

Dr. Ramchandra Bedse



**MARATHA VIDYA PRASARAK SAMAJ'S  
KARMAYOGI DULAJI SITARAM PATIL  
COLLEGE OF AGRICULTURE,  
CHACHADGAON (NASHIK)  
(AFFILIATED TO MAHATMA PHULE KRISHI VIDYAPEETH, RAHURI)**

**DIVISION OF AGRONOMY**

**THEORY NOTES  
OF  
COURSE NO. AGRO-233  
Principles and Practices of Natural Farming**

**Compiled and Prepared By**

**Dr. Ramchandra D. Bedse  
M. Sc. (Agri), Ph D. (Agronomy), NET  
Assistant Professor**

## **Lecture No-1**

### **Natural Farming**

#### **Indian Heritage of Ancient Agriculture**

Indian agriculture boasts a rich heritage dating back to 9000 BCE, marked by early cultivation of crops and domestication of animals. This led to settled life and the development of agricultural techniques and implements. The double monsoon system allowed for two harvests annually, contributing to a thriving agricultural landscape. Indian agricultural practices, including irrigation, crop rotation, and the use of manure, were sophisticated even in ancient times.

#### **India's ancient agricultural heritage:**

##### **Early Cultivation and Domestication:**

Agriculture in India began with the cultivation of plants and domestication of animals, laying the foundation for settled life and agricultural advancements.

##### **Settled Life and Technological Advancements:**

The development of agricultural implements and techniques, including irrigation systems, enabled the growth of settlements and civilizations.

##### **Double Monsoon System:**

The unique monsoon patterns in India allowed for two harvests in a year, enhancing agricultural productivity.

##### **Vedic Texts and Iron Tools:**

Vedic texts from 3000-2500 BCE describe the use of iron tools for agriculture, cultivation of various crops and fruits, animal husbandry, and the use of manure and irrigation.

##### **Indus Valley Civilization and Irrigation:**

The Indus Valley Civilization (4500 BCE) witnessed significant innovations in irrigation, contributing to the growth and prosperity of cities.

##### **Crop Rotation and Mixed Cropping:**

Ancient Indian farmers practiced eco-friendly farming systems like crop rotation and mixed cropping, demonstrating a deep understanding of nature and sustainable practices.

### **Animal Husbandry and Manure:**

Animal husbandry was an integral part of ancient Indian agriculture, with animal waste used as manure to enrich the soil.

### **Globally Important Agricultural Heritage Systems (GIAHS):**

India has been recognized for its unique agricultural systems, such as the Pampore Saffron Heritage (Jammu & Kashmir), Koraput Traditional Agriculture (Odisha), and Kuttanad Below Sea Level Farming System (Kerala).

### **Sustainable Practices:**

Ancient Indian agricultural practices, like mixed cropping and crop rotation, offer valuable insights into sustainable farming for modern-day agriculture.

### **History of Natural Farming**

Natural farming, also known as Fukuoka Method, Do-nothing farming, or the natural way of farming, has its roots in the mid-20th century, popularized by Japanese farmer and philosopher Masanobu Fukuoka. It emphasizes minimal human intervention in agricultural practices, focusing on natural processes and biodiversity. The concept gained traction globally, with notable influence in India through figures like Subhash Palekar.

Here's a more detailed look at the history:

- **Early Influences (Pre-20th Century):**

Before the widespread adoption of modern agricultural techniques, farming practices around the world, particularly in the Global South, relied heavily on natural methods. These practices included crop rotation, composting, and intercropping, with a focus on maintaining soil fertility.

- **Masanobu Fukuoka's Contribution (1940s-1970s):**

Masanobu Fukuoka, a Japanese farmer and scientist, developed and popularized the concept of natural farming through his book "The One-Straw Revolution" (published in 1975), which described his "do-nothing" farming approach. Fukuoka's method emphasizes working with nature rather than against it, minimizing tillage, avoiding synthetic fertilizers and pesticides, and promoting biodiversity.

- **Growth and Recognition (Late 20th Century onwards):**

Natural farming gained global recognition, influencing movements like organic farming and permaculture. In India, the practice was further popularized by agriculturalist Subhash Palekar, who developed the "Zero Budget Natural Farming" (ZBNF) method.

- **Current State:**

Natural farming is now practiced in various forms worldwide, with a growing emphasis on sustainability and ecological balance. Many regions are actively promoting natural farming practices as a way to address environmental concerns and promote food security.

### **Concept & Scenario**

#### **Concept**

Natural Farming is a chemical-free farming system rooted in Indian tradition enriched with modern understanding of ecology, resource recycling and on-farm resource optimization. It is considered as agroecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. It is largely based on on-farm biomass recycling with major stress on biomass mulching, use of on-farm cow dung-urine formulations; maintaining soil aeration and exclusion of all synthetic chemical inputs. Natural farming is expected to reduce dependency on purchased inputs. It is considered as a cost-effective farming practice with scope for increasing employment and rural development.

#### **Scenario**

Many states are already following natural farming and have developed successful models. State of Andhra Pradesh, Karnataka, Himachal Pradesh, Gujarat, Uttar Pradesh and Kerala are among the leading states. Currently, the acceptance and adoption of natural farming systems are at early stages and gradually gaining acceptance among the farming community.

## **Natural farming Practices**

Natural farming aims at restoring soil health, maintenance of diversity, ensure animal welfare, stress on efficient use of natural/local resources and promote ecological fairness. Natural farming is an ecological farming approach where farming system.

works with the natural biodiversity, encouraging the soil's biological activity and managing the complexity of living organisms both plant and animal to thrive along with food production system. Important practices, essential for adoption of natural farming includes:

- No external inputs,
- Local seeds (use of local varieties), .
- On-farm produced microbial formulation for seed treatment (such as bijamrita),
- On-farm made microbial inoculants (Jivamrita) for soil enrichment,
- Cover crops and mulching with green and dry organic matter for nutrient recycling and for creating a suitable micro-climate for maximum beneficial microbial activity in soil.
- Mixed cropping,
- Managing diversity on farm through integration of trees
- Management of pests through diversity and local on-farm made botanical concoctions (such as neemastra, agniastra, neem ark, dashparni ark etc);
- Integration of livestock, especially of native breed for cow dung and cow urine as essential inputs for several practices and
- Water and moisture conservation.

## **Lecture No-2 and 3**

### **Importance of Natural Farming**

#### **1. CLIMATE CHANGE**

Natural farming plays a crucial role in combating climate change by enhancing carbon sequestration in soil, reducing greenhouse gas emissions, and improving the resilience of agricultural systems. It achieves this by eliminating synthetic inputs, promoting soil health, and fostering biodiversity, ultimately contributing to a more sustainable and climate-resilient food production system.

#### **How natural farming helps:**

##### **Carbon Sequestration:**

Natural farming techniques like cover cropping, reduced tillage, and composting increase the amount of carbon stored in the soil, drawing down carbon dioxide from the atmosphere.

##### **Reduced Greenhouse Gas Emissions:**

By eliminating synthetic fertilizers and pesticides, natural farming significantly lowers the carbon footprint of agriculture, which is a major source of greenhouse gas emissions.

