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MiniReview

Comprehensive Analysis of Natural Farming Practices Across India: A Systematic Review

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Abstract

Natural farming, encompassing traditional, organic, and sustainable agricultural practices, is gaining prominence as a viable alternative to conventional farming. In India, with a significant proportion of the world's organic producers, natural farming has historical significance and diverse regional adaptations. This systematic review delves into the principles, historical evolution, techniques, regional adaptations, and impacts of natural farming on soil health, biodiversity, and economic viability. Natural farming, particularly Zero Budget Natural Farming (ZBNF), reduces input costs and enhances soil health, although challenges such as lower initial yields and higher labor costs persist. This review highlights successful case studies, including ZBNF in Andhra Pradesh and organic farming in Sikkim. Additionally, these findings underscore the positive effects of natural farming on soil carbon sequestration and microbial activity. Despite these challenges, opportunities for scaling up natural farming are significant and supported by government policies and community initiatives. Future research needs to focus on long-term impacts, cost-effective bio inputs, and socioeconomic benefits to establish natural farming as a sustainable agricultural practice in India.

Keywords: natural farming, zero budget natural farming, organic agriculture, soil health, biodiversity, sustainable agriculture practices

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1 INTRODUCTION

Natural farming, also known as traditional, organic, or sustainable agriculture, has gained significant attention in recent years as an alternative to conventional farming practices. This shift is driven by its potential to enhance soil health, promote biodiversity, and provide economic benefits to farmers. In India, natural farming has a rich historical background and has evolved with various philosophies and techniques across different agroclimatic zones[1-3].

India is home to 30% of the world's organic producers, though it accounts for only 2.59% of the total organic cultivation area globally. The northeastern region alone offers considerable scope for organic farming, with an estimated 18 million hectares available for organic production. Before the Green Revolution in the 1960s, Indian agriculture relied on traditional practices without synthetic fertilizers and pesticides. However, to ensure food security, conventional farming practices were adopted[4,5].

Natural farming, particularly Zero Budget Natural Farming (ZBNF), has gained traction in India as a potential solution to agricultural challenges, especially for smallholder farmers. Studies on ZBNF reveal that

farmers adopting techniques such as Jeevamrutham and crop rotation experience lower input costs than non-ZBNF farmers, although their net profits may be lower. Organic farming can offer greater net profits—by 22% compared to conventional farming—due to premium prices for certified organic produce and reduced cultivation costs. However, without premium prices, higher cultivation costs can make organic farming economically unfeasible[3,5,6].

This systematic review provides an in-depth analysis of natural farming practices in India, examining their principles, historical evolution, techniques, regional adaptations, and impacts on soil health, biodiversity, and economic viability.

The primary research question guiding this systematic review is "What are the underlying principles, techniques, and regional adaptations of natural farming in India, and how do these practices impact soil health, biodiversity, and economic viability?"

2 METHODOLOGY FOR THE STUDY

This review follows a structured methodology to ensure comprehensive coverage and systematic analysis of the relevant literature. The methodology involves several key steps:

(1) Database and Source Selection: We sourced articles and data from multiple academic databases, including PubMed, Scopus, and Web of Science, as well as gray literature from governmental and nongovernmental reports related to agricultural practices in India.

(2) Search criteria: The keywords used in the search included "natural farming," "Zero Budget Natural Farming" "organic farming in India," "sustainable agriculture practices," and "biodiversity in agriculture." The time frame for the literature search was set from 2000 to 2024 to capture the most relevant and recent data.

(3) Inclusion and Exclusion Criteria: Articles were included if they discussed natural farming practices within the Indian context, with a specific focus on principles, techniques, regional adaptations, and measurable impacts on environmental and economic factors. Studies that did not focus on India or were not in English were excluded.

(4) Data Extraction and Analysis: Relevant data from the selected articles were extracted, including authors, year of publication, study location, farming techniques, and key outcomes related to soil health, biodiversity, and economic impacts. These data were then synthesized to identify common themes, regional practice variations, and gaps in the existing research.

(5) Quality Assessment: The quality of the included studies was assessed using standardized checklists from the Joanna Briggs Institute (JBI) for systematic reviews. This assessment helped ensure the reliability and validity of the findings presented.

