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POLICY PAPER

Policy Framework for Certified Evaluation for Sustainable Agriculture

Novel Methodological Framework for Evolving National Standards From the Grassroots Upwards

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Policy Framework for Certified Evaluation for Sustainable Agriculture

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Foreword

Agriculture in India is constitutionally a state subject; however, transforming the sector in a sustainable direction requires a coherent and coordinated national vision. The Government of India launched the National Mission on Sustainable Agriculture (NMSA) in 2010 as one of the eight missions under the National Action Plan on Climate Change (NAPCC) to promote environmentally sound farming practices through a range of targeted programs. Within this broader policy framework, agroecological approaches—particularly natural farming—have emerged as a promising pathway to restore ecological balance, strengthen farmers' livelihoods, and ensure the availability of safe, chemical-free food for consumers.

However, the diverse and localized nature of India's agricultural challenges spanning varied topographies, agroclimatic conditions, and socioeconomic contexts underscores why a centralized, one-size-fits-all approach often falls short. The effective transformation of agriculture requires locally relevant, bottom-up innovation.

India has historically relied on a top-down certification regime for quality assurance, these systems, however, proved largely unsuitable for the smallholder farmers due to its high cost and complexity. The dominant approach to certification remained centralized and export-oriented.

Agriculture and allied sectors contribute approximately 18–20% of India's total greenhouse gas emissions, largely driven by the use of synthetic fertilizers, methane emissions, and certain land-use practices. In this context, natural farming systems offer a viable pathway toward achieving India's net-zero emissions target by 2070. The CETARA-I framework provides an innovative, mechanism to assess and monitor these systemic transitions at scale. Within this framework, CETARA-I fulfills a critical function by providing a transparent, participatory, and technology-enabled certified evaluation mechanism that reinforces confidence between producers and consumers while upholding the right to safe food.

Existing certification systems in India, such as PGS-India and the National Programme for Organic Production serve important objectives but are not explicitly engineered to measure systemic agroecological transformation or provide real-time policy analytics.

CETARA-I introduces a groundbreaking approach:

- It delineates certified evaluation as distinct from conventional certification.
- It integrates participatory farmer self-assessment with sophisticated algorithmic analytics.
- It facilitates the aggregation of data from the farm level up to the national scale.
- It acknowledges federal diversity while fostering convergence over time.

The Himachal Pradesh initiative under the Prakritik Kheti Khushhal Kisan Yojana (PK3Y) constitutes the inaugural application of this framework, demonstrating that certified evaluation can be accessible to farmers and cost-effective. CETARA-I is not merely an instrument of compliance, it serves as an engine of transformation. By integrating grassroots participation with advanced analytical capabilities, it establishes the foundation for measurable advancement toward sustainable development goals, climate action, carbon sequestration accounting, heightened consumer confidence, and resilient agrifood systems.

This framework aims to build a single national system that respects diversity, where different methods from various states come together and work towards a shared eco-friendly future for India, while also supporting climate goals and ensuring that consumers have the right to safe and clear food systems.

(RS Chandel)

Preface

The objective of this policy paper is to complement and holistically reimagine the mechanisms of quality assurance and evaluation in the agricultural sector. By conceptualizing evaluation as a continuous process of learning and improvement, rather than solely a one-time compliance verification, certified evaluation frameworks offer a potent pathway to deepen our understanding of diverse agricultural practices, foster greater stakeholder engagement across the farming community, and equip governmental bodies with robust tools to catalyze and monitor systemic, long-term transitions within the food system.

Historically, quality assurance in agricultural food has justifiably relied on established certification systems such as Participatory Guarantee System (PGS-India) and the National Programme for Organic Production (NPOP), which have built substantial credibility for organic and sustainable products by verifying conformity to predefined standards. While invaluable for market differentiation, these systems can often present procedural complexities, financial burdens, and structural prerequisites that inadvertently constrain the accessibility and participation of smallholder farmers. This can impede their ability to compete effectively in markets and broadly adopt sustainable methodologies. Many current certification paradigms tend to emphasize static compliance with specific standards rather than dynamically assessing the broader transformation or system-level evolution essential for the sustained effectiveness and scaling of varied sustainable agriculture initiatives.

