharya Devvrat, who is presently the Governor of Gujarat. It is the result of his sheer efforts that natural farming has reached all the Panchayats and villages of the state in a small span of three years.
- Evolution of ZBNF as a grassroots social movement and evolving into a major policy initiative in Andhra Pradesh.
- Himachal Pradesh under Prakritik Kheti Khushal Kisan Yojna started Natural Farming under the nomenclature Subhash Palekar Natural Farming (SPNF) in 2018 and now it is implemented at large scale.
- Govt. of India coined the terminology for natural farming ‘Bhartiya Prakritik Krishi Paddhati’ (BPKP), though the roots of all kinds of terminologies exists in Vrikshayurveda, a broad based knowledge of natural farming, which is completely in harmony with nature.
- Hon’ble Finance Minister Nirmala Sitharaman mentioned Natural Farming in her speech on the occasion of union budget in the year 2019- 20 and invoked the need to replicate this innovative model.
- Hon’ble Prime Minister of India Sh. Narendra Modi while addressing a conference on Natural Farming on 16th December 2021 emphasised to go for adoption of Natural Farming in India.
- Prakrutik Krishi Vikas board was established in 2021-22 in Gujarat by the Government of Gujarat.

- Hon’ble Finance Minister Nirmala Sitharaman made announcements in her budget speech 2022, about promotion of chemical free natural farming throughout the country, with focus on farmers' land in 5 km wide corridors along the river Ganga in the first stage. Budget also mentions that states will be encouraged to revise the syllabus of agriculture universities to meet the needs of natural, zero- budget and organic farming, modern day agriculture, value addition and management.

Importance of natural farming:

Several studies have reported the effectiveness of natural farming in terms of increase in production, sustainability, saving of water use, improvement in soil health and farmland ecosystem. It is considered as a cost- effective farming practices with scope for raising employment and rural development. Natural Farming offers a solution to various problems, such as food insecurity, farmers’ distress, and health problems arising due to pesticide and fertilizer residue in food and water, global warming, climate change and natural calamities. It also has the potential to generate employment, thereby stemming the migration of rural youth. Natural Farming, as the name suggests, is the art, practice and, increasingly, the science of working with nature to achieve much more with less.

- Ecological Balance: With increasing concerns about environmental degradation, natural farming is essential to maintain and restore ecological balance by prioritizing biodiversity and healthy ecosystems.

- Sustainable Agriculture: For agriculture to be sustainable in the long run, we need farming practices that don't deplete the earth's resources. Natural farming emphasizes such regenerative practices.

- Health Implications: The rising health issues associated with chemical residues in food highlight the importance of practices that ensure food safety and nutrition.

- Resilience in Changing Climate: With the unpredictability brought about by climate change, natural farming builds resilience in crops and soil due to its inherent biodiversity and holistic approach.

- Cultural and Traditional Preservation: Natural farming often integrates indigenous knowledge and practices, ensuring the preservation and continuation of invaluable traditional wisdom.

Features of Natural Farming:

- ❖ Natural farming practices hold that plants receive 98% of their nutrients from the air, water, and sunlight. And healthy soil with lots of helpful microbes can fill the remaining 2% of the gap.
- ❖ The soil must always be covered with organic mulch, which produces humus and promotes the development of beneficial microbes.
- ❖ Instead of using fertilizers, farm-made bio-cultures called Jeevamrita, Beejamrita, etc. are put into the soil to boost the microflora. Jeevamrita and Beejamrita are made from very little desi cow breed cow manure and urine.
- ❖ It can potentially increase farmers' income while providing a wide range of advantages, including mitigating and reducing greenhouse gas emissions, restoring soil fertility, and environmental health.
- ❖ The process needs cow dung and cow urine (Gomutra), which can only be acquired from cows of Indian breed. In terms of the microbiological composition of cow dung and urine, Desi cow appears to be the cleanest.
- ❖ Neither chemical nor organic fertilizers are put into the soil in natural farming. In fact, neither the soil nor the plants receive any exogenous fertilizers.
- ❖ In natural farming, earthworms and bacteria are encouraged to break down organic materials on the soil surface, gradually adding nutrients to the soil over time.
- ❖ In natural farming, weeding is done as it would be in natural ecosystems without using fertilizers, ploughing, or soil tilting.
- ❖ To fight pests and diseases, farms utilize natural insecticides like Dashparni Ark and Neem Astra.
- ❖ Weeds are employed as a live or dead mulch layer and are considered necessary.
- ❖ Multiple cropping is recommended over single crop

Advantages of Natural Farming:

1. The main aim for promotion of natural farming is elimination of chemical fertilizers and pesticides usage and promotion of good agronomic practices. Natural Farming also aims to sustain agriculture production with eco-friendly process in tune with

nature to produce agricultural produce free of chemicals. Soil fertility and soil organic matter is restored by natural farming practices. Natural farming systems require less water and are climate friendly.

2. It aims to rural development as it improves the value of all forms of life including rural communities, by satisfying and sustaining their socio-economic and traditional aspirations besides firming their social association, while protecting natural resources.
3. It brings in the aspect of rural development as it combines tradition, innovation and science to help the environment, promote impartial relationships and thereby a superiority of existence for rural people.
4. Holistic approach to natural farming adds to rural progress in many ways and most important are:

- ❖ Enhanced governance: Farmer is kept at the centre of the farming strategy, reinstating a decision- making part to native groups, guarantees their right to manage their individual resources and gives them freedom for engaging themselves and actively participates in value-added sustenance.
- ❖ Vibrant economic space: Diversified production decreases the effects of crop failures and increases marketing chances. Income and food security is realized through multiplicity of crops and options under natural farming.
- ❖ Healthy environment: Integrity of the ecosystem and the productivity of natural resources are maintained through ecological approach being adopted under natural agricultural systems. It conserves natural and wild resources, reinstates life to soils and upholds agrobiodiversity. Ecological based agriculture practices provide a healthier working environment to farmers by reducing the use of chemical inputs.
- ❖ Social capital for rural areas: Being knowledge and skill intensive, rather than capital and resource intensive, it uses traditional information and promotes farmer-to-farmer interchange. Provides tools for review and control that strengthen social organization and authorize rural groups.
- ❖ Sustains traditional food systems: More and more farmers are dependent on only a few crops which demand considerable investments and create requirement on sometimes inaccessible and unsuccessful agri-inputs. Input costs are high and market prices remain to decrease making farmers and labors to think twice on cultivation. Farmers' knowledge of biological systems, setting and their conventional understanding play more role in making farming more sustainable.

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CHAPTER 2:

DEFINITION; OBJECTIVE OF NATURAL FARMING, ESSENTIAL CHARACTERISTICS AND PRINCIPLES OF NATURAL FARMING

Definition:

Masanobu Fukuoka

The natural way of farming" or "do-nothing farming", is an ecological farming approach established by Masanobu Fukuoka, a Japanese farmer and philosopher. He introduced the term in his book The One-Straw Revolution, the four principles of natural farming. No cultivation that is, no ploughing or turning of the soil. The earth cultivates itself naturally by means of the penetration of plant roots and the activity of microorganisms, small animals, and earthworms. No chemical fertiliser or prepared compost- For fertiliser, Mr. Fukuoka grows a leguminous cover of white clover, returns the threshed straw to the fields, and adds a little poultry manure. No weeding by tillage or herbicides. No dependence on chemicals: Mr Fukuoka grows his grain crops without chemicals of any kind. On some orchard trees, he occasionally uses machine oil emulsion for the control of insect scales. He used no persistent or broad-spectrum poisons, and has no “pesticide” programme.

The Ministry of Agriculture and Farmers’ Welfare - Definition of Natural Farming (NF) A chemical-free natural farming system wherein use of low-cost inputs (cow dung/urine and plant extract based) coupled with recommended agronomic practices like mulching and intercropping are promoted.

According to NITI Aayog, Natural Farming can be defined as “chemical- free andlivestock based farming”. This definition is based on the prevailing practices. Soundly grounded in agro-ecology, it is a diversified farming system that integrates crops, trees and livestock, allowing the optimum use of functional biodiversity.

“Natural Farming in the Indian context is a holistic agricultural production system in tandem with the laws of nature to provide food for all living beings ensuring production without harming the panchmahaboota or panchtatva (Prithvi, Agni, Jal, Vaayu and Aakash).

Objective of natural farming:

- Preserve natural flora and fauna
- Restore soil health and fertility and soil’s biological life
- Maintain diversity in crop production

- Efficient utilization of land and natural resources (light, air, water)
- Promote natural beneficial insects, animals and microbes in soil for nutrient recycling and biological control of pests and diseases
- Promotion of local breeds for livestock integration
- Use of natural / local resource-based inputs
- Reduce input cost of agricultural production
- Improve economics of farmers

Essential characteristics of Natural Farming:

- According to natural farming principles, plants get 98% of their supply of nutrients from the air, water, and sunlight. And the remaining 2% can be fulfilled by good quality soil with plenty of friendly microorganisms. (Just like in forests and natural systems)
- The soil is always supposed to be covered with organic mulch, which creates humus and encourages the growth of friendly microorganisms.
- Farm made bio-cultures named 'Jeevamrit, Beejamrit etc.' are added to the soil instead of any fertilizers to improve microflora of soil. Jeevamrit, Beejamrit are derived from very little cow dung and cow urine of desi cow breed.
- It holds the promise of enhancing farmers' income while delivering many other benefits, such as restoration of soil fertility and environmental health, and mitigating and/or reducing greenhouse gas emissions.
- The system requires cow dung and cow urine (Gomutra) obtained from Indian breed cow only. Desi cow is apparently the purest as far as the microbial content of cow dung, and urine is considered.
- In natural farming, neither chemical nor organic fertilizers are added to the soil. In fact, no external fertilizers are added to soil or given to plants whatsoever.
- In natural farming, decomposition of organic matter by microbes and earthworms is encouraged right on the soil surface itself, which gradually adds nutrition in the soil, over the period.
- In natural farming there is no ploughing, no tilling of soil and no fertilizers, and no weeding is done just the way it would be in natural ecosystems.
- Natural, farm-made pesticides like Dashparni ark and Neem Astra are used to control pests and diseases.

- Weeds are considered essential and used as living or dead mulch layer.
- Multi-cropping is encouraged over single crop method.

Basic universal principles of Natural Farming

- ✓ **Co - existence in Natural Farming**: It is the state or fact of living or existing at the same time or in the same place. Coexistence is defined as a dynamic but sustainable state in which humans and wildlife co-adapt to living in shared ecosystem, landscapes, where human interactions with wildlife are governed by effective institutions that ensure long-term wildlife population persistence, social legitimacy, and tolerable levels of risk.
- ✓ **Principal of Complementary**: It is the quality of being different but useful when combined form strongest matches. Every living organism complements each other in nature to keep balance of nature intact.
- ✓ **Principal of Diversity**: It is the variations in ecosystems within a geographical location and its overall impact on human existence and the environment. Ecosystem diversity addresses the combined characteristics of biotic properties and abiotic properties.
- ✓ **Principal of crop density:** It is the principle which deals with number of crop, plants species that occurs within a farm unit. Number of plants per unit area in the cropped field is the plant population or plant density.
- ✓ **Principal of Ecology**: It is the principle that deals with relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them.
- ✓ **The Generic Principles that Govern Natural Farming:** A healthy soil microbiome is critical for optimal soil health and plant health, and thereby animal health and human health, use of bio stimulants as Catalyst. Use of local and indigenous seeds and plant varieties, the seeds and varieties should be suitable for specific agro-ecology, so that local soil microbes support their germination and growth.

Soil may be covered with crops for maximum period of the year, 365 days crop cover. The soil across a farm or larger field /collection of fields should have diverse crops, a minimum of 08 crops over the year. The greater the diversity, the better. Minimal disturbance of soils is critical, hence no till farming or shallow tillage is recommended. Animals should be incorporated into farming. Integrated farming systems are critical for promoting Natural farming. Healthy soil microbiome is the key to retaining and enhancing soil organic matter.

Bio stimulants are necessary to catalyze this process. There are different ways of making bio stimulants. In India, the most popular bio-stimulants are based on fermentation of animal dung and urine, and uncontaminated soil. Increasing the amount and diversity of natural residues returned to the soil is very important. These include crop residues, grasses, cow dung etc.

Pest and disease management should be done through better agronomic practices, as treasured in Integrated Pest and disease management and through applications of botanical pesticides, only when required. Use of synthetic fertilizers and other biocides is harmful to this process of regeneration and is not allowed.

As per the farmers who are regularly practising natural farming the following practices has been considered:

Beejamrit.

Jivamrit.

Mulching.

Whapasa.

Plant Protection.

Can be achieved through following specific principles:

- Adoption of diversified cropping system-based agriculture
- Recycling of naturally available nutrients in fields
- Recycling of on-farm generated biomass
- Use of locally developed and refined practices based on plant, animal and microbial source as raw materials
- Innovative practices continuously evolve on the field of farmers based on the cropping pattern, local climatic conditions, altitude, soil quality, severity and variability of insects and pests etc.

CHAPTER 3:

SCOPE AND IMPORTANCE OF NATURAL FARMING. MAIN PILLARS OF NATURAL FARMING; METHODS/ TYPES/ SCHOOLS OF NATURAL FARMING

Scope of Natural Farming

Natural farming, with its emphasis on sustainable and eco-friendly practices, holds significant promise for the future of agriculture and its role in a balanced ecosystem. The scope of natural farming extends far beyond just the fields, offering numerous advantages across various dimensions.

1. Environmental Scope:

Soil Health: Natural farming techniques enhance the organic matter in soil, promoting microbial activity and improving soil structure.

Biodiversity: By avoiding monocultures and chemicals, natural farming supports a diverse range of flora and fauna.

Water Conservation: With practices like mulching and no-till farming, there's a significant reduction in water evaporation, promoting efficient water use.

Reduced Pollution: The absence of synthetic chemicals ensures that waterways and groundwater are not polluted with harmful runoffs.

2. Economic Scope:

Cost Efficiency: Natural farming often requires fewer external inputs, thus reducing costs related to fertilizers, pesticides, and machinery.

Premium Pricing: Produce cultivated through natural farming can often fetch higher prices in niche markets and among health-conscious consumers.

Resilience: With diverse cropping and natural resilience building, farms can better handle market fluctuations and crop failures.

3. Health Scope:

Nutrient-Rich Produce: Crops grown in naturally nourished soil often possess a richer nutrient profile.

Reduced Chemical Residues: The avoidance of synthetic chemicals means lesser residues on food, translating to safer consumption.

4. Social Scope:

Empowered Communities: As natural farming leans on traditional knowledge, it empowers local communities and encourages collaborative efforts.

Connection with Nature: Natural farming promotes a deepened connection between farmers, consumers, and the earth, fostering respect for the environment.

5. Innovation and Research Scope:

New Techniques: As the demand for natural farming grows, there's increasing research on refining techniques, discovering new practices, and integrating traditional knowledge with modern science.

Technological Aids: Modern technology can be employed to support natural farming, from apps that aid in pest identification to tools that help monitor soil health.

