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NATURAL FARMING FOR SUSTAINABLE AGRICULTURE IN INDIA: CONSTRAINTS, OPPORTUNITIES AND PATHWAYS FOR SCALING WITH A PROVEN CASE-STUDY FROM RURAL LANDSCAPE OF BUNDELKHAND REGION

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ABSTRACT

Climate change, degradation of natural resources, declining soil health and rising costs of agricultural inputs have created an urgent need to transform conventional agricultural systems towards more sustainable and climate-resilient approaches. Agriculture is simultaneously a major victim of climate change and an important contributor to greenhouse-gas (GHG) emissions. This paradox necessitates production systems that can sustain food security while reducing dependence on externally purchased inputs and protecting the ecological foundations of agriculture. Natural Farming (NF) has emerged as one such approach. Broadly, it promotes ecological processes, soil biological activity, crop diversity, recycling of biomass, local resources and reduced dependence on synthetic fertilisers and pesticides. In India, the evolution of Natural Farming has been influenced by traditional knowledge, *Rishi Kheti*, the work of Masanobu Fukuoka and, more recently, Zero Budget Natural Farming (ZBNF) and community-managed approaches such as Andhra Pradesh Community Managed Natural Farming (APCNF). However, the terminology and package of practices vary considerably across regions, and Natural Farming should therefore be understood as a context-specific ecological farming approach rather than a single uniform technology. This review examines the concept and historical development of Natural Farming, assesses available evidence regarding its effects on soil health, productivity, farm economics and resilience, and identifies the major constraints to its large-scale adoption in India. The literature indicates that Natural Farming can reduce cultivation costs, improve soil biological activity, enhance resource-use efficiency and, under appropriate agro-ecological conditions, provide competitive yields and better benefit-cost ratios. However, evidence also indicates that outcomes are highly location-, crop- and management-specific, and that transition periods may involve productivity risks. Major constraints include inadequate extension support, shortage of locally available bio-inputs, labour requirements, limited scientific standardisation, weak market incentives, inadequate transition support and insufficient long-term field research. Large-scale adoption therefore requires a science-based, farmer-centric and regionally differentiated strategy integrating research, extension, community institutions, market development and convergence of public programmes.

Keywords: Natural Farming; Climate-resilient agriculture; Soil health; Agroecology; Regenerative agriculture; Microbial activity; Farm economics; Sustainable agriculture; Smallholder farmers

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1. INTRODUCTION

Climate change has become a major challenge to agricultural production through increasing temperatures, irregular rainfall, droughts, floods, prolonged dry spells and other extreme weather events. These changes directly affect crop yields, farm incomes and rural livelihoods. At the same time, agriculture contributes to greenhouse-gas emissions through fertiliser use, livestock, rice cultivation, residue burning, land-use change and energy consumption. The challenge, therefore, is not merely to produce more food but to produce it in a manner that is economically viable, ecologically sustainable and resilient to climate variability. The conventional input-intensive agricultural model has played an important role in increasing food production and achieving food security, particularly during the Green Revolution. However, prolonged and excessive dependence on external inputs in several regions has also been associated with soil degradation, declining soil organic matter, loss of biodiversity, groundwater depletion and rising production costs. These concerns have encouraged the development and adoption of alternative approaches such as organic farming, conservation agriculture, agroecology, regenerative agriculture, agroforestry and Natural Farming. Natural Farming is particularly relevant for small and marginal farmers because of its emphasis on reducing dependence on purchased external inputs and making greater use of locally available biological resources and ecological processes. Nevertheless, the large-scale adoption of Natural Farming should not be based only on ideological or prescriptive approaches. It needs to be supported by robust scientific evidence, location-specific protocols, farmer experimentation, appropriate extension systems and reliable markets.

2. CONCEPT AND EVOLUTION OF NATURAL FARMING

Natural Farming is not a single standardised package of practices. Its core philosophy is to work with ecological processes rather than attempting to control crop production entirely through external chemical inputs. The approach generally emphasises minimum soil disturbance, maintenance of soil cover, crop diversification, recycling of biomass, integration of livestock, biological pest management and enhancement of soil microbial activity. The modern Natural Farming movement is strongly associated with Japanese farmer-philosopher **Masanobu Fukuoka**, whose philosophy emphasised minimum soil disturbance, avoidance of synthetic fertilisers and pesticides, reduced dependence on weeding and pruning, and allowing ecological processes to support crop production. His approach influenced subsequent discussions on sustainable and ecological agriculture. In India, several traditional systems have historically relied on locally available resources, mixed cropping, livestock integration and recycling of organic materials. The concept of *Rishi Kheti* is one such example. Subsequently, **Subhash Palekar** developed and popularised Zero Budget Natural Farming, emphasising locally prepared formulations such as *Beejamrut* and *Jeevamrut*, mulching, intercropping and soil-moisture management. More recently, Natural Farming has gained institutional support through state-level programmes, including APCNF in Andhra Pradesh and natural farming initiatives in Himachal Pradesh, Karnataka and other States. For the purpose of this review, Natural Farming may be understood as an ecological production system that seeks to minimise or eliminate dependence on synthetic agricultural inputs, strengthen biological processes within the farm ecosystem, recycle locally available resources and maintain soil, crop and ecosystem health. Importantly, Natural Farming should not be treated as synonymous with organic farming. Organic farming permits the use of approved organic inputs, whereas different Natural Farming models may place greater emphasis on in-situ biological processes and reduced external input use.

