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Natural Farming

Bridging Farmers' Wisdom and Scientific Principles

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Natural Farming is not merely a set of practices; it relies on the philosophy of co-existence with nature. It emphasizes the idea that soil, plants, animals, and humans are interconnected components of one living system. The ultimate goal of natural farming is to produce nutritious food while preserving ecological balance and maintaining the health of both soil and human being. One of the most recognized forms of natural farming in India is Zero Budget Natural Farming (ZBNF), which seeks to minimize external inputs and rely on locally available, natural resources for soil fertility and crop management. However, natural farming goes beyond input substitution, it focuses on building self-sustaining ecosystems that mimic natural processes.

The scientific principles of natural farming include:

- Enhanced biomass recycling: Returning organic matter to the soil to maintain nutrient cycling.
- Strengthened immune systems: Promoting plant and soil health through biodiversity rather than synthetic protection.
- Improved soil health: Encouraging microbial activity, earthworm populations, and enzyme production to build long-term fertility.
- Reduced energy and nutrient loss: Creating closed-loop systems that minimize external dependency.
- Diversification of genetic resources: Ensuring resilience against pests, diseases, and climatic stresses.
- Enhanced beneficial biological interactions: Fostering cooperation between plants, microbes, and animals for ecosystem balance.

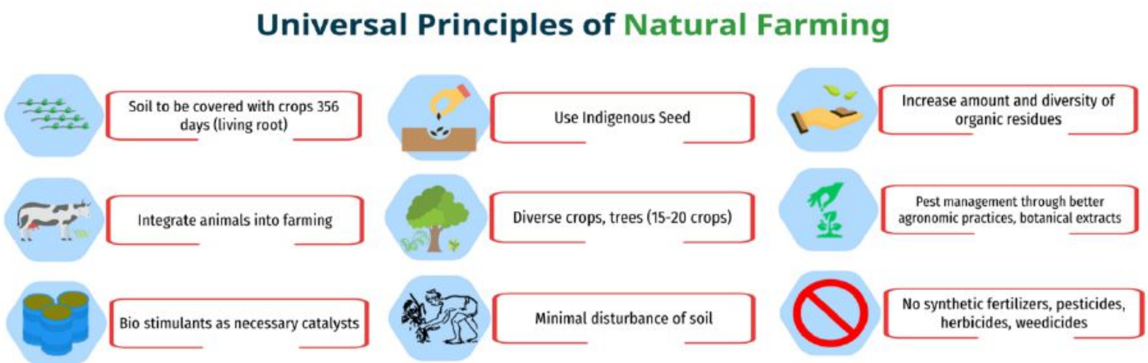

Fig 1: The Universal Principles of Natural Farming

(Source: www.cgiar.org)

Altieri (2002) has demonstrated that, these ecological interactions lead to measurable improvements in soil structure, organic carbon content, and nutrient bioavailability, thus bridging the gap between traditional knowledge and scientific understanding. Liao *et al.* (2019)

compared the effect of seven years' conventional practice (CP), conventional practice without chemicals (CF), and natural farming (NF) on soil properties and microbial community structure at two soil depths (0–10, 10–20 cm) in an experimental cabbage field. Both soil depth and agricultural practice significantly influenced edaphic measures and microbial community structure. NF improved bulk density, pH, electrical conductivity, urease activity, and nitrate reductase activity in topsoil; similar trends were observed in deeper soil. Pyrosequencing demonstrated that the use of pesticides in conventional farming (CP) led to lower microbial abundance and diversity in topsoil than CF. Similarly, NF increased microbial abundance compared to CP.

The Scientific Foundation of Natural Farming

The scientific principles underlying natural farming depends on decades of agroecological research. Studies indicate that natural farming production systems improve soil physical, chemical, and biological properties compared to conventional systems. They also enhance soil enzyme activity, microbial diversity, and carbon sequestration potential, contributing both to productivity and climate resilience. From a physiological standpoint, plants grown under NF conditions exhibit stronger immune responses, better nutrient uptake efficiency, and higher resistance to biotic and abiotic stress. This is partly due to the living soil microbiome, which provides natural disease suppression and nutrient cycling.

Furthermore, natural farming links soil health directly to human nutrition, encapsulated in the concept of *"From Soil to Plate."* Nutrient-rich soils yield crops with higher micronutrient content, antioxidants, and phytochemicals essential for human health. Several comparative studies have shown that produce from natural farming systems tends to be richer in iron, zinc, and other trace minerals than chemically grown counterparts.