6. Global Scope:

Climate Change Mitigation: With its potential for carbon sequestration, natural farming can play a role in global efforts to combat climate change.

Sustainable Development Goals: Natural farming aligns well with several United Nations Sustainable Development Goals, including responsible consumption and production, life on land, and clean water and sanitation.

Importance of Natural Farming:

Ecological Balance: With increasing concerns about environmental degradation, natural farming is essential to maintain and restore ecological balance by prioritizing biodiversity and healthy ecosystems.

Sustainable Agriculture: For agriculture to be sustainable in the long run, we need farming practices that don't deplete the earth's resources. Natural farming emphasizes such regenerative practices.

Health Implications: The rising health issues associated with chemical residues in food highlight the importance of practices that ensure food safety and nutrition.

Resilience in Changing Climate: With the unpredictability brought about by climate change, natural farming builds resilience in crops and soil due to its inherent biodiversity and holistic approach.

Cultural and Traditional Preservation: Natural farming often integrates indigenous knowledge and practices, ensuring the preservation and continuation of invaluable traditional wisdom.

Benefits of Natural Farming:

Improved Soil Health: Natural farming enriches the soil with organic matter, promotes microbial life, and ensures long-term fertility.

Water Conservation: Techniques such as mulching and no-till farming reduce water evaporation and run-off, leading to efficient water use and reduced dependence on irrigation.

Reduced Carbon Footprint: By avoiding synthetic fertilizers and heavy machinery, and through carbon sequestration in the soil, natural farming contributes to lower greenhouse gas emissions.

Economic Advantages: Lower input costs, combined with the potential for premium prices for naturally grown products, can lead to better profitability for farmers.

Biodiversity Enhancement: Diverse cropping systems and the absence of harmful chemicals create a haven for various flora and fauna, fostering a balanced ecosystem.

Healthier Produce: Without synthetic chemicals, food is free from potentially harmful residues, and some studies suggest naturally grown produce may have a richer nutrient profile.

Community Empowerment: Natural farming often involves community-based efforts, leading to strengthened local ties, shared resources, and collective learning.

Reduced Pollution: By avoiding synthetic fertilizers and pesticides, natural farming eliminates a significant source of soil and water pollution.

Resilience to Pests and Diseases: Biodiverse ecosystems are less susceptible to large-scale infestations and diseases, reducing crop loss.

Preservation of Natural Resources: Natural farming practices preserve vital resources like topsoil, clean water, and air, ensuring they're available for future generations.

Four Pillars of Zero Budget Natural Farming:

- **Bijamrita:**

Farmers have been treating their seeds by local cow urine, cow dung and little soil from the bund of the farm or land of the farm since time immemorial (mentioned even in our vedasas well as other ancient literature) This was the traditional method and also a totally scientific method. However, with the advent of chemical agriculture number of fungicides and insecticides have been recommended for treating the seeds before sowing. Also, when the seeds treated with these poisonous chemicals germinate and grow, these poisons are also absorbed by the roots with the soil water solution and are deposited in the body organs of the plants and when consumed, these poisons are transmitted to our body and causes number of diseases and other health conditions. The higher costs incurred on the purchase of these fungicides and other chemicals for seed treatment results in the exploitation of the farmers and also increase the cost of cultivation for the farmers. Hence, under Natural Farming, the seeds are treated with the formulation made from cow urine, cow dung and other locally available material which is equally effective in checking seed borne diseases.

How to prepare Bijamrita?

Materials used: 20 litre water, 5 Kg local cow dung, 5 litre local cow urine, 50 g lime& small quantity of soil from the bund of the farm.

Method:

- ✓ Take 5 Kg local cow dung in a cloth and bound it by tape.
- ✓ Hang this in the 20 Litre water up to 12 hours.
- ✓ Take one litre water and add 50 gm lime in it and let it stabilize for a night
- ✓ Then next morning, squeeze this bundle of the cow dung in that water thrice continuously, so that all essence of cow dung will accumulate in that water.
- ✓ Then add a handful of soil in that water solution and stir it well.
- ✓ Then add 5 litre desi cow urine in that solution & add lime water and stir it well.
- ✓ Bijamrita is then used to treat the seeds which are done by spreading it over the seeds, mixing these seeds by hands, drying it well and use for sowing.

❖ **JIWAMRITA**

It is a fermented microbial culture. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of micro-organisms in the soil as well increases the earthworm activities Jivamrita also helps to prevent the fungal and bacterial plant diseases

Preparation of Jivamrita:

- ✓ Add 10 kg cow dung and 10 litres cow urine
- ✓ Add 2 kg jaggery
- ✓ Add 2 kg of pulse flour and a handful of soil from the bund.
- ✓ Put water to make 200 litres volume in a barrel.
- ✓ Stir the solution well and let it ferment in shade for 48 hours.

❖ **Acchadana (Mulching):**

Mulching promotes humus formations, suppresses weeds and maintains the water requirement of crops. For the proper growth, multiplication and activity of beneficial micro – organisms that are applied through Jivamrita, a favourable definite microclimate is required. In this favourable microclimate the temperature of the soil should be in the range of 25 to 32 °C with 65 to 72 % moisture, darkness and warmth. When we much mulch the soil, this microclimate is created automatically.

There are three types of Mulching:

A. Soil Mulching

B. Straw Mulching

C. Live Mulching

Soil Mulching:

This protects topsoil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil. Therefore, deep ploughing should be avoided.

Straw Mulching:

This application of dried straw biomass of the previous plants or crops as a soil cover in the succeeding crop is called straw mulching. This straw mulch is very important as the seeds are covered by this straw mulch and it saves seeds from birds, insects and animals. It creates a micro-climate which activates the micro-organisms and local earthworms and favourable condition to decompose the organic matter in soil such as roots and to prepare humus in the soil for future new crop.

Live Mulching (Intercrops & Mixed Crops):

Live mulching means that intercrops and mixed crops, which have a symbiotic association with each other. Specific crops, mostly legumes, are grown as intercrops as they help in fixing atmospheric nitrogen and make it available to the main crop.

❖ **Whapasa (Moisture)**

According to Palekar, what roots need is water in the form of vapours. Whapasa is that microclimate in the soil, by which the soil organisms and roots can live freely with availability of sufficient air and essential moisture in the soil. In one sentence, shortly, the Whapasa means the mixture of 50 % air and 50 % water vapours in the cavities between two soil particles. Most of the micro – organisms and root hair (which absorb water and nutrients) are active in the top 10 – 15 cm of soil layer and it is important to maintain Whapasa in that zone of soil.

Types Natural farming:

- Fertility farming
- Organic Farming
- Sustainable agriculture
- Agro- ecology
- Agroforestry
- Eco agriculture
- Permaculture

Fertility Farming

In 1951, Newman Turner advocated the practice of 'Fertility Farming' a system through the use of a cover crop, no tillage, no chemical fertilizer, no pesticides, no weeding and no composting. He also suggested a natural method of animal farming.

Organic Farming

Improper farming practices such as monocropping, imbalanced fertilization, poor soil organic matter management, soil contamination, soil compaction, mining of soil nutrients, water logging, depletion of ground water, decline in soil biodiversity and changing pest and disease complex and application of imbalanced NPK fertilizers ratio of 7.9:3:1 as against normal values of 4:2:1 are the major factors for soil degradation.

Organic farming is the system of production that depends upon the animal manures, organic wastes, crop rotations, legumes, pest control through biological means. It does not allow the use of synthetically produced fertilizers, pesticides, growth regulators and livestock additives. It is the ecological production management system that promotes and enhances biodiversity, biological cycles and biological activities of the soil. The essence of organic farming is to make the soil capable of supplying all the essential nutrients to the crop for its proper growth and development. Organic farming sustains and enhances productivity by improving the soil health and agro-ecosystem. Recently, organic food production is gradually gaining momentum worldwide relying upon the minimal cost of farm inputs and management practices that restore, maintain and sustain ecological harmony. In the organic crop production system, it is found that there is yield drop during the conversion period as it needs certain time for the soil and plants to reach equilibrium. Yield of crops may attain to the satisfactory level once the systems get established. To sustain fertility and productivity of Indian soils there is urgent need to promote liberal application of organic manures by the farmers. India is blessed with various types of naturally available organic form of nutrients but quality of these inputs needs to be improved through Integrated Nutrient Management (INM), Integrated Pest Management (IPM) and Integrated Weed Management (IWM) systems. Integrated Farming Systems make a linkage between organic farming and intensive agriculture (Singh, 2001).

India has brought 4.72 million ha under organic certification processes, including 0.6 million ha of cultivated agricultural land and 4.12 million ha for wild harvest collection in forests, as of March 2014. Sikkim has become India's first fully organic state by implementing organic practices on approximately 75,000 ha of agricultural land. Institutional support for organic

production was created by the launch of the National Program for Organic Production (NPOP) by the Agriculture and Processed Food Export Development Authority (APEDA), Ministry of Commerce. The NPOP supports promotional initiatives, accreditation of inspection and certification agencies, and offers support to agri-business enterprises to facilitate export. APEDA has been interacting with the European Union (EU), the United States Department of Agriculture (USDA), Japan, and IFOAM for recognition of equivalence of the Indian quality assurance system.

Major destinations for organic products from India are the U.S., the EU, Canada, Switzerland, Australia, New Zealand, South-East Asian countries, West Asia, and South Africa. Soybean comprised 70% of the commodities, and products exported followed by cereals and millets other than basmati rice (4%), sugar (3%), tea (2%), pulses and lentils (1%), dry fruits (1%), and spices (1%).

Organic farming is growing rapidly among Indian farmers and entrepreneurs, especially in low productivity areas, rain-fed zones, hilly areas, and the north-eastern states, where fertilizer consumption is less than 25 kg $ha^{-1}year^{-1}$. Nine states in India have promoted policies and programs on organic farming. Uttarakhand has made organic a thrust for improving its mountain agriculture farm economy and livelihood. Mizoram and Sikkim declared their intentions to move to total organic farming. Karnataka has formulated organic policies, and Maharashtra, Tamil Nadu, and Kerala have supported public-private partnerships for the promotion of organic farming.

There are the four principles of organic farming namely Principle of health, Principle of Ecology, Principle of fairness and Principle of care. Major advantages of organic farming are nutritional, poison free and tasty food, low growing cost, enhancement of soil nourishment, more energy efficient, more carbon sequestration, less water pollution and ecofriendly practices.

Important steps for organic production include:

- 1-3 years conversion period.
- Farm designing with the cattle shed, compost yard, storehouse, multipurpose border trees, fodder shrubs, grasses and legumes and farm diversification by keeping apiculture, dairy farming *etc*.
- Land management with well decomposed FYM @ 10-15 t
- ha^{-1} or vermi-compost @ 2-5 t ha^{-1}.

- Choice of crops and varieties which are naturally resistant to insect pests and diseases.
- Nutrient management with organic recycling, enrichment of compost, vermicomposting, animal manures, urine, farm yard manure, litter composting, use of botanicals, green manuring *etc*. Biofertilizers like Azolla, Azospirillium, Azotobacter, Rhizobium culture, PSB, saw dust, calcified seaweed, limestone, gypsum, chalk, magnesium rock and rock phosphate, liquid sprays *etc*.
- Weed management manually or with rotary weeder and practice of intercropping, mulching, crop rotation and growing of cover crops.
- Soil and water conservation with mulching, preparation of half-moon terraces, bench terraces, contour bunding, planting of double row of herbaceous fruits crops across the slope and fruit trees on the contour line, use of drip irrigation system for high value fruit crops and construction of water storage tank (Jalkund).

Indigenous Technical/ Traditional Knowledge (ITK)

Indigenous Technical/ Traditional Knowledge (ITK) is an accumulated intimate knowledge of farmers environment comprising land, water, tree, plants, animal *etc*. and they have found solutions to manage the problems by taking series of decision and implementing them by allocating resources in efficient manner. This knowledge consists of many facts and helped them to evolve many practices which have been tested over long periods of time and proved beneficial. They depend entirely on locally available resources and knowledge base for maintaining productivity of crops and livestock. In the modern developmental efforts, knowledge of such indigenous practices provides valuable inputs to make efficient use of natural resources. Such components can be incorporated for the development of sustainable farming system and practices (De, 2021).

- Cucurbit seeds are kept embedded in fresh cow dung ball which then buried deep in soil for better germination (Musara and Chitamba, 2014).
- In desert areas, Chickpea is sown behind camel drawn plows in sand dune area.
- Cut ends of sugarcane sets are plastered with a mixture of honey, ghee, the fat of hogs and cow dung.
- In Rajasthan, soil fertility is renewed by using FYM (cowdung, sheep, goat and camel faecal pellets), wood ash, animal urine, growing nitrogen fixing leguminous crops intermixed/ intercropped with cereals/ oilseeds, allowing certain local weeds and xerophytic plants *viz*. bui (*Kochia indica*), fog (*Caligonum polygonoids*), Kheinp

(*Crotalaria burhia*), bordi (*Zizyphus manuritiana*) to grow undisturbed and maintaining adequate khejri (*Prosopis cineraria*) tree population (8-12 trees ha^{-1}) in the field.

- Ancient Tamil test widely quoted the use of *Calotropis gigantea*, *Morinda tinctoria*, *Thespesia populnea*, *Jatropha gossypifolia*, *Ipomoea* spp. and *Adhatoda* spp. to be used as green leaf manure. Ancient agriculturists relied on crop rotation and intercropping to restore soil fertility. Fauna including ants, earthworm and frogs were used to improve soil physical properties. Composting practices have also been documented in ancient literature on ideal farming practices.
- In Sikkim, rotten forest litter or organic matter rich top soil is used to put into grooves or rock over potato seed or farmers use forest litter as bedding material for compost production.
- In Nepal, farmers bury dead animal and use toilets as an integral part of soil fertility management.
- In Karnataka, Vetiver grass (*Vetiveria zizanoides*) is planted along farm boundaries and bunds to conserve soils. Ancient dynasties from Mauryans to Mughals evolved various systems for soil water management such as anicuts, earthen dams, field bunds, checks dams, canals, tanks, pound wells and reservoirs.
- In Gujarat, the most common practices followed by the farmer to conserve soil moisture are summer tillage, field boundary bunds with vegetative cover and intercultural operations. In Arunachal Pradesh, Farmers protect springs from flooding and encroachment of livestock. They maintain water sources by using locally available materials mainly stone, wood, bamboo, soil *etc*.
- In the hills, natural perennial streams are the main source of water for domestic and irrigation uses. The drip irrigation using bamboo is practiced by farmers in Jaintia hills of Meghalaya to irrigate arecanut and betelvine grown on steep hill slope with bouldary soil.
- In Sikkim, rice and maize cultivation on terraces are practiced since long time. This method controls surface run off and prevents rill formation and controls the advancement of already existing gullies.
- In some parts of Rajasthan (Jaipur, Sikar), farmers use smoke from mixture of half-dried cowdung + shell of peahen egg + dried cow horn to control fruit rotting and fruit

dropping in cucurbits, chilli and mango.

