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Review Article

Enhancing Natural Farming Practices: A Pathway to Sustainability and Chemical Pesticide-Free Superior Food Quality

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Abstract: The Green Revolution marked a paradigmatic shift, projecting India from a state of chronic food insecurity to agricultural self-sufficiency. However, as a consequence, the non-judicious use of synthetic inputs, stagnant yields, and market volatility have made agriculture unsustainable, depleting soil nutrient status and compromising soil quality. Natural farming emerges as a panacea, amalgamating traditional Indian agronomic practices with scientific innovations. By avoiding synthetic agrochemicals, this approach prioritizes soil biology over chemistry and promotes practices such as multi-cropping, continuous soil coverage, and the application of cow-dung and cow-urine-based formulations to stimulate soil microbial activity. Over the past decade, deliberate efforts have been directed toward engendering awareness and fostering stakeholder alignment for science-based natural farming methodologies. Several Indian states have already adopted natural farming, with the assistance of governments promoting it through various schemes. The principles of natural farming stand on four pillars, namely *Jeevamritha*, *Beejamritha*, *Acchadana* (mulching), and *Whapsa* (soil moisture), which invigorate soil microbes and retain moisture, consequently enriching the soil's nutrient profile. Apart from addressing crop yield and soil quality, natural farming also serves as an excellent method of on-farm waste valorization. However, more research interventions are required to develop the science behind natural farming. This chapter explores the necessity, prevailing landscape, initiatives, research trends, case studies, and strategic frameworks of natural farming in India, illuminating its potential and challenges for sustainable agrarian transformation.

Keywords: Crop quality, Mulching, Soil health, Sustainability, Nature-based farming, ZBNF.

Introduction

In Japan, Masanobu Fukuoka pioneered natural farming by observing nature closely and adopting its inherent methods for crop cultivation. Natural farming emphasizes reducing external inputs that can harm the natural fertility and structure of soil. In India, Subash Palekar introduced the concept of Zero-Budget Natural Farming (ZBNF), which follows the same principle but relies on traditional, farm-based resources to sustain crop growth.

Why Choose Natural Farming

The growing global population necessitates the improvement of farming systems in order to fulfil rising food demand. While conventional agricultural practices have increased food yields over time, they have also depleted natural resources. The Green Revolution transformed India into a food-surplus country, but it also brought issues such as soil degradation, agricultural pollution, biodiversity loss, and increased farming expenses.

The extensive use of chemical fertilizers and pesticides, along with declining crop output, unstable markets, and climate change, has made farming less viable [1]. Furthermore, long-term usage of these substances has substantial consequences for human health. In response to these issues, natural farming has become a sustainable option. Natural farming preserves soil health, protects biodiversity, and lowers cultivation costs by eliminating chemical inputs and focusing on environmentally friendly techniques such as composting, crop rotation, and bio-fertilizers. It improves food production, mitigates the negative effects of climate change, and assures long-term agricultural sustainability, making it an essential method for the future of farming.

Across the country, natural farming takes various forms, with farmers tailoring practices to suit local conditions, farm types, and ecological settings through specific adaptations and modifications. Among them, zero-budget natural farming (ZBNF) is gaining more importance in improving productivity and soil health due to its low cost. ZBNF is a method of farming where the cost of growing to harvesting the crops is zero. Shri Subhash Palekar was honoured with the Padma Shri in 2016 for his significant contribution to the development and promotion of this sustainable farming method [2]. Initially, it was named 'Zero Budget Natural Farming [3], which was later renamed 'Zero Budget Spiritual Farming' (ZBSF), and of late, it has been named 'Subhas Palekar Natural Farming' (SPNF) [4]. This approach has seen significant success in southern parts of India, particularly in Karnataka, where it initially gained momentum. Instead, it encourages farmers to use low-cost locally sourced on-farm inputs, which are easily available to the farming community, such as natural mixtures made using cow dung, cow urine, jaggery, pulse flour, mulch, crop covers, and symbiotic intercropping to stimulate the soil's microbial activities. It enhances soil conditions through improved organic matter and biological activity, crop diversification, and enhanced biomass recycling with enriched biological interactions on the farm. Natural farming allows for a wide range of agroecological practices like composting, mulching, green manuring, intercropping, tree intercropping, and livestock integration, and takes a holistic approach to farming systems. The crops and by-products produced through natural farming are completely free from the residual effects of any chemical pesticides, and therefore, they are always safe for human beings.