This policy paper introduces and meticulously examines an alternative, yet complementary, framework "Certified Evaluation" which fundamentally shifts the focus from certifying the end-product to certifying the rigor, transparency, and reliability of the evaluation process itself. The Certified Evaluation Tool for Agroecological Resources Analysis (CETARA-I) exemplifies this paradigm shift as a novel Innovation. It is a technology-enabled system designed to evaluate diverse natural farming and agroecological methods across varied farm typologies. Distinct from conventional certification's one-dimensional focus, CETARA-I utilizes a multi-source data approach, critically incorporating farmer self-assessments.

CETARA-I represents a vital evolutionary step beyond a simple verification tool. By generating star-based production profiles and aggregating granular, farm-level data, the system furnishes policymakers with unparalleled, real-time insights into the patterns of agroecological adoption and the trajectory of

systemic transformation across multiple scales-from individual holdings to communities, districts, and states. It pioneers a unified national interface capable of capturing the immense agro-climatic and methodological diversity inherent in India's farming systems, while simultaneously enabling the systematic and adaptive monitoring of the agricultural transition towards natural farming and broader agroecology.

This policy paper undertakes an exploration of the conceptual distinctions and potential synergies between the foundational structures of traditional certification systems and the emerging, adaptive framework of certified evaluation, highlighting their respective strengths and limitations in the Indian context. By examining the existing certification structures and elucidating the transformative potential of technology-driven evaluation models like CETARA-I, the paper seeks to contribute meaningfully to the evolving policy landscape on how agricultural sustainability and comprehensive transformation can be judiciously measured, strategically supported, and sustainably scaled over time, providing a model for the evolution of quality assurance frameworks.

- Authors

Executive Summary

This paper proposes a paradigm shift from conventional agricultural certification systems to an innovative approach—the Certified Evaluation Tool for Agroecological Resource Analysis – India (CETARA-I)—for the national-scale assessment of natural farming practices. Traditional systems primarily focus on verifying adherence to predefined standards.

CETARA-I is a technology-based system that focuses on making the evaluation process clear, reliable, and transparent. Instead of depending only on traditional inspection methods, it also includes farmer self-assessments, ecological indicators, and actual farming practices. Based on this, farmers receive not just a certificate but also a detailed star-rating profile.

This automated approach makes the system more efficient, consistent, and scalable, while reducing the need for time-consuming human inspections. At the same time, the evaluation method is carefully reviewed and certified by experts, ensuring that it remains scientifically sound, fair, and trustworthy.

The concept of CETARA-I is "Agroecology", aligning with internationally recognized frameworks such as the 13 Principles of the High-Level Panel of Experts and the 10 Elements of the Food and Agriculture Organization. By integrating environmental, social, and economic dimensions, the system incentivizes sustainable farming practices, lowers input costs, safeguards biodiversity, and enhances climate resilience.

Crucially, CETARA-I is engineered as a federated national platform that respects India's diverse agro-climatic conditions and federal structure. It accommodates varied evaluation methodologies developed by individual states while ensuring coherence (alignment with core agroecological principles) and equivalence (comparability with other approved frameworks) via analytical algorithms. This mechanism enables the system to assimilate farmer-centric national evaluation framework over time.

CETARA-I transcends its function as merely a compliance tool; it serves as an engine of systemic transformation. By aggregating granular, farm-level data, it furnishes policymakers with real-time intelligence to monitor systemic agricultural shifts, assess the impact of various programs, and track measurable progress toward Sustainable Development Goals (SDGs), climate action, and resilient agrifood systems.