- To check frost damage in chickpea and mustard, crop dried parts + straw is half burnt near crop boundary to create smoke during night.
- A rope is passed over the chickpea crop in the early hours of day to disturb the dew which in turn to check the frost damage.
- In paddy, spray with a solution of cowdung prepared by mixing 3 kg cowdung in 3 litres of water was effective against the control of paddy blast and bacterial blight.
- In case of bunchy top disease in chillies, dusting of ash, spray of butter milk, spray of liquid waste of tanned leather and spray if cow/ goat urine was recorded in the tribal areas.
- Some farmers used to apply fresh cowdung near the collar region of chilli to control fungal disease *viz*. damping off and dieback.
- In case of soil diseases, root rot, collar rot, the castor cake, karanj cake or neem cake were used as control measures.
- The milk solution (1 litres milk in 9 litres of water) is effective to control powdery mildew and viral diseases.
- 20 kg of *Casuarina equisetifolia* leaves boiled in water for 20 min. After cooling, the solution should be filtered. Then the extract will be diluted with water and can be given to control some bacterial and fungal diseases.
- The wheat seeds are soaked in the milk before sowing to avoid diseases.
- Prepare solution from 2 kg fresh leaves of papaya in 3 to 4 litre of water and keep it overnight. After filtration, this is diluted with 50-60 litres of water and 250 ml soap solution added to it, is effective to control brown spot disease of paddy.
- Cultivation of marigold followed by solanaceous vegetable crop is effective to control bacterial diseases.
- Leaves of Khair (*Acacia catechu*) can be put into water channel to control brown spot disease of paddy.
- Application of wood or cowdung ash on foliage of vegetables *e.g.*, Chilli, Onion and Cucurbits to prevent insects such as thrips and aphids is a common practice.
- 4 kg tobacco leaves and twigs are boiled in 40 litres of water for 40 min. After cooling, one kg soap powder is mixed and solution is diluted 7-8 times and sprayed to control

aphids and white files in kinnow and other citrus plants.

- Smoke created by putting sulphur over hot cowdung has been reported to kill/ repel aphids and other sucking pests of mango.
- Maize seeds are soaked in cow urine for 10-12 hours before sowing. According to farmers, this treatment increases resistance against insect pests.
- Rice seedlings raised from seed treated with extract of neem kernel are resistant to leaf hopper.
- In paddy, spraying a solution of 4 litre of cow urine and 10 g asafoetida in 10 litres of water repel aphids and jassids.
- For prevention of infestation of shoot borer in mango tree, common salt is mixed with soil near the collar region of tree.
- In case of insect holes made by shoot borer and bark eaters in mango, jiggery is placed in the holes to attract other predators so that they kill feed upon the insert present in the hole. Similarly, the practices of pouring Kerosene or Petrol in holes and blocking holes with mud or cowdung are also common in citrus plants.
- In Arunachal Pradesh, farmers believe that the use of cowdung slurry can protect crops from aphid attack and as repellent to cutting and biting insects and animals. Cattle urine has successfully used against thrips, mites, aphids and caterpillars. Application of extracts prepared from the parts Sisnu (*Urtica* spp.) and fruits of Timuz (*Zanthoxylum armatum*) plants are used to control many kinds of chewing, biting and cutting insects. Leaf and leafy extracts of Chinese berry (*Melia azadirachta*) controls various kinds of insects.
- In Arunachal Pradesh, Padam Minyong Adi society observes different rituals when field crop is attracted by pests' diseases. In one of the rituals, an alter is erected by using small branches of selected trees, leaves of Talo, Kow, and bamboo tumbler in one of the corners of the field. Near the altar, 10-15 big containers of Apong (a local drink), sufficient quantity of rice, small pieces of fresh cut ginger and one red coloured cock are offered to Goddess of crops of kine- nane. The Adis of pasighat area perform another ritual Irrii whenyoung paddy plants just grow up. Likewise, the Galo-Adi society performs Ampu-yolu ritual for the protection of their crops from pests and diseases. The Adi tribes of Basar, West Siang District, Arunachal Pradesh offer four worship during the Kharif season:

- *Dibin*: Worship (Puja) after sowing of paddy for better germination .This worship is done during the months of February-March. During the worship day poultry birth are offered to the Goddess and no one enters the paddy field on that day. It is believed that the person who will enter the field on that day, his crop will not perform better.
- *Tachi*: Worship for control of pests in maize. This is done in the month of May-June. Pigs or poultry birds are sacrificed to Goddess and there is a ban to enter the field on that day.
- *Ampu*: This is an important worship of Adi tribes of Arunachal Pradesh. It is done to control the insect-pest problem in Jhum rice as well as wet land rice. It is done for two days. During these two days, no one enter the crop filed. Sacrifice of pig is a must in this worship.
- Mari: This is the worship of Goddess Laxmi after the harvest of the paddy crop. This is done in the months of November–December. Like Ampu sacrifice of pig is compulsory in this puja.
- Green gram can be kept free from any pest infestation by treating with 1% neem leaf powder.
- Leaves of lakki (*Vitex negundo*) are incorporated in any pulse seeds for long time preservation.
- There is a common practice of storing food grains in wheat or barley straw to prevent storage pest damage.
- A layer of sand (5-7 cm) is effective to protect pulses from beetle attack.
- Pulses mixed with little cowdungs powder in earthen post can be stored for long time.
- Seed mixed with *Acorus calamus* (Baje) powder in the ratio of 10:1 kg, respectively would help in preserving the seeds free from stored pests for long time.
- Milled chickpea, green gram and others pulses are stored after thoroughly treated mustard oil.
- In Rajasthan, garlic leaves are used for safe storage of food grains.
- Fishing is an exotic origin among Adis of Arunachal Pradesh. There are altogether 32 different fishing techniques adopted by tribes only. Out of them, Hib Rinam is more harmful to aquatic life. Rilen Minnam, Hibok Pena, Hill Monam and Hibok Tumnam are harmful and Likam Panam, Liru Hinam, Ngou Paanam and Ngoi Tumnam are

harmful. Other techniques are completely harmless to aquatic life.

Sustainable Agriculture

It seeks to sustain farmers, resources and communities by promoting farming practices and methods that are profitable, environmentally sound and good for communities. Five components of sustainable farming are soil management, crop management, water management, disease/pest management and waste management. Three main pillars of sustainable agriculture are environmental, social and economic. Principles of sustainable agriculture includes improving the efficiency in the use of resources, conserving, protecting and enhancing natural ecosystems and protecting and improving rural livelihoods and social wellbeing.

Diversified Farming System is an important tool for enhancement of agricultural growth by promoting food and nutritional security, income and employment generation, poverty alleviation, judicious use of natural resources and ecological environments.

Agroecology

This is the study of ecological processes applied to agricultural production systems. It is the study of interactions between plants, animals, humans, and the environment within the agricultural systems. It would be organic, regenerative, integrated or industrial, intensive of extensive agriculture. The system properties of agro-ecosystems include productivity, stability, sustainability and equitability.

Agroforestry

Agroforestry is a dynamic and eco based natural resource management practice through integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefit. Agroforestry farming systems are means of increasing and sustaining agricultural productivity as a source of essential food, fuel wood, fodder and building material and as a supplementary source of income that buffers instability in agriculture income. Traditional agroforestry systems include jhum cultivation, taungya cultivation, trees on farm lands, agri-silviculture, shelterbelts, silvi-pastoral systems, trees on farm boundary, home gardens, plantation crops or commercial agroforestry systems. Trees incorporated in farming systems have the following benefits:

- They provide marketable products such as timber, building poles, firewood, animal fodder, fruits and medicines to earn extra income.

- They improve soil fertility by fixing nitrogen from the air and recycling nutrients from the soil and thereby increase crop yields.
- They help to hold moisture during hot winds during summer, reduce soil erosion and downstream flooding.
- They provide a sustainable source of wood and building materials.
- They serve as live fences in semi-arid regions protecting from biotic interference.
- They increase above and below ground ecosystem biodiversity and help in improving global climate change by sequestering carbon in their biomass as well as in the soil.

Agro-Forestry Systems and Soil Fertility

In agroforestry systems, nutrient absorbed by the roots from deeper soil layer add in upper surface of soil through leaf litter. Tree roots harbour many beneficial organisms and enhance microbial activity in the rhizosphere of roots. Nutrient cycling is another means in which trees draw large portion of absorbed nutrients from deeper soil layer in returned to the soil through crown wash, stem flow and leaf fall. The accumulated litter after decomposition releases nutrients for reuse by tree stand. In organic matter addition to soil, tree roots play vital role and about 25% of total living biomass of the trees. Quick growing nitrogen fixing trees when combined with herbaceous crops enhance fertility status of soil through litter contribution and nitrogen fixation.

Agro-Forestry Systems and Soil and Water Conservation

Himalayan regions are characterized by marginality, inaccessibility, high intensity rain fall, steep slopes, large scale deforestation and faulty management practices. Natural resources face great stress due to mounting human and livestock pressure. The frequent natural disasters like landslides, floods, droughts and deterioration of water bodies due to enhanced deforestation, conversion of marginal land or forest land into agriculture and unscientific developmental activities further aggravate the problem. Soil erosion is the major bottleneck in cultivation. High intensity precipitation in the rainy season causes excessive run off and soil loss. Due to loss top soil, the crop yields in the region are low as well as variable. Therefore, prominent agroforestry interventions have played important role in conserving soil and water and arresting environmental degradation in the region. Alley cropping and vegetative barriers with *Leucaena leucocephala*, *Vetiveria zizanioides*, Guinea grass and *Panicum maximum* are well accepted by the people for reducing soil and water loss.

Agro-Forestry Systems for Food and Nutritional Security

Agri-Horticulture

This system can provide sound farm economy, improved nutrition and health standards for the family and stability of income. In arid regions, fruit crops like ber, pomegranate and aonla and intercrops like moong bean, mothbean and cluster bean are grown every year. In semiarid locations, mango, sapota, guava, tamarind, cashew nut, jackfruit, phalsa, wood apple, passion fruit are suitable alternatives for the systems. For hilly regions, fruit crops such as citrus, peach, plum, pineapple and intercrops like ginger, turmeric, french beans, cucurbits, radish etc are grown every year.

Silvipasture

Silvi-pasture woody perennials provide a fodder protein bank. Trees and bushes supply green fodder in rainy season when grasses are not available. These systems are most suitable for degraded lands and for areas facing acute shortage of fodder. Suitable species for silvi-pastoral systems are given below:

(a) Trees, shrubs, grasses and legumes for salt affected areas:

Trees and shrubs: *Leucaena leucocephala, Acacia nilotica, Dendrocalamus strictus, Dalbergia sissoo, Albizzia lebbek, Prosopis julifera, Terminalia arjuna, Azadirachta indica*.

Grasses and legumes: *Chrysopogon fulvus, Cenchrus ciliaris, Pennisetum pedicellatum, Saccharum spontaneum, Dicanthium annulatum, Phaseolus atropurpureus, Stylosanthes* spp.

(b) Trees, grasses and legumes for semi-arid regions:

Trees: *Acacia* sp., *Ailthes excelsa, Albizia* sp., *Azadirachta indica, Dalbergia sissoo, Leucaena leucocephala, Prosopis julifera, Zizyphus mauritiana*.

Grasses: *Chrysopogon fulvus, Cenchrus ciliaris, Pennisetum pedicellatum, Panicum maximum*.

Legumes: *Stylosanthes hamata, Stylosanthes scabra, Clitorea ternatea*.

(c) Trees, grasses and legumes for arid regions:

Trees: *Prosopis julifer, Prosopis cineraria, Acacia tortilis, Acacia raddiana, Acacia senegal, Zizyphus mauritiana*.

Grasses: *Panicum turgidum, Panicum antidotale*

(d) Trees, grasses and legumes for hill regions:

Trees: *Gmelina arborea, Morus laevigata, Gliricidia maculata, Pinus kesiya, Alnus nepalensis, Erythrina indica, Moringa oleifera*

Grasses: *Thysolema maxima, Napier grass, Stylosanthes* spp.

Legumes*: Phaseolus vulgaris, Vicia faba, Vigna* spp.

Agri-Silvi Culture

The intercropping of annual food crops and woody perennials in a land use systems enhances productivity and ensure sustainability. At the same time, it helps to stabilize slopes, minimize erosion and fulfill the farm needs for fuel wood, poles, small timber, fruits and nuts or organic manure and fodder.

Agro-Forestry Systems for Human Health and Climate Change

Human Health

Herbal medicines play an important role in alleviating diseases and disorders in tribal and rural areas. In Africa, *Prunus domestica* has been domesticated the bark of which is highly valued for prostrate disorders. Another multipurpose tree, *Warburgia ugandensis* found in the low land rainforest and upland dry evergreen forest of Africa, the bark, root and leaves of which are valued for treatment of malaria.

In India, cultivation of medicinal plants like neem (*Azadirachta indica*), aonla (*Emblica officinalis*), Hara (*Terminalia chebula*), Bahera (*T. belerica*), Bel (*Aegle marmelos*), Mahua (*Madhuca latifolia*), Mentha, Aloe, Tulsi, garlic, imli, sanai, *Terminalia arjuna etc*. in different agroforestry models have made tremendous effect in improving health and economic viability of rural people.

Climate Change

Agroforestry has dual advantages storing carbon through enhancing build up of soil organic matter and by adding leaf and root biomass that would pool more carbon dioxide out of the air. Poplar shows some of the highest carbon dioxide exchange rates and photosynthetic capacities among woody plants. This tree forms a unique combination with agricultural crops for carbon

sequestration in the atmosphere. Similarly, usage oils of *Jatropha curcas* as biofuel help in mitigating the effect of global warming.

Agro-Forestry and Biodiversity Conservation

In India, it is estimated that biological diversity has more than 45,000 plant species and 81,000 animal species covering about 7% of the world flora and 6.5% of world fauna. Agroforestry interventions contribute to biodiversity conservation through integrated conservation development approach. It helps in improvement in new varieties and population. In north east India, polyculture of indigenous trees and crops form a multi strata system like a natural forest.

Agroforestry Systems and Shifting Cultivation

Shifting cultivation is practiced in 2.4 mha in many parts of India. The prevalence of shifting cultivation with short cycle, raised bed along the slopes and pervasive deforestation has led to degradation of soil, water, flora and fauna in these areas. Agroforestry has a long tradition plays an important role to improve livelihood security through higher income and creating more employment in addition to reduce the soil erosion and deforestation.

Eco-Agriculture

This ensures healthy farming and healthy food. It protects the soil, the water and the climate. Ecological farming rejects genetically modified crops, chemical fertilizers and pesticides. Eco-farmers limit insect damage to their crops by avoiding large monocrop plantation and preserving ecosystem diversity. It restores soil nutrients with natural composting systems. These types of farming take advantages of natural ecosystem services, such as water filtration, pollination, oxygen production and disease and pest control.

Permaculture

This is an approach to land management and settlement design that adopts arrangements observed in flourishing natural ecosystems. It is an agricultural system or method that seeks to integrate human activity with natural surroundings so as to create highly efficient self-sustaining ecosystems. Examples include buildings that support outside plant life, backyard and balcony gardens and energy saving green initiatives such as the installation of gray water reclamation systems. Three ethical principles of permaculture are *Care of Earth*, *Care of People* and *Return of Surplus to Earth and People*.