Saharan *et al.* (2023) have investigated the effect of Jeevamrit on soil chemical and microbial properties of the ZBNF field coupled with metagenomic analysis and the economics of ZBNF. The percentage increase in soil properties, such as organic carbon, available phosphorus, and available potassium, was recorded up to 46%, 439%, and 142%, respectively, while micronutrients, such as Zn, Fe, Cu, and Mn, also increased up to 98%, 23%, 62%, and 55%, respectively, from 2017 to 2019. Further, functional analysis showed a high representation of genes/enzymes involved in amino acids and carbohydrate metabolism contributing to soil fertility, plant growth, defense, and development.

Yankit *et al.* (2024) carried out a study to investigate the effects of NF *vis-a-vis* organic farming (OF) and conventional farming (CF) systems on soil microbial population, enzymatic activity, and microarthropod population under tomato crop in the mid-hill zone of Himachal Pradesh, India. The results showed that bacterial population under NF increased by 42.8% and 24% in comparison to CF and OF, respectively. Similarly, the population of soil fungi and actinomycetes under NF increased by 80.5 and 67.7% over CF, and by 47.9 and 39.6% over OF, respectively. The soil dehydrogenase activity under NF (22.5µg TPF/g soil/h) was 150.6% higher than CF and 85.2% higher than OF. Similar trend was found for phosphatase and urease activity. Soil micro arthropod population after two years of experiment was also highest under NF followed by OF and CF. The system yield was statistically at par to each other, among different farming systems.

Biodiversity and the Five-Layer Model: A Holistic Design

One of the hallmark features of Natural Farming, especially under the ZBNF framework, is maximum diversification. The five-layer model, as developed and demonstrated in Gujarat Natural Farming Science University (GNFSU), is a remarkable example of designing biodiversity into farming systems.

- First Layer: Fruit trees like mango, sapota, guava, and coconut form the upper canopy, with border trees such as teak, neem, and jamun offering windbreaks and microclimate regulation.
- Second Layer: Intermediate-height crops like sweet orange, clove, fig, and palms contribute to structural diversity.
- Third Layer: Crops such as papaya, banana, black pepper, and arecanut add further functional and nutritional diversity.
- Fourth Layer: Understory crops like curry leaf, lime, custard apple, and medicinal plants like aloe vera create additional income and ecological stability.
- Fifth Layer: Ground crops such as vegetables, pulses, and millets provide daily sustenance and maximize land-use efficiency.

Fig 2: Five layer model at Gujarat Natural Faming Science University, Halol, Panchmahal

This five-layer diversification model not only enhances productivity per unit area but also reduces pest outbreaks, improves soil moisture retention, and increases total biomass. It is an applied demonstration of the ecological principle that diversity brings stability.

Climate Resilience and Adaptation

The reality of climate change demands adaptive farming systems capable of withstanding shocks such as floods, cyclones, and droughts. Natural farming practices have shown remarkable resilience in this regard.
A recent case in December 2023, when Cyclone Michaung struck the eastern coast of India, provided a striking example. Farmers practicing Natural Farming reported that their paddy crops survived standing floodwaters, while conventional farms nearby suffered severe losses. The enhanced soil structure, organic matter, and root strength in NF systems are key to this resilience. Another emerging technique is Pre-Monsoon Dry Sowing (PMDS), which allows farmers to utilize early monsoon moisture effectively and reduces dependence on chemical seed treatments or irrigation. Such methods align with low-carbon, climate-smart agriculture and can play a pivotal role in ensuring national food security under changing environmental conditions.

Economic Viability and Social Empowerment

Natural Farming can be economically competitive and socially empowering. Data from the Andhra Pradesh ZBNF (APZBNF, 2018) initiative reveal that farmers practicing ZBNF often achieve higher net incomes than those relying on chemical inputs, primarily due to reduced input costs and diversified income sources.

Key drivers for scaling up natural farming include:

- Community-based learning and farmer-to-farmer training.

- Constructivist teaching models that explain soil ecology and nutrient cycles in simple, relatable terms.
- Strong local leadership and self-organized training workshops.
- Policy support and favorable markets for natural produce.
- External alliances with research institutions, NGOs, and consumer groups to ensure quality assurance and knowledge dissemination.

These social dimensions are essential for transforming Natural Farming from a grassroots movement into a mainstream agricultural paradigm.

Conclusion: The Path Ahead

Natural farming represents a scientifically credible and socially inclusive pathway toward restoring balance in India’s agricultural landscape. It offers solutions that integrate economic viability, environmental sustainability, and nutritional well-being, demonstrating that modern science and traditional ecological knowledge can indeed coexist harmoniously. By nurturing the soil, supporting biodiversity, and empowering farmers, Natural farming not only restores productivity but also redefines the relationship between humans and nature. As the motto “From Soil to Plate” suggests, healthy soil creates healthy food, which in turn creates healthy people—a vision central to the future of sustainable agriculture in India.

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