Table of Contents

Glossary of abbreviations

ATMA	Agriculture Technology Management Agency
ATM	Assistant Technology Manager
BTL	Base Template Library
BTM	Block Technology Manager
CETARA I	Certified Evaluation Tool for Agro-ecology Resource Analysis - India
CETARA NF	Certified Evaluation Tool for Agro-ecology Resource Analysis - Natural Farming
FAO	Food and Agricultural Organisation of the United Nations
GMOs	Genetically modified organisms
HLPE	High Level Panel of Experts
PK3Y	Prakritik Kheti Khushhal Kisan' Yojana
SDGs	Sustainable Development Goals
SPIU	State Project Implement Unit
SPNF	Subhash Palekar Natural farming
TAPE	Tool for Agroecology Performance Evaluation
T_C	Coherence threshold
T_E	Equivalence threshold
UT	Union TerritoryExecutive Summary

1. Introduction

The transformation of current agrochemical-based farming production systems towards sustainable agriculture presents a formidable, yet essential, challenge in the contemporary global context. Addressing the critical need for sustainability in agricultural production and broader agrifood systems is imperative for mitigating the escalating effects of climate change. However, establishing effective, large-scale mechanisms for this transition is inherently complex.

Agrifood systems are not limited to the primary production phase by farmers; they encompass the entire infrastructure, including post-harvest handling, intricate supply and value chains, consumption patterns, and resource recycling. Therefore, any successful transformative process must effectively connect and integrate this vast and diverse chain of stakeholders. Furthermore, within a national policy framework, the mechanism must respect and incorporate constitutional principles of proprietary rights and ensure the inclusiveness of both state governments and the citizenry. By its very nature, such a transformation must be deeply participatory.

To address this challenge, this discussion paper introduces a novel and innovative mechanism: the "Certified Evaluation Tool for Agroecological Resource Analysis - India (CETARA-I)."

CETARA-I: A Framework for Participatory Transformation

CETARA-I is proposed as a system designed to facilitate a large-scale agricultural transformation using a participatory approach. Crucially, it is intended to be complementary to existing national certification systems in India, specifically the Participatory Guarantee Systems (PGS) and various third-party certification mechanisms. The inherent design of CETARA-I makes it particularly well-suited for supporting circular economy-based localized food systems. This adaptability allows for inter- and intra-state adoption across India, enabling a consistent yet flexible framework for food systems transformation based on this innovative tool.

Constitutional and Federal Basis for CETARA-I

India operates as a unique constitutional arrangement—a union as well as a federated system of states. The governance of agrifood systems is significantly influenced by the Seventh Schedule of the Indian Constitution, which details the legislative powers distributed between the Union and the States through three lists: List I (Union), List II (State), and List III (Concurrent).

Specifically relevant to this transformation are sectors defined in List II (State List), over which states have exclusive legislative authority:

1. **Article 14:** *Agriculture, including agricultural education and research, protection against pests, and prevention of plant diseases.*
2. **Article 8:** *Markets and fairs.*
3. **Article 26:** *Trade and commerce within the state are subject to the provisions of entry 33 of List III.*

Additionally, List III (Concurrent List), where both the Center and the States can legislate, includes:

- **Article 33:** *Trade and commerce in, and the production, supply and distribution of,* goods.

The legislative interplay between List II and List III establishes the participatory basis for the center and state governments to collaboratively develop and implement agrifood-related transformation regionally and nationally.

Addressing Regional Diversity

India's vast geography translates into a diversity of production-related Agroclimatic zones and a unique set of production complexities in each state. Consequently, each state must uniquely identify the impacts of agrifood systems on its local producer and consumer populations. Furthermore, states engage in trading surplus produce both at the national and international levels.

This reality places each state at the center of any transformation effort, poised to precisely evaluate its production methodologies and recommend the necessary mechanisms for change. As multiple states develop such evaluation systems, a diverse range, or 'constellation,' of methodologies is bound to emerge. CETARA-I provides the necessary algorithms and framework to encapsulate this diversity, offering a common national platform for convergence and equivalence. This design ensures that the system provides a truly participatory mechanism fully aligned with the spirit and text of List II and III of the Seventh Schedule of the Constitution of India.