3. EVIDENCE ON EFFECTIVENESS

Available studies indicate several potential benefits of Natural Farming, although results vary according to crop, location, soil, rainfall, management practices and duration of adoption. A study in Himachal Pradesh reported that Natural Farming systems achieved comparable or higher crop-equivalent yields than conventional systems in several crop combinations while reducing cultivation costs. The reduction in cultivation cost was particularly important for smallholders because it can improve net farm returns even where yield differences are modest. Research from Tamil Nadu comparing organic, Natural and integrated conventional farming systems reported improvements in soil-quality indicators under regenerative and Natural Farming practices. The study also reported a higher benefit-cost ratio for Natural Farming compared with the integrated conventional system. Such findings indicate that economic assessment of Natural Farming should focus not only on yield but also on input costs, net returns, soil-health outcomes and risk reduction. Soil biological activity is another important area of interest. Studies involving Natural and organic farming systems have reported increases in microbial populations, enzyme activity and microbial biomass carbon. These processes can contribute to nutrient cycling, soil aggregation and improved soil functioning. However, the precise contribution of individual microbial groups to crop nutrition and productivity remains insufficiently understood. Evidence from long-term natural management systems also suggests that greater

biological diversity in the rhizosphere and phyllosphere can contribute to ecological regulation and disease suppression. Similarly, diversified and biologically active farming systems may improve the capacity of crops and soils to withstand climatic and biological stresses. However, the available evidence should be interpreted cautiously. Natural Farming does not automatically guarantee higher yields in every crop and every location. During the transition from conventional farming, farmers may experience yield fluctuations, particularly where soils are degraded or where management knowledge is inadequate. Consequently, productivity, profitability and ecological outcomes must be assessed together over several seasons rather than through single-season comparisons.

4. MAJOR CONSTRAINTS TO LARGE-SCALE ADOPTION

Despite its potential, Natural Farming faces several constraints in achieving large-scale adoption in India.

First, inadequate technical knowledge and extension support remain major barriers. Natural Farming requires farmers to understand soil moisture, crop diversification, mulching, pest ecology, biological inputs and locally appropriate practices. Conventional extension systems are often better equipped to disseminate standard input-based packages than ecological management practices.

Second, availability of labour and local resources can be a constraint. Some Natural Farming practices require timely mulching, intercultural operations, biomass management and preparation of farm-based formulations. Labour shortages and rising rural wages can make adoption difficult, particularly for elderly farmers and households with limited family labour.

Third, availability and quality of bio-inputs require attention. Farmers may not always have adequate access to livestock-based resources, botanical materials or standardised biological inputs. Community-level production and quality assurance mechanisms are therefore necessary.

Fourth, market incentives remain weak. Farmers generally receive limited price differentiation for Natural Farming produce. Without reliable aggregation, branding, certification or assurance mechanisms, farmers may hesitate to bear the additional management risk associated with transition.

Fifth, scientific standardisation is inadequate. The term Natural Farming encompasses diverse practices, and different studies use different definitions and treatment combinations. This makes comparison across locations difficult. There is a need for clear minimum principles, while retaining flexibility for agro-ecological adaptation.

Sixth, transition risk is an important concern. Farmers dependent on assured yields may be reluctant to shift immediately from conventional systems. Demonstration plots, phased transition, risk mitigation and temporary handholding are therefore essential.

Seventh, research and extension remain insufficiently connected. A considerable proportion of research is conducted through experimental plots, whereas farmers require evidence under real-world conditions involving variable soils, rainfall, labour availability, market access and household economics.

5. OPPORTUNITIES FOR LARGE-SCALE ADOPTION

India has substantial opportunities to scale Natural Farming because of its large smallholder population, rich traditional knowledge, community institutions and growing demand for safe and sustainable food.