##### **Enhanced Soil Health:**

Natural farming practices, such as using organic matter and promoting soil biodiversity, improves soil structure, water retention, and nutrient availability, leading to healthier and more productive soils.

##### **Climate Resilience:**

Diversified farming systems in natural farming are more resilient to extreme weather events like droughts and floods, ensuring food security even in the face of climate change.

##### **Reduced Input Costs:**

Natural farming often relies on locally available resources and traditional knowledge, reducing the need for expensive and environmentally harmful synthetic inputs.

### **Improved Water Management:**

Practices like mulching and water harvesting in natural farming help conserve water resources, making agriculture more sustainable and adaptable to changing rainfall patterns.

### **Specific Examples:**

#### **Zero Budget Natural Farming (ZBNF):**

This Indian model emphasizes the use of locally available resources and natural inputs to minimize costs and environmental impact.

#### **Intercropping and Cover Cropping:**

These techniques enhance soil health, increase biodiversity, and improve carbon sequestration.

#### **Composting and Vermicomposting:**

These methods convert organic waste into nutrient-rich fertilizers, reducing reliance on synthetic inputs.

In essence, natural farming offers a holistic approach to agriculture that not only addresses the challenges of climate change but also promotes sustainable food production and rural development.

## **2. SOIL HEALTH**

Natural farming is crucial for soil health as it enhances fertility, improves soil structure, and increases beneficial microbial activity. It achieves this by minimizing or eliminating synthetic inputs, promoting organic matter decomposition, and fostering a diverse and thriving soil ecosystem. According to the National Mission on Natural Farming, this approach leads to healthier, more resilient soil, supporting sustainable and productive agriculture.

### **How natural farming helps:**

#### **1. Enhanced Soil Fertility and Structure:**

##### **Organic Matter Decomposition:**

Natural farming practices like composting and mulching accelerate the breakdown of organic matter, releasing essential nutrients into the soil.

### **Nutrient Cycling:**

A healthy soil ecosystem, fostered by natural farming, facilitates efficient nutrient cycling, making them more readily available for plant uptake.

### **Improved Soil Structure:**

Increased organic matter and microbial activity contribute to better soil aggregation, improving water infiltration, aeration, and root development.

## **2. Increased Microbial Activity and Biodiversity:**

### **Beneficial Microorganisms:**

Natural farming promotes a diverse and thriving microbial community, including bacteria, fungi, and other beneficial organisms, crucial for soil health and nutrient availability.

### **Reduced Synthetic Inputs:**

By minimizing or eliminating synthetic fertilizers and pesticides, natural farming allows beneficial microbes to flourish, enhancing soil health.

### **Resilient Ecosystem:**

A diverse soil ecosystem is more resilient to changes in environmental conditions, such as drought or disease outbreaks.

## **3. Reduced Environmental Impact:**

### **Lower Carbon Footprint:**

Natural farming practices like reduced tillage and cover cropping can sequester carbon in the soil, helping to mitigate climate change.

### **Water Quality Protection:**

By reducing reliance on synthetic chemicals, natural farming minimizes the risk of water pollution from runoff.

### **Erosion Control:**

Practices like mulching and cover cropping help to protect soil from erosion, preserving topsoil and preventing soil loss.

#### **4. Cost-Effectiveness and Sustainability:**

##### **Reduced Input Costs:**

Natural farming relies on locally available, on-farm inputs, reducing the need for expensive synthetic fertilizers and pesticides.

##### **Increased Resilience:**

A healthy soil ecosystem makes farms more resilient to climate change and other environmental challenges.

##### **Long-Term Productivity:**

By focusing on soil health, natural farming promotes sustainable and long-term agricultural productivity.

#### **3. WATER USE**

Natural farming practices are crucial for water conservation in agriculture by enhancing water use efficiency and reducing water consumption. These methods improve soil health, which in turn increases water retention and reduces the need for irrigation. By minimizing reliance on external inputs and promoting natural processes, natural farming contributes to sustainable water management and a more resilient agricultural system.

##### **How natural farming helps:**

##### **Improved Water Retention:**

Natural farming techniques like mulching, using cover crops, and reduced tillage improve soil structure and organic matter content. This leads to better water infiltration and retention in the soil, reducing the need for frequent irrigation.

##### **Reduced Water Consumption:**

By optimizing water use and minimizing losses through evaporation and runoff, natural farming can significantly reduce overall water consumption in agriculture.

##### **Groundwater Recharge:**

Healthy soil with good water retention capacity can help replenish groundwater reserves, especially when combined with rainwater harvesting techniques used in natural farming.

### **Mitigation of Water Scarcity:**

In areas prone to water scarcity, natural farming practices can help farmers adapt to drier conditions by utilizing water more efficiently and reducing their reliance on external water sources.

### **Prevention of Water Pollution:**

Natural farming minimizes the use of synthetic chemicals, preventing water pollution from agricultural runoff.

### **Resilience to Climate Change:**

By promoting water-efficient practices and enhancing soil health, natural farming helps farmers build resilience to the impacts of climate change, such as droughts and floods.

### **Sustainable Water Management:**

Natural farming aligns with sustainable water management principles by prioritizing efficient water use, protecting water resources, and promoting ecological balance.

Overall, natural farming offers a holistic approach to water management in agriculture, promoting both water conservation and sustainable food production.

## **4. CARBON SEQUESTRATION**

Natural farming significantly contributes to carbon sequestration, which is the process of capturing and storing atmospheric carbon dioxide in soil and vegetation, helping to mitigate climate change. By implementing practices like reduced tillage, cover cropping, and composting, natural farming enhances soil health, increases carbon storage capacity, and reduces greenhouse gas emissions.

### **How natural farming helps:**

#### **1. Improving Soil Health and Structure:**

##### **Reduced Tillage:**

Minimizing soil disturbance through reduced or no-till practices helps preserve soil structure and prevent the release of stored carbon.

### **Cover Cropping:**

Planting cover crops during off-seasons helps protect the soil from erosion, adds organic matter, and enhances water retention, all of which contribute to carbon sequestration.

### **Composting:**

Converting organic waste into nutrient-rich compost and incorporating it into the soil improves soil structure and increases carbon content.

## **2. Reducing Greenhouse Gas Emissions:**

### **Eliminating Synthetic Fertilizers and Pesticides:**

Natural farming practices avoid the use of synthetic fertilizers and pesticides, which are major sources of greenhouse gas emissions.

### **Lowering Energy Consumption:**

Natural farming methods often require less energy compared to conventional farming, further reducing the carbon footprint of agriculture.

## **3. Enhancing Carbon Sink Capacity:**

### **Increasing Soil Organic Matter:**

By promoting healthy soil ecosystems, natural farming increases the amount of organic matter in the soil, which acts as a significant carbon sink.

### **Enhancing Biodiversity:**

Natural farming practices foster a diverse range of plants and microorganisms in the soil, which improves soil health and its ability to store carbon.

## **4. Promoting Sustainable Agriculture:**

### **Long-Term Soil Health:**

Natural farming focuses on building healthy soil over the long term, making it a more sustainable approach to agriculture.

### **Climate Resilience:**

By improving soil health and enhancing carbon sequestration, natural farming contributes to making agricultural systems more resilient to climate change impacts.