This systematic approach ensures a rigorous review of the literature, providing a comprehensive understanding of natural farming practices across different regions of India and their broad impacts on agriculture and sustainability.

3 DEFINITION AND PRINCIPLES OF NATURAL FARMING

Natural farming, often synonymous with ZBNF, emphasizes minimal external inputs and relies on natural processes for crop production. The core principles include no-till farming, avoidance of synthetic chemicals, and fostering a symbiotic relationship between plants, animals, and microorganisms within the ecosystem (Table 1)[1].

3.1 Historical Background and Evolution of Natural Farming in India

The roots of natural farming in India are traced back to traditional agricultural practices that rely on locally available resources and ecological principles. However, the formalization of natural farming gained momentum in the late 20th century. These efforts emerged as a response to the adverse environmental and socioeconomic impacts associated with the Green Revolution.

3.2 Concepts and Philosophies

Key Philosophies of Natural Farming: The philosophical underpinnings of natural farming in India are deeply rooted in the country's cultural and spiritual traditions. These guiding principles include the following:

Respect for nature: Natural farming emphasizes harmony with natural ecosystems, acknowledging the innate wisdom of nature.

Minimalism and self-reliance: By minimizing external inputs and maximizing on-farm resources, natural farming fosters self-reliance among farmers.

Holistic approach: Viewing the farm as a complex, interconnected system where the well-being of soil, plants, animals, and humans are interdependent.

Spiritual connection: Some practitioners integrate spiritual and philosophical elements, such as "Vasudhaiva Kutumbakam" (the world is one family), into their farming practices.

Sustainability: Ensuring long-term soil health and productivity without relying on synthetic inputs.

3.3 Comparison with Other Sustainable Agriculture Practices

Natural farming aligns closely with organic farming,

Table 1. Core Principles of Natural Farming

Principle	Description	References
Biodiversity Enhancement	Promoting crop diversity and natural habitats for beneficial organisms.	[7]
No-till Farming	Avoiding plowing to maintain soil structure and health.	[8]
Mulching	Using organic materials to cover soil, conserving moisture, and suppressing weeds.	[6]
Natural Pest Management	Utilizing natural predators and biopesticides for pest control.	[9]
Soil Enrichment	Adding organic matter like compost and manure to improve soil fertility.	[10,11]

Table 2. Comparison of Sustainable Agriculture Practices

Practice	External Inputs	Synthetic Chemicals	Soil Health Practices	Biodiversity Focus
Natural Farming	Minimal	None	No-till, mulching	High
Organic Farming	Moderate	None	Crop rotation, composting	Moderate
Permaculture	Minimal	None	Permanent cover crops	Very High
Agroecology	Variable	Minimal	Diverse cropping systems	High

permaculture, and agroecology but is distinguished by its rigorous avoidance of external inputs and reliance on natural processes. Table 2 provides a comparative analysis of these sustainable agricultural practices.

3.4 Natural farming techniques and practices

Soil Health Management: Maintaining soil health is pivotal in natural farming. Practices such as mulching, cover cropping, and the application of natural fertilizers such as compost and green manure are employed to bolster soil structure, enhance fertility, and stimulate microbial activity[10-13].

Water Conservation Strategies: Effective water management lies at the core of natural farming. Techniques include rainwater harvesting, micro-irrigation, and mulching to conserve soil moisture[6], thereby reducing reliance on groundwater and fortifying drought resilience.

Pest and Disease Management: Natural strategies for pest and disease control revolve around fostering biodiversity to attract beneficial organisms, employing biopesticides, and implementing crop rotation to disrupt pest life cycles[9].

Crop Diversity and Rotation: Emphasizing diverse cropping systems and rotations is integral to natural farming. These practices not only bolster soil health but also diminish pest and disease pressure while bolstering overall farm resilience. Mixed cropping and agroforestry are common techniques.

4 REGIONAL PRACTICES AND ADAPTATIONS

4.1 Natural Farming in Different Agro-Climatic Zones of India

The varied agroclimatic zones in India necessitate nuanced adaptations of natural farming practices (Figure 1). In arid regions, techniques prioritize water conservation, whereas tropical areas focus on managing high rainfall and humidity levels effectively.

