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HV Korat
Gujarat Natural Farming Science University, Halol, Panchmahal, Gujarat, India

VN Shiyal
Gujarat Natural Farming Science University, Halol, Panchmahal, Gujarat, India

KR Khunt
Gujarat Natural Farming Science University, Halol, Panchmahal, Gujarat, India

BM Keshwala
Gujarat Natural Farming Science University, Halol, Panchmahal, Gujarat, India

SN Chaudhari
Gujarat Natural Farming Science University, Halol, Panchmahal, Gujarat, India

Corresponding Author:
HV Korat
Gujarat Natural Farming Science University, Halol, Panchmahal, Gujarat, India

A review: Enhancing crop productivity and soil health through natural farming practices

HV Korat, VN Shiyal, KR Khunt, BM Keshwala and SN Chaudhari

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Abstract
Natural farming is sustainable approach to conserve soil health and increase soil biodiversity by using the key components are Jeevamrit, Ghanjeevamrit, mulching and intercropping. Jeevamrit and Ghanjeevamrit increases the microbial diversity and population that facilitate nutrient cycling, nutrient solubilization and promote the plant growth. Mulching with crop residue cover the soil that helps to maintain the appropriate moisture, food for microbes and enhances the activity of earthworms. Decomposition of organic mulch improve the organic carbon, stabilize the soil structure, store house for nutrients and holding moisture *etc* as organic carbon is heart of soil. Intercropping of different crops in the same area creates synergistic interactions that enhance resource utilization and soil biological activity. Diverse root exudates stimulate beneficial microbial populations, while the presence of multiple crops reduces production risks under drought and other abiotic stresses, thereby improving system resilience and stability. Beyond improving soil health and agricultural sustainability, natural farming also contributes to the production of safe and nutritious food, thereby supporting human health and well-being. However, for the wider adoption and successful scaling of natural farming, strong policy support, research investments, and extension services are essential. Furthermore, the development of standardized protocols and location-specific packages of natural farming practices is required to improve their scientific credibility, farmer acceptance and large-scale implementation.

Keywords: Natural farming, soil health, crop productivity, *jeevamrit*, mulching, intercropping

Introduction

Natural Farming is a chemical-free, traditional farming method that emphasizes ecological balance and sustainability. Recognized by NITI Aayog as an agroecology-based, diversified farming system, it integrates crops, trees and livestock to promote functional biodiversity. This approach applies the laws of nature directly to agricultural practices, encouraging the natural biodiversity of each farm area to flourish. It supports the complexity of living organisms both plant and animal that shape each unique ecosystem, allowing them to thrive alongside cultivated food crops. Rather than relying on synthetic inputs, natural farming builds upon the ecological processes already present in and around farms. It respects and enhances these natural systems, creating a self-sustaining cycle of growth and regeneration. This method holds significant promise for increasing farmer's incomes while delivering a range of additional benefits, including the restoration of soil fertility, improved environmental health, and the mitigation or reduction of greenhouse gas emissions.

The concepts of modern natural farming are not new discoveries; they are a reclamation of indigenous and traditional practices that sustained human civilizations for thousands of years without degrading the biosphere. In ancient India, agriculture was treated as a sacred, symbiotic relationship between humans, animals and the earth. Texts such as the Shri Bhagvad Gita, Rigveda, Atharvaveda have descriptions of agriculture (Aithal, 2022) [2] and later specialized manuscripts like the Krishi Parashara and Upavanavinoda detailed highly sophisticated, chemical-free farming systems. Rishi kheti and vedic formulations like Kunapajala and Pachagavya found in ancient history. The pioneered of Rishi kheti was Pratap Aggarwal in 1980, an agriculture practitioner of Madhya Pradesh. The concept is no-tilling the land, residue retention, nothing to purchase from outside, use of cosmic energy rich input to nourished the plant. Every Plants has own language to communicate with the living organism in the soil to get food.