Framework and Novelty

This discussion paper outlines a detailed framework for achieving coherence and equivalence among multiple production methodologies geared towards sustainable agriculture. It proposes a common framework capable of learning, binding, assimilating, and converging these varied methodologies at a national level.

A key novelty of the paper is the clear distinction between certification and

certified evaluation. Following this, the paper provides a comparative brief of existing certification systems in India, thereby building a compelling case for this specific innovation in agrifood systems transformation. The ultimate goal is to establish a sustainable agrifood system based on the principles of agroecology. Within the contemporary policy landscape, this critical transformation is envisioned to be enabled and driven primarily through the widespread adoption of natural farming practices.

1.1. Certification Vs Certified Evaluation

1.1.1. The Historical Pitfalls of the Current Certification Regime

To understand the necessity of a paradigm shift in agricultural certification, it is crucial to analyze the genesis of India's current regulatory landscape. As chronicled in the historical evolution of organic agriculture in India, the formalized certification mechanisms introduced in the early 2000s—such as the National Programme for Organic Production (NPOP)—were fundamentally derivations of methodologies from the Global North (e.g., IFOAM standards).

While these frameworks successfully introduced India to the global organic trade, they carried inherent, systemic flaws:

Export-Centricity Over Domestic Sustainability

The prevailing frameworks were designed almost exclusively to satisfy the compliance demands of European and North American markets. This market-led approach marginalized the development of a robust domestic organic ecosystem, prioritizing export metrics over holistic ecological regeneration (Sharma et al., 2025).

The Cost and Complexity Exclusion

The bedrock of the current regime is centralized, Third-Party Auditing. This mechanism is prohibitively expensive and procedurally onerous for the small and marginal farmers who constitute the vast majority of India's agrarian workforce. Consequently, formal certification became a privilege accessible primarily to wealthy farmers and corporate agribusinesses (Mishra, 2024).

Top-Down Simplification of Complex Ecosystems

Historically, centralized standard-making relies on rigid, "one-size-fits-all" input checklists. This top-down imposition fails to accommodate the sheer agro-climatic diversity and traditional agricultural wisdom inherent to India. It forces hyper-local, diverse farming practices into overly simplified, standardized global formats, stripping them of their ecological context (Willer et al., 2023).

Inevitability of Methodological Diversity in Sustainable Agrifood Systems Production

The shift toward sustainable agriculture, reacting to mid-20th-century agrochemical dominance, shows an evolution from "organic" to systems like biodynamics,natural farming (zero-budget), and the latest iterations, regenerative and carbon-neutral agriculture, focusing on ecosystem services (Ramesh et al., 2010). This chronological diversity makes tailored, adaptive farming solutions inevitable. Given this proliferation of distinct but aligned frameworks, an overarching analytical mechanism is necessary for coherent policy. Since no existing system can harmonize these diverse approaches, CETARA-I provides a crucial, technology-enabled structure to accommodate and measure all future sustainable agroecological methodologies.

1.1.2. Why Existing Frameworks are ill-Suited for Future Evolution

The current certification frameworks are structurally static and deeply centralized, rendering them ill-suited to manage the dynamic future of agriculture, particularly in the face of climate change.

- **Regulatory Stagnation:** Existing frameworks rely on fixed registries of "approved" or "banned" inputs. If a local community innovates a highly effective, climate-resilient natural farming practice, a centralized top-down framework lacks the agility to recognize, validate, and integrate this innovation into its national standard without years of bureaucratic friction.
- **State-vs-Center Fragmentation:** Because agriculture is fundamentally a state subject under the Indian Constitution, various states have naturally developed their own indigenous natural farming programs tailored to their unique geographies. Current central frameworks view these state-level deviations as non-compliant anomalies rather than valuable localized adaptations, leading to a fractured, divergent national policy landscape.
- **Inability to Monetize Broader Ecosystem Services:** Traditional organic certification stops at the "chemical-free" label. It lacks the multidimensional analytics required to translate regenerative practices into modern environmental assets, such as carbon offsets or green credits, leaving immense economic value on the table for smallholder farmers.