4.2 Case Studies from Various States

ZBNF in Andhra Pradesh: Andhra Pradesh has emerged as a leader in promoting ZBNF, championed by Subhash Palekar. With robust government backing and extensive training initiatives, farmers have reported enhanced yields, reduced input costs, and improved soil health[1].

Natural farming in Himachal Pradesh: Himachal Pradesh adopts natural farming methods tailored to its mountainous terrain, emphasizing terrace farming, organic mulching, and the use of indigenous manure. These practices have led to improved soil fertility and erosion control[9].

Organic Farming in Sikkim: Sikkim has successfully transitioned to become India's first fully organic state, prioritizing traditional farming techniques and local resource utilization to achieve sustainable agricultural practices.

5 IMPACT ON SOIL HEALTH AND BIODIVERSITY

Effects on Soil Carbon Changes: Natural farming in India, particularly ZBNF, has been shown to have a positive impact on soil health and biodiversity[1-3]. Natural farming practices significantly enhance soil carbon sequestration, thereby contributing to climate change mitigation. By incorporating organic matter and minimizing soil disturbance, natural farming enhances the soil's capacity to store carbon. Research indicates that organic farming systems exhibit a 46% greater pool of very labile carbon (CVL) than conventional methods (publication under process from International Rice Research Institute South Asia Regional Centre). Figure 2 illustrates the varying distribution of soil organic carbon fractions among different farming practices under a rice-based cropping system.

Enhancement of Soil Microbial Activity: Studies have shown that it can lead to an increase in soil microbial activity (Figure 3), with greater populations of bacteria, fungi, actinomycetes, and other beneficial

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Western plain zone:
- Four cropping systems for organic farming have been identified for this region through AI-NPOF.

Tamil Nadu Agro Climatic Zones:
- Rainfed crops are cultivated in this zone. Groundnut is the most widely cultivated rainfed crop in this zone. Other crops like sesame, cotton, and sorghum are also cultivated.

Agroecology based diversified farming system:
- This system integrates crops, trees, and livestock with functional biodiversity.

Macro-level planning:
- - Several attempts have been made to delineate major agro-ecological regions in respect to soils, climate, physiographic and natural vegetation for macro-level planning.

Rainfed crops:
- Rainfed crops are successfully cultivated in areas with low rainfall.

Agro-climatic factors:
- Regions are divided based on agro-climatic factors like soil, climate, temperature, rainfall, and natural vegetation.

Figure 1. Agro-Climatic Zones of India and Corresponding Natural Farming Practices.

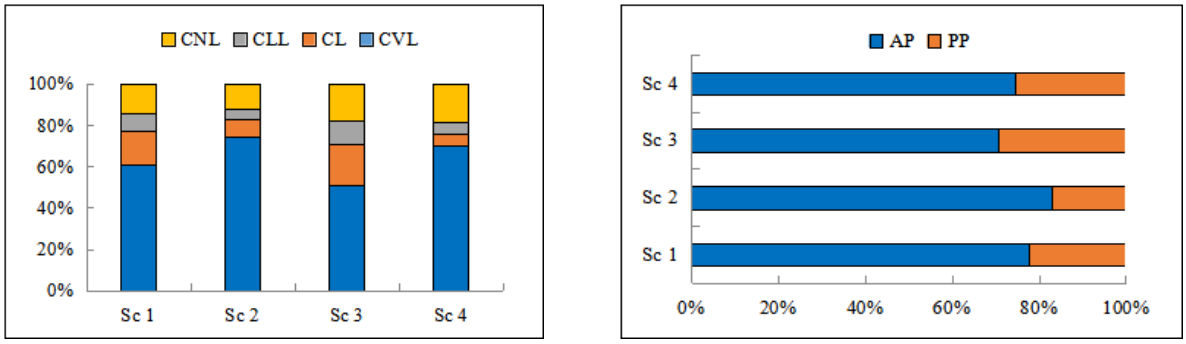

Figure 2. Distribution of soil organic carbon fractions of different labilities (as a percentage of total organic C) under different farming practices in a rice-based cropping system. Sc1: conventional farming, Sc2: organic farming, Sc3: integrated nutrient management, Sc4: conservation agriculture practices.