The Panchagavya (cow milk, yogurt and ghee, cow manure, cow urine), green manuring, crop rotation, mulching etc., that are beneficial for maintaining of soil health, water conservation, climate resilience and the produce are also free from contaminants and thus, beneficial for the human consumption and health (Shweta et al. 2025) [25]. Kunapajala documented in Vrikshayurveda and Lokopakara is a liquid plant-based formulation (Saikat and Rupa, 2025) [24]. Valmiki Sreenivasa Ayangarya, a mathematician was the first one who experimented with Kunapajala anddocumented the beneficial role of herbal Kunapajala on mango and coconut (Ayangarya, 2004) [55].

The modern concept of natural farming given by Masanobu Fukuoka (1913-2008), a Japanese microbiologist and soil scientist. Working in the mid-20th century a period dominated by the aggressive expansion of the chemical-intensive Green Revolution. Fukuoka pioneered an alternative paradigm on his family orchard in Shikoku. His landmark text, The One-Straw Revolution (1975), introduced the philosophy of mu (nothingness or non-action), which argued that human intervention in agriculture often creates the very problems it attempts to solve. Rather than asking "What happens if I do this?" Fukuoka asked, "What happens if I don't do this?". So far, he focusses on No cultivation (tillage), No chemical fertilizers or prepared compost, No weeding by tillage or herbicides and No dependence on chemicals.

In recent decades, natural farming has transitioned from localized philosophy to large-scale state policy. Initiated as Zero Budget Natural Farming (ZBNF) by Subhash Palekar, and later expanded as Andhra Pradesh Community-Managed Natural Farming (APCNF), this methodology relies on cow-based inputs such as Jeevamrit and Ghanjeevamrit along with mulching, have emerged as effective approaches for improving the productivity and sustainability of cereal-legume cropping systems. These inputs play a crucial role in enhancing soil biological activity, nutrient availability and overall crop performance.

Jeevamrit

Jeevamrit, a fermented liquid microbial rich formulation prepared from cow dung, cow urine, jaggary, pulse flour and virgin rhizosphere soil. The baseline efficacy of Jeevamrit lies in its unique fermentation matrix. When cow dung and urine are combined with jaggery (a complex carbon source) and pulse flour (a rich protein/nitrogen source), it initiates a hyper-accelerated microbial breeding ground. Within a 7 to 10 days fermentation cycle, the indigenous microflora present in the ruminant dung and the virgin rhizosphere soil multiply exponentially, converting complex organic matrices into bioavailable metabolites, organic acids, and plant growth regulators. The microbial profile of Jeevamrit changes dynamically across its preparation cycle, typically peaking between days 8 and 12. Jeevamrit does not directly provide the nutrient to the crops as like chemical fertilizers but it improves the soil microbial diversity that improve the nutrient cycling (Aulakh et al., 2013) [4].

A bio-stimulant acts as source of beneficial microbes to improve nutrient availability for the plant. In well fermented Jeevamrit made from indigenous cow dung has large number of actively professed microbial population. Some studies reported that, Jeevamrit contain 5-7 times high nitrogen fixing and phosphate solubilizing bacteria as compared to their original cow dung. This clear that Jeevamrut provide enrichment environment for microbial proliferation. Soil application of Jeevamrit enrich the soil Proteobacteria and bacterial phyla including Bacillus, Pseudomonas, Rhizobium, and Panibacil lus (Saharan et al., 2023) [23]. Jeevamrut introduces and stimulates a diverse population of beneficial microorganisms in the soil, functioning as an effective microbial inoculant. It supports the proliferation of important nitrogen-fixing bacteria such as Azotobacter and Rhizobium, as well as potassium-solubilizing bacteria like Pseudomonas. Additionally, Jeevamrut enhances the growth of actinomycetes and decomposer fungi, including Aspergillus and Trichoderma, thereby improving soil biological activity and nutrient availability (Somdutt et al., 2023) [26].