In essence, natural farming offers a pathway to a more sustainable and climate-friendly agricultural system by enhancing carbon sequestration and reducing the negative impacts of agriculture on the environment.

## **5. BIODIVERSITY CONSERVATION**

Natural farming is crucial for biodiversity conservation because it fosters a diverse ecosystem on farms, reducing reliance on external inputs and promoting a self-sustaining environment. This approach enhances the variety of plant and animal species, creating a balanced ecosystem that is more resilient to environmental changes and less susceptible to pests and diseases.

### **How natural farming helps:**

#### **Promotes diverse flora and fauna:**

Natural farming encourages a wide range of plants and animals within the farm ecosystem.

#### **Restores soil fertility and biological life:**

By focusing on natural processes, it enhances soil health and supports beneficial microorganisms, insects, and other organisms.

#### **Reduces reliance on external inputs:**

Natural farming minimizes the use of synthetic fertilizers and pesticides, which can harm biodiversity and disrupt natural ecosystems.

#### **Enhances resilience and productivity:**

A diverse farm ecosystem is more adaptable to changes in climate and less vulnerable to outbreaks of pests and diseases.

#### **Supports beneficial insects and pollinators:**

Natural farming practices, such as growing diverse crops and using cover crops, attract and support beneficial insects, including pollinators, which are vital for crop production.

#### **Improves water quality:**

By reducing the use of chemicals and promoting healthy soil, natural farming can help improve water quality and protect aquatic ecosystems.

**Conserves natural resources:**

Natural farming practices often involve water conservation techniques and efficient use of land, contributing to resource conservation.

**6. FOOD SECURITY**

**Enhancing Food Production and Diversity:**

1. Natural farming, including organic farming, promotes diverse cropping systems, such as multi-cropping, agroforestry, and intercropping. This contrasts with the monoculture-based approach of conventional farming, leading to a wider variety of food sources and improved nutritional security.
2. It increases the resilience of agricultural systems to climate change impacts, including droughts and floods, by promoting diverse and adaptable plant species.
3. Natural farming practices can improve crop yields, particularly in resource-constrained areas, ensuring a more reliable food supply.

**7. NUTRITIONAL SECURITY**

Natural farming plays a crucial role in nutritional security by promoting healthy soil, which in turn leads to nutrient-rich food production and reduced reliance on external inputs. This approach enhances soil health, conserves water, and minimizes the use of synthetic chemicals, resulting in food with higher nutritional value and a reduced risk of health issues. Furthermore, natural farming can empower small-scale farmers, particularly in developing countries, by providing a sustainable and cost-effective means of food production.

**How natural farming helps:**

**1. Enhanced Nutritional Value of Food:**

**Increased Nutrient Content:**

Studies have shown that crops cultivated through natural farming methods, such as vegetables, can have significantly higher levels of essential nutrients like vitamin C, iron, fiber, and antioxidants.

### **Improved Soil Health:**

Natural farming practices, such as using organic matter and promoting microbial activity, lead to better soil structure and nutrient availability, allowing plants to uptake a wider range of nutrients.

### **Reduced Chemical Residues:**

By avoiding synthetic fertilizers and pesticides, natural farming minimizes the presence of harmful chemical residues in food, contributing to safer and healthier food consumption.

## **2. Improved Soil Health and Sustainability:**

### **Soil Fertility:**

Natural farming practices like composting and mulching enhance soil organic carbon, which is essential for long-term soil fertility and nutrient cycling.

### **Reduced Land Degradation:**

By minimizing the use of chemical inputs, natural farming helps prevent soil erosion and degradation, preserving land for future food production.

### **Water Conservation:**

Natural farming promotes water-efficient practices, such as using diverse crops and mulching, to minimize water loss through evaporation.

## **3. Economic Benefits for Farmers:**

### **Reduced Input Costs:**

Natural farming relies on locally available resources, reducing the need for expensive synthetic fertilizers and pesticides, thus lowering production costs.

### **Increased Income:**

Natural farming can lead to increased income for farmers through diversification, value addition, and local marketing of their produce.

### **Sustainable Livelihoods:**

By promoting ecological balance and resilience, natural farming can contribute to the long-term sustainability of agricultural livelihoods.

#### **4. Environmental Benefits:**

##### **Reduced Carbon Footprint:**

Natural farming practices minimize the use of synthetic fertilizers and pesticides, which are often associated with high carbon emissions.

##### **Biodiversity Conservation:**

Natural farming promotes biodiversity by encouraging the cultivation of a wider variety of crops and by creating habitats for beneficial insects and other organisms.

##### **Ecosystem Restoration:**

Natural farming can contribute to the restoration of degraded ecosystems by improving soil health and promoting natural processes.

#### **8. SUSTAINABLE DEVELOPMENT GOALS (SDGs)**

Natural farming practices are crucial for achieving many of the **Sustainable Development Goals (SDGs)**, particularly those related to food security, environmental sustainability, and economic well-being. By promoting ecological balance and reducing reliance on external inputs, natural farming contributes to a more resilient and sustainable agricultural system.

##### **Here's how natural farming aligns with specific SDGs:**

**1. No Poverty (SDG 1):** Natural farming can reduce input costs, potentially increasing farmer incomes and reducing reliance on expensive chemical inputs. It can also improve soil fertility and crop yields, leading to more stable and sustainable livelihoods.

**2. Zero Hunger (SDG 2):** Natural farming practices enhance soil health and biodiversity, leading to more resilient and productive agricultural systems. This can improve food security, particularly in vulnerable regions.

**3. Good Health and Well-being (SDG 3):** By minimizing or eliminating the use of synthetic pesticides and fertilizers, natural farming reduces exposure to harmful chemicals, promoting healthier food and a safer environment.

**4. Climate Action (SDG 13):** Natural farming practices, such as cover cropping and reduced tillage, can sequester carbon in the soil, helping to mitigate climate change. It also improves the resilience of agricultural systems to climate change impacts like droughts and floods.

**5. Life on Land (SDG 15):** Natural farming promotes biodiversity, protects soil health, and reduces pollution from synthetic inputs, contributing to the conservation and sustainable use of terrestrial ecosystems.

**6. Responsible Consumption and Production (SDG 12):** Natural farming practices encourage sustainable consumption patterns by promoting locally sourced, healthy food, and reducing reliance on resource-intensive agricultural practices.

**7. Partnerships for the Goals (SDG 17):** Natural farming can be a catalyst for collaboration between farmers, researchers, policymakers, and consumers, fostering a more sustainable and equitable food system.

In essence, natural farming offers a holistic approach to agriculture that aligns with multiple SDGs, promoting environmental sustainability, economic viability, and social well-being.

Dr. R. D. Bedse

## **Lecture No-4**

### **Concept of Natural Farming**

#### **Definition of Natural Farming**

“Natural Farming is a chemical-free traditional farming method. It is considered as Agro ecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity”-Niti Ayog Natural farming is a system where the laws of nature are applied to agricultural practices. This method works along with the natural biodiversity of each farmed area, encouraging the complexity of living organisms, both plants, and animals that shape each particular ecosystem to thrive along with food plants. Natural Farming builds on natural or ecological processes that exist in or around farms.