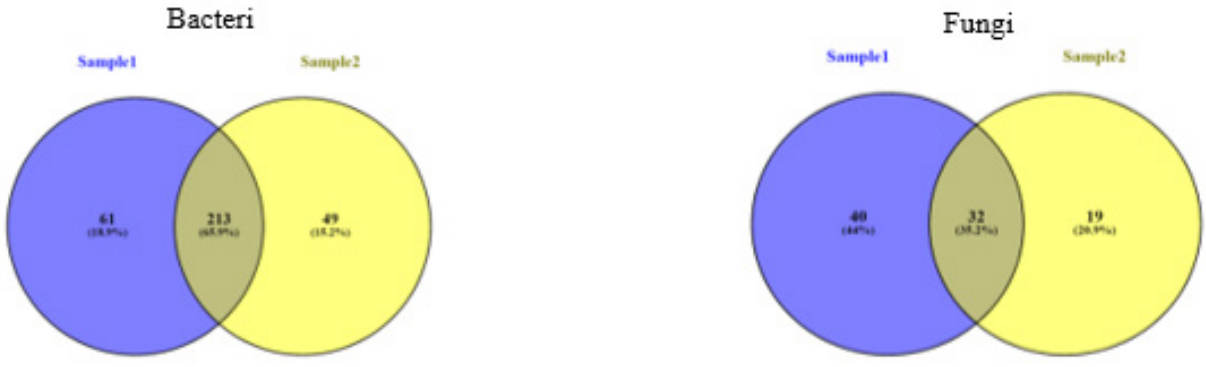

Figure 3. Venn diagrams representing the comparison of unique and common taxa between the 2 samples revealed that the organic sample (Sample 1) had the most unique taxonomic features compared to the conventional sample (Sample 2).

microorganisms[1]. This is further supported by the finding that natural farming can enhance soil carbon change, which is crucial for maintaining soil fertility and health[1]. Soil microbial activity serves as a critical indicator of soil health. Studies have demonstrated that natural farming practices enhance microbial biomass and diversity, which are essential for nutrient cycling and maintaining soil fertility. Research conducted at the International Rice Research Institute South Asia Regional Centre Varanasi, Uttar Pradesh, India, analyzed the impact of chemical versus

Table 3. Economic Comparison of Natural vs. Conventional Farming

Aspect	Natural Farming	Conventional Farming
Input Costs	Low	High
Yield Variability	Low	High
Long-term Profitability	High	Moderate

organic fertilization strategies on soil microbial diversity and community structure using amplicon sequencing of both the 16S and ITS regions (publication under process).

Impact on Biodiversity Conservation: In terms of biodiversity conservation, natural farming is effective at promoting genetic diversity and preserving traditional crop varieties, which is essential for long-term food security[3]. Natural farming promotes biodiversity both above and below ground. Diverse cropping systems and the preservation of natural habitats support a wide range of species, contributing to ecosystem stability and resilience.

5.1 Economic Viability and Productivity

Cost–Benefit Analysis of Natural Farming: The cost–benefit analysis of natural farming reveals that while initial adoption may require investment in knowledge and transition practices, long-term benefits include reduced input costs, improved yield stability, and increased profitability. According to previous research, natural farming not only offers agronomic advantages but also provides a range of social and economic benefits to farmers (Table 3)[14].

Productivity Comparisons with Conventional Farming: Although productivity per unit area may initially be lower in natural farming than in conventional farming, over time, the productivity gap narrows as soil health improves and farmers gain expertise in natural practices.

6 POLICY AND INSTITUTIONAL SUPPORT

Government Policies and Programs Promoting Natural Farming: The Indian government has launched several initiatives to promote natural farming, including subsidies for organic inputs, training programs, and research grants. The Paramparagat Krishi Vikas Yojana (PKVY) is a notable example of a supporting organic and natural farming practice[15].

Role of Non-Governmental Organizations (NGOs) and Community Initiatives: NGOs and community organizations play a pivotal role in spreading awareness, providing training, and facilitating market linkages for natural farming products. They act as catalysts for grassroots adoption and scaling up of natural farming practices[16].

7 CHALLENGES AND OPPORTUNITIES

Natural farmers face several challenges, including the following:

Lower Yields: Organic farming typically results in lower yields than conventional farming due to the avoidance of synthetic fertilizers and pesticides.