Current Scenario of Natural Farming

Natural farming in India has gained significant momentum, with around 9.5 lakh hectares brought under its ambit across 17 states and approximately 20.08 lakh farmers adopting this eco-friendly practice [5]. States like Andhra Pradesh, Gujarat, Madhya Pradesh, Chhattisgarh, and others have contributed the most to this expansion. In West Bengal too, farmers are gradually shifting towards natural farming, leveraging traditional knowledge and local resources. The Indian government has actively promoted this approach through multiple schemes such as the National Mission on Natural Farming, Paramparagat Krishi Vikas Yojana (PKVY) under BPKP, APCNF, and MOVCDNER. Emphasizing chemical-free agriculture, these initiatives aim to reduce input costs, enhance soil health, and ensure sustainable food production.

Natural farming in West Bengal is in its early stages but is gradually expanding through concerted efforts from government schemes, research institutions, and NGOs. Under the Bhartiya Prakritik Krishi Padhati (BPKP), pilot projects have been initiated in tribal and rainfed districts like Purulia, Bankura, and Birbhum, where the sustainability of chemical-intensive agriculture is low [6]. Farmers in these areas practice techniques such as jivamrita, bijamrita, mulching, and cow-based inputs inspired by Subhash Palekar's Zero Budget Natural Farming (ZBNF) model [7]. The Indian Council of Agricultural Research – Agricultural Technology Application Research Institute (ICAR-ATARI), Kolkata, has played a pivotal role by organizing hands-on training for KVK staff and farmers on natural formulations and crop management strategies [8].

Despite these initiatives, by 2023, only around 5,000 hectares in West Bengal were under natural farming, mostly in areas supported by Krishi Vigyan Kendras (KVKs) and NGOs [9]. Constraints include a lack of farmer awareness, market access, and affordable certification systems [10]. Nevertheless, promising results have been observed in areas like Hatinada village in Purulia, where integrated natural farming has led to improved soil health and reduced production costs. Recent awareness campaigns and training in North Bengal tea gardens and the Sundarbans also reflect a growing acceptance of chemical-free, climate-resilient practices [8]. The state government has shown interest in scaling up these practices under its climate adaptation strategies, but a coordinated action plan is still evolving [11].

Natural Farming Components and Practices

Natural farming is a practice where, without the application of herbicides, inorganic fertilizers, and pesticides, crops are cultivated. Here, actual physical work and labour have been seen to reduce by up to 80% compared to other farming systems [12].

The basic difference that lies between the practice of organic and natural farming is that in natural farming no inputs are applied to meet the nutritive needs of the crop rather the microbial formulations activate and enhance the activities of beneficial microorganisms in the soil that eventually help in better nutrient cycling and making nutrients available for easy uptake by crop roots. The main concept lies in feeding the soil (microbes) and not the plants.

Zero-Budget Natural Farming (ZBNF) introduces microbial-rich inputs like *beejamrutha* and *jeevamrutha* to support beneficial microbial life in the soil. It replaces chemical pesticides with traditional herbal concoctions such as *neemastra* and *brahmastra*, made from plant extracts and cow urine. The philosophy behind ZBNF is to eliminate dependence on costly chemical inputs and prevent farmers from falling into debt. The method integrates ecological principles with traditional wisdom to enhance soil health and farm productivity. ZBNF primarily aims to empower farmers economically by cutting market dependence and revitalizing soil health through practices like crop rotation, mulching, and applying fermented bio-inputs like *jeevamrutha*, also known as the 'nectar of life'.

ZBNF has basically 4 pillars [13].

1. Jivamrita/Jeevamrutha: This is a naturally fermented mixture consisting of 20 kg of cow dung, 5–10 liters of cow urine, 20 kg of jaggery, and 2 kg of pulse flour. It is used as an organic supplement for enhancing soil microbial activity and supporting plant growth.

2. Bijamrita/Beejamrutha: *Beejamrutha* is an organic seed treatment mixture prepared by blending 20 liters of water with 5 kilograms of cow dung, 5 liters of cow urine, 50 grams of lime, and a small amount of unpolluted native soil containing beneficial microbes. It is used to protect seeds from fungal infections and soil-borne pathogens before sowing.