Jeevamrit improves soil health by enhancing microbial populations and nutrient availability. Increased availability of nitrogen, phosphorus and potassium along with improved microbial populations was reported under Jeevamrit application (Chavan and Pawar, 2019) [6]. Kale observed increased microbial biomass carbon and enzymatic activities, indicating improved soil biological functioning. Cow dung manure increases the soil organic matter, N, P, K, Ca, Mg as compared to other manures (Adekiya et al., 2020) [1] Similarly, Kamble et al. (2023) [10] reported improvements in soil pH, cation exchange capacity and earthworm population, highlighting the role of Jeevamrit in maintaining soil fertility.

Jeevamrit promotes plant growth through multiple mechanisms. The enriched microbes produce plant growth-promoting regulators such as indole-3-acetic acid (IAA), gibberellins and cytokinins. Furthermore, the organic acids released by KSB and PSB solubilize fixed soil nutrients, making them bioavailable to crops. Studies across various crops (e.g., rice, wheat, and vegetables) demonstrate enhanced root biomass, higher chlorophyll content and robust vegetative growth, ultimately translating into sustainable crop yields comparable to chemical farming without environmental degradation. It is rich in beneficial microorganisms, promotes rapid microbial multiplication in the rhizosphere, thereby improving nutrient solubilization and uptake, which ultimately enhances plant growth and yield attributes (More et al., 2019; Kaur et al., 2020) [18, 11].

Ghanjeevamrit

Ghanajeevamrit is a solid formulation of Jeevamrit used as a basal soil application. Prepared by enriching dry cow dung with liquid Jeevamrit, it activates native soil microbes to effectively convert unavailable nutrients into plant absorbable forms. Ghanjeevamrit, a solid form of manure, provides a slow and sustained release of nutrients and supports soil microbial proliferation, leading to improved plant growth, nodulation in legumes and higher yield (Patil and Gaikwad, 2019; Pawar et al., 2020) [20, 21]. Ghanjeevamrit enhances nutrient uptake by improving microbial activity and organic matter decomposition. Increased NPK content in soybean under combined application of Ghanjeevamrit and vermicompost was reported (Patil and Gaikwad, 2019) [20]. Studies have reported that Ghanjeevamrit enhances microbial biomass carbon, microbial diversity and soil biological activity, resulting in improved nutrient transformation processes and better crop growth (Yadav *et al.*, 2020; Devakumar *et al.*, 2014) [27, 77].

Mulching

An important soil management practice widely used in agriculture. In sustainable agriculture, mulching is recognized as an effective practice for improving soil physical conditions and reducing environmental stress on crops. The word mulch is derived from the German word mulch, which means "easy to decay" (Lightfoot, 1994) [15]. In natural farming, the concept of mulch extends to use residue mulch, live mulch with crop and soil mulch. Mulching has been demonstrated to provide a number of positive benefits. It protects the soil from water and wind erosion, reduce the water need, increase the activity of earthworm, act as food materials to soil fauna and flora, increase organic carbo after decomposition of crop residue, etc.

Lower bulk density is a sign of healthy soil. In natural farming, after harvesting of economic product, whatever the residue left over is turning into to soil. Returning crop residues as mulching to the soil improves soil quality and productivity through favorable effects on soil properties (Lal and Stewart, 1995) [14]. Upon time, under appropriate moisture content organic mulch materials decompose and add organic matter into soil that leads to lower bulk density. Decomposed organic matter increases the aggregate stability. Stable aggregates produce favorable conditions for plant growth and soil quality improvement by maintaining the water infiltration, moisture content, nutrient cycle, and especially the carbon storage (Kumar). Mulches conserve the moisture by reducing the evaporation of water from the surface of the soil. Mulches covers to the soil surface, it helps to reduce weed infestation and its help in maintaining the surface temperature which is beneficial for plant growth. Increased porosity with mulch, reduce soil runoff and erosion by increasing rate of water infiltration. Mulch with organic material covers soils and creates a physical barrier to soil water evaporation, preserves a beneficial soil structure, soil aggregate stability and protects plants from soil contamination (Mulatu and Teshale, 2023) [19]