#### **Concept of Natural Farming**

Natural Farming can be defined as “chemical- free farming and livestock based”. 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 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. Natural Farming builds on natural or ecological processes that exist in or around farms

#### **Features (Characteristics) of Natural Farming**

1. 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)
2. The soil is always supposed to be covered with organic mulch, which creates humus and encourages the growth of friendly microorganisms.
3. 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.

4. 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. Natural, farm-made pesticides like Dashparni ark and Neem Astra are used to control pests and diseases.
10. Weeds are considered essential and used as living or dead mulch layer.
11. Multi-cropping is encouraged over single crop method.

**AIMS AND OBJECTIVES FOR NATURAL FARMING PROMOTION:**

- 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

### **Current Scenario of Natural Farming in India**

Many states have taken up initiatives for natural farming promotion Andhra Pradesh, Gujarat, Himachal Pradesh, Odisha, Madhya Pradesh, Rajasthan, Uttar Pradesh and Tamil Nadu are among the leading states. As of now more than 10 lakh ha. area is covered under natural farming in India.

**Natural farming major practices may include :-** No external inputs, Local seeds (use of local varieties), Microbial Seed treatment, Microbial inoculants for soil health, Cover crops for biomass mulching and bio-mass incorporation for creating a suitable micro-climate for maximum beneficial microbial activity, Mixed cropping, Integration of trees into the farm, Integration of livestock, especially of native breed for cow dung and cow urine as essential inputs for several practices, Water and moisture conservation. Natural farming aims for restoring Soil Health, maintenance of diversity, animal welfare, Efficient use of natural/local resources and ecological fairness and balances. NF is an ecological farming approach where farming system works with the natural biodiversity, encouraging the soil's biological activity and managing the complexity of living organisms both plant and animal to thrive along with food production system Natural farming major practices may include :No external inputs, Local seeds (use of local varieties), Microbial Seed treatment, Microbial inoculants for soil health, Cover crops for biomass mulching and bio-mass incorporation for creating a suitable micro-climate for maximum beneficial microbial activity, Mixed cropping, Integration of trees into the farm, Integration of livestock, especially of native breed for cow dung and cow urine as essential inputs for several practices, Water and moisture conservation. Natural farming aims for restoring Soil Health, maintenance of diversity, animal welfare, Efficient use of natural/local resources and ecological fairness and balances.

### **Major Objectives of Natural farming:**

- Preserve natural flora and fauna
- Restore Soil fertility and production and biological life
- Maintain diversity of crop production
- Efficient utilization of land and natural resources (light, air, water)
- Promote inbuilt natural insects, animals and microbes in soil

- Promotion of local breeds of Livestock integration
- Use of Natural / local based inputs
- Reduce input cost of agricultural production
- Improve economy of farmers

## **Principles of Natural Farming**

### **Key Principles and Practices:**

#### **Minimal Soil Disturbance:**

Natural farming avoids intensive plowing or tilling, allowing the soil to cultivate itself naturally.

#### **No Synthetic Inputs:**

It eliminates the use of chemical fertilizers, pesticides, and herbicides.

#### **Biodiversity:**

Encourages a diverse range of plants, animals, and microorganisms within the farm ecosystem.

#### **Natural Pest and Disease Control:**

Relies on natural methods like companion planting, crop rotation, and the use of natural pest repellents.

#### **Mulching:**

Using organic matter like straw or leaves to cover the soil, which helps retain moisture, suppress weeds, and enrich the soil.

#### **Cover Cropping and Crop Rotation:**

These practices help maintain soil fertility and reduce the need for external inputs.

#### **Jeevamrutha/Beejamrutha:**

These are natural concoctions, typically made from cow dung, cow urine, and other natural ingredients, used to enhance soil fertility and seed germination.

A healthy soil microbiome is critical for optimal soil health and plant health, and thereby animal health and human health. Soil may be covered with crops for maximum period of the year. The soil across a farm or larger field/collection of fields should have diverse crops, a minimum of 8 crops over the year. 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 A healthy soil microbiome is critical for optimal soil health and plant health, and thereby animal health and human health. Soil may be covered with crops for maximum period of the year. 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 organic residues returned to the soil is very important. These include crop residues, cow-dung, compost, etc. Pest management should be done through better agronomic practices (as enshrined in Integrated Pest management) and through botanical pesticides (only when necessary). 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 practicing natural farming the following practices has been considered as the most important components of Natural Farming:

Beejamrit, Jivamrit. Mulching. Whapasa. Plant Protection.

**Can be achieved through following specific principles:**

1. Adoption of diversified cropping system-based agriculture
2. Recycling of naturally available nutrients in fields
3. Recycling of on-farm generated biomass
4. Use of locally developed and refined practices based on plant, animal and microbial source as raw materials
5. 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.

## Lecture No- 5

### Scope, Importance and Pillars 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 and Benefits of Natural Farming**

Natural farming, rooted in the philosophy of working in harmony with nature, is gaining traction across the world for its multifaceted advantages. Understanding its importance and benefits can shed light on why it's a vital paradigm shift in modern agriculture.

#### **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.

### **Other Benefits of Natural Farming:**

1. **Improve Yield** Farmers practicing Natural Farming reported similar yields to those following conventional farming. In several cases, higher yields per harvest were also reported.
2. **Ensures Better Health:-** As Natural Farming does not use any synthetic chemicals, health risks and hazards are eliminated. The food has higher nutrition density and therefore offers better health benefits.
3. **Environment Conservation:-** Natural Farming ensures better soil biology, improved agro-biodiversity and a more judicious usage of water with much smaller carbon and nitrogen footprints.
4. **Increased Farmers' Income:-** Natural Farming aims to make farming viable and aspirational by increasing net incomes of farmers on account of cost reduction, reduced risks, similar yields, incomes from intercropping.
5. **Employment Generation**
6. Natural farming generates employment on account of natural farming input enterprises, value addition, marketing in local areas, etc. The surplus from natural farming is invested in the village itself.
7. **Reduced Water Consumption:-** By working with diverse crops that help each other and cover the soil to prevent unnecessary water loss through evaporation, Natural Farming optimizes the amount of 'crop per drop'.
8. **Minimized Cost of Production:-** Natural Farming aims to drastically cut down production costs by encouraging farmers to prepare essential biological inputs using on-farm, natural and homegrown resources.
9. **Eliminates Application of Synthetic Chemical Inputs**
10. The overuse of synthetic fertilizers, especially urea, pesticides, herbicides, weedicides etc. alters soil biology and soil structure, with subsequent loss of soil organic carbon and fertility.
11. **Rejuvenates Soil Health**

12. The most immediate impact of Natural Farming is on the biology of soil—on microbes and other living organisms such as earthworms. Soil health depends entirely on the living organisms in it.

13. Livestock Sustainability

14. The integration of livestock in the farming system plays an important role in Natural farming and helps in restoring the ecosystem. Eco-friendly bio-inputs, such as Jeevamrit and Beejamrit, are prepared from cow dung and urine, and other natural products.

### **The world of Natural Farming- Cattle and non-Cattle based**

The cattle-based farming is cow-based farming which is considered as boon for sustainable agriculture. Cow-based farming results in the conservation of natural resources, soil, water and lives. Even the water and electricity requirements are reduced by 90% in this manner, lowering the cultivation cost to a bare minimum. This method would also utilize only 10% of the irrigation water in the farming practice. Also, because there is less power consumption, there is less pollution and also there are several advantages to embracing cow-based farming.