A major opportunity lies in **community-based adoption**. Farmer groups, Self-Help Groups (SHGs), Farmer Producer Organisations (FPOs), Village Organisations and Cluster Level Federations can facilitate local production of bio-inputs, peer learning, aggregation and market linkage. This can reduce the transaction costs faced by individual farmers.

The **DAY-NRLM institutional ecosystem** provides an important platform for integrating Natural Farming with women-led livelihoods. SHG members and Community Resource Persons can be trained as local resource persons for ecological crop management, preparation of locally suitable inputs, seed conservation, kitchen gardens, nutrition-sensitive agriculture and value addition. Such convergence can transform Natural Farming from an individual farm practice into a community livelihood enterprise.

There is also significant scope for **convergence with government programmes** relating to natural farming, soil health, watershed development, livestock, agroforestry, irrigation, rural livelihoods and FPO development. Public support should focus on capacity building, demonstrations, transition assistance, local bio-input infrastructure, soil-health monitoring, certification or assurance mechanisms and market development.

Large-scale adoption should also follow a **cluster-based and agro-ecological approach**. Instead of promoting one uniform package throughout India, clusters should be selected based on crop suitability, rainfall, soil conditions, existing farmer practices and market opportunities. The approach can initially focus on crops and locations where input costs are high, ecological risks are significant and farmers can readily substitute purchased inputs with locally available resources.

6. RESEARCH PRIORITIES

Future research should move beyond the simple comparison of yield between Natural and conventional farming. Long-term multidisciplinary trials are required to assess:

1. soil organic carbon, microbial diversity and nutrient cycling;
2. crop productivity and yield stability over multiple seasons;
3. farm-level profitability and labour requirements;
4. climate resilience under drought, heat and excess rainfall;
5. pest and disease dynamics;
6. nutrient balance and nutrient-use efficiency;
7. greenhouse-gas emissions and carbon sequestration;
8. transition-period risks and appropriate support mechanisms; and
9. consumer demand, price premiums and market viability.

A particularly important research gap is the understanding of **soil microbial communities and their functional contribution to crop nutrition and resilience**. Better integration of soil biology with conventional soil testing could provide a more comprehensive assessment of soil health.

7. CONCLUSION

Natural Farming offers a promising pathway towards more resource-efficient, climate-resilient and economically viable agriculture in India. Available evidence indicates potential benefits in terms of reduced cultivation costs, improved soil biological activity, enhanced ecological functioning and competitive farm returns. However, the evidence does not justify treating Natural Farming as a universally applicable replacement for all conventional practices. Its performance is highly dependent on agro-ecological conditions, crop choice, farmer knowledge and the quality of implementation.

The principal challenge is therefore not simply to increase the number of farmers practising Natural Farming, but to create an enabling ecosystem in which farmers can adopt, adapt and sustain ecological practices without compromising food security or household income. This requires stronger research-extension linkages, farmer-led experimentation, community institutions, local bio-input systems, market incentives, transition support and rigorous long-term monitoring.

For India, Natural Farming should consequently be positioned as an important component of a **diversified national strategy for climate-resilient and sustainable agriculture**, rather than as a one-size-fits-all prescription. A farmer-centric, evidence-based and agro-ecologically differentiated approach, supported by institutions such as SHGs, FPOs, SRLMs, Krishi Vigyan Kendras and State Agriculture Departments, can provide a practical pathway for taking Natural Farming from isolated demonstrations to sustainable large-scale adoption.

For **DAY-NRLM**, the Bundelkhand experience can be converted from an individual farmer model into a **women-SHG-led livelihood model**:

SHG women → Krishi Sakhi → Natural Farming Learning Group → Community bio-input production → Demonstration plots → Crop diversification → Aggregation through FPO → Value addition → Local/institutional markets

This is particularly relevant because the model can combine **natural farming, livestock, kitchen gardens, agroforestry, medicinal plants and small-scale value addition** rather than treating natural farming as a standalone intervention.

Proposed replicable model for Natural Farming in Bundelkhand Region

"Bundelkhand Natural Farming Livelihood Model"

1. Demonstration: 10–20 SHG women per village
↓
2. Training: Natural farming + water management + livestock
↓
3. Bio-input unit: Jeevamrit/compost/bio-pesticide and other locally appropriate inputs
↓
4. Diversified production: Cereals + pulses + oilseeds + vegetables + horticulture
↓
5. Agroforestry: Fruit/fodder/multipurpose trees on field boundaries
↓
6. Value addition: Cleaning, grading, processing and packaging
↓
7. Aggregation: SHG/VO/CLF/FPO
↓
8. Market linkage: Local market + institutional buyers + digital platforms
↓
9. Outcome: Lower cultivation costs + diversified income + improved soil/water resilience + enhanced household nutrition.