1.1.3. The Strategic Imperative for CETARA-I: A Future-Proof Architecture

To transition from a fragmented regulatory environment to a unified, scalable, and equitable national standard, a novel architecture is required. CETARA-I is not merely an alternative certification label; it is a transformation engine designed to solve the evolutionary bottlenecks of the past.

Reversing the Paradigm (Bottom-Up Emergence)

Instead of imposing a standard from New Delhi onto the states, CETARA-I respects the constitutional and ecological realities of India. It allows states to design their own localized, culturally relevant methodologies. Through its Base Template Library (BTL), the national standard acts as a living repository that organically evolves by absorbing grassroots realities.

The Algorithms of Coherence and Equivalence

CETARA-I utilizes advanced algorithmic frameworks to parse disparate state-level methodologies. The Coherence Algorithm links hyper-local practices (e.g., the use of *Khatti Lassi* in Himachal Pradesh or *Whapasa* in Maharashtra) to the FAO's globally recognized 10 Elements of Agroecology. The Equivalence Algorithm ensures that a 3-Star (*Vishisht*) rating holds identical market and ecological weight regardless of the state of origin, creating seamless interstate parity.

Democratized Trust via Peer-Appraisal

By utilizing a Participatory Guarantee System (PGS) enforced by digital peer-attestation, CETARA-I completely eliminates the financial burden of third-party auditors. It restores agency to the farming community while maintaining rigorous, statistically verifiable data streams.

Integration with Global SDG and Climate Markets

Unlike legacy systems, CETARA-I is inherently mapped to the UN Sustainable Development Goals. By digitizing farm-level agroecological data, the framework is pre-configured to plug into advanced Measurement, Reporting, and Verification (MRV) analytics, paving the way for India's farmers to directly access the Voluntary Carbon Market and the domestic Green Credit Program.

Future proofing for methodological diversity

CETARA-I's architecture, based on agroecology and coherence/equivalence algorithms, is a future-proof solution extending beyond natural farming. It can assimilate and standardize any sustainable production method (e.g., organic, regenerative) by focusing on measurable agroecological outcomes (soil health, biodiversity) rather than input checklists. This technology-driven platform offers systemic resilience and adaptability for India's sustainable agriculture standardization challenges.

In the context of quality assurance and standardization, the terms "certification" and "certified evaluation" are often used interchangeably, but they represent distinct processes with different objectives and outcomes. This section aims to clarify the differences between these two concepts, using CETARA-I and PGS as

illustrative examples. Certification and certified evaluation, while both contributing to quality assurance, differ significantly in their focus and outcomes. Certified evaluation, on the other hand, centers on the evaluation process itself. CETARA-I exemplifies this approach, but with a key distinction: it leverages technology for its evaluations. While it still results in a certificate and a star rating, the core focus is on the rigorous and transparent assessment of a farmer's natural farming practices through an automated system. Instead of trained human evaluators, CETARA-I utilizes a technology platform powered by algorithms, machine learning, and big data. This platform is built upon a methodology that has been rigorously evaluated and certified by experts, ensuring its scientific validity and reliability. The algorithm, and thus the underlying methodology, is itself certified by relevant authorities, providing assurance of its transparency, quality, and impartiality.