CHAPTER 4:

INTRODUCTION TO CONCEPT OF ECOLOGICAL, WATER, CARBON AND NITROGEN FOOT PRINTS, CONCEPT AND EVALUATION OF ECOSYSTEM SERVICES

Ecology

Is the study of the relationship between living organisms, including humans and their physical environment, it seeks to understand the vital connections between plants and animals and world around them.

Ecology is the study of organisms and how they interact with environment around them; it's a relationship between living things with their habitats.

Agroecology is a dynamic concept that contributes to transforming food systems by applying ecological principles to agriculture and ensuring a regenerative use of natural resources and ecosystem services while also addressing the need for socially equitable food systems. Agroecology embraces a science, a set of practices and a social movement and has evolved over recent decades to expand in scope from a focus on fields and farms to encompass whole agriculture and food systems. It now represents a transdisciplinary field that includes all the ecological, sociocultural, technological, economic and political dimensions of food systems, from production to consumption.

Agroecology is a transdisciplinary science, combining different scientific disciplines to seek solutions to real world problems, Initially the science was focused on understanding field- level farming practices that use few external inputs but high agrobiodiversity, emphasize recycling and maintenance of soil and animal health, including managing interactions among components and economic diversification. The focus has since expanded to include landscape-scale processes, encompassing landscape ecology and, more recently, social science and political ecology related to the development of equitable and sustainable food systems.

A carbon footprint is a crucial metric that quantifies the total greenhouse gas (GHG) emissions associated with an individual, organization, event, or product. These gases, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), contribute to global warming and climate change. It is calculated by summing the emissions resulting from every stage of a product or service's lifetime (material production, manufacturing, use, and end-of-life).

What Contributes to a Carbon Footprint?

Direct Emissions: These occur from burning fossil fuels for transportation, heating, and manufacturing. For instance, driving a car or using natural gas for cooking releases CO_2 directly into the air.

Indirect Emissions: These are associated with the production and consumption of goods and services. For example, the electricity used to power your home or the manufacturing process of the products you buy also contributes to your carbon footprint.

What Is a Water Footprint?

A water footprint is an essential indicator that considers both direct and indirect water use by consumers and producers. It quantifies the total volume of freshwater required to produce the goods and services consumed by individuals, communities, or businesses. Currently estimated at 9 trillion tons per year, this staggering volume represents almost 300,000 tons of water per second.

A **nitrogen footprint** is the amount of reactive nitrogen that enters the environment through human activities minus the nitrogen that is prevented from entering the environment."

1. Cover crops

Covering soil with live crops is one of the key practices that build soil in less time by adding carbon to the soil, besides giving additional income from the crops. Live crops increase soil carbon in a short time through a phenomenon called rhizodeposition (releasing of photosynthates through the root hairs into soil). For all the living organisms, energy is obtained by consuming food. Plants are the primary producers of food (by means of photosynthesis) and every other organism derives energy by consuming food prepared by plants eventually. The food material (carbon substances) is prepared by plants by using CO2 gas from the atmosphere. Around 40% of the food material is utilized for shoot development, around 30% is utilized for root development and the remaining 30% is released into the soil from the root hairs. This process is called rhizodeposition. These root exudates start the soil food web in the soil. The quantity of residues exuded from roots is more while the crop is in vegetative stage. A portion of these exudates, being rich in carbon also convert to soil organic carbon which contributes to

a) Improved soil biology

b) Better soil structure resulting in improved water holding capacity of the soil;

c) Better infiltration capacity of the soil;

d) And improved root ability of plant roots to easily grow deep in such soil.

For these benefits, soil should be ensured of living-roots throughout the year so that Soil organic carbon continuously increases. When these roots exudate from the root systems spreading into various depths, the depth of soil getting this carbon pumped in increases and soils quickly improve. The root exudates that are released it is estimated that the rate of soil organic carbon increase is 5-30 times faster in the soil compared to the addition of organic residues in the soil. In order to ensure crop cover, strategies to fill fallow periods need to be done with the help of proven practices like PMDS (Pre-Monsoon Dry-Sowing) and Year-long crop cover.

PMDS (Pre Monsoon Dry Sowing)

- Diverse crop seeds pelletized with clay and bio stimulant to be sown with minimal moisture from rain or irrigation the seeds germinate and establish themselves.
- Provide a thick organic mulch.
- In this manner, it's possible to establish a crop cover with less resources.
- Foliar application of liquid bio stimulants ensures crop growth.
- Greater the seed diversity greater are the results for the development of organic carbon content in the soil.
- Leafy vegetables, vegetables, fodder, can be sowed in PMDS cropping.
- Some biomass may be used as cattle fodder, harvesting the above ground portion of the crop. Keeping the roots intact in the soil.
- Balanced biomass may be incorporated into the soil.

2. Crop diversity

Ensuring diversity while growing crops is very important for the following reasons:

a) Diverse food available for consumption b) Different root depths of root systems of different crops improve the depth of Soil quickly c) Crop losses due to specific insects, diseases is minimized d) Pest build up in slowed down or stopped in fields with diverse crops e) Productivity (yield) of whole land increases with increase in diversity.

Crop diversity increases the total yield (in terms of biomass) of the land. The experimental results say that diversity should be minimum from 4 different plant groups, and a minimum of 12 crop species at any given time. Each crop has specific microbial associations with their roots in the soil. Ensuring diversity of crops ensures microbial

diversity in the soil also. Above ground diversity reflects soil microbial diversity. Crop diversity should be planned taking into account the plant species that provide (i) income potential from various short to long duration crops (2) organic residues in large amounts (3) fodder sources (4) protection to soil by covering it and holding the soil together for longer periods.

3. No/low tillage

Tillage is a practice that is done generally to loosen up the soil to absorb rainwater and allow seeds to grow roots deeper. But this practice harms the soils in many ways as follows:

a) Very valuable soil carbon is escaped into the soil as a gas by means of oxidation Process

b) Soil structure is destroyed and soil becomes powdery leading to sealing of pore Spaces after rains leading to more compaction

c) Compact soils cannot support crop roots to grow deeper; and have less water Holding capacity to support crop growth

d) d) Soil biology is affected as soil carbon is getting reduced.

The following results will be obtained if a soil is not tilled.

a) Due to activity of crop roots, earthworm activity and other insects' activity, the tunnels created will become strong overtime if they are not destroyed by tillage

b) The tunnels allow lot of water to absorb into soil and reduce run off.

c) The tunnels will help crop roots to grow deeper very easily and – provides better anchorage to plants in times of floods, allows roots to access nutrients and water from deep layers. Deep summer ploughings cause a lot of oxidations of soil organic carbon.

Every farmer is being encouraged to develop farm models that will have permanent trees integrated with crops and will not involve land preparation or intercultural operations that involve tillage every season.

4. Integrate animals

In nature, trees and animals depend on each other to grow. In NF practices, it is important that crop planning should include fodder crops, and also integrate animal (buffaloes or cows) by-products (such as dung and urine) to be used in the preparation of NF inputs (like Jeevamrit, Beejamrit, etc) in agriculture crop production. In situations where a PMDS (Pre-Monsoon Dry-Sowing) crop is being grown for green manuring purposes,

allowing cattle to graze in the fields is much better than incorporating the crop in the soil. Cattle will eat healthy grown fodder. Incorporating PMDS crops in soil leads to loss of valuable carbon in plant matter up to 90% in the decomposition process.

5. Bio-stimulants

Bio stimulants are materials (other than fertilisers) that promote plant growth when applied in small quantities. Plants and animal by-products have some substances that are acting as bio stimulants. In NF, Beejamrit, Jeevamrit, etc are used in small quantities which are giving very good results. Bio stimulants are made up of a variety of biological substances, microorganisms, and compounds that can be applied directly to plants, seeds, or soil to improve a plant's Vigor, increase crop yields, and relieve plant stress. The use of bio stimulants can start in the seed germination phase and continue throughout the plant's life cycle. Bio stimulants work by enhancing the plant's ability to absorb nutrients so it can develop properly. When applied to soil, bio stimulants improve the soil's complementary microbes that help a plant's roots thrive and form a beneficial symbiotic relationship. Plants benefit from bio stimulants by creating higher yields, stronger growth, enhanced water absorption, better overall appearance, and an improved tolerance for heat, dry spells, pests, diseases, and transplanting shock, etc.

Normally in conventional agriculture, crop residues are seen as sources of plant nutrients and that's why they are composted and applied to soil; and also, FYM is seen that way and is applied in large quantities. But in NF, only small quantities are being used. Bio stimulants are all natural and biologically derived. Examples of bio stimulants – Beejamrit, Jeevamrit, Saptadhanyankura tonic, etc.

6. Addition of diverse organic residues

Besides a live crop, having organic residues spread on soil as a mulch is very beneficial.

Mulch provides the following benefits:

- Avoids compaction of soil caused by beating action of rain
- Protects soil from the heat of the sun and it helps retain more soil moisture, and provides better living conditions for the soil organisms.
- The nutrients and water in the residues locked in the residues are gradually released into soil upon decomposition

- During rains, presence of mulch on soil surface reduces the erosion of soil and reduces runoff of rainwater.

Applying 2-3 inches of (or around 2-3 tons/acre) crop residues as mulch is recommended as it is giving required benefits. Using rice husk has given bad feedback from farmers and is not recommended for use as mulch. Diversity of organic residues need to be maintained. It is important to note that the main advantage of adding organic matter is to improve soil biology and protect soil, and not as a source for providing nutrients.

7. No use of agrochemicals (fertilisers, insecticides, fungicides, weedicides, etc.)

Agrochemicals are the chemicals used in agriculture like fertilisers, insecticides, fungicides, weedicides, etc. These chemicals work in a way to meet the temporary need for the crop without working along with nature and living things in the agriculture ecosystem. For example, fertilizers provide nutrients directly to plant by harming soil structure and soil biology; pesticides try to kill all insects including beneficial ones and leave harmful chemical residues in food products, water and soil.

ECOSYSTEM SERVICES

An ecosystem is a group or community composed of living and non-living things and their interactions with each other. It is a dynamic complex of biotic components and abiotic components. These biotic and abiotic interactions maintain equilibrium in the ecosystem. We as humans are an integral part of it. The numerous benefits we obtain from the ecosystem are known by the term ecosystem services.

The earth is home to millions of species. Every organism depends on one or another organism for energy, survival, and other life processes. This dependence of organisms on one another and their surroundings forge an interacting system called ecosystems. The interactions among different components of ecosystems are fundamental to a well-defined environment.

As a part of an ecosystem, humans derive lots of benefits from the biotic and abiotic components. These benefits are collectively termed as ecosystem services. Life and biodiversity on earth depend on these services. For example, Wetlands provide fresh, clean water, regulate pollution, and reduce climate risk and uncertainty for people, agriculture and aquaculture (fisheries). They are also hotbeds of biodiversity and are home to a vast range of animals, especially bird species.

Some examples of ecosystems are:

1. Deciduous forest ecosystem- A deciduous forest is characterised by trees that shed their leaves annually and renew them at the beginning of the next growing season. They shed leaves as an adaptation to the cold season in temperate climates or the dry seasons in subtropical and tropical climates.

2. Savannah ecosystem- Savannah ecosystems combine woodland and grassland elements. Light can penetrate and reach the ground thanks to the widely spaced, scattered canopy trees. As a result, grass-dominated shrubs and herbaceous strata are able to develop abundantly as well.

3. Coral reef ecosystem- The coral reef is an ecosystem formed by corals that build reefs. Coral reefs are groups of coral polyps, such as stony corals, that live together in colonies. They are one of the world's most diversified ecosystems. As a result, they're known as the sea's rainforests.

4. Hot spring ecosystem- A hot spring is one with water temperatures that are higher than the ambient temperature. The water from the spring is geothermally heated, meaning it is heated by the earth's mantle.

5. Micro-ecosystems- Micro-ecosystems are ecosystems that are confined to small or microscopic spaces yet are determined by unique environmental conditions. Consider the environment of a tree. A tree produces a miniature ecosystem that is home to a variety of species. Lichens and other epiphytes, for example, may be found on a tree (arboreal plant).

Ecosystem services are classified into four types:

Provisioning Services

This includes the products/raw materials or energy outputs like food, water, medicines and other resources from ecosystems. Ecosystems are a source of food, water, medicines, wood, biofuels, etc. Also, they provide conditions for these resources to grow.

Regulating Services

This includes the services which regulate the ecological balance. For example, terrestrial environments like forests purify and regulate air quality, prevent soil erosion, and control greenhouse gasses. Biotic components such as birds, rats, frogs, act as natural controllers and thus help in pest and disease control. Hence, ecosystems act as regulators.

Supporting services

Supporting services form the basis for other services. They provide habitat for different life forms, retain biodiversity, nutrient cycling, and other services for supporting life on the earth.

Cultural services

It includes tourism; provides recreational, aesthetic, cultural and spiritual services, etc. Most natural elements such as landscapes, mountains, caves, are used as a place for cultural and artistic purposes. Even a few of them are considered sacred. Moreover, ecosystems provide enormous economic benefits in the name of tourism.

ECOSYSTEM SERVICES FLOWING TO AGRICULTURE

The production of agricultural goods is highly dependent on the services provided by neighbouring natural ecosystems, but only recently have there been attempts to estimate the value of many of those services to agricultural enterprises. Some services are more easily quantified than others, to the extent that they are essential to crop production or they substitute directly for purchased inputs.

(a)Biological pest control

Biological control of pest insects in agroecosystems is an important ecosystem service that is often supported by natural ecosystems. Non-crop habitats provide the habitat and diverse food resources required for arthropod predators and parasitoids, insectivorous birds and bats, and microbial pathogens that act as natural enemies to agricultural pests and provide biological control services in agro ecosystems. These biological control services can reduce populations of pest insects and weeds in agriculture, thereby reducing the need for pesticides. Because the ecosystem services provided by natural enemies can substitute directly for insecticides and crop losses to pests can often be measured, the economic value of these services is more easily estimated than many other services.

(b)Pollination

Pollination is another important ecosystem service to agriculture that is provided by natural habitats in agricultural landscapes. Approximately 65 per cent of plant species require pollination by animals, and an analysis of data from 200 countries indicated that 75 per cent of crop species of global significance for food production rely on animal pollination, primarily by insects. Of the most important animal-pollinated crops, over 40 per cent depend on wild pollinators, often in addition to domesticated honeybees. Only 35–40% of the total volume of food crop production comes from animal-pollinated crops, however, since cereal crops typically do not depend on animal pollination. Based on data from the United Nations Food and Agriculture Organization (FAO) on the production of 87 globally important crops during 1961–2006 it is estimated that the consequences of a complete loss of pollinators for total global agricultural production would be a reduction of 3–8%. The percentage increase in

total cultivated area that would be required to compensate for the decrease in production was much higher, particularly in the developing world where agriculture is more pollinator-dependent.