3. Acchadana (Mulching): Mulching refers to the practice of covering the soil surface with materials like loose soil, dried crop residues, or living plants. This technique helps in conserving moisture, suppressing weeds, and enhancing soil fertility as the mulch decomposes over time.

4. Whapasa: *Whapasa* refers to the condition in the soil where moisture exists as vapor, in combination with air. This balance is essential for optimal plant growth. Unlike conventional belief that plant roots require plenty of water, ZBNF suggests that roots thrive better in the presence of water vapour and oxygen. Hence, irrigation is done less frequently - preferably during midday and in alternate furrows - to maintain this ideal air-water balance in the soil.

Some other nutrient and plant protection elements used in natural farming, along with their composition and uses are mentioned below.

Table 1: Inputs used in Natural Farming for Soil Nutrient Enrichment

Sl. No.	Name of the product	Composition	Use
1.	*Panchagavya*	Cow dung, cow urine, cow milk, cow curd, and cow ghee (5:3:2:2:1 ratio)	Helps in the growth and development of plants.
2.	*Sasyagavya*	Cow dung, cow urine, vegetable waste or crop residues, and water (1:1:1:2 ratio).	Improves soil structure and provides essential nutrients to the plant and overall plant vigour.
3.	*Kunapajala*	Cow dung, cow urine, any animal flesh like the fleshy part of fishes, poultry birds or animals, and water (1:1:1:2 ratio)	Enhance soil fertility, promote microbial activity, Improve soil structure etc.
4.	*Sanjivani*	Cow dung, cow urine, water (1:1:2 ratio)	Protects the crop from harmful soil-borne and seed-borne pathogens, and provides nutrients and growth-promoting hormones.
5.	*Ghanajivamrita*	Cow dung (100 kg), cow urine (3 liters), jaggary (1 kg), pulse flour (1 kg), and 250 g of soil	Improves soil fertility and texture and activates soil microbes.

(Source: [14])

Table 2: Inputs Used in Natural Farming for Plant Protection

Sl. No.	Input name	Composition	Use
1.	*Dhasaparni churna*	Neem, vitex, Pongamia, Tinospora, castor, datura, drumstick, bitter gourd, pomegranate, custard apple leaf	To manage pests such as mealy bugs, aphids, tobacco caterpillars, and various borers.
2.	*Amritpani*	Water-200 liters, Cow dung -10 kg, Honey or jaggery -500g, Desi cow Ghee/Mustard oil -250g/ml.	Helps in Seed or seedling treatment and for better germination.
3.	*Neemastra*	Cow dung 2 kg, cow urine 5 lit, water 100 lit, neem leaf extract 5 kg	For controlling sucking pests.
4.	*Agneyastra*	Ipomea leaf 1 kg, chilli 500g, garlic 50g, neem leaf 5kg, cow urine 10 lit.	For controlling the borers.
5.	*Brahmastra*	Leaf of neem, custard apple, datura, pomegranate, papaya 2kg each	For controlling sucking insects.
6.	*Chilli-garlic solution*	Chilli 5kg, garlic 500g, kerosene oil 100ml, neem, soap 250g	For controlling the larval stage of pests.
7.	*Lohastra*	250g rust iron, 2 lit cow urine	Used as a fungicide.

(Source: [15])

Influence of Natural Farming on Chemical Pesticide-Free Superior Food Quality

The primary objective of agriculture is to produce enough food to sustainably feed 9 or 10 billion people by 2050 [16]. Most of our farmers are uninformed of the negative consequences of pesticides and we wouldn't really blame them for ignoring the long-term effects to the soil. Vendors of pesticides often do not provide farmers with proper training on the correct usage, safety measures, and other important precautions and as a result the farmers do not instruct them proper usage level, its precautions etc, so farmers use them indiscriminately which ultimately reduce the soil health. There are many experiments conducted by scientist on the use of natural farming for improving food quality. They mainly focus on a combinatorial study and breakthrough aid at distinguishing between conventional and organic farming systems, ensuring the achievement of the criteria of good soil fertility, nutrition, quality, productivity, yield, economics, and food security and safety for vegetable crops and fruit. The results suggest that improving soil fertility in organic farming through the use of composts and on-farm input is dependent on a better knowledge of the impacts of application methods on soil fertility, enhanced technology transfer of research findings into practice as well as produce pesticide-free foods for human beings.