In developing an effective certification system for natural farming, extensive research on sustainability certification has been analyzed. Various certification models exist, ranging from privately managed to government-regulated systems (Lambin and Thorlakson, 2018; Moser and Leipold, 2021). One approach focuses on methodology-based certification, emphasizing standards and benchmarking (Ruben, 2017) for instance, both the Participatory Guarantee System (PGS) and the National Programme for Organic Production (NPOP) are certification schemes that mix these approaches. They establish criteria for organic production, and if a farmer's practices meet these criteria, they receive a certificate (e.g., a PGS Organic certificate or an NPOP organic certificate) (Gupta, 2016). This certificate serves as a guarantee to consumers that the product is organic, based on a defined set of rules. The focus is on the product or process meeting the standard. It is a formal procedure conducted by a recognized authority to verify that a product, process, or system meets specified standards or requirements. The primary goal of certification is to provide assurance to stakeholders, including consumers, regulators, and other interested parties, that the certified entity complies with established criteria. PGS is a certification system focused on organic farming. It involves a participatory approach where farmers, consumers, and other stakeholders collectively verify and certify the organic status of agricultural products. The PGS certification ensures that the products meet organic farming standards, providing credibility and trust in the market (Khurana, 2020).

Another approach examines the institutional design of certification schemes, including their adoption, evolution, and diffusion (Arnold, 2022; Marx et al., 2022; Schouten and Bitzer, 2015). Concluding these research efforts, this paper recommends certified evaluation over traditional certification systems to ensure

a more inclusive, transparent, and farmer-centric approach. A recent study highlights the benefits of the Certified Evaluation Tool for Agroecological Resources Analysis – Natural Farming (CETARA-NF) in Himachal Pradesh (Vashishat et al.,2024). The study demonstrates how CETARA-NF effectively assesses agroecological practices, empowering farmers with self-evaluation tools and achieving sustainable agricultural transitions without the financial and administrative burdens of certification. This reinforces the need for a shift from conventional certification systems to a more adaptable and locally driven certified evaluation approach.

Certified evaluation, on the other hand, centers on the evaluation process itself. CETARA-I exemplifies this approach, but with a key distinction: it leverages technology for its evaluations. While it still results in a certificate and a star rating, the core focus is on the rigorous and transparent assessment of a farmer's natural farming practices through an automated system. Instead of trained human evaluators, CETARA-I utilizes a technology platform powered by algorithms, machine learning, and big data. This platform is built upon a methodology that has been rigorously evaluated and certified by experts, ensuring its scientific validity and reliability. The algorithm, and thus the underlying methodology, is itself certified by relevant authorities, providing assurance of its quality and impartiality. The technology platform analyzes data from various sources, including farmer self-assessments, remote sensing data, soil tests, soil organic carbon (SOC), and other relevant production-related information. The machine learning component allows the system to continuously learn and improve its evaluation capabilities, refining the algorithms and ensuring they remain relevant and effective. The big data aspect enables the platform to handle vast amounts of information, allowing for comprehensive and scalable assessments.

This automated approach allows CETARA-I to conduct evaluations more efficiently and consistently than traditional methods. While the system operates autonomously, human intervention is still possible and necessary, particularly for complex cases or when updates to the methodology are required. The primary function of CETARA-I is to converge the same, similar, or overlapping methodologies from different states, specific to their production systems. This convergence happens through an evaluation process based on coherence and equivalence. Once the process is completed-with time and participation - the system learns and develops into a unified platform producing star ratings for farmers from across India. The star rating generated by the platform reflects the farmer's overall production profile, providing a nuanced picture of their practices. The certificate, in this case, is a result of the automated evaluation process, not the primary goal. Therefore, the system beautifully evaluates and

fulfills multiple tasks, viz., combined methodological aspects from across India based on agroecology and provides a unified national interface based on this diversity. As this entire evaluation process is certified at the center, the certified evaluation process is different from certification itself. Herein lies the novelty of CETARA-I over other prevalent systems in India. With time, methodologies are also allowed to adapt and evolve while keeping the overall framework the same.

