AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 03 (March, 2026)
Available online at http://www.agrimagazine.in

Natural Farming – A Sustainable Pathway to Soil Regeneration and Environmental Sustainability

*Seema Hodkashia and Sarvendra Kumar
Division of Soil Science and Agricultural Chemistry,
ICAR-Indian Agricultural Research Institute, New Delhi, India
*Corresponding Author's email: seemahodkashia42@gmail.com

The Green Revolution significantly increased India's agricultural productivity but led to long-term problems like soil degradation, declining biodiversity, and the quality of groundwater. These are negatively impacted by excessive use of chemical inputs. The natural farming system emerged as a sustainable alternative that emphasizes ecological balance, soil regeneration, and minimal external inputs. It promotes the use of biological formulations like *Jeevamrit*, *Beejamrit*, and panchgavya as well as techniques such as waapsha, Acchadana/Mulching, crop rotation, and no-tillage. It encourages the soil health and climate resilience by increasing microbial activity, moisture content, nutrient cycling, and organic matter content. This article considers the concepts of natural farming in the context of its eco-friendly nature and sustainability.

Key words: Natural farming, soil degradation, soil health, sustainability, biodiversity.

Introduction

Green revolution technologies revolutionized food production and transformed Indian agriculture from a subsistence to a surplus-generating enterprise, creating a diverse range of employment avenues and livelihood opportunities. The current conventional farming management practices are more dependent on market inputs such as hybrid seeds, chemical fertilizers, insecticides, fungicides and herbicides. Imbalanced and over use of these chemicals coupled with reduced or non-use of organic manure/amendments in the soil has resulted in deterioration of soil health. Therefore, worldwide, priorities in agriculture are gradually shifting from production to resource conservation, restoration of soil health and fertility, minimizing the adverse impact on soil and environment, and moving to natural and traditional practices-based non-synthetic farming systems. Natural farming practice (NF) includes key principles (Figure 1). NF systems largely rely on biomass recycling, biological rejuvenation of natural nutrient cycles, and on-farm plant and livestock-based inputs that prioritize ecological balance and sustainability while supporting rural livelihoods.

Figure 1- Principles of Natural farming practices

Origin, Promotion and Current Status

Masanobu Fukuoka, a Japanese farmer, and philosopher who is widely considered as the pioneer of NF, advocated "no-till, no-herbicide grain cultivation" in the mid-1970s and 80s. Later this form of cultivation was called "do-nothing farming" or "Fukuoka farming". The accounts of NF practices in traditional Indian agriculture are well documented by Subhash Palekar in the mid-1990s. His considerable efforts to popularize ancient Indian practices of cow-centric agriculture which involves the application of natural inputs made using cow dung, cow urine, jaggery, pulse flour combined with mulching practices, and symbiotic intercropping. The "Subash Palekar NF (SPNF)" also referred to as "Zero Budget Natural Farming (ZBNF)" and "Zero Budget Spiritual Farming (ZBSF)" falls under the larger umbrella of traditional Indian agriculture. NF practices, promoted through various government initiatives, are supported by a range of policy schemes, as illustrated in Figure 2.