The application of soil amendments has been associated with desirable soil properties including a water-holding capacity, lower bulk density, and beneficial microorganisms. A similar correlated study highlights the fact that microbial activity and biomass is recorded higher in fields with organic amendments than in conventional fields. Bulluck conducted a two-year field experiment in Virginia and Maryland during 1996 and 1997 to assess how organic and chemical soil fertility amendments affected soil microbial communities, along with the physical and chemical properties of the soil [17]. Three duplicated plots received two treatments: composted garden waste or animal manure, as well as synthetic soil amendment. A canonical association was discovered, which revealed greater negative in fields with a traditional past and synthetic fertilizers compared to a positive link in areas with organic output. Soils from organic fields had higher propagated densities of Trichoderma spp., thermophilic microorganisms, and enteric bacteria. The concentration of the key elements (calcium (Ca), potassium (K), magnesium (Mg), and manganese (Mn) was reported to be higher.

Overall, organic application boosted beneficial soil microbes, reduced pest-pathogen populations, and increased soil organic matter, hence enhancing soil health and fertility. Compost additions provide benefits such as pH stabilisation and increased water penetration rates [18]. Manure and compost integration has been shown to improve soil organic matter content, lowering bulk density and increasing porosity, which has a major influence on soil erosion protection. This increase in soil organic matter content is directly proportional to an increase in cation exchange capacity. Food safety is defined as the guarantee of food quality that it will not hurt the customer throughout the preparation or eating process, as intended. It is predicted that between 1996 and 2008, 82 food-borne disease outbreaks were linked to the intake of fresh vegetables. According to the scientists [19], the nutritional content, quality, and safety of foods varies greatly throughout the world. One of the top priorities for the foreseeable future is to achieve these three objectives.

Sustainability through Natural Farming

Natural farming contributes greatly to sustainable agriculture by focussing on ecological balance, resource efficiency, and climatic resilience. Natural farming, as opposed to conventional farming, which mainly depends on synthetic inputs, takes an agroecological strategy, focussing on the regeneration of natural systems to sustain agriculture.

The restoration of soil health is a crucial method that natural farming supports sustainability. Conventional farming operations frequently affect soil quality by decreasing organic matter and microbial activity. Natural farming, on the other hand, improves soil fertility by using bio-inputs such as *jivamrita* (a combination of cow dung, urine, and jaggery) and *bijamrita* (a seed treatment solution). These nutrients encourage microbial activity, increase organic content, and aid in the development of a strong soil structure. These inputs promote microbial activity, increase organic content, and aid in the formation of a strong soil structure. Mulching and crop rotation techniques help to keep the soil aerated and nutrient-rich, laying the groundwork for long-term agricultural output.

Natural farming is also very important for biodiversity conservation. It provides habitat for a diverse flora and fauna by avoiding monocultures and chemical intrusions. This diverse agro-ecosystem not only benefits pollinators and natural pest predators, but it also improves the farm's resilience to pests and illnesses. A biodiverse farming system is more resistant to catastrophic failures, making it intrinsically more sustainable.

Water conservation is yet another important part of natural farming's contribution to sustainability. Natural farming lowers water evaporation and improves soil water retention by using little tillage, mulching, and no water-intensive synthetic inputs. The absence of artificial fertilisers and pesticides helps to keep local water bodies clean, such as rivers, lakes, and groundwater reserves. Furthermore, the method reduces emissions of dangerous greenhouse gases such as methane and nitrous oxide, which are significant contributors to global warming. Natural farming also demonstrates its value in increasing climate resilience. Farms with improved soil health and crop diversification may better resist extreme weather events such as droughts, floods, and cyclones. Furthermore, natural farming encourages sustainable livestock management. Indigenous cows, whose dung and urine are widely utilised to prepare natural inputs, have regained importance in the farming process. This method not only decreases reliance on synthetic inputs, but it also promotes the conservation of indigenous cattle breeds, assuring their continuing involvement in rural livelihoods and ecological agricultural systems.

In essence, natural farming reflects the ideals of sustainable agriculture by combining environmental protection, resource optimisation, and climatic flexibility. It guarantees that farming systems stay productive and sustainable while also protecting ecosystem health and future generations.