Crucially, CETARA-I goes beyond simply assessing individual farms. It is designed to be a tool for measuring transformation at different levels. By aggregating the data collected through the automated evaluations, CETARA-I provides a valuable mechanism for tracking progress at the community, regional, and even national levels. This allows policymakers and program managers to understand the impact of interventions, identify areas for improvement, and measure the overall shift towards natural farming practices. Therefore, CETARA-I not only evaluates individual farmers but also serves as a powerful tool for monitoring and driving systemic change in the agricultural landscape through a certified and automated evaluation process. In summary, certification focuses on conformity to a standard, while certified evaluation, in the case of CETARA-I, emphasizes the quality and reliability of the automated assessment, leading to a more detailed and nuanced understanding of the evaluated subject and providing a method to measure transformation across different levels. CETARA-I is, eventually, not just a certificate-producing machine but a powerful learning engine, which measures, tracks, and evaluates the agrifood systems transformation based on the diversity of India. Certified evaluation is a systematic process to assess the performance, quality, or suitability of a product, system, or process against specific criteria. Unlike certification, which is often a one-time event, certified evaluation provides a detailed analysis for improvement and validation. CETARA-I exemplifies this approach by leveraging technology in its evaluations. While it results in a certificate and star rating, the focus is on the rigorous assessment of natural farming practices through an automated system that converges multiple methodologies. CETARA-I utilizes algorithms, machine learning, and big data to assess data from sources such as farmer self-assessments. This automated approach ensures efficiency, consistency, and scalability in evaluations. The platform continuously learns and improves, with human intervention only required for complex cases or methodology updates. CETARA-I evaluates diverse methodologies across India, producing a unified national interface and star ratings for farmers based on agroecology.

CETARA-I goes beyond individual farm assessments by aggregating data to track progress at community, regional, and national levels. This provides

policymakers with insights into the impact of interventions and the shift toward natural farming practices. Ultimately, CETARA-I is not just a certificate producer but a tool for monitoring and driving systemic transformation in agriculture for policymakers. It offers a more nuanced understanding of farming practices and serves as a powerful engine for agrifood systems transformation in India.

1.2. Comparative Brief of Existing Certification Systems in India

In conclusion, CETARA-I represents a necessary evolutionary leap. By harmonizing local biodiversity with national coherence and global climate economics, it provides a resilient, adaptive, and inclusive framework capable of guiding Indian agriculture not just for today but for the foreseeable future.

India has a diverse range of certification systems that aim to promote agricultural practices, ensure quality, and improve market access for farmers. These systems, which focus primarily on organic and fair trade standards, differ in structure, implementation, and focus areas. The major certification systems in India include government-regulated schemes like PGS-India, private sector initiatives, and international certifications.

PGS-India (Participatory Guarantee System) is a decentralized certification system introduced by the Ministry of Agriculture and Farmers' Welfare (MoAFW). Unlike other certification systems that rely on external inspectors, PGS-India uses the principle of participatory guarantees, where farmers, producers, and local communities play an active role in verifying and certifying organic produce. This system is designed to be cost-effective and accessible for smallholder farmers. However, as PGS-India is government-led and operates under a formal structure, it limits the organic integrity and trust-building features seen in grassroots-led PGS models globally.

NPOP (National Programme for Organic Production) is the official certification scheme for organic products in India, managed by the Agricultural and Processed Food Products Export Development Authority (APEDA). It is a government-regulated system offering national and international certification. While NPOP is globally recognized, particularly for export-oriented organic farming, its certification process is often lengthy and expensive, which poses challenges for smallholder farmers. Fair Trade India certification promotes sustainable livelihoods, social justice, and environmental stewardship. This system is widely used for products like tea, coffee, cotton, and handicrafts, providing farmers with fair wages, better working conditions, and access to international markets. However, the cost of certification and stringent criteria may limit its adoption among smallholder farmers. The ISO 17065 organic certification, applicable globally, ensures that products meet organic standards