Like biological control, pollination services are more readily quantified than many other services. Early estimates of the value of pollination services were based on the total value of animal-pollinated crops, but recent estimates have been more nuanced. Since most crops are only partly dependent on animal pollination, a dependence ratio or a measure of the proportion reduction in production in the absence of pollinators can provide a better approximation of production losses in the absence of pollinators. Clearly, these estimates are also fairly crude and intended to provide a broad brush assessment of potential economic benefits.

(c)Water quantity and quality

The provision of sufficient quantities of clean water is an essential ecological service provided to agroecosystems, and agriculture accounts for about 70 per cent of global water use. Perennial vegetation in natural ecosystems such as forests can regulate the capture, infiltration, retention and flow of water across the landscape.

Water availability in agroecosystems depends not only on infiltration and flow, but also on soil moisture retention, another type of ecosystem service. While the supply of surface water and groundwater (‘blue water’) inputs to agriculture through irrigation are indispensable in some parts of the world, 80 percent of agricultural water use comes from rainfall stored in soil moisture (‘green water’). Water storage in soil is regulated by plant cover, soil organic matter and the soil biotic community (bacteria, fungi, earthworms, etc.).

Trapping of sediments and erosion are controlled by the architecture of plants at or below the soil surface, the amount of surface litter and litter decomposition rate. Invertebrates that move between the soil and litter layer influence water movement within soil, as well as the relative amounts of infiltration and runoff. These soil processes provide essential ecosystem services to agriculture.

(d) Soil structure and fertility

Soil structure and fertility provide essential ecosystem services to agroecosystems. Well-aerated soils with abundant organic matter are fundamental to nutrient acquisition by crops, as well as water retention. Soil pore structure, soil aggregation and decomposition of organic matter are influenced by the activities of bacteria, fungi and macrofauna, such as earthworms, termites and other invertebrates.

Micro-organisms mediate nutrient availability through decomposition of detritus and plant residues and through nitrogen fixation. Agricultural management practices that degrade soil structure and soil microbial communities include mechanical ploughing, cultivating and harvesting, but management practices can also protect the soil and reduce erosion and runoff. Conservation tillage and other soil conservation measures can maintain soil fertility by minimizing the loss of nutrients and keeping them available to crops. Cover crops facilitate on-farm retention of soil and nutrients between crop cycles, while intercrops and border vegetation reduce erosion and runoff among fields. Incorporation of crop residues can maintain soil organic matter, which assists in water retention and nutrient provision to crops. Together these practices conserve a suite of ecosystem services to agriculture from the soil.

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CHAPTER 5:
REARING PRACTICES FOR ANIMALS UNDER NATURAL FARMING, NUTRIENT MANAGEMENT IN NATURAL FARMING AND THEIR SOURCES, INSECT, PEST, DISEASE AND WEED MANAGEMENT UNDER NATURAL FARMING

Some practices for rearing animals under natural farming include:

- **Providing space**: Animals should have enough space to rest and should be protected from excess heat, wind, rain, and light.
- **Using natural bedding**: The floor should have natural bedding material.
- **Feeding organic food**: Animals should be fed pure organic food.
- **Avoiding antibiotics and artificial growth hormones**: These should not be used.
- **Raising animals on certified organic land**: Animals should be raised on land that is certified organic.
- **Providing access to the outdoors**: Animals should have access to the outdoors year-round.
- **Using natural pesticides**: Farm-made pesticides like Dashparni ark and Neem Astra can be used to control pests and diseases.
- **Avoiding ploughing and tilling**: Natural farming does not involve ploughing, tilling, or weeding.
- **Breeding naturally**: Breeding should be done naturally, but artificial insemination is allowed.

  Natural farming is related to sustainable agriculture, organic farming, agroecology, agroforestry, and permaculture.

Nutrient management in natural farming:

It relies on the principles of plants getting most of their nutrients from the air, water, and sunlight, and the rest from soil. Here are some ways that nutrients are managed in natural farming:

- **Organic mulch**: Covers the soil to create humus and encourage the growth of beneficial microorganisms

- **Bio-cultures**: Farm-made bio-cultures like Jeevamrit and Beejamrit are added to the soil to improve the soil's microflora
- **Crop rotation**: Improves soil fertility
- **Cover cropping**: Recycles or lifts nutrients already in the soil
- **Reduced tillage**: Reduces carbon loss to the atmosphere and helps sequester carbon
- **Compost**: Adds new nutrients to the soil
- **Manure**: Adds new nutrients to the soil
- **Green manures**: Recycles or lifts nutrients already in the soil
- **Monocotyledons and dicotyledons**: Planting a mix of these in the same field provides all the essential nutrients

A common framework for approaching nutrient management is known as the "Four Rs":

- Right amount - the proper rate of application
- Right source - applying the proper type
- Right placement - using the appropriate method for application
- Right timing - applying at the correct time in the lifecycle of the system

Crop rotation, cover crops, decreased tillage, and the use of compost are some of the techniques used in organic agriculture systems to increase soil fertility. Less carbon is lost to the atmosphere due to reduced tillage, which results in more soil organic carbon. This prevents soil from becoming inverted and exposed to air. A few industrial fertilisers, including de-oiled cakes, bone meal, biofertilizers, and a variety of mineral powders, including rock phosphate and green sand, a potassium-rich type of potash that occurs naturally. Lime and sulphur are examples of natural pH supplements that can be used when the pH has to be changed.

Panchagavya

An organic compound called panchagavya has the ability to support plant growth and enhance immunity. Cow dung, cow urine, milk, curd, jaggery, ghee, bananas, tender coconuts, and water are the nine ingredients that make up panchagavya. It's application enhances the formation of new leaf and canopy formation. The primary benefit of Panchagavya is its ability to successfully raise all crop growth and yield parameters when the

land is transformed from an inorganic to an organic cultural system starting in the first year. It extends the shelf life of the cultivated product while also enhancing their flavour.

Jeevamrutha

It is an inexpensive, fermented, microbial preparation that enhances soil mineralization while enriching the soil and promoting the proliferation of microorganisms. It is one of the major inputs in the natural farming. It also provides resistance to pests and diseases, encourages the activity of beneficial organisms, and increases the amount of organic carbon in the soil.

Composting

Composting is an aerobic process that breaks down organic wastes into solid wastes that can be recycled. Compost created during the process of decomposing organic matter, is a beneficial fertiliser for plants and majorly used in nutrient management for organic agriculture.

Green Manuring

Green manuring is the process of growing leguminous and other plants in the field, and incorporating into the soil when they reach the 50% flowering stage. *Crotalaria juncea, Sesbania bispinosa, Phaseoulus trilobus,* and *Sesbania rostrata* are the most significant green manure crops.

Greenleaf manuring

Green leaf manuring is the application of green leaves and twigs of trees, shrubs, and plants that have been collected from elsewhere. The primary sources of green leaf manure are forest tree leaves. Another source of green leaf manure is vegetation that grows in wasteland, field bunds, etc. Neem, mahua, wild indigo, Glyricidia, Karanji (*Pongamia glabra*), calotropis, *Sesbania grandiflora*, subabul, and other shrubs are significant plant species suitable for producing green leaf manure.

Organic manuring benefits

Micronutrients are provided to plants by organic manures. The physical characteristics of the soil, its ability to store water, its hydraulic conductivity, and its capacity for infiltration are all improved by the application of organic manures. The carbon dioxide that is released during decomposition reacts with water to form carbonic acid, which is used as nutrient provider. Organic manures promote soil fertility by increasing nutrient availability and providing energy (food) for bacteria. Green manures also have the benefit of fixing atmospheric nitrogen, which reduces the need for nitrogen in crop production. They also take nutrients from deeper soil layers and concentrate them on the soil's surface for use by future crops.

Need of Weed Management in Natural Farming

Weeds are essential and are used as living or dead mulch layers in natural farming. However, Weeds are the most important biotic constraints to increase agricultural productivity and farmers' income in both developing and developed countries. It is also a major constraint to increase agricultural productivity and farmers' income, particularly in developing countries like India. In general, weeds cause the highest potential yield loss to crops along with pathogens (fungi, bacteria, etc.) and animal pests (insects, rodents, nematodes, mites, birds, etc.). In India, reduction in crop yield was estimated as 31.5% (22.7% in winter and 36.5% in summer and rainy seasons) by weeds. Actual economic losses were high in the case of rice (USD 4420 million) followed by wheat (USD 3376 million) and soybean (USD 1559 million). Thus, annual total actual economic loss of about USD 11 billion was estimated due to weeds alone in 10 major crops of India viz. groundnut (35.8%), soybean (31.4%), greengram (30.8%), pearlmillet (27.6%), maize (25.3%), sorghum (25.1%), sesame (23.7%), mustard (21.4%), direct-seeded rice (21.4%), wheat (18.6%) and transplanted rice (13.8%). Yield losses in crops due to weeds depend on several factors such as weed emergence time, weed density, type of weeds and crops, etc. Left uncontrolled, weeds can result in 100% yield loss. Weeds compete with crops for sunlight, water, nutrients and space. In addition, they harbor insects and pathogens, which attack crop plants.

Furthermore, they destroy native habitats, threatening native plants and animals. Weeding is completely restricted in natural farming; therefore, yield and economic losses are higher in natural farming when compared to modern agriculture. Hence it is essential to follow suitable weed management practices without affecting the concepts of natural farming to boost the crop productivity.

Methods of Weed Management

To achieve higher yield and income by managing weeds in natural farming, some of the suitable weed management practices are discussed below. However, none of the single method is effective for all weeds and to manage weeds effectively and sustainably in the long run, it is essential to integrate possible weed management practices for natural farming.

1. Use of Weed Free Seeds

Use clean seed that is free from weed seeds for sowing purpose. Inspect seed, necessary stocks for the presence of weed seeds, tubers, rhizomes, weed seedlings etc. The cropped area, bunds, irrigation channels etc. should be kept clean or free of weeds. Keep threshing yard and manure pits free from weeds.

2. Selection of Variety

Careful selection of crop varieties is essential to limit weeds problems and to satisfy market needs. Any crop variety that is able to quickly shade the soil between the rows is able to grow more rapidly than the weeds will have an advantage.

3. Crop Rotation

Crop rotation involves alternating different crops in a systematic sequence on the same land. It is an important strategy for developing a sound long term weed control program. Weeds tend to thrive with crops of similar growth requirements as their own and cultural practices designed to contribute to the crop may also benefit the growth and development of weeds. Monoculture, that is growing the same crop in the same field year after year, results in a build-up of weed species that are adapted to the growing conditions of the crop. When diverse crops are used in a rotation, weed germination and growth cycles are disrupted by variations in cultural practices associated with each crop (tillage, planting dates, crop competition, etc). Within a rotation, crop choice will determine both the current and the potential future weed problems that a grower will face. Traditionally, potato (*Solanum tuberosum* L.) is included in the rotation to reduce weed problems before a less competitive crop was grown.

For an organic grower, crop choice is complicated further by the need to consider soil fertility levels within the cropping sequence and to include fertility building periods in the rotation. Variations in crop and weed responses to soil nutrient levels can also play an important part in weed management. The inclusion of a fallow period in rotation will reduce perennial weeds. It is best to alternate legumes with grasses, spring planted crops with fall planted crops, row crops with close planted crops and heavy feeders with light feeders.

4. Planting Patterns

Crop population, spatial arrangement, and the choice of cultivar (variety) can affect weed growth. For example, studies have shown that narrow row widths and a higher seeding density will reduce the biomass of later-emerging weeds by reducing the amount of light available for weeds located below the crop canopy. Similarly, fast growing cultivars can have a competitive edge over the weeds.

5. Intercropping

Intercropping involves growing a smother crop between rows of the main crop. Intercrops are able to suppress weeds and minimize soil erosion. When legumes are included as intercrop, it fixes atmospheric nitrogen in the soil and enhances soil fertility. However, the use of

intercropping as a strategy for weed control should be approached carefully. The intercrops can greatly reduce the yields of the main crop if competition for water or nutrients occurs.

6. Cover Crops

Rapid development and dense ground covering by the crop will suppress weeds. The inclusion of cover crops such as rye, red, clover, buckwheat and oilseed radish or over wintering crops like winter wheat or forages in the cropping system can suppress weed growth. Highly competitive crops may be grown as short duration 'smother' crops within the rotation. Additionally, cover crop residues on the soil surface will suppress weeds by shading and cooling the soil. When choosing a cover crop, consideration should always be given to how the cover crop will affect the succeeding crop. In addition, decomposing cover crop residues may release allelochemicals that inhibit the germination and development of weed seeds.

7. Mulching

Mulching or covering the soil surface can prevent weed seed germination by blocking light transmission preventing seed germination. Mulches physically suppress weed seeds emergence. There are many forms of mulches available. The following two are suitable for natural farming.

a. Living mulch : Living mulch is usually a plant species that grows densely and low to the ground such as clover. Living mulches can be planted before or after a crop is established. It is important to kill ad till in, or manage living mulch so that it does not compete with the actual crop. A living mulch of *Portulaca oleracea* from broadcast before transplanting broccoli suppressed weeds without affecting crop yield. Often, the primary purpose of living mulch is to improve soil structure, aid fertility or reduce pest problems and weed suppression may be merely an added benefit.

b. Organic mulches : Materials such as straw, bark, and composted material can provide effective weed control. Producing the material on the farm is recommended since the cost of purchased mulches can be prohibitive, depending on the amount needed to suppress weed emergence. An effective but labor-intensive system uses newspaper and straw. Two layers of newspaper are placed on the ground, followed by a layer of hay. It is important to make sure the hay does not contain any weeds seeds. Organic mulches have the advantage of being biodegradable. Cut rye grass mulch spread between planted rows of tomatoes and peppers was more economic than cultivation. Fresh bark of conifers and oak as well as rapeseed straw gave good control of weeds when they were laid as mulches under the trees in apples orchards.

8. Field Scouting

It involves the systematic collection of weed and crop data from the field (weed distribution, growth stage, population, crop stage etc.). The information is used, in the short term, to make immediate weed management decisions to reduce or avoid economic crop loss. In the long term, field scouting is important in evaluating the success or failure of weed management programs and for making sound decisions in the future.

9. Water Management

Effective water management is a key to controlling weeds in a vegetable operation. Buried drip irrigation minimizes weed growth in natural farming. Drip tape buried below the surface of the planting bed can provide moisture to the crop and minimize the amount of moisture that is available to weeds closer to the surface. If properly managed, this technique can provide significant weed control during dry period.

10. Allelopathy

Allelopathy is the direct or indirect chemical effect of one plant on the germination, growth or development of neighboring plants. It is now commonly regarded as component of biological control. Species of both crops and weeds exhibit this ability. Allelopathic crops include barley, rye, annual ryegrass, buckwheat, oats, sorghum, sudan sorghum hybrids, alfalfa, wheat, red clover, and sunflower. Vegetables, such as horseradish, carrot and radish, release particularly powerful allelopathic chemicals from their roots. Suggestions have been made that allelochemicals and other natural products or their derivatives could form the basis of bio herbicides. However, it is unclear whether the application of natural weed killing chemicals would be acceptable to the organic standard authorities.

MECHANICAL WEED CONTROL

The mechanical methods include tillage, hoeing, hand weeding, sickling, mowing, burning, floods, mulching, and digging.