Effect of Natural Farming on Soil Health and Quality

The inputs used in natural farming act as a tonic for the soil, improving the overall quality and health (Table 3). The use of different fermented liquid and solid fertilizers enhances soil fertility. Also, they introduce and activate various beneficial soil microorganisms that help in making the nutrients available for plant uptake by enhancing soil nutrient cycling and regulating soil reaction [14]. Also, they increase the carbon content leading to soil carbon sequestration, a mechanism just opposite of carbon emission from soil. The soil's physical properties like structure and water-holding capacity are also improved due to natural input addition. Unlike chemical pesticides (pesticides, weedicides, fungicides, etc), natural plant protection chemicals do not disturb the beneficial living soil micro and macro flora and thus help to keep the soil health steady. Acchadana or mulching is another very important unit of natural farming. They preserve the soil moisture and keep the rhizosphere moist. Upon drying and decomposition by soil microbes, they keep adding nutrients which help the plant to meet its nutrient demand during later phases of growth. These practices also aid in the formation of soil humus and help improve soil aeration and water retention. The addition of organic matter, the proliferation of beneficial soil bacteria, less soil disturbance, and effective resource management all help to improve soil structure, hydraulic properties, and overall soil health, resulting in increased productivity of crops.

Table 3: Impact of Natural Farming on Soil Health and Quality.

Sl. No.	Natural Farming Components	Crop	Soil Parameter	Effect	Reference
1.	Crop rotation, reduced tillage, biofertilizer addition, mulching with crop residues	Cabbage-Rye	Water content (%)	Increased by 10.15%	[20]
			Bulk density (g/cm)	Reduced by 4.95%	
			Total carbon (%)	Increased by 0.73%	
			Urease activity (mg/ kg soil-37°C 2 h)	Increased by 23.78 mg/ kg soil-37°C 2 h	
			Nitrate reductase activity (mg/ kg soil-25°C 24 h)	Increased by 92.13 mg/ kg soil-25°C 24 h	
2.	Ghanjivamrita, Jivamrita, and mulching	Wheat + Chickpea	Organic carbon (%)	Increased by 0.27%	[21]
			Available N (kg/ha)	Increased by 17.99%	
			Available P (kg/ha)	Increased by 44.35%	
			Available K (kg/ha)	Increased by 25.86%	
			Bacteria (106 cfu/g soil)	Increased by 77.16%	
			Fungi (103 cfu/g soil)	Increased by 64.15%	
			Actinomycetes (105 cfu/g soil)	Increased by 56.16%	
			Dehydrogenase activity (µg TPF/g soil/hr)	Increased by 92.88%	
3.	Ghanjivamrita, Jivamrita, and Bijamrita	Rice	Microbial biomass carbon (mg/kg)	Increased by 26.3 %	[22]
			Microbial biomass nitrogen (mg/kg)	Increased by 68.10%	
			Organic carbon (%)	Increased by 0.04%	
			Bacteria (106 cfu/g soil)	Increased by 63.91%	
			Fungi (103 cfu/g soil)	Increased by 44.11%	
			Actinomycetes (105 cfu/g soil)	Increased by 50%	

Impact of Natural Farming on Crop Productivity

Various studies conducted across India highlight the positive influence of natural farming components on crop yield. The following table summarizes experimental findings showcasing yield improvements under different natural farming interventions:

Table 4: Influence of Natural Farming Techniques on Crop Yield.

Sl. No.	Natural Farming Components	Crop	Place of Experiment	Effect on Yield	Reference
1.	*Bijamrit*a (root dip), *Jivamrita* as (foliar spray) *Ghanajivamrita* (soil treatment)	Rice (cv Bokul Joha)	Assam, India	Grain yield increased by 25.61% Straw yield increased by 27.49%	[23]
2.	Jivamrita	Maize	Himachal Pradesh, India	Grain yield increased by 27.38%	[24]
3.	*Ghanjivamrita, Jivamrita*, and mulching	Wheat (cv HPW 368)	Himachal Pradesh, India	Grain yield increased by 55.27%	[21]
4.	*Bijamrita, Jivamrita,* Mulching, Green manure	Black gram (cv Shekhar 2)	Uttar Pradesh, India	Grain yield increased by 58.74% Stover yield increased by 19.75%	[25]
5.	*Jivamrita*	Finger millet	Himachal Pradesh, India	Grain yield increased by 47.72%	[26]