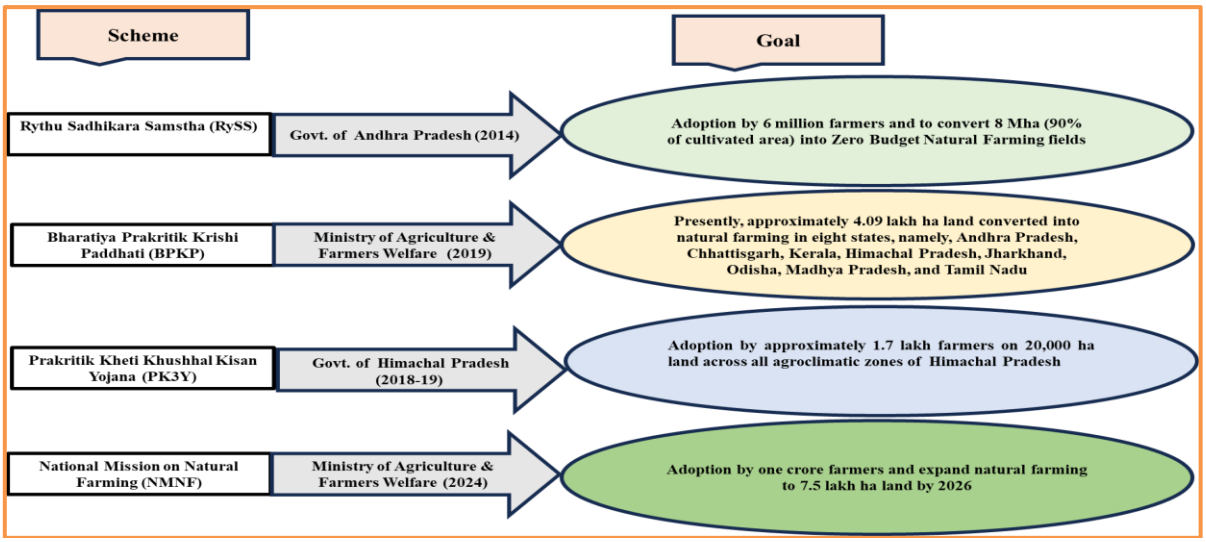

Figure 2- Different schemes Natural farming in India

Natural Farming: Framework and practices

It advocates the complete elimination of synthetic external inputs (fertilizers and pesticides) and instead encourages the application of natural homemade formulations and concoctions prepared from on-farm ingredients such as cow dung, cow urine, jaggery (sugar), pulses flour (chickpea, pigeon pea, etc.), etc. Further, it promotes agronomic practices such as no-tillage, cover crops, crop rotations, crop residue mulching, symbiotic intercropping systems, minimal irrigation amounts etc. It helps to build the fertility of the soil and enhance ecosystem services through nutrient cycling, biological nitrogen fixation, natural regulation of pests and diseases, and biodiversity conservation. This contributes towards the sustainability of agroecosystems. NF relies mostly on Jeevamrit (prepared using local cow dung, cow urine, jaggery, pulse flour, and undisturbed soil) along with Beejamrit (seed treatment with locally prepared liquids comprising of local cow dung, local cow urine, lime, and soil), Ghana jeevamrit (processed cowdung mixed with cow urine), Panchgavya (made from the cow: milk, curd, ghee, urine, and dung) Acchadana (soil, straw, and live mulch), Whapasa (encouraging both air and water molecules through humus build-up and irrigating in alternate furrows) and Bramhastra, Agniastra, Neemastra, etc., as prophylactic measures for pest and disease management. The practice consists of four principles, referred to by ZBNF practitioners as the four 'wheels' of ZBNF (Table 1).

Table 1: The four wheels of Natural farming and their impacts

Wheel and practices	Intended Impact
Bijamrita (Seed treatment) The application of a homemade seed treatment consisting of cowdung and urine to seeds and seedlings.	○ Protection from seed and soil-borne disease ○ Increase soil carbon ○ Activate nutrients

Jeevamrita (Liquid and solid inoculants) The application of an in-situ culture of water, cow manure and urine, unrefined cane sugar, legume flour and uncontaminated/ virgin soil (to introduce local soil microbiota).	○ Improve soil condition ○ Increase activity of soil biota including microbes and earthworms ○ Increase soil organic matter ○ Prevent harmful fungal and bacterial growth
Acchadana (Mulching) Soil mulching (avoiding tillage), straw mulching (the application of straw to the soil) and live mulching (intercropping with, e.g. nitrogen-fixing crops).	○ Improving soil condition, particularly topsoil ○ Adding organic matter and fertility ○ Increased activity of soil biota (including microbes activated by Jeevamrita) and soil insects.
Whapasa (Soil aeration)	○ Reduced overreliance on irrigation and improved aeration and soil moisture profile