Tillage

Weeds are killed by tillage because it removes them from the soil. By damaging the pruning of the roots and stems, it may harm plants by lowering their ability to compete or regenerate. Also, weeds are buried by tillage.

Hoeing

The best and most popular weeding instrument for ages has been the hoe. It is still a really helpful tool for getting results quickly and affordably, though. For row crops, it is an addition to the cultivator. Hoeing can totally eradicate weed growth, making it especially more effective on annuals and biennials.

Weeding by hand

It is accomplished physically by pulling weeds out by hand or by using tools called khurpis, which resemble sickles. It is most likely the earliest method of weed control, and it is still a useful and effective way to get rid of weeds in both cropped and uncropped regions.

Mowing and sickling

In order to starve the subsurface sections of weeds and hinder seed formation, sickling is also done by hand with the aid of a sickle. It is common in muddy places where only the tall weed growth is sickled, leaving the soil's root system to retain the soil and avoid soil erosion. The majority of the time, machines are used to mow lawns and the sides of roadways.

Burning

Using fire or burning is frequently a cost-effective and useful way to get rid of weeds. It is employed in conditions when cultivation and other conventional procedures are impractical to (a) get rid of vegetation (b) destroy adult weeds' dry tops, and (c) kill green weed development.

Flooding

Against weed species that are susceptible to prolonged submersion in water, flooding is effective. By limiting the amount of oxygen available for plant growth, flooding destroys plants. The success of flooding hinges on the weeds being completely submerged for longer periods of time.

CULTURAL WEED CONTROL

To create favourable conditions for the crop, a variety of cultural practices including tillage, planting, fertiliser application, irrigation, etc., are used. If carried out appropriately, these methods aid in weed control. While cultural approaches cannot completely eradicate weeds, they can help to reduce their population. As a result, they ought to be employed in addition to other strategies. Tillage, fertiliser application, and irrigation are crucial in cultural practices. In addition, factors including variety choice, sowing method, cropping strategy, farm hygiene, etc., can all help reduce weed growth.

Field preparation

Weeds must be kept out of the field. Weeds shouldn't be permitted to flower. This aids in reducing the growth of the weed seed population.

Seasonal tillage

One of the most successful cultural practices to slow the spread of perennial weeds in crop cultivation is the use of summer or off-season tillage.

Optimal plant population maintenance

Lack of sufficient plant population makes weed infestations more likely and later more challenging to eradicate. To achieve a proper and uniform crop stand that can compete with weeds, practices including proper seed selection, appropriate sowing technique, adequate seed rate, protection of seed from soil transmitted pests and diseases, etc., are crucial.

Crop Rotation

If the same crop is planted year after year, the likelihood of a certain weed species or set of species emerging is higher. Crop rotation often eliminates or at least significantly reduces problematic weed issues. By integrating low land rice in crop rotation, noxious weeds like *Cyperus rotundus* can be efficiently controlled.

Intercropping

The ability to use crops as weed control techniques is made possible by the fact that intercropping suppresses weeds more effectively than solitary cropping. Numerous short-lived pulses, such as moong and soybean, effectively smother weeds without affecting main crop’s yield.

Mulching

Mulch is a substance that is kept on top of the soil surface as a protective layer. Mulching inhibits top growth by blocking light from a plant's photosynthetic areas, which has a suffocating impact on weed control. It is extremely powerful against some perennial weeds, such as *Cynodon dactylon*, as well as annual weeds.

Stale seedbed

When the first one or two flushes of weeds are eliminated before planting a crop, the seedbed is said to be "stale." This is accomplished by soaking a field that has been properly prepared with irrigation or rain and letting the weed seeds develop. A non-residual pesticide like paraquat or shallow tillage can be employed at this point to eradicate the profusion of early weed plants.

Blind tillage

Blind tillage is the term for soil preparation done after a crop is sown but before the crop plants actually start to grow. When emergence of crop seedlings is hampered by soil crust created on receipt of rain or irrigation soon after sowing, it is frequently used to reduce weed intensity in drill sowing crops.

Weeds are major threat for crop production and challenge for successful natural farming. Adopting of effective weed management practices will enhance the crop

productivity and income of the farmers involved in natural farming. In addition to the growing concern for protection of environment, maintain biodiversity and protection of human and animal health, integrated weed management approaches are needed and more of research efforts are required to develop low cost and environment friendly weed management practices without altering the core concept of natural farming.

Insect, pest and disease management under natural farming

In natural farming the pests (and weeds) are seen as a symptom rather than as the problem. Whenever the farmers observe an increase in the number of insect pests they should see it as an indication of something that is wrong with the farming system/ cultivation practices, which could be:

a) Crop/ variety not suitable to the region

b) Grown in an inappropriate season.

c) Cultivating susceptible cultivars.

d) High Density plant population

e) Mono-cropping.

f) Deficiency or excess of nutrients

g) Water logging or water stress.

A well-managed farming system is a successful way of reducing the level of pest or disease population. Certain crop varieties have more effective mechanisms than others due to the adaptive nature to the environment and therefore have a lower infection risk. Mono-cropping increases the risk of pest infestation.

The health condition of a plant depends to a large extent on the fertility of the soil. When nutrition and pH is well balanced, the plant becomes stronger and is therefore less vulnerable to infection. Climatic conditions, such as suitable temperatures and sufficient water supply, are further factors which are crucial for a healthy plant. If one of these conditions is not suitable, the plant can become stressed. Stress weakens the defence mechanisms of plants and makes them easy targets for pests and diseases. One of the most important points for a natural farmer is therefore to grow diverse and healthy plants. This avoids many pest and disease problems. Farmers have observed that the insect population is also affected by the waning and waxing phases of the moon. The aspects of improving soil health and crop diversity are long term measures.

Preventive Measures:

1) Selection of varieties which are well adapted to the local environmental conditions (temperature, nutrient supply, pests and disease pressure), as it allows them to grow healthy and makes them stronger against infections of pests and diseases.

2) Selection of good seeds/ planting material which has been inspected for pathogens and weeds at all stages of production.

3) Mixed cropping systems can limit pest and disease pressure as the pest has less host plants to feed on and more beneficial insect life in a diverse system. Crop rotation reduces the chances of soil borne diseases and breaks the life cycle of monophagous pests and increases soil fertility.

4) Green manuring and cover crops increases the biological activity in the soil and can enhance the presence of beneficial organisms (but also of pests; therefore, a careful selection of the proper species is needed).

5) No chemical fertilisers: steady growth makes a plant less vulnerable to infection. Synthetic fertilizers lead to lush growth resulting in susceptibility to insect pests and also reduces soil fertility, opening the way for secondary infections.

6) Input of organic matter increases micro-organism density and activity in the soil, thus decreasing population densities of pathogenic and soil borne fungi. It stabilises soil structure and thus improves aeration and infiltration of water.

7) Application of suitable soil cultivation methods facilitates the decomposition of infected plant parts, regulates weeds, which serve as hosts for pests and diseases, and protects the microorganisms which regulate soil borne diseases.

8) Conservation and promotion of natural enemies: Natural farming practices such as pest management and crop diversification help to build the natural enemies of pests.

9) Pest avoidance: Most pests attack the plant only in a certain life stage; therefore, it's crucial that this vulnerable life stage doesn't correspond with the period of high pest density and thus that the optimal planting time is chosen.

10) Remove infected plant parts (leaves, fruits, crop residues) from the ground to prevent the disease from spreading and eliminate residues of infected plants after harvesting.

CHAPTER 6:

MECHANIZATION IN NATURAL FARMING, PROCESSING, LABELLING, ECONOMIC CONSIDERATIONS AND VIABILITY, CERTIFICATION AND STANDARDS IN NATURAL FARMING, MARKETING AND EXPORT POTENTIAL OF NATURAL FARMING PRODUCE AND PRODUCTS

Mechanization in natural farming:

It can include a range of technologies, from basic hand tools to motorized equipment. The goal of mechanization is to reduce hard labor, improve productivity, and make agricultural operations more timely.

Essential Farm Implements and Tools:

Hand Tools: Hand tools are the backbone of natural farming, allowing farmers to work closely with the land and crops. Tools like hoes, spades, and digging forks enable gentle soil manipulation, reducing compaction and disturbance. Weeding implements, such as scuffle hoes and hand weeders, facilitate precise weed removal without disrupting the soil structure.

Seed Planters and Spreaders: To enhance the precision of planting and sowing in the context of natural farming, specialized seed planters and spreaders are readily available. These implements are designed to ensure optimal seed spacing and appropriate planting depth, contributing to consistent germination and uniform growth of crops.

Mulching Equipment: Mulching stands as a cornerstone within the framework of natural farming serving multiple essential functions such as moisture conservation, weed suppression, and soil enrichment. To facilitate the uniform application of organic matter throughout fields, various mulching implements such as straw spreaders, rotary mulchers, hay rakes, and mulch layers are used. These tools contribute to the even distribution of mulch materials. This uniformity is crucial, as uneven distribution can pose challenges during the seeding and emergence of subsequent crops.

Animal-Drawn Implements: In accordance with the principles of natural farming, harnessing the capabilities of animals for plowing and cultivating fields aligns seamlessly with the philosophy. The utilization of animal-drawn plows and cultivators serves multiple purposes: it reduces dependence on fossil fuels, minimizes soil compaction, and fosters a more harmonious relationship between humans, animals, and the environment. Furthermore, the implementation of animal-drawn implements contributes to the responsible utilization of male cows, which might otherwise be left wandering on roads and streets. This not only poses risks to public safety but also harms crops when these animals venture into fields. The

issue of stray cattle is particularly pronounced in the cow belt of India. Farmers often voice concerns about this matter on various platforms. The presence of stray cattle hampers the cultivation of diversified crops, including legumes, as they can cause damage. By effectively channeling these bulls for farm work, akin to practices from earlier periods, a win-win situation can be created. This approach not only addresses the issue of stray cattle but also harnesses their potential to contribute positively to agricultural endeavors.

Animal drawn cultivator: This type of cultivator is designed to be pulled by an animal, such as a buffalo or bullock, and is used for intercultural operations in fields, particularly in sugarcane cultivation. The cultivator has specific features such as 3-5 tynes (tines) for cultivating the soil, wheels to reduce the effort required by the operator and to improve manoeuvrability, and a plastic-covered handle for comfortable handling. Intercultural operations involve activities like weeding and soil loosening, which are crucial for maintaining the health and growth of crops like sugarcane. The cultivator helps remove weeds, aerate the root zone, and reduce soil compaction, which can contribute to better crop yields. In the sugarcane belt of Uttar Pradesh, India, this type of animal draw cultivator is commonly used. It's attached behind a male buffalo, which pulls the implement through the field.

Rotatory conoweeder: Intercropping with rice poses a consistent challenge due to the constraint of finding compatible crops that can thrive in the standing water conditions unique to rice fields. To address this, it is recommended that farmers consider cultivating either azolla or Sesbania aculeata as intercrops. These options can be effectively incorporated into the soil using a rotary conoweeder. This process serves to not only integrate the green intercrop material into the soil but also to suppress competing weeds and enhance the root zone's aeration. In instances where Sesbania aculeata is chosen for intercropping with rice, providing light irrigation during the initial growth stages is advisable.

What is Certification?

Certification is a formal attestation of whether a good is produced as per the standards of the category. Upon definition of standards and regulations, the accreditation body may allow a third party to provide certification. It ensures and assesses compliance with the defined standards and provides an official certification mark or a declaration of conformity. This enables the product to have a competitive advantage in various markets, add to the brand value and gain premium prices.

Why is Certification Needed?

The growing demand for naturally grown products has stimulated the growth of natural produce. The Covid situation in the country has also impacted on consumers in India to go for organic and safe, healthy and immunity booster products. The organic market in the couple of years has rapidly grown 25 to 30 % a year. There are several states practicing Natural Farming. Prominent among them are Andhra Pradesh, Chhattisgarh, Kerala, Gujarat, Himachal Pradesh, Jharkhand, Odisha, Madhya Pradesh, Rajasthan, Uttar Pradesh and Tamil Nadu. To address this demand the quality of produce has to be checked and fraud has to be prevented. Therefore, certifying a product assures it of its quality.

Scope:

The NFC (Natural Farming Certification) may be voluntary in nature and nonbinding. It is based on continuity and recognizes the farmers adopting natural farming systems as unique to the area and crops. NFCS may be based on producer's declaration of the practices adopted against the standards followed by the physical appraisal by group peers and finally declared themselves to be 'certified'. NFC standards may be applicable to crop production, livestock production and processed products made thereof. NFC certification standards may provide traceability to ensure that Certified Products are grown/ produced, handled, processed and packed throughout the value chain through documented and verifiable chain-of-custody.

National Standards for Natural Farming (NSNF): National Standards for Natural Farming (NSNF) for certified Natural Farming Products (NFP) include all agricultural, horticultural, medicinal & herbal and agroforestry crops, wild harvest (non-timber minor forest produce), livestock / fisheries/ Bee keeping systems and their products. Processing under NSNF is limited to on-farm processing at individual or at group of producers. Multi-ingredients processing, where raw material from different sources and from different certification systems are derived is not part of natural farming standards. **General Requirements**:

Certification can be taken up as a stand-alone certification for either crop production, wild harvest, livestock or processing or an integrated certification for crop-livestockprocessing. Use of synthetic/ chemical inputs (chemical fertilizers, pesticides, hormones or synthetic growth hormones/ growth stimulants, synthetic feed additives) and genetically modified seeds/ planting material or their derivatives or products either directly or indirectly are prohibited. Natural farming system avoids use of purchased inputs (organic, chemical or otherwise), therefore all inputs shall be prepared on-farm. Preferably the entire landholding with livestock should be converted to natural farming as per the standards. If the whole farm cannot be converted, it should be ensured that the natural and conventional parts of the farm are separate and distinct. For this purpose a buffer zone or a natural barrier should be

maintained. Simultaneous production of same crop (parallel production) in natural and conventional method should be avoided.

Natural Farming Certification:

A quality assurance system ensures consumers that the natural farming has been adopted and production met as per NFCS standards by producers which shall be verified by quality assurance authorities which may have the **following major features**:

- Provides traceability across the entire value chain.
- Enable producers, processors and brands to demonstrate their compliance with standards for claim verification. o Educate producers about the Naturally Grown trait of their products.
- Provide recognition to producers that their systems and products are truly Naturally Grown
- Increase confidence of consumers in their choice for naturally grown food

Why Natural Farming Certification is required?

To build Trust: In India, conventional, organic and natural farm products are being produced and sold. A strong certification mechanism and institutional structure is to be developed to identify natural products. In case of identity and trust in the product by consumer, the products should have label consisting of logo or certificate no.

Identity and differentiate products from non-certified products: Every product should have its own identity to be able to differentiate itself among many products when placed together.

Quality: Quality is the most important aspect of any product. In India, several quality control mechanisms have been developed in the food sector namely BIS, ISI, FSSAI, HALMARK, AGMARK etc. In the same way, the natural/ organic products should have specific standards to assure their quality. **Guarantee:** Any product which follows certification under proper institutional mechanism with rules and regulations will guarantee the consumer regarding the quality.