### **Pillars of Natural Farming**

The pillars of natural farming, particularly Zero Budget Natural Farming (ZBNF), are Bijamrita, Jivamrita, Acchadana (Mulching), and Whapasa (Soil Moisture). These pillars aim to create a sustainable and cost-effective farming system by minimizing external inputs and maximizing the use of natural processes.

### **Here's a breakdown of each pillar:**

#### **1. Bijamrita:**

This is a natural seed treatment that uses a mixture of cow dung, cow urine, soil, and lime to protect seeds from fungal and other soil-borne diseases.

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 vedas as 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.

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

**Method:**

1. Take 5 Kg local cow dung in a cloth and bound it by tape.
2. Hang this in the 20 Litre water up to 12 hours.
3. Take one litre water and add 50 gm lime in it and let it stabilize for a night
4. 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.
5. Then add a handful of soil in that water solution and stir it well.
6. Then add 5 litre desi cow urine in that solution & add lime water and stir it well.
7. 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.

**2. Jivamrita:**

Jeevamrita/jeevamrutha is a fermented microbial culture. In simple words, we can say that it's a combination of some organic components in water which is fertile and useful for plants. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil. Jeevamrita also increases the earthworm activity in the soil. The earthworms make the land porous; which helps the easy penetration of air and sunlight. This increases the nitrogen percentage in the soil and also helps to increase some helpful bacteria.

## **Advantages**

The concept of Jeevamrita comes from the Zero Budget Natural Farming. The Zero Budget Natural Farming was initially started in the areas of Karnataka and Maharashtra. The practitioners of Zero Budget Natural Farming used Jeevamrita, Beejamrita, Achhadana (Mulching) and Whapasa (Moisture). They are called as the four pillars of Zero Budget Natural Farming. Jeevamrita is used for a longer period and given with water. It is very important for improving soils fertility. It has many advantages:

- It acts as an agent to increase the microbial count and friendly bacteria in the soil.
- As the preparation time is only 4-5 days, it can be used effectively and frequently for a longer period of time.
- Jeevamrita helps to increase the earthworm count in the soil. Earthworm makes the soil porous which has a higher water holding capacity. It also improves aeration, bring up minerals from deep in the subsurface that are often in short supply in surface layers.
- If used consistently it can eradicate the need for chemical fertilizers completely. It improves the PH level of the soil.
- Suitable for all crops and increases the yield and cuts down on entire expenses of Chemical fertilizers.

## **How to Prepare**

Cow dung and urine are main component for preparing Jeevamrita. A handful of undisturbed soil is also added to the preparation, as inoculate of native species of microbes and organisms. Jeevamrita also helps to prevent fungal and bacterial plant diseases. Under, Zero Budget Natural Farming, it is suggested to use Jeevamrutha continuously for three years. Later that, the system becomes self-sustaining. It will not require more Jeevamrita and can provide all important component naturally. We have studies about the advantages of Jeevamrita yet. Let's know the method of preparing Jeevamrita step by step:

- Place 200 liters of water in a barrel.
- Add 10 Kg fresh local cow dung.
- Add 10 liters aged cow urine.
- Add 2 Kg of Jaggery (a local type of brown sugar).

- 2 Kg of pulse flour and a handful of soil from the bund of the farm.
- Stir the solution well and let it ferment for 48 hours in the shade.
- Now jeevamrita is ready for application.

### **How to Use**

You can prepare Jeevamrita by using this method. Now it's important to know that how to use the Jeevamrita, so that it can be effective and useful. First of all its important to identify the area of land to be covered for using Jeevamrita. As per the standard use, 200 liters of Jeevamrita is sufficient for one acre of land. Jeevamrita can be used twice a month. The best way to use Jeevamrita is to mix with the irrigation water. You can also apply it as a 10% foliar spray

### **3. Acchadana (Mulching):**

This involves covering the soil surface with organic materials like straw, dried leaves, or crop residues. Mulching helps retain soil moisture, suppress weeds, regulate soil temperature, and improve soil health.

- **Soil Mulch** – protects topsoil while cultivation and does not destroy it by tilling. Moreover, it promotes aeration and water retention in the soil. Palekar has advocated the avoidance of deep ploughing.
- **Straw Mulch** – straw material hints at the dried biomass waste of previous crops. This, as Palekar suggests, can be composed of the dead material of any living beings such as plants, animals, etc.
- **Live Mulch (symbiotic intercrops and mixed crops)** – As suggested by Palekar, it is pivotal to develop multiple cropping patterns of monocotyledons and dicotyledons grown in the same field so as to supply the essential elements to the soil and crops.

### **4. Whapasa (Soil Moisture):**

This refers to maintaining a balanced soil moisture level where both water molecules and air molecules are present in the soil. It is achieved through proper irrigation and mulching techniques.

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.

These four pillars, when implemented together, create a self-sustaining ecosystem that minimizes the need for external inputs like chemical fertilizers and pesticides, leading to more sustainable and environmentally friendly agricultural practices.

Dr. R. D. Bedse

## Lecture No- 6

### Natural farming and farm

#### Methods/ Types/ Schools of Natural Farming

Natural farming emphasizes minimal human intervention and aims to work with natural processes to cultivate crops. It focuses on building healthy soil ecosystems, using on-farm resources, and minimizing external inputs. Key methods include: 1) Soil Health Management: Building healthy soil through composting, mulching, and cover cropping. 2) Diverse Cropping Systems: Employing mixed cropping, intercropping, and crop rotation to enhance biodiversity and soil health. 3) Natural Pest and Disease Control: Utilizing botanical pesticides and biological control methods. 4) Water Conservation: Implementing techniques like mulching and contour farming to reduce water usage.

#### Detailed Methods:

##### 1. Soil Management:

- **Composting:** Decomposing organic matter (crop residues, animal manure, etc.) into nutrient-rich compost, which acts as a natural fertilizer.
- **Mulching:** Covering the soil surface with organic materials (straw, leaves, etc.) to retain moisture, suppress weeds, and improve soil fertility.
- **Cover Cropping:** Planting crops specifically to cover the soil, preventing erosion and enriching the soil with nutrients when they are incorporated back into the soil.

#### Soil Health Management

Agriculture, globally as well as in India, has witnessed several technological advancements. However, today sustainability of agricultural production systems vis-à-vis environment is a major concern. Soil and crop management practices affect the relationship between soil processes and agro-ecosystem function to a great extent, and thus affect the sustainability of agricultural production systems (Jernigan et al. 2020 and White et al. 2012).

#### Soil health and present day concerns with Soil

Soil is a fundamental and essential natural resource for existence of all living organisms.

- Soil health or quality is defined as the capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality and promote plant and animal health
- A healthy soil would ensure proper retention and release of water and nutrients, promote and sustain root growth, maintain soil biotic habitat, respond to management and resist degradation
- Healthy soil is the foundation of productive, profitable and environment friendly agricultural systems
- Intensive crop cultivation using broadly using imbalanced fertilizer, high nutrient mining through monoculture, decline in organic matter status, deficiencies of secondary and micronutrients, etc. have deteriorated the soil health across the country, resulting into declining crop productivity growth.
- There are 6 major soil types in India- Alluvial soil, Red soil, Black soil, Laterite soil, Arid soil and Forest & mountain soil. Each soil type has its own characteristics in terms of physical and chemical properties, like Alluvial soil is highly fertile, with high phosphorus and potash content. Laterite soil is acidic in nature, while Black soil is rich in potash and magnesium, but poor in phosphorus. Red soil has high iron and potash content but lacks phosphate.