Higher labor costs: Organic farming requires more labor-intensive practices, such as manual weeding and crop rotation, increasing labor costs.

Higher Production Costs: Organic farming often requires more expensive inputs, such as organic fertilizers and pest control methods, increasing production costs.

Limited Availability of Organic Inputs: Access to organic inputs, such as organic fertilizers and pest control methods, can be limited in some regions.

Certification Costs: Obtaining organic certification can be costly and time-consuming, creating a barrier for small-scale farmers.

Market Fluctuations: Organic produce prices can fluctuate, making it challenging for farmers to secure stable incomes.

Limited Scalability: Organic farming can be more difficult to scale up to large commercial operations due to the need for more labor and resources.

Weather and Climate Risks: Organic farming is more vulnerable to weather and climate-related risks, such as droughts and floods, due to the reliance on natural practices.

Limited Options for Pest and Disease Management: Organic farming has limited options for managing pests and diseases, which can lead to crop losses.

Soil Degradation: If not properly managed, organic farming can lead to soil degradation and erosion due to the intensive use of soil resources.

8 OPPORTUNITIES FOR SCALING UP NATURAL FARMING PRACTICES

Despite these challenges, there are significant opportunities for scaling up natural farming:

Community-led initiatives: Empowering local communities to take ownership of natural farming practices, promoting grassroots adoption and innovation.

Government support and policies: Encouraging policy

frameworks, subsidies, and extension services to support natural farming, providing a favorable environment for scaling up.

Sustained leadership and vision: Committed leaders and visionaries driving the natural farming movement, inspiring and mobilizing others to join the effort.

Financial sustainability: Access to funding sources, such as grants, loans, and investments, to support farmers, researchers, and entrepreneurs in natural farming.

Alignment with enabling environments: Creating an ecosystem that supports natural farming, including markets, supply chains, and infrastructure.

Diverse funding sources: Leveraging various funding streams, such as government schemes, corporate social responsibility initiatives, development funds, philanthropies, and impact investors.

Public-private partnerships: Collaborations between government agencies, private companies, and civil society organizations to promote natural farming and share resources.

Capacity building and training: Providing education, training, and capacity-building programs for farmers, extension agents, and other stakeholders to adopt and promote natural farming practices.

Research and development: Continuous scientific research and innovation to improve natural farming practices, address challenges, and develop new technologies.

Market development and access: Expanding market opportunities and access to natural farming products, ensuring fair prices and incentives for farmers.

Networking and knowledge sharing: Facilitating knowledge exchange, networking, and collaboration among natural farming practitioners, researchers, and stakeholders to share best practices and innovations.

9 FUTURE PROSPECTS AND RESEARCH NEEDS

Emerging Trends in Natural Farming: Emerging trends in natural farming include the integration of digital technologies for farm management, the development of bio inputs, and research on climate-resilient crop varieties[17].

Areas for Future Research and Development:Future research should focus on the following: (1) Long-term impacts of natural farming on soil health and productivity. (2) Development of cost-effective bio inputs. (3) Socioeconomic impacts on farming communities.

10 CONCLUSION

This systematic review of natural farming in India highlights its potential to address the multifaceted challenges faced by the agricultural sector, including environmental degradation, farmer distress, and food insecurity. This review underscores the diverse regional adaptations, the positive impacts on soil health and biodiversity, and the growing policy and institutional support for natural farming in the country. However, the review also identifies the need for further research, particularly on long-term productivity, socioeconomic impacts, and the development of innovative approaches to overcome the existing challenges. By addressing these research gaps and strengthening the enabling environment, natural farming can emerge as a viable and scalable solution for sustainable agriculture in India.

10.1 Summary of Findings

Natural farming in India is a sustainable alternative to conventional agriculture, with significant benefits for soil health, biodiversity, and economic viability. While challenges exist, the growing support from government policies and community initiatives provides a robust foundation for the future.

10.2 Recommendations for Policy Makers, Farmers, and Researchers

Policy Makers: Increase funding for research and training in natural farming practices[14].

Farmers: Engage in community-based learning and share best practices.