Intercropping

Intercropping is a sustainable farming approach involving two or more crops being concurrently grown on a single plot of land. The increasing human population and decreasing cultivable land resources necessitate intensifying agricultural production (Maitra et al. 2021) [16]. Intercropping practices have been associated with certain ecosystem services and benefits such as optimizing resource utilization, soil moisture and nutrient conservation, minimizing the risk of crop failure due to climatic anomalies and aiding the farmers with additional revenue (Meena et al. 2024) [17]. When cultivated together, wheat (cereal crop) and chickpea (pulse crop) have different root structures and physiological traits that might enhance soil health, control of pests and diseases and overall agronomic performance (Hauggaard Nielsen et al. 2001) [9]. Cereal crops like wheat usually possess strong competitive qualities for light and nutrients, while legumes like chickpea can fix atmospheric nitrogen to improve soil fertility and benefit neighboring crops (Księżak et al. 2023) [12]. Biostimulants are compounds that can generate an overall improvement in the plant and soil microbiome, and they further enhance nutrient uptake and stress tolerance. Intercropping practices coupled with biostimulant application could boost crop productivity while envisaging a sustainable environment (Kumar et al. 2023) [13]. Biostimulants demonstrate a critical role in improving the efficiency of an intercropping system through enhanced root development, assimilation of nutrients, and reducing abiotic stresses (Rakkammal et al. 2023) [22]. In cereal-legume intercropping systems, these practices synergistically enhance growth parameters such as plant height, leaf area index and biomass production, while also improving yield attributes like number of pods, grains per spike and grain weight. The inclusion of legumes further contributes to biological nitrogen fixation, enriching soil fertility and benefiting associated cereal crops (Dwivedi et al., 2015) [8].

Integration of components for the development of an ideal Agro-Ecological System

Natural farming is not merely a single agricultural practice but a holistic agro-ecological management system that integrates multiple biological and ecological components to enhance soil health, nutrient cycling and crop productivity. The core principle of natural farming is to create favorable conditions for beneficial soil microorganisms, which are considered the driving force behind nutrient transformation and ecosystem functioning. Among the various practices, the combined application of Jeevamrut, Ghanjeevamrit, mulching and intercropping plays a pivotal role in establishing a biologically active and self-sustaining soil environment.

The synergistic interaction among these components forms the foundation of natural farming. From an agro-ecological perspective, natural farming can therefore be regarded as a "farming of microbes" rather than a farming system dependent on external nutrient inputs.

Way forward

Natural farming has emerged a promising agro-ecological approach. Although the benefit of Jeevamrit, Ghanjeevamrit, mulching and intercropping have been reported across the various crops, but further scientific investigation is required to strengthen their wider adoptions and policy integration.

- Standardized protocols for the development of various concoctions used in natural farming
- Optimizing the integration of Jeevamrit, Ghanjeevamrit for different agro-climatic zones
- Long term, multi-location trials should be conducted to evaluate the natural farming models
- Advanced molecular and microbiological studies required to understand microbial dynamics
- Development of location specific package of natural farming practices
- Integration of digital technologies, remote sensing and precision agriculture tools with natural farming.

Conclusion

Natural farming offers a sustainable and ecologically sound alternative to conventional agriculture by improving soil health, enhancing biodiversity and reducing dependence on synthetic inputs. The key components Jeevamrit, Ghanjeevamrit, mulching and intercropping work synergistically to stimulate beneficial microbial activity, improve nutrient cycling, conserve soil moisture and enhance soil fertility. Jeevamrit and Ghanjeevamrit enrich the soil with diverse microorganisms that facilitate nutrient availability and plant growth, while mulching improves soil organic carbon, moisture retention, and soil structure.

Intercropping further enhances resource-use efficiency, biological nitrogen fixation and system resilience. The integration of these practices creates a biologically active and self-sustaining agroecosystem where soil microorganisms drive nutrient transformations and ecosystem functioning. Beyond improving crop productivity, natural farming contributes to environmental conservation, climate resilience and the production of safe and nutritious food. Although encouraging results have been reported across various crops and regions, further long-term and location-specific research is required to standardize practices and strengthen their scientific validation. Overall, natural farming holds significant potential for achieving sustainable agricultural production while preserving soil health and ecological balance for future generations.

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