Eco-Friendly Pest Management in Natural Farming

Natural farming adopts ecologically sound methods for pest control, relying on naturally available substances and biological interactions rather than synthetic pesticides. Botanical extracts such as neem oil (*Azadirachta indica*) serve as effective natural insecticides by interfering with insect feeding behaviour, growth, and reproductive cycles [27]. Additionally, cow urine - an integral part of *Jeevamrutha*- exhibits antimicrobial and antifungal properties that help suppress a range of crop diseases. Soil-applied biocontrol agents like *Trichoderma spp*. and *Pseudomonas fluorescens* inhibit soil-borne pathogens through mechanisms such as competition, mycoparasitism, and production of antifungal compounds [28].

Natural farming also integrates ecological strategies such as intercropping and trap cropping, which disrupt pest lifecycles and reduce pest colonization by enhancing habitat complexity [29]. Diversified cropping systems further support populations of natural predators, improving the predator–prey balance and contributing to pest suppression without chemical intervention. Integration of entomopathogenic fungi, particularly *Beauveria bassiana*, into natural farming systems shows promise in controlling key pests like the yellow stem borer in *boro* rice cultivation [30]. Compatibility studies of such biocontrol agents with existing agro-ecological practices are essential to strengthen future integrated pest management strategies [31]. Together, these practices ensure sustainable pest regulation while maintaining soil health and ecological stability.

The scientists of Rice Research Station, Chinsurah, West Bengal are working on pest management of rice through natural farming in All India Co-ordinated Research Project on Rice (AICRPR) under ICAR-IIRR and different state research programmes. The *agneyastra*, *azadirachtin* and neem leaf extract proved better results to manage rice yellow stem borer and whorl maggot. The scientists also [32] showed that the use of *Azadirachtin, Beauveria*, and other eco-friendly insecticides effectively decreased the incidence of yellow stem borer (YSB) and enhanced the tillering of rice plants. The '*Tricho*' cards and pheromones were also useful to control YSB and rice leaf folder.

Challenges in Adoption

- Natural farming practices are labour-intensive and heavily dependent on inputs like cow dung and cow urine. With India's limited livestock population relative to arable land, maintaining consistent input supply is difficult.
- Widely used agri-inputs for natural farming such as *agneyastra, jeevamrita, bijamrita, dashparni churna* and *brahmastra* which work slowly are being popular day by day to the farmers for their effectiveness, and stability. But if there is a huge attack of pests (crossed ETL), they fall in challenges to manage pests.
- Natural farming faces challenges in managing crop-specific pests, diseases, and weeds. Traditional formulations often fail to provide adequate protection under high-pressure conditions, leading to potential yield losses.

- Naturally grown produce is often sold at prices similar to conventionally grown crops due to poor certification, weak branding, and lack of consumer awareness. This reduces the economic incentive for farmers.
- While natural farming avoids heavy machinery to prevent soil compaction, there is a lack of alternative low-cost technologies. Additionally, rural areas often lack facilities like composting units and decentralized bio-input production centres.
- A comprehensive policy framework for natural farming is required. The absence of defined standards, quality control, certification systems, and institutional incentives creates confusion and uneven adoption across states.
- Farmers struggle to access appropriate planting materials and stable, ready-to-use formulations of growth enhancers and pest repellents, many of which have short shelf lives and are unavailable in local markets.