**Nutrient deficiencies in Indian soils:** Overall, about 59 and 36 per cent of Indian soils are low and medium in available N, respectively. Similarly, soils of about 49 and 45 percent area are low and medium in available P, respectively; while soils of around 9 and 39 per cent area are low and medium in available K, respectively (Chaudhari et al., 2015). Among various soil characteristics that affect the availability and uptake of micronutrients, soil pH and organic carbon content are the two most important factors.

#### **Role of Micro-organisms in Nutrient Management**

- Microbes can make nutrients and minerals in the soil available to plants, produce hormones that spur growth, stimulate the plant immune system and trigger or dampen stress responses. In general, a more diverse soil microbiome result in fewer plant diseases and higher yield.

- Soil microorganisms play an active role in soil fertility as a result of their involvement in the cycle of nutrients like carbon and nitrogen, which are required for plant growth.
- For example, soil microorganisms are responsible for the decomposition of the organic matter entering the soil (e.g. plant litter) and therefore in the recycling of nutrients in soil.
- Certain soil microorganisms such as mycorrhizal fungi can also increase the availability of mineral nutrients (e.g. phosphorus) to plants.
- Other soil microorganisms can increase the amount of nutrients present in the soil. The group of bacteria called rhizobia live inside the roots of legumes and fix nitrogen from the air into a biologically useful
- The microorganisms, which improve the fertility status of the soil and contribute to plant growth, have been termed 'biofertilizers'
- Several microorganisms have been found to produce compounds (such as vitamins and plant hormones) that can improve plant health and contribute to higher crop yield. These microorganisms are called 'phyto-stimulators'
- Certain native microorganisms present in the soil are antagonistic to pathogenic microorganisms and can prevent the infection of crop plants.
- Other soil microorganisms produce compounds that stimulate the natural defense mechanisms of the plant and improve its resistance to pathogens. Collectively, these soil microorganisms have been termed 'biopesticides'
- Azospirillum induces the proliferation of plant root hairs which can result in improved nutrient uptake.
- Mycorrhizae or root fungi form a dense network of thin filaments that reach far into the soil, acting as extensions of the plant roots they live on or in. These fungi facilitate the uptake of water and a wide range of nutrients, thereby improving plant growth and overall health.

### **SOM is the prime indicator of soil health**

- Food source for soil microorganisms

- Highly decomposed organic matter (humus) provides a storehouse for the exchangeable and available cations.
- Acts as a buffering agent which checks rapid chemical changes in pH and soil reaction
- Index of the productivity of the soil
- Creates a granular condition of soil which maintains favorable condition of aeration and permeability
- Increases water holding capacity of soil and reduces surface runoff, erosion etc.

### **What is Humus?**

Humus is dark, organic material formed by decay of plant and animal matter.

### **Process of humus formation:**

Plants drop leaves, twigs, and other material to the ground. These materials pile up and form leaf litter. When animals die, their remains add to the litter. Over time, all this litter decomposes/breaks down, into its most basic chemical elements through the process known as **humification**. The thick brown or black substance that remains after most of the organic litter has decomposed is called humus. The humus produced by humification is thus a mixture of compounds and complex biological chemicals of plant, animal, or microbial origin that has many functions and benefits in soil.

### **Humification:**

- Plant remains, including those that animals digested and excreted, contain organic compounds: sugars, starches, proteins, carbohydrates, lignins, waxes, resins, and organic acids.
- These organic matters are acted upon by saprotrophic fungi, bacteria, microbes and animals such as earthworms, nematodes, protozoa, and arthropods,
- Decay in the soil begins with the decomposition of sugars and starches from carbohydrates.
- Cellulose and lignin decompose more slowly.
- Proteins, organic acids, starches, and sugars decompose rapidly.
- Crude proteins, fats, waxes, and resins remain relatively unchanged for longer periods of time.

### **Benefits of Humus:**

- Makes the soil fertile as it contains many useful nutrients for healthy soil. One of the most important is nitrogen. Nitrogen is a key nutrient for most plants.
- It helps in suppression of soil –borne diseases
- It helps the soil retain moisture by increasing micro porosity
- Encourages the formation of good soil structure.
- Increases availability of plant nutrients
- Humus are additional sources of nutrients for microbes.

### **Role of Earthworms in Nutrient Management**

Earthworms consume biodegradable materials and convert it into rich manure.

**Earthworms** "plow" and mix up the soil. Their tunneling loosens the soil so water and nutrients **can** go downward. The nutrients in **worm** castings enrich the soil. The slime they secrete contains nitrogen, an important nutrient for plants.

**Improved nutrient availability:** Worms feed on plant debris (dead roots, leaves, grasses, manure) and soil. Their digestive system concentrates the organic and mineral constituents in the food they eat, so their casts are richer in available nutrients than the soil around them. Nitrogen in the casts is readily available to plants. Worm bodies decompose rapidly, further contributing to the nitrogen content of soil.

**Improved drainage:** The extensive channeling and burrowing by earthworms loosens and aerates the soil and improves soil drainage. Soils with earthworms drain up to 10 times faster than soils without earthworms. In zero-till soils, where worm populations are high, water infiltration can be up to 6 times greater than in cultivated soils. Earthworm tunnels also act, under the influence of rain, irrigation and gravity, as passageways for lime and other material.

**Improved soil structure:** Earthworm casts cement soil particles together in water-stable aggregates. Upon cast deposition, microbial products, in addition to earthworm mucilage's, bind soil particles and contribute to the formation of highly stable aggregates. These are able to store moisture without dispersing. Research has shown that earthworms

which leave their casts on the soil surface rebuild topsoil. In favorable conditions they can bring up about 50 t/ha annually, enough to form a layer 5 mm deep.

**Improves activities of soil microorganisms:** They concentrate nutrients and resources that are further used by soil microorganism communities. In addition to this mixing effect, mucus production associated with water excretion in the earthworm gut is known to stabilize SOM through its incorporation and protection in their casts

**Increase soil pH:** An important role of EWs is the dramatic increase in soil pH by incorporating organic matter into the soil.

## **2. Diverse Cropping Systems:**

**Mixed Cropping:** Growing different crops together in the same field, which can improve nutrient uptake and pest control.

**Intercropping:** Growing two or more crops simultaneously, optimizing space and resource utilization.

**Crop Rotation:** Changing the type of crops grown in a field each season, preventing soil exhaustion and pest/disease cycles.

### **Economical Benefits of multi-cropping:**

**Higher Productivity:** Multi-cropping maximizes land productivity by intensifying land and labor use for better profit and income stability.

**Fodder Stock:** Growing multiple crops ensures an adequate supply of fodder for livestock.

**Food Security:** Even if one or two crops fail, other crops can still be harvested, ensuring food availability throughout the year.