CASE STUDY FROM BUNDELKHAND REGION ON SHG

Case Study: Durga Self-Help Group – An SHG-led Sustainable Farming Model in Bundelkhand

Location: Digwahi Village, Badokhar Block, Banda District, Uttar Pradesh
Region: Bundelkhand
Programme: Deendayal Antyodaya Yojana – National Rural Livelihoods Mission (DAY-NRLM)
SHG: Durga Self-Help Group
Key Livelihood: Organic/Low-External-Input Farming/ Natural farming

Major Crops: Arhar (Pigeon Pea) and Coarse Grains/Kathiya

1. Background

Bundelkhand is characterised by recurrent drought, water scarcity, rainfed agriculture and increasing production risks. In such a challenging agro-climatic environment, strengthening women's collective institutions and promoting low-cost, climate-resilient farming practices are critical for improving rural livelihoods.

The experience of **Durga Self-Help Group (SHG) of Digwahi village in Banda district** demonstrates how the institutional platform of NRLM can support women to move from collective savings and credit towards productive farm-based livelihoods.

2. Journey from SHG to Farm Enterprise

The Durga SHG was formed in **2018** under the NRLM framework. The group subsequently adopted organic farming practices and began cultivating locally relevant crops such as **arhar dal and coarse grains/kathiya**.

The SHG platform enabled women to collectively access livelihood opportunities and financial services. An important milestone was access to support for **farm mechanisation**, through which the group obtained a tractor and agricultural implements. This helped demonstrate the potential of collective access to productive assets for women farmers in a region where timely farm operations are often constrained by limited resources.

3. Key Features of the Model

SHG Institution → Access to Credit → Farm Livelihood → Low-Input/Organic Farming → Farm Mechanisation → Crop Diversification → Collective Enterprise

The experience highlights that natural/organic farming can be strengthened when combined with:

- Locally suitable and climate-resilient crops;
- Reduced dependence on external agricultural inputs;
- Collective access to farm machinery;
- SHG-based savings and credit;
- Community-based technical support; and
- Scope for aggregation, processing and market linkage.

4. Relevance for Natural Farming under DAY-NRLM

The Digwahi experience provides a useful foundation for developing an **SHG-led Natural Farming model for Bundelkhand**. The existing farming system can be further strengthened through preparation and use of locally available bio-inputs, mulching and biomass recycling, crop diversification, water conservation, livestock integration and community-level demonstrations.

The model can subsequently be connected with **Producer Groups/FPOs** for aggregation, value addition, branding and marketing of pulses, millets and other natural-farming produce.

5. Key Lessons

1. **SHGs can become platforms for farm-based enterprises**, beyond savings and credit activities.
2. **Collective access to productive assets**, particularly farm machinery, can reduce operational constraints faced by women farmers.
3. **Low-external-input farming combined with locally adapted crops** can contribute to resilience in drought-prone regions.
4. **Crop diversification** can reduce dependence on a single crop and provide opportunities for additional income. This is a part /parcel of natural farming
5. The model has potential for **value addition and FPO-based market linkage**.

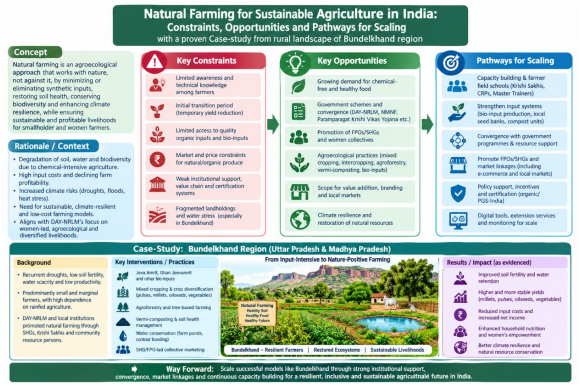
6. Way Forward – Bundelkhand Natural Farming SHG Model

SHG → Krishi Sakhi → Natural Farming Demonstration → Community Bio-input Production → Diversified Cropping → Custom Hiring/Farm Mechanisation → Aggregation → Value Addition → FPO → Market Linkage

Outcome

The Durga SHG experience demonstrates a pathway for transforming women's collectives into farm-based livelihood institutions, combining financial inclusion, sustainable agriculture and productive asset access. With systematic technical support and market linkage, the model can be further developed as a Bundelkhand Natural Farming and Climate-Resilient Livelihood Model under DAY-NRLM.

Source: Publicly reported account of Durga SHG, Digwahi, Banda, Uttar Pradesh. The available source describes the intervention as organic farming; additional SRLM records should be used before characterising it as an officially documented NMNF Natural Farming intervention.



Schematic diagram of Natural Farming

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