Role of Natural farming practices on soil health

Healthy soil is built up productive, profitable and environment friendly agricultural systems. Sustainability of a farming system is related to its effect on changes in soil quality over time. Changes in farming practices are foremost reflected in the changes in biological properties such as microbial populations and soil enzymatic activity. Soil enzymes have been suggested as one of the important indicators of soil quality, and for evaluating the degree of alteration and assessing the effect of different cropping systems on nutrient dynamics and soil quality. The soil microorganisms perform various biogeochemical functions and help in replenishing soil fertility, as they are involved in nutrient cycling. The NF positively affected soil physical, chemical, and biological properties within sustainable farming systems (Figure 3). Soil organisms like earthworms and microarthropods remain under-represented in soil processes. Earthworms are a major component of soil faunal communities in the NF ecosystem. Soil fauna is crucial to soil formation, litter decomposition, nutrient cycling, biotic regulation, and for promoting plant growth. Soil microarthropods have been found to be sensitive to changes in land management practices. Earthworms improve soil structure by dragging down organic matter, mixing soil and creating tunnels that improve drainage. Worm casts are rich in recycled plant nutrients, and can contain up to 40% more beneficial humus than the plough layer. A systematic comparison between NF and non-NF fields conducted in Andhra Pradesh reveals that the NF fields host an average 232 earthworms per square metre compared with just 32 on non–NF fields (Sadyal et al, 2021). The increased microbial activity contributes to nutrient availability in soil.

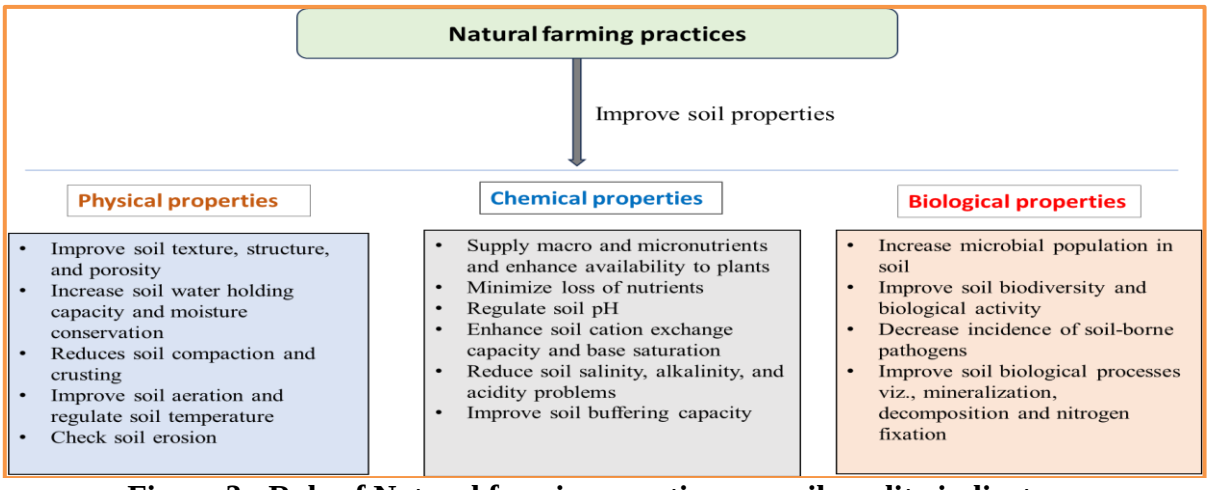

Figure 3 - Role of Natural farming practices on soil quality indicators

Role of Natural farming practices on water conservation

Agriculture remains the most water-intensive sector in India, accounting for approximately 80–90% of total freshwater withdrawals. This heavy dependence on water, combined with the growing effects of climate change, poses serious challenges to water sustainability. According to the World Resources Institute (WRI), India ranks 13th among the world's 17 most water-stressed countries, reflecting a severe imbalance between water demand and availability. In this context, adopting sustainable agricultural practices becomes critical for ensuring long-term water security. NF, particularly Zero Budget Natural Farming (ZBNF), has emerged as an effective agroecological approach to address these challenges by promoting water-efficient techniques that align with environmental and economic sustainability. ZBNF improves water conservation through several synergistic mechanisms. Practices are-