Case Studies and Success Stories on Natural Farming

1. Mr. Tejpal Jatiya has been engaged in natural farming practices for over six years. He adopted indigenous practices for crop cultivation, viz., *jivamrita, bijamrita*, intercropping, etc., applied crop residues mulch, resulting in control over weed infestation, avoided insecticides, by growing different herbal plants like *aak, dhatura*, castor, neem, desi babul on the farm's boundary, which are used for preparation of different bio-pesticides, performed Homa farming for early and enhanced flowering in lemon, and prepared lemon seedlings from seed for market. Major outcomes include direct sales of citrus fruits and plant saplings to consumers, improvement in soil organic content and microbial biodiversity, effective recycling of farm residues and organic waste, and complete independence from synthetic agrochemicals and market-purchased inputs.
2. Mr. Bheru Lal has also followed natural farming methods consistently for the past six years. He used indigenous crop cultivation techniques such as *jivamrita, bijamrita, ghanjivamrita,* waste decomposer, mulching, intercropping, herbal ark, and using old papaya leaves for mulching in plant basins as well as biopesticide preparation for insect control. He also practiced Homa farming and used its ash for flowering and insect control. He is recognized as a prominent practitioner of natural farming within his district. The key achievements/benefits are reduced reliance on external inputs such as agrichemicals and agri-inputs, lower cultivation costs, enhanced soil organic matter and beneficial soil microbes, and the utilisation of crop residual and farm waste. He has been awarded at block level by the district collector under ATMA Project.
3. On-farm trials were carried out at 28 different sites throughout Andhra Pradesh from June 2019 to June 2020. It has been proven that ZBNF methods promote soil organic matter development, which leads to better water retention. Microbial inoculants have been related, in certain situations, to increased nutrient intake and improved plant nutritional status. Furthermore, ZBNF methods boost soil biological activity, as seen by increased earthworm populations.

Conclusion

Natural farming offers a sustainable solution to the challenges posed by conventional agricultural practices, including soil degradation, biodiversity loss, and escalating farming costs. By relying on eco-friendly practices such as bio-inputs, composting, mulching, crop diversification, and minimal water usage, natural farming restores soil health, enhances biodiversity, and reduces dependency on synthetic fertilizers and pesticides. The practices of Zero-Budget Natural Farming (ZBNF) and other indigenous methods enrich microbial activity, improve soil structure, and contribute to higher water retention, all of which are critical for long-term agricultural productivity.

ZBNF has several advantages, including little or no cost, no chemical use, encouraging the use of local seeds, and using less water, making it a viable and sustainable choice for farmers. Additionally, its zero-budget approach facilitates year-round income opportunities, reduces farming risks, and fosters economic resilience.

Natural farming adheres to sustainable agriculture principles, including enhancing food quality and safety and limiting the consequences of climate change. It fosters ecological balance while promoting resource efficiency and economic resilience among farmers. As India's natural farming initiatives expand, backed by supportive government policies and traditional knowledge systems, it paves the way for a future where agriculture is not only productive but also environmentally regenerative. In essence, natural farming holds the promise of superior food quality, sustainable soil health, and a resilient agro-ecosystem for present and future generations.

References

1. Pretty, J. (2018). Sustainable intensification of agriculture: Greening the world's food economy. Routledge.

2. Patoliya, B. M. & Kasondra, R. M. (2020). Zero budget natural farming: A path towards sustainable agriculture. International Journal of Agriculture Sciences, 12(24), 10417–10420.

3. Korav, S., Kumar, S. & Patel, P. (2020). Zero budget natural farming: A sustainable solution for India's agricultural challenges. Indian Journal of Agricultural Economics, 75(3), 410–418.

4. Dev, S., Bera, M. & Ray, D. (2022). Natural farming in India: A sustainable approach to agriculture. Journal of Agri-Economic Research, 75(2), 112–123.

5. Rajesh, M., Yadav, R. & Kumar, N. (2024). Current status and scope of natural farming in India: Policy perspectives and progress. Indian Journal of Environmental and Agricultural Research, 13(1), 56–68.

6. Ministry of Agriculture & Farmers Welfare. (2021). Bhartiya Prakritik Krishi Padhati: Scheme guidelines. Government of India.

7. Rao, C. A. R., Ramesh, P., & Palekar, S. (2021). Zero Budget Natural Farming: An agroecological approach for sustainable agriculture. Indian Journal of Agricultural Sciences, 91(12), 1678–1685.

8. ICAR-ATARI Kolkata. (2023). Out scaling of Natural Farming through KVKs. Indian Council of Agricultural Research.

9. NITI Aayog. (2023). Natural farming: Towards a sustainable agriculture future. Government of India.

10. Mukherjee, R., & Basu, D. (2021). Challenges in transitioning to organic and natural farming in eastern India. Journal of Agroecology and Rural Development, 9(1), 88–97.

11. West Bengal Department of Agriculture. (2023). Climate resilient strategies in agriculture. Government of West Bengal.