**Multiple Uses:** Crops provide not only grains but also fodder and fuelwood.

### **Agronomic Benefits of multi-cropping:**

**Pest Management:** Growing a variety of crops together reduces pest problems and optimizes soil nutrients, water, and land use.

**Nitrogen Fixation:** Intercropping leguminous crops with others reduces the demand for nitrogen.

**Weed Management:** Multi-cropping suppresses weed growth, making efficient use of resources.

**Sustainable Crop Production:** It reduces the need for chemical fertilizers and pesticides.

### **3. Natural Pest and Disease Control:**

#### **Pest identification**

##### **Type of Pests**

1. Regular pest- Frequently- Rice stem borer, Pod borer.
2. Occasional – Case worm in rice, Mango stem borer.
3. Seasonal Pests- Red Hairy Caterpillar, Cotton pink bollworm, Mango Hopper.
4. Persistent pests- Round the year- Thrips, Mealy bug, cotton ball worm.

##### **Causes for outbreak of pests**

1. Destruction of forest or bringing forest area under cultivation.
2. Indiscriminate use of pesticides leads to destruction of natural enemies, pest resistance, pest resurgence.
3. Intensive cultivation.
4. Introduction of new crops and varieties ( many high yielding varieties are more susceptible to insects)
5. Improved agronomic practices (higher 'N', close, spacing, weed control etc. improved crop growth and reduced competition for food to the insects)
6. Introduction of new pest in a new area.
7. Accidental introduction of foreign pests.
8. Large scale storage of food grains (outbreak of stored product pests, rat problem)

##### **Pest management in natural farming**

###### **1. Preventive Measures:**

- Selection of varieties
- Selection of safe seeds/ planting material.
- Mixed cropping systems
- Use of good water management:
- Conservation and promotion of natural enemies
- Optimal planting time.

- Sufficient distance between the plants.
- Remove infected plant parts

## 2. Curative methods:

- Minimize the application of natural pesticides
- Allow some pests to live in the field which will serve as food or host for natural enemies.
- Establish a diverse cropping system (e.g. mixed cropping).
- Include host plants providing food or shelter for natural enemies (e.g. flowers which adult beneficial insects feed on).
- **Botanical Pesticides:** Using plant-based extracts (e.g., neem, garlic) to control pests.

## Plant based concoctions and decoctions for pest and disease management

### A. BRAHMASTRA (broad spectrum botanical pesticide)

#### ➤ Ingredients

- ✓ Neem Leaves - 3 Kg
- ✓ Karanj Leaves - 2 Kg
- ✓ Custard Apple Leaves - 2 Kg .
- ✓ Papaya Leaves - 2 Kg
- ✓ Guava Leaves - 2 Kg
- ✓ Cow Urine - 10 Litre

#### Methodology:

- Take 10 liters of cow urine
- Add 03 kg of crushed green leaves of neem.
- Add 02 kg crushed Karanj Leaves.
- Add 02 kg crushed Custard Apple Leaves.
- Add 02 kg crushed Papaya Leaves.
- Add 02 kg crushed Guava Leaves.
- Now dissolve all this mixture in cow urine and and boil it.
- After 3-4 boils, take it down from the fire.
- Let it cool for 48 hours and then filter the solution with a cloth.
- Now Solution is ready to spray on the crop.

**How to Use?** 2-3% Spray with water

**Uses** For the control of sucking insects and pod/fruit borer.

**B.NEEMASTRA (broad spectrum botanical pesticide)**

**Ingredients**

Neem Leaves - 5 Kg

Cow Urine - 5 Litre

Cow Dung - 1 Kg

Water - 100 Litre

**Methodology:**

- Take five kg of green leaves of neem or take five kg of dried fruits of neem and keep the leaves or fruits crushed.
- Add this crushed neem or fruit powder in 100 liters of water.
- Put 5 liters of cow urine in it and mix one kg of cow dung.
- Stir it with wood and keep it covered for 48 hours.
- Dissolve thrice a day and after 48 hours filter the solution with a cloth. Now spray on the crop.

**How to Use?** 2-3% Spray with water

**Uses** For the management of sap sucking insects and small caterpillars.

**C.AGNEYASTRA**

**Ingredients**

Neem Leaves - 5 Kg

Green Chilli - 0.5 Kg

Garlic - 0.5 Kg.

Cow Urine - 20 Litre

**Methodology**

- Take 20 liters of cow urine
- Add 05 kg of crushed green leaves of neem.
- Add 0.5 kg crushed Green Chilli.
- Add 0.5 kg crushed Garlic.
- Now dissolve all this mixture in cow urine and and boil it.
- After 3-4 boils, take it down from the fire.

- Let it cool for 48 hours and then filter the solution with a cloth.
- Now Solution is ready to spray on the crop.

**How to Use?** 2-3% Spray with water

**Uses** For insects living in tree trunks or stalks, all types of large bollworms and caterpillars.

### **SOME OTHER PEST CONTROL FORMULATIONS**

Many organic farmers and NGOs have developed large number of innovative formulations which are effectively used for control of various pests. Although none of these formulations have been subjected to scientific validation but their wide acceptance by farmers speak of their usefulness.

Farmers can try these formulations, as they can be prepared on their own farm without the need of any purchases. Some of the popular formulations are listed below:

#### **Cow urine**

Cow urine diluted with water in ratio of 1: 20 and used as foliar spray is not only effective in the management of pathogens & insects, but also acts as effective growth promoter for the crop.

#### **Fermented curd water**

In some parts of central India fermented curd water (butter milk or Chaach) is also being used for the management of white fly, jassids aphids etc.

#### **Dashparni extract**

Crush neem leaves 5 kg, *Vitex negundo* leaves 2 kg, *Aristolochia* leaves 2 kg, papaya (*Carica papaya*) 2 kg, *Tinospora cordifolia* leaves 2 kg, *Annona squamosa* (Custard apple) leaves 2 kg, *Pongamia pinnata* (Karanja) leaves 2 kg, *Ricinus communis* (Castor) leaves 2 kg, *Nerium indicum* 2 kg, *Calotropis procera* leaves 2 kg, Green chili paste 2 kg, Garlic paste 250 gm, Cow dung 3 kg and Cow Urine 5 lit in 200 lit water ferment for one month. Shake regularly three times a day. Extract after crushing and filtering. The extract can be stored up to 6 months and is sufficient for one acre.

### **Neem-Cow urine extract**

Crush 5 kg neem leaves in water, add 5lit cow urine and 2 kg cow dung, ferment for 24 hrs with intermittent stirring, filter squeeze the extract and dilute to 100 lit, use as foliar spray over one acre. Useful against sucking pests and mealy bugs.

### **Mixed leaves extract**

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

### **Chilli-garlic extract**

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

### **Broad spectrum formulation - 1**

In a copper container mix 3 kg fresh crushed neem leaves and 1 kg neem seed kernel powder with 10 lit of cow urine. Seal the container and allow the suspension to ferment for 10 days. After 10 days boil the suspension, till the volume is reduced to half. Ground 500 gm green chillies in 1 lit of water and keep overnight. In another container crush 250gm of garlic in water and keep overnight. Next day mix the boiled extract, chilli extract and garlic extract. Mix thoroughly and filter. This is a broad spectrum pesticide and can be used on all crops against wide variety of insects. Use 250 ml of this concentrate in 15 lit of water for spray.