Researchers: Focus on interdisciplinary studies to optimize natural farming techniques and assess long-term impacts.

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Not applicable.

Conflicts of Interest

The authors declared no conflict of interest.

Data Availability

Data sharing is not applicable to this review as no datasets were generated or analyzed during the current study.

Author Contribution

Mishra AK carried out research supervision, was responsible for the conceptualization, edited the manuscript, conducted inventory analysis and validated the results. Maurya PK

developed the methodology, performed the analysis, interpreted the data and wrote the manuscript. Sharma S was in charge of research supervision, edited the manuscript and approved the final version of the manuscript.

Abbreviation List

ZBNF, Zero Budget Natural Farming
PKVY, Paramparagat Krishi Vikas Yojana
NGOs, Non-Governmental Organizations

References

[1] Yankit P, Chandel R, Verma S et al. Insights on soil biological properties and crop yields under natural farming in western Himalaya. *Indian J Agr Sci*, 2024; 94: 89-94.[DOI]

[2] Daifa OM, Panchal N, Jangir S et al. Cultivating abundance and harmony: exploring the ecological, economic, and cultural implications of natural farming: A. 2024.[DOI]

[3] Kavitha V, Chandran K. Organic farming in conserving biodiversity in India-A review. *Agr Rev*, 2017; 38: 316-320.[DOI]

[4] Daifa OM, Tolossa DN, Panchal N et al. Advancing natural farming: a systematical literature review of natural farming practices in India. *EPRA Int J Agric Rural Econ Res*, 2024; 12: 16-21.[DOI]

[5] Gurav PP, Choudhari PL, Lakaria BL et al. Constraints in organic farming: An Indian perspective. *Indian Farming*, 2019; 69.

[6] Ramesh P, Panwar NR, Singh AB et al. Status of organic farming in India. *Cur Sci*, 2010; 99: 1190-1194.

[7] Mishra AK, Yadav P, Maurya P et al. Comparison of microbial diversity and community structure in soils managed with organic and chemical fertilization strategies using amplicon sequencing of 16S and ITS regions. *Front Microbiol*, 2024; 15.

[8] Duiker SW. Soil management. The Mid-Atlantic Nutrient Management Handbook, 2006: 127.

[9] Razaq M, Shah FM, Ahmad S et al. Pest management for agronomic crops. *Agronomic Crops: Volume 2: Management Practices*, 2019: 365-384.[DOI]

[10] Mishra A K, Shinjo H, Jat H S et al. Conservation agriculture enhances crop productivity and soil carbon fractions in Indo-Gangetic Plains of India. *Front Sustain Food S*, 2024; 8: 1476292.[DOI]

[11] Grover D, Mishra A K, Rani P et al. Soil Management in Sustainable Agriculture: Principles and Techniques. In: Technological Approaches for Climate Smart Agriculture. Cham: Springer: Berlin, Germany, 2024: 41-77.[DOI]

[12] Mishra AK, Maurya PK, Sharma S. Impact of different farming scenarios on key soil sustainability indicators driving soil carbon and system productivity of rice-based cropping systems. *Front Plant Sci*, 2024; 15: 1408515.[DOI]

[13] Mishra AK, Grover D, Das R et al. Carbon sequestration potential in agricultural systems. In: Agro-biodiversity and Agri-ecosystem Management. Singapore: Springer: Berlin, Germany, 2022: 87-111.[DOI]

[14] Er AC, Ahmad H, Manaf AA. Comparative cost benefit analysis of conventional farming and agroecological farming for paddy cultivation in Bachok, Kelantan. *Int J Environ Sci Dev*, 2021; 12: 181-187.[DOI]

[15] Iles A, Marsh R. Nurturing diversified farming systems in industrialized countries: how public policy can contribute. *Ecol Soc*, 2012; 17.[DOI]

[16] Fitzpatrick IC, Millner N, Ginn F. Governing the soil: natural farming and bionationalism in India. *Agr Hum Values*, 2022; 39: 1391-1406.[DOI]

[17] Mishra AK, Tiwari A, Maurya PK et al. Enhancing ecosystem dynamics: Organic and regenerative practices in rice-wheat systems and their impact on soil arthropod biodiversity. *Front Env Sci*, 2024; 12: 1407954.[DOI]