12. Devarinti, S. (2016). Natural farming in India: Practices and prospects. Indian Journal of Agricultural Research and Extension, 12(2), 45–51.

13. Palekar, S., Naik, P. & Deshpande, A. (2014). Zero Budget Natural Farming: The principles and practices. Subhash Palekar Natural Farming Foundation.

14. Mandal, R. & Dhar, S. (2023). Natural farming systems in India: Emerging models and field practices. Agri-Ecology and Sustainability Journal, 15(2), 78–89.

15. Dey, R. & Saha, P. (2023). Advancing natural farming practices: A study on ecological sustainability and farmer livelihoods in India. Journal of Organic and Natural Agriculture, 11(1), 55–67.

16. Lal, R. (2016). Feeding 11 billion on 0.5 billion hectare of area under cereal crops. Food and Energy Security, 5(4), 239-251.

17. Bulluck, L. R., Brosius, M., Evanylo, G. K. & Ristaino, J. B. (2002). Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms. Applied Soil Ecology, 19(2), 147–160.

18. Sayara, T., Basheer, A., Sánchez, A. & Al-Lagtah, N. M. A. (2020). A review on composting of organic wastes: Monitoring, microbiology, and compost quality. Environmental Reviews, 28(2), 208–225.

19. Lairon, D. (2009). Nutritional quality and safety of organic food. A review. Agronomy for Sustainable Development, 30(1), 33–41.

20. Liao, J., Xu, Q., Xu, H., & Huang, D. (2019). Natural farming improves soil quality and alters microbial diversity in a cabbage field in Japan. Sustainability, 11(11), 3131.

21. Choudhary, P., Verma, A., Thakur, D. & Rana, S. (2022). Impact of natural farming practices on soil properties and yield of wheat and chickpea. Indian Journal of Agricultural Sciences, 92(11), 1315–1320.

22. Darjee, B., Ghosh, A. & Nath, R. (2024). Effects of bio-inputs on microbial biomass and soil fertility under natural farming. Journal of Soil and Water Conservation, 23(1), 15–21.

23. Dutta, D., Borah, D. & Hussain, M. (2024). Effect of Jeevamrit and Beejamrit on productivity of scented rice variety Bokul Joha in Assam. Oryza, 61(2), 130–135.

24. Raveena, M., Thakur, D., & Verma, A. (2024). Response of maize to organic liquid fertilizers under natural farming in mid hills of Himachal Pradesh. Green Farming, 15(1), 42–45.

25. Singh, R., Singh, R. K. & Yadav, S. (2023). Impact of integrated natural farming techniques on black gram yield and soil properties in Eastern Uttar Pradesh. Legume Research, 46(1), 98–104.

26. Singh, R., Verma, S. & Tripathi, R. (2022). Influence of Jeevamrit on finger millet productivity in rainfed region of Himachal Pradesh. Journal of Millets Research, 2(1), 22–26.

27. Panneerselvam, P., Halder, J. & Tiwari, R. (2020). Neem-based formulations for eco-friendly pest management. Indian Journal of Natural Products and Resources, 11(2), 123–129.

28. Gopalakrishnan, S., Humayun, P., Kiran, B. K., Kannan, I. G. K. & Vidya, M. S. (2011). Evaluation of bacterial and fungal biological control agents for the management of soil-borne diseases. Crop Protection, 30(8), 1070–1076.

29. Chaudhary, B., Bhattarai, K. & Upadhyay, S. (2018). Intercropping and trap cropping: Eco-friendly pest management. Journal of Agriculture and Environment, 19, 95-102.

30. Singh, Banhishikha & Chatterjee Sitesh (2021). Relative efficacy of some biorational and microbial insecticides against yellow stem borer and whorl maggot of boro paddy. Journal of Biopesticides, 14(2):90-96.

31. Mondal P., Pramanik P. & Chatterjee S. (2019). Studies on compatibility of Beauveria bassiana (Balsamo) Vuillemin with different agro-chemicals used in crop protection. Progressive Agricultural Sciences, 1(1): 1-5.

32. Chatterjee, S., & Mondal, P. (2014). Management of rice yellow stem borer, Scirpophaga incertulas Walker using some biorational insecticides. Journal of Biopesticides, 7(Suppli.), 143–147.

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