Uniqueness: Uniqueness of a product enables specific differentiation among the certified products. **Ownership:** Any product which comes under certification mechanism with proper labelling, i.e., by logo or UID no. enables any producer/ salesperson to build their brand with ownership of the specific logo.

Brand: In the market, many products are sold by retailers/ producers and most popular products become brands. By way of issuing certification for the natural farming products, it may facilitate making the product a brand.

Consumer acceptance: The certified products will likely have more acceptance among the consumers which may enable the farmer to get premium prices for their natural produce.

Documentation Aspects for Certification

To make sure that farmers or groups adopted Natural Farming Standards, package and practices in the farm, livestock rearing, etc documentation is necessary. Farmer's Identification: Farmer's document related to their identity like ID card, Aadhaar card, driving license, passport etc. are to be recorded so that the farmers practising Natural Farming can be easily identified.

Farm Field – Gps, Coordinates Photos

Every farm field should be recorded by a unique survey number or land record and also GPS co-ordinates. This documentation also enables to integrate in future with GI system.

Purchase of Seeds

In the market, several type of seeds like chemically treated, botanical treated seeds, GM seeds, traditional seeds are available. In the Natural Farming, farmers are encouraged to use traditional seeds/ locally available seeds. To track farmers whether they are using seeds as per requirement of Natural Farming standards, the bill's copy may be documented.

Natural Farming Inputs

In Natural Farming, locally available inputs / on-farm inputs are supposed to be used. To track inputs used by farmers, throughout the cultivation period, they need to be recorded. The unit's/ field preparations/ utensils pictures (Panchgavya, jeevamrit, Beejamrit, botanicals, compost etc.,) can be taken from time to time and recorded for verification.

Cultivation/ Production Practices

The Natural farmers are to adopt diversified crops, intercropping, multiple cropping, crop rotation etc. Its integration with horticulture and agro-forestry is a common feature. These practices need to be documented throughout the year at different intervals. This can be documented digitally by taking photographs and making videos for verification and certification.

Natural Ways of Pest Management

In Natural Farming, pests anddiseases are to be managed by use of locally available botanicals/ ITKS/ soil fertility management / cropping pattern etc. Usually, the pest and diseases will be managed by using various bio inputs. These practices need to be documented

including their preparation, application and time/ quantity of applications in the farm field for certification.

Buffer Zone

The neighbouring farmers may not be practising Natural Farming. The chances of movement of chemical and pesticide residues to Natural Farming fields is possible. In order to avoid this, a clear buffer zone may be created between Natural Farming and conventional farming. The buffer zone may include bunding/ planting trees around the boundary of farm fields and making proper water channels to prevent entry of water from neighbouring fields. This should be documented during the certification.

Before and After Harvest

Inspection/ verification done needs to be documented during the crop standing in the field. The field pictures/ videos during the crop duration and also after harvest may be documented for certification process. The product pictures in the field should be documented for double verification and validation for quantity of crop produced.

Storage

The Natural Farming products should be stored separately to avoid mingling with other products. A separate storage unit/ utensils/ material should be used for Natural products. The pictures of storage units, materials used for handling Natural Farming products may be recorded for certification.

Transportation

When Natural Farming produce is harvested, care should be taken to transport it without mingling with conventional product. Preferably, a separate transport facility may be used. The transport unit can be recorded/ documented.

Labelling and Branding

The label is most important to identify/ to bring uniqueness. The label should have proper size and design as per standards. Labelling with proper UID/ certificate no. should be recorded. The pictures/ online traceability system may be developed/ used in labelling.

Processing and Handling Unit with Machineries and Infrastructure

In Natural Farming, products may be manufactured, collected or purchased by the dedicated production unit/ processor which have been certified or authorised by accredited agency/ organisation. They are to be properly inspected from time to time. Verification and evaluation are necessary to keep the processor operating as per Natural Farming standards. The processing units their machinery, storage, transportation, production, packaging,

labelling, sale all need to be documented in a proper way to maintain quality of the products. Therefore, it is essential to keep records by way of pictures/ videos from time to time.

Training Records

To encourage and mobilise the farmers to adopt natural farming, farmer has to be exposed to regular training to update their knowledge on the latest package and practices and certification requirements on Natural Farming. The regular participation of the farmers in trainings will directly influence overall quality of Natural Farming production.

Meeting Records

The farmers practising Natural Farming either individually or in groups need regular interactions among the members to identify and resolve various issues. The regular participation in the meeting will enhance their shared vision and focused approach to make Natural Farming certification successful. Such kind of meetings regularly conducted by Natural Farmer groups is essential in the certification, which needs to be documented.

Field Inspection

The most important feature of any certification system is physical inspection of field by individuals/ inspectors when the crop is in the field. The farmers are evaluated for their knowledge, their practices of natural farming. The entire process has to be evaluated, recorded and compliance and noncompliance statement prepared based on which certification status may be decided. The name of the person conducting inspection, how many times in the year physical inspection was done are important aspects for certification purpose and need to be properly documented.

Marketing

It enables the farmers to achieve economies of scale, streamline distribution from various sources into a single, centralized location, collection of fresh produce and products from multiple farmers or farmer groups into a common pool to access larger markets, and streamline distribution.

Important Steps for Successful Marketing

A) Aggregation of fresh produce and products.

Aggregation is the process of collecting and combining data or items from various sources into a single, centralized location. In the context of agriculture and farming, aggregation refers to the collection of fresh produce and products from multiple farmers or farmer groups into a common pool. This pooling of resources enables farmers to achieve economies of scale, access larger markets, and streamline distribution. Farmers should be made aware of

the contamination and commingling. There could be contamination while storing, processing and value addition. Cold storage should be avoided where chemical fumigation is done. Persistent or carcinogenic pesticides and disinfectants are not permitted for storing. Produce can be protected from destruction by rodents by physical barriers, traps (including static bait traps), sound, ultrasound, light and UV light, and diatomaceous earth.

The steps involved in the aggregation process:

1. Identifying Farmer Interest Group (FIGs) & Collection Centre units: FIGs are community-based farmer organizations that are formed to promote collective farming, marketing, and support. Identify and collaborate with these groups to understand their produce and products.
2. Cataloging Fresh Produce and Products: Create a comprehensive catalogue of the various types of fresh produce and products being cultivated and produced by the FIGs & FPOs. This catalogue should include details like product name, description, quantity available, packaging, and any other relevant information.
3. Quality Assessment: Establish quality standards for the produce and products to ensure consistency and customer satisfaction. Implement a quality assessment process to monitor the products before aggregation.
4. Logistics and Transportation: Arrange for efficient logistics and transportation to collect the produce from different farmer groups and transport it to the aggregation centre. This could involve setting up collection centres at various locations or coordinating with farmers for delivery.
5. Storage and Warehousing: Have proper storage facilities in place to preserve the freshness and quality of the collected produce and products. Proper warehousing is essential to prevent spoilage and wastage.
6. Market Access: Develop a distribution network to sell the aggregated produce and products to retailers, wholesalers, or directly to consumers. Establish partnerships with supermarkets, restaurants, and other potential buyers.
7. Financial Management: Set up a transparent financial management system to ensure fair revenue distribution among the farmer groups involved. This is crucial for building trust and fostering long-term partnerships.
8. Data Management & Analysis: Maintain detailed records of the aggregation process, including the quantity of produce collected, sales data, customer feedback, and any challenges faced. Analyze this data to make informed decisions and improvements.

B) The steps to manage the supply chain of fresh produce under FIGs & collection centres.

1. Demand Forecasting: Understand market demands and consumer preferences for various fresh produce. Analyze historical data, market trends, and customer feedback to forecast the demand accurately. This will help farmers plan their production accordingly.

2. Communication and Coordination: Establish clear communication channels between FIGs, collection centres, and other stakeholders in the supply chain. Regularly update each party on product availability, quality, and transportation schedules.

3. Quality Control and Standardization: Implement strict quality control measures at both the farmer level and the collection centres. Standardize grading, packaging, and labelling to maintain consistency and meet market requirements.

4. Inventory Management: Use technology to track inventory levels and manage stock efficiently. This minimizes wastage and ensures a steady supply of fresh produce.

5. Compliance and Regulation: Stay informed about relevant agricultural regulations, certifications, and food safety standards. Ensure that all produce meets the necessary compliance requirements.

6. Training and Capacity Building: Provide training to farmers and collection centre staff on best practices for handling, storage, and transportation of fresh produce. Continuous education enhances the overall efficiency of the supply chain.

C) Value addition aspect of naturally cultivated fresh produce

Value addition refers to the process of enhancing the value of a product through various methods and techniques. For small farmer collectives involved in naturally cultivated fresh produce, value addition can play a significant role in increasing their profitability, expanding market opportunities, and creating a competitive advantage.

Here are some value addition aspects that small farmer collectives can consider:

1. Processing & Preservation: Small farmer collectives can process their naturally cultivated fresh produce into value-added products such as jams, sauces, pickles, dried fruits, frozen items, or canned goods. This not only extends the shelf life of the produce but also opens up new market segments.

2. Packaging and Branding: This is detailed out separately.

3. Certification & Labels: Obtain certifications for organic, sustainable, or fair-trade practices. These certifications add credibility to the products and appeal to consumers looking for environmentally friendly and socially responsible options.

4. Market Diversification: Explore different market channels, such as farmers' markets, speciality stores, online platforms, and restaurants. Diversifying the distribution channels can lead to increased sales and a broader customer base.

5. Product Differentiation: Highlight the unique qualities and flavours of the naturally cultivated produce to differentiate it from conventionally grown products. Educate consumers about the benefits of consuming naturally grown food.

6. Adding Convenience: Offer pre-cut, pre-washed, or ready-to-eat fresh produce to cater to the convenience-seeking consumer segment. This can be especially appealing to busy urban dwellers.

7. Value-Added Services: Provide value-added services like recipe cards, cooking tips, or educational workshops to create a deeper connection with customers and showcase the versatility of the produce.

8. Collaborations and Partnerships: Partner with local chefs, restaurants, or food companies to create unique dishes or products using naturally cultivated fresh produce. Such collaborations can enhance brand visibility and credibility.

9. Export Opportunities: Explore export opportunities for value-added products in regions where there is a demand for organic and naturally cultivated produce.

D) Packaging

Packaging of value-added products from naturally cultivated produce is a critical aspect of the overall branding and marketing strategy. The packaging should not only protect the product but also reflect the premium nature of value-added offerings and communicate their unique selling points.

Packaging as per Natural farming certification standards using approved Products for Packaging of Organic Foodstuffs can also be recommended for natural foodstuffs. Paper, wax paper, cold boxes with coating film or inside bag, textile packaging (tested for harmful substances), glass and other methods (clip seals).

1. Differentiation: Create packaging that stands out from conventional products on the market. Consider unique shapes, colours, and designs that catch the consumer's eye and convey the product's speciality.

2. Product Information: Provide clear and comprehensive information about the valueadded product on the packaging. Include the product name, key ingredients, nutritional facts, usage instructions, and any certifications or sustainability credentials.

3. Story Telling: Use the packaging as a canvas to tell the story of the small farmer collective and the unique journey of the naturally cultivated produce. Storytelling enhances the emotional connection with consumers.

4. Brand Identity: Ensure that the packaging design reinforces the brand identity of the small farmer collective. Use consistent brand colours, fonts, and logos to create a recognizable and cohesive visual presence.

5. Functional Packaging: Consider packaging that enhances the convenience and usability of the value-added product. For example, resalable pouches or containers can prolong the shelf life of the product and offer easy storage for consumers

6. Window Packaging: For products with appealing visual qualities, consider window packaging that allows consumers to see the product inside. This can enhance the product's appeal and help build trust with customers.

7. Regulatory Compliances: Ensure that the packaging complies with all relevant food safety and labelling regulations. Adhere to packaging size requirements, allergen labelling, and other industry-specific regulations.

8. Batch or Lot information: Add batch or lot numbers on the packaging to facilitate traceability and quality control. This is especially important for products with limited shelf life or seasonal variations. 9. Consumer Engagement: Use packaging as a tool to engage consumers. This could include adding QR codes that lead to the product's webpage, recipes, or information about the farmer collective's practices.

10. Sustainable Packaging Practices: Consider implementing sustainable packaging practices throughout the value chain, such as using minimal materials, optimizing packaging sizes to reduce waste, and encouraging consumers to recycle or reuse the packaging.

11. Packaging Durability: Ensure that the packaging protects the value-added product during transportation and handling. Fragile products may require additional protective measures.

Branding

1. Brand Name: Choose a compelling and memorable brand name that reflects the essence of the value-added products and resonates with the target audience.

2. Logo Design: Design a visually appealing logo that embodies the natural and organic values of the produce and establishes brand recognition.

3. Brand Colors and Fonts: Establish a consistent colour palette and font selection that reinforces the brand identity across all marketing materials, including packaging and promotional materials.

4. Brand Story: Craft a captivating brand story that narrates the origin, mission, and values of the small farmer collective. Share this story through packaging, websites, and marketing materials to create an emotional connection with consumers.

Preservation of naturally cultivated products

Instead of using chemical preservatives, small farmer collectives that focus on naturally cultivated produce may employ various other techniques to extend the shelf life of their products:

- ✓ Refrigeration and Cold Storage: Keeping produce at low temperatures helps slow down spoilage and maintain freshness. Many naturally cultivated products are sold in refrigerated sections or stored in cold storage facilities.
- ✓ Drying and Dehydration: Drying fruits, vegetables, and herbs removes moisture and inhibits the growth of microorganisms, making the produce less susceptible to spoilage.
- ✓ Canning and Fermentation: Freezing fresh produce immediately after harvesting helps retain its nutrients and quality until it reaches the consumers.
- ✓ Freezing: Freezing fresh produce immediately after harvesting helps retain its nutrients and quality until it reaches the consumers.
- ✓ High-Acid and Low pH Foods: Certain fruits and vegetables have natural acidity that acts as a preservative. Pickling and preserving in vinegar are examples of this preservation technique.
- ✓ Salt and Sugar: Salt and sugar are natural preservatives used in certain products, like salted vegetables or fruit preserves.
- ✓ Harvest Timing: Harvesting produce at the optimal stage of ripeness ensures that it reaches the market at its peak freshness, reducing the need for preservation.

Preservation of naturally cultivated produce as per ITKs

Indigenous Traditional Knowledge (ITK) includes a wealth of practices and techniques developed by local communities over generations to preserve and utilize natural resources, including the preservation of agricultural produce. These practices are often rooted in the local ecosystem and take advantage of natural methods to extend the shelf life and nutritional value of produce.

Some common preservation methods from ITKs for naturally cultivated produce:

- ➢ Sun Drying: Sun drying is a traditional method of preserving various fruits, vegetables, and herbs. Produce is spread out in the sun until it loses most of its moisture, making it less susceptible to spoilage.
- ➢ Smoking: Smoking is used for preserving meat, fish, and certain fruits and vegetables. The smoke acts as a natural preservative and helps protect the produce from insects and bacteria.