Mulching: It involves covering the soil with organic residues, significantly reduce surface evaporation, enhancing soil infiltration, and help retain moisture within the root zone. The application of 0.25-1.00 kg/m^{2}of mulch enhances soil drainage for 56–60% of total rainfall compared to bare soil. Overall, it was determined that 0.25–0.50 kg/m^2 mulch application efficient for maximum water retention (Wang et al., 2021).

Waaphasa: It involves alternating between furrow irrigation and aeration to maintain optimal soil moisture and aeration conditions. This method enhances root development and reduces waterlogging, leading to more efficient water use.

Farm ponds and dead furrows: The development of small-scale water harvesting structures, such as farm ponds, facilitates in-situ water conservation. Dead furrows slow down runoff and enhance groundwater recharge, particularly in drought-prone regions.

Additionally, NF promotes diverse cropping systems through crop rotation and intercropping, which improve soil structure and organic matter content, thereby increasing the soil's water-holding capacity. NF also supports water quality conservation. By eliminating the use of synthetic agrochemicals, natural and organic farming systems reduce leaching of nitrates, phosphates, and pesticides into aquatic ecosystems. This not only safeguards water quality but also promotes its potential reusability for irrigation and other agricultural operations. Overall, NF practices improve soil health and microbial activity, which further enhance the soil's ability to retain water. This integrated approach not only strengthens the resilience of agricultural systems to climate variability but also supports long-term water conservation and sustainable resource management in regions facing severe water stress.

Role of natural farming on Carbon Sequestration

Carbon sequestration is the process of removing and storing carbon dioxide (CO2) from the atmosphere, to stop it from contributing to global warming. Common NF techniques such as crop rotation, cover crops, and crop diversification improve soil health and organic matter, which helps sequester carbon. According to a study by Lal (2020), the addition of cover crops can increase carbon sequestration by 0.20 to 0.45 Mg per hectare annually. Because different crops have different root structures, root exudates, and residue decomposition rates, so, crop diversity is essential for soil carbon storage. The diversified crop rotations have a greater effect on soil carbon storage than monoculture systems. Rotations with cover crops and perennial crops raised SOC concentrations by 6.3 and 12.5%, respectively, compared to rotations with only grains (King et al., 2018). The increased root biomass and organic matter inputs from diverse cropping systems were identified as key factors in higher soil carbon levels. Additionally, the integration of leguminous crops in rotations contributes biologically fixed nitrogen, promotes biomass production and raises soil carbon inputs even more. Overall, the transition in NF from monoculture to diversified cropping systems improves soil resilience and is essential for reducing atmospheric carbon levels through sequestration.

Conclusion

Natural farming is an ecologically sustainable approach that improves soil health, conserves water, and enhances climate resilience. By reducing the use of synthetic inputs and relying on

natural formulations like Jeevamrit, panchgavya, beejamri, and mulching, it promotes microbial activity and soil biodiversity. Practices such as Waaphasa, crop rotation, and intercropping improve soil moisture retention and reduce dependence on irrigation. Additionally, NF practices contribute to carbon sequestration by increasing soil organic matter and root biomass. It is supported by government schemes, NF addresses key challenges of soil degradation and productivity loss, making it a vital strategy for sustainable crop production and environmental conservation. It strengthens soil health, ensuring resilience in the face of a changing climate.

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