### **Broad spectrum formulation - 2**

Suspend 5 kg neem seed kernel powder, 1kg Karanj seed powder, 5 kg chopped leaves of besharam (Ipomea sp.) and 5kg chopped neem leaves in a 20lit drum. Add 10-12 lit of cow urine and fill the drum with water to make 150 lit. Seal the drum and allow it to ferment for 8-10 days. After 8 days mix the contents and distil in a distiller. Distillate will act as a good pesticide and growth promoter. Distillate obtained from 150lit liquid

will be sufficient for one acre. Dilute in appropriate proportion and use as foliar spray. Distillate can be kept for few months without any loss in characteristics.

### **Tutikadarasam**

Tutikadarasamis prepared from Datura leaves and cow urine. The leaves are boiled in cow urine for 2-3 hours, cooled and then filtered using cloth.

### **Sonthastra**

Take 2 litres of water, add 200 grams of ginger powder (Sonth) and mix it and cover with a lid. Now boil it till it reduces to half of the solution. Keep this solution for cooling. Take 2 litre milk in another container and boil it slowly on low flame. After boiling milk, allow it to cool down, remove the cream from the milk. Now take 200 litres of water, add a solution of ginger powder and milk without cream. Mix it properly and cover this solution with gunny bags for two hours. During this process ion exchange will occur, filter it with muslin cloth and spray this solution within 48 hours.

### **Jungle Ki Kanddi**

Take kanddi powder (powder of indigenous cow's dung also known as jungle kikanddi) and keep it in muslin cloth. Tie one end of this bag in the centre of a wooden stick in such a way so that this bag hangs above the centre of the drum filled with 200 litres of water. After this, keep 5 Kg kanddi powder bags into 200 litres of water drum and leave for 48 hours. Stir this solution two times in a day for 2-3 minutes in the clockwise direction. The colour of the solution will change to a reddish brown colour (Katha/brass colour). After 48 hours, take out this bag and squeeze it, dip it again and then squeeze. Repeat this process three times. Stir this solution properly. Spray this solution within 48 hours. Before spraying, filter this solution.

- **Biological Control:** Introducing beneficial insects or microorganisms to manage pests and diseases.

### **Non-Insect Pests:**

Other than insects, there are a group of animals known as non-insect pests viz., rodents, birds, mollusks, monkeys, mites, snails, slugs and wild animals are all included that cause significant output losses in agricultural crops.

### **Management of Non-Insect Pests:**

**Cultural control:** Regular monitoring of crop for pest incidence is essential.

**Mechanical control:** An effective tool to manage the mites and other small bodied arthropods. A forceful stream of water should be used on where the mite population are high while on the sturdy plants take measures to avoid damage. Mechanical Traps and sound deterrents can be used for managing wild animals and birds.

**Use of Deterrents Decoctions:** Deterrent and test altering decoctions prepared from bitter smelling and test botanicals and livestock byproducts can be used to protect the crop from non-insect pests.

### **Beneficial Insects:**

Beneficial insects belong to three categories: predators, parasitoids, and pollinators.

**Predators:** capture and eat other organisms such as insects or mites. Predators include ladybird beetles and wasps.

**Parasitoids:** are insects that parasitize other insects. The immature stages of parasitoids develop on or within its host, eventually killing it.

**Pollinators:** include honeybees, other wild bees, butterflies, moths and other insects that visit flowers to feed on nectar and pollen. Pollinators transfer pollen in and between flowers of the same species (pollination) which is essential to seed and fruit production for plants.

### **4. Water Conservation:**

**Mulching:** As mentioned above, mulching helps retain soil moisture, reducing the need for irrigation.

**Contour Farming:** Planting crops along the contours of the land to minimize soil erosion and improve water infiltration.

### **How do we harvest and retain rainfall in the soil?**

#### **Why rain water harvesting:**

- Surface water is inadequate to meet our demand and we have to depend on ground water.
- Due to rapid urbanization, infiltration of rain water into the sub-soil has decreased drastically and recharging of ground water has diminished.

- Irrigation requirements

**Rain water harvesting techniques:** There are two main techniques of rain water harvestings.

- Storage of rainwater on surface for future use.
- Recharge to ground water.

**Techniques for water Harvesting:**

**Pits:** - Recharge pits are constructed for recharging the shallow aquifer. These are constructed 1 to 2 m, wide and to 3 m. deep which are back filled with boulders, gravels, coarse sand.

**Trenches:** - These are constructed when the permeable stram is available at shallow depth. Trench may be 0.5 to 1 m. wide, 1 to 1.5m. deep and 10 to 20 m. long depending up availability of water. These are back filled with filter. materials.

**Dug wells:** - Existing dug wells may be utilised as recharge structure and water should pass through filter media before putting into dug well.

**Hand pumps:** - The existing hand pumps may be used for recharging the shallow/deep aquifers, if the availability of water is limited. Water should pass through filter media before diverting it into hand pumps

**Recharge wells:** - Recharge wells of 100 to 300 mm. diameter are generally constructed for recharging the deeper aquifers and water is passed through filter media to avoid choking of recharge wells.

**Diversion of runoff into existing surface water bodies**

Construction activity in and around the city is resulting in the drying up of water bodies and reclamation of these tanks for conversion into plots for houses. Free flow of storm runoff into these tanks and water bodies must be ensured. The storm run off may be diverted into the nearest tanks or depression, which will create additional recharge.

**Water and moisture management through Mulching**

**Mulching**

Mulching is defined as covering of soil surface using either live crops or straw (dead plant biomass) to conserve moisture, increase infiltration, lower soil temperature

around plant roots, prevent soil erosion, improve soil structure, reduce runoff and weed growth. Mulching prevents the formation of hard crust after each rain.

### **Role of Earthworms in water recharge**

The native earthworms are also known as indicators of soil fertility. Some thinkers also consider the native earthworms as “heart of Mother Earth”, as these earthworms also create vibrations in the soil surface as they move up and down, like our heartbeats. As the native earthworms traverse the soil, they fertilize it and enrich it with nutrients by secreting mucilaginous substances, which helps in binding of soil particles and thus enhances the water holding capacity of soil. Earthworms require shade to function as well and thus the micro-climate formed under the mulch helps the process. If there is an absence of a microenvironment, earthworms cannot do their work, and the soil cannot become productive.

Soil pores formed by earthworm also improves water infiltration rate, distribution of nutrient, and gas exchange during the plant respiration and thus promote root growth besides enhancing the microbial decomposition of organic matter. Water infiltration in the soil is mainly dependent upon the soil porosity rather than the other soil properties. Large macro pores created by native earthworms play a vital role in the regulation of water infiltration.

### **5. Other Practices:**

**Agroforestry:** Integrating trees into the farming system to enhance biodiversity and soil health.

**Using Local Seeds:** Employing seeds that are adapted to the local environment, promoting resilience and sustainability.

**Minimal Tillage:** Avoiding or minimizing plowing to preserve soil structure and microbial life.

**Using On-Farm Inputs:** Utilizing locally available resources like cow dung and urine, rather than relying on external inputs.

**Biodiversity Promotion:** Encouraging a wide variety of plants and animals on the farm to create a balanced ecosystem.