- Fermentation: Fermentation is a technique used to preserve foods by promoting the growth of beneficial micro-organisms: It is commonly used for preserving some vegetables.
- Salt Curing: Salting is a traditional method for preserving fish, meat, and certain vegetables. Salt draws out moisture from the produce, preventing bacterial growth and spoilage.
- Pickling: Pickling involves preserving produce in a solution of vinegar, salt, and spices. The acidic environment inhibits the growth of spoilage-causing microorganisms.
- Root Cellars: Root cellars are cool and dark storage areas used to preserve root vegetables, tubers, and fruits. The stable temperature and humidity slow down spoilage and maintain freshness.
- Herbal Preservatives: Some ITKs involve using specific herbs with natural preservative properties to extend the shelf life of produce.
- Covering with Ash or Sand: In some cultures, produce like root vegetables or fruits are stored by burying them in ash or sand, providing protection and insulation against spoilage.
- Honey and Syrup preservatives: Coating certain fruits in honey or syrup can preserve them while also adding sweetness.

India has the potential to export more natural farming produce and products, including organic products, due to the following factors:

- **Organic product exports**: In 2020–21, India's organic product exports increased by 51% to US\$1.04 billion. The United States was the largest importer of India's organic products, accounting for 54% of the total. Other countries that import India's organic products include the European Union, Canada, the UK, Australia, Switzerland, Israel, and South Korea.
- **Organic farming**: Organic farming uses natural processes and resources, such as compost and natural fertilizers, to produce healthier food and protect soil fertility. This helps improve soil and water quality, and prevents water bodies from becoming polluted.
- **Number of organic food producers**: India has the highest number of organic food producers in the world.

  Some examples of organic food products exported from India include:

- Organic fruit bars

- Organic traditional beverages
- Organic candies
- Organic freeze dried fruits
- Organic puffed snacks
- Organic gluten-free cookies
- Organic chyawanprash
- Organic pickles

CHAPTER 7:

INITIATIVES TAKEN BY GOVERNMENT (CENTRAL/STATE), NGOs AND OTHER ORGANIZATIONS FOR PROMOTION OF NATURAL FARMING AND CHEMICAL FREE AGRICULTURE

Central Govt. Initiatives:

MANAGE:

MANAGE is the Centre of Excellence & Knowledge Repository on Natural Farming

List of Master Trainer supporting Institutions

ICAR Institutions: ICAR committee will draft syllabus and course curriculum for inclusion in UG and PG courses. ICAR has already notified a dedicated Masters course in Organic farming. Gujarat Organic Agricultural University (GOAU), Godhra, is running degree courses on natural farming.

EEIs: Organising different OF and NF trainings for farmers and stakeholders. Externally aided and National projects: Institutions such as IFAD, World Bank, GIZ etc are supporting organic and natural farming projects of respective state governments.

KVKs: KVKs as Model Centres for Natural Farming. The farmers associated through KVKs will be identified and Trainer farmers and CRPs will be selected.

NCONF: NCONF for Certification and Training. The farmers associated through PGS will be listed and Trainer farmers and CRPs identified.

Namami Gange: "Natural Farming to be promoted throughout the country, with a focus on farmers' lands in 5- km wide corridors along river Ganga".

NRLM: Focusing on women SHGs and their federation-based NF and OF. Krishi Sakhis will be trained as NF trainers at village and cluster level.

Cooperatives: Focusing on PACS and higher-level coops-based development comprising of all types of agriculture. PACS which promote NF will be identified and Trainer farmers and CRPs identified for training and capacity building. Farmers Interest Groups (FIGs) and FPOs would be the key stakeholders. It will be ensured that there is no duplication of beneficiaries from different schemes.

State Government initiatives: SAUs, Agricultural Departments, Watershed Department, Soil and Waters Conservation, Animal husbandry, Fisheries, ATMA, Projects etc., Identified Trainer farmers and CRPs will be trained for NF. Communicate the guidelines for NF as per State at least before Kharif and Rabi crops as done under the NF project in Andhra Pradesh. Roles and responsibilities of stakeholders and administrative instructions communicated

clearly. The PoP for various crops under NF that are already available are compiled. Region specific PoPs have to be developed as per the need. HP Agriculture department has prepared the Kisan diary in which the month wise activities to be carried are communicated with photos. NGOs: WASSAN, CSA, RySS, NCNF, etc Sahaja Samruddha and other initiatives have been working on seed conservation. Best practices can be upscaled. In addition, individual farmers are actively involved in traditional and indigenous seeds collection and distribution.

Input Supplies of NF: Bio Resource Centres

Spiritual Agencies: Isha Foundation, Art of Living, Patanjali etc. have following of lakhs of persons who represent the urban and rural communities. Initiatives like Yoga and overall wellbeing of the individuals and communities is at the core of their initiatives which can be synergized with the NMNF.

Consumers: Family Farmer, Govt agencies, hostels, export etc.

Financing Agencies: NABARD, GIZ, CSR etc.

Private Sector: ITC, Mahendra, Swaraj etc.

Co-operatives: FPOs, AMUL, SAFAL, HOPCOMS, PACS, IFFCO

Branding & Marketing: Content making, documentation, processing, branding & certification, advertising Engaging with Schools,

Universities with Students and Teachers: learning through games, practical activities, short projects, debates, banner, poem writing activities etc. Concept of voluntary knowledge sharing by farmers and stakeholders can be reviewed and upscaled eg. Yogahaar.

Extension Advisory Services

- Toll Free No.
- Chat Bot
- Websites
- Social Media
- Literature for Study material

Knowledge Sharing and Training:

Collaborating with agricultural research centers, universities, and extension services offers access to scientific knowledge and research-based information. These institutions can conduct workshops, training programs, and seminars to educate farmers about the principles

and techniques of natural farming. Farmers gain a better understanding of the underlying science, helping them make informed decisions when implementing these practices.

Skill Enhancement:

Stakeholders, such as experienced farmers and local agricultural communities, hold valuable practical knowledge gained from years of working in the local environment. Their insights about local soil conditions, climate patterns, and indigenous crop varieties are invaluable. Linking with these stakeholders allows new natural farmers to benefit from their expertise, learn from their successes and failures, and gain hands-on experience in the field.

Adaptation to Local Context:

Natural farming practices need to be adapted to suit local conditions. Institutions and stakeholders provide context-specific advice and recommendations for optimizing natural farming techniques based on the specific agroecological characteristics of the region. This tailoring enhances the effectiveness of natural farming and ensures that practices are aligned with local realities.

Access to Resources and Inputs: Natural farming often requires specific resources, such as organic fertilizers, compost, and natural pest control methods. Collaborating with institutions can help farmers access these resources, either through research or direct connections. Stakeholder networks can provide practical insights on producing these resources locally, reducing costs and environmental impacts.

Policy Advocacy: Institutions are often involved in policy research and advocacy. Collaborating with these entities allows farmers to voice their needs and concerns, influencing policies that promote and support natural farming practices. Building alliances with stakeholders also strengthens advocacy efforts, as collective voices have a greater impact on policymakers.

Market Access and Value Chains: Establishing linkages with farmer cooperatives, local markets, and organic food networks facilitates the transition from production to market. These stakeholders can connect natural farmers with consumers who value organic and naturally grown products. Collaborating with such entities helps farmers access premium markets and receive fair prices for their produce.

Research and Innovation: Research institutions are centers of innovation. Collaborating with them can lead to the development of new natural farming techniques, tools, and approaches. These innovations can improve productivity, reduce environmental impact, and address emerging challenges faced by natural farmers.

Risk Mitigation: Institutions and stakeholders often have insights into managing risks associated with natural farming. They can provide information on pest and disease management strategies, climate-resilient practices, and methods to cope with adverse weather conditions. By sharing these strategies, they help farmers mitigate risks and ensure stable yields.

Community Support and Knowledge Exchange: Collaborating with local communities and farmer groups creates a support network for natural farmers. Regular meetings, workshops, and knowledge exchange platforms allow farmers to share their experiences, troubleshoot challenges, and learn from one another's successes and failures. This sense of community support fosters a culture of continuous learning and improvement.

Scaling Up and Replication: Once successful natural farming models are established, institutions and stakeholders can play a pivotal role in scaling up the practices. They can organize demonstration plots, field days and knowledge-sharing events to showcase the benefits of natural farming to a wider audience. This encourages more farmers to adopt these practices and expand the movement. The linkages with institutions and stakeholders are integral to the success of natural farming. These collaborations provide essential knowledge, resources, policy support, risk management strategies, and community engagement creating an enabling environment for farmers to effectively implement and benefit from natural farming practices.

EXTENSION APPROACHES:

- ✓ **Farmer -to -farmer extension**: Extension Support at the village level to be provided to the farmers through a Farmer Friend (FF) in every village. This would be very useful in extending the reach of the agriculture extension system up to the farmer level.
- ✓ **Farmer field schools (FFS):** FFS is a season long training programme imparted to the farmer for one day in a week throughout the season. Intern these farmer train other farmers.

- ✓ **Farm school:** Farm Schools would provide season long technical backstopping/ training to target farmers by having an interactive session once at least during each of the 6 critical stages in a cropping season.
- ✓ **Farmer to consumer:** building awareness and creating demand for natural products
- ✓ **Problem solving approach:** Identification and solving the problems through the farmers

CHAPTER 8:

CASE STUDIES AND SUCCESS STORIES IN NATURAL FARMING AND CHEMICAL FREE TRADITIONAL FARMING, ENTREPRENEURSHIP OPPORTUNITIES IN NATURAL FARMING

Here are some success stories of natural farming and chemical-free traditional farming:

- ✓ **Mitulbhai**

A tribal farmer in Wankla village of Gujarat who adopted natural farming practices to grow tindora and brinjal. He received assistance from the Sadhan Sahay Yojana to construct pavilions for vine vegetables. His success led to other farmers in the area adopting natural farming.

- ✓ **Bhaskar Save**

An organic farmer in Valsad district of Gujarat who owns a 14-acre farm called Kalpavruksha. The farm's gate has a blue plaque with white lettering that says "Su-Swagatam".

- ✓ **Sh. Tejpal Jatiya S/o Sh. Chena**

Village : Badwai Tehsil : Bhupalsagar District : Chittorgarh. He is a well-known natural farmer at district level. The main achievements/benefits include consumers directly purchase citrus fruits as well as seedlings from his farm, improved soil organic matter and beneficial soil microorganisms, utilized crop residue and farm wastage and no dependency on external inputs like agri-chemicals and agri-inputs. So, reduced cost of cultivation.

- ✓ **Sh. Bheru Lal S/o Sh. Teja Jatiya**

Village : Daulatpura Tehsil : Bhupalsagar District : Chittorgarh Sh. Bheru Lal is a well-known natural farmer at district level. The main achievements/benefits include no dependency on external inputs like agri-chemicals and agri-inputs, reduced cost of cultivation, improved soil organic matter and beneficial soil microorganisms and utilized crop residue and farm wastage. He has been awarded at block level by the district collector under ATMA Project.

- ✓ **Jasbir Singh**

He a resident of village Mangoli, Dist. Kurukshetra, Haryana. He is graduated and owns 5 hectares of land. The successful farmer (Jasbir Singh) has experience of 7 years in organic farming and is a well known progressive farmer in his locality. He is practicing natural farming in his whole land (5 hectares). Now he grows all major crops (wheat, paddy, sugarcane, legume crops) in his fields. Knowing the importance of mixed cropping, he grows

chana and wheat as a mixed crop in rabi season. He is also practicing apiculture and livestock to increase the economic status of his family.

✓ **Atma Ram**

A resident of Kalpa block (Kinnaur, HP), who retired from the post of health supervisor was fed up with the increasing use of pesticides and other chemicals. Knowing the importance of health, he adopted natural farming in 2018 and is now connecting other farmers of the area with this method. Atma Ram came to know about natural farming from the officials of the Department of Agriculture. Enthused by the initial knowledge, he took formal training in natural farming from Palekar in Kufri (Shimla) in 2016. He was so impressed by this 6-day training camp that as soon as he came back, he started using natural farming inputs in his fields and observed good production. Apart from fruits, he has also adopted this method on cereals and vegetables. In 2022, he has harvested 1.5 q cabbage, 1 q tomato and 1 q pumpkin from his field. He has also planted saffron in his orchard for home consumption. Incidence of woolly apple aphid was observed but it was controlled by the spray of Dashparni ark. Although the yield was less but the quality of fruit was better. Atma Ram's agriculture-horticulture model is also encouraging other farmers of the district.

✓ **Jeet Negi**

After doing organic farming for a decade, Jeet Negi, who turned to natural farming in Kinnaur (HP), said that a camp was organized in Rohru in August 2018 which changed his perspective towards farming. He attended a 2-day training camp and started practicing natural farming in his farm. He said that initially people were of view that adopting the new method would result in loss of crop but he got good results in the first year itself. He also attended the World Organic Expo in 2019 with his produce. People appreciated his produce in this exhibition and he also sold black potatoes at ₹200/kg and apples at ₹325/kg. After participating in this expo, he expanded his area under natural farming. Currently, he is using natural inputs on 2500 apple plants in two orchards. He produces an average of 1500 boxes of apples every year. He has also planted natural farming trial on Asafoetida and Kuth and if his trial is successful, he will cultivate asafoetida on a larger scale.

✓ **Ganga**

Ganga, a teacher, suffered from health issues realized that one of the major reasons for her health issues was non-availability of chemical free produce. Therefore, from 2013, she started experimenting on various farming methods. When Ganga started her natural farming trail, she was not supported by her family. But after getting a good yield of french bean, coriander and radish, she even started natural farming in apple and is now supported by her

family. She came to know about natural farming through internet and in 2018, got training from Subhash Palekar in Kufri and hence adopted this method. Presently, Ganga is practicing natural farming in apple, peas, carrot, cucumber, french bean, coriander and radish. To support Ganga, her husband took voluntary retirement from job in 2019. Now the couple is successfully doing natural farming in their farm. She noticed that Jivamrita and Khatti Lassi were effective in controlling fungal diseases, whereas, Saptdhyankur enhanced the colour and shine in apple. This year, they sold peas worth 10,000, coriander worth 4,000 in the local market. She said that PK3Y is changing the fortune of farming and horticulture and is also empowering women. She also has a WhatsApp group to connect and share information with other women farmers regarding natural farming.

Some entrepreneurship opportunities in natural farming:

- **Organic farming**

  This agribusiness is a leading trend in India due to its sustainable practices and health-conscious consumer preferences. Organic farming uses natural fertilizers and pest control methods to produce nutrient-rich crops.

- **Herb growing**

  Medicinal herbs are in demand due to their therapeutic properties.

- **Beekeeping**

  This sustainable business has a high profit margin, especially with the rising demand for natural and organic honey.

- **Dairy farming**

  This is a top agricultural business in India due to the rising demand for milk and the need for manure.

- **Hydroponics**

  This type of business can be a solution to maximize efficiency while reducing water use and waste.

- **Tree farming**

  The Christmas tree market is seasonal and highly profitable.

- **Manure business**

  Composting organic waste like food scraps, leaves, and manure to create a nutrient-rich fertilizer.

- **Precision agriculture**

This offers benefits like enhanced crop yields, reduced input costs, and improved environmental sustainability.

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