and regulations (Brito et al., 2022). This certification is often used by larger organic producers and exporters in India. The certification process under ISO 17065 involves detailed documentation, inspections, and audits. While globally recognized, the high cost and complexity of the certification process make it less accessible for small-scale producers. Global GAP (Good Agricultural Practices) is an internationally recognized certification system that ensures food safety, environmental sustainability, and worker health. In India, it is adopted by large-scale producers and exporters, although it is generally not affordable for smallholder farmers due to its complex requirements and high cost of certification (Kassem et al., 2021). Rainforest Alliance certification focuses on promoting sustainable farming practices, particularly for crops like tea, coffee, and cocoa. It emphasizes environmental conservation, social equity, and sustainable livelihoods for farmers. However, the significant investment in training, audits, and documentation can be a barrier for small-scale farmers (Arai et al., 2023).

When comparing these systems, key factors such as simplicity, cost and accessibility, market reach, transparency, trust, and sustainability impact become apparent. Government-led systems like PGS-India tend to be more affordable and accessible for small farmers compared to internationally recognized certifications like Global GAP or NPOP, which involve higher costs and complex procedures. In all foreign-driven certifications, a marketing agency or external organization is required, which supports marketing to enable access to smallholder farmers. International certifications like FairTrade and Rainforest Alliance provide broader market access, particularly in export markets, while PGS-India remains regionally focused, limiting access to international markets. Furthermore, community-driven PGS systems can offer greater transparency and trust, as local communities are directly involved in the certification process. On the other hand, government and private certifications, which often rely on external auditors, may reduce farmer trust, especially with large-scale audits. In terms of sustainability impact, all systems aim to promote sustainable practices, but the extent to which they succeed in fostering long-term ecological and economic benefits varies. It cannot be stated with confidence that any one certification system among these is singly suitable for the conditions for smallholder farmers in India. It is, indeed, the case that smallholders require accessibility in their vernacular systems with ease of use and localized relevance. Towards this, one of the more popular certifications in India for organic produce is PGS-India, which is a government-led organic farming certification system adopted by the Ministry of Agriculture and Farmers' Welfare (MoAFW) in 2014–15, inspired by civil society-run PGS models (Khurana et al., 2023). Unlike

globally recognized Participatory Guarantee Systems (PGS), which emphasize decentralized, community-driven certification based on trust, social networks, and knowledge exchange, PGS-India operates under government control. Since June 2020, only PGS-India certification is valid in the country. Some research indicates that while certification schemes can enhance well-being in certain cases, their impact varies across regions, standards, crops, and producers (Traldi, 2021). In some cases, they may even have negative effects, particularly when increased labor requirements or higher transaction and production costs are not balanced by better prices (My et al., 2025). In the case of PGS, which expanded in reach after it was promoted through schemes such as Prampragat Krishi Vikas Yojana (PKVY) (Chauhan et al., 2023) and Bhartiya Prakritik Krishi Paddhati (BPKP) and through schemes such as National Rural Livelihood Mission (NRLM). However, even in these cases, the structure of PGS is relegated to being akin to a third party and in limited verbiage. Formation access to PGS-India from 2013-2018 remained limited with minimal access for farmers. It also requires funding support of organizations called regional councils to enable and upkeep the system. It remains to be seen if, without these support programs, PGS can exist independently without the occurrence of these programs (Reddy, 2020).

Table 1 has a comparative basis for two major certification systems in India - PGS and third-party (NPOP) with CETARA-I. It is important to note that Certification is not a guarantee for marketing to occur. At best this enables marketing differentiating Organic/Natural produce against chemically grown one. It is a dichotomy where food grown without Chemicals is required to certify periodically under a regulatory framework however, the same is not applicable to chemically grown food in conventional markets. This also indicates that there is a deeper inquiry required to the purpose of certification itself. Here, certified evaluation justifies itself as a mechanism, which not only outputs a certificate but also provides a mechanism to measure and evaluate program outcomes for Food Systems transformation. The process itself is simple and free of cost for farmers, it also provides for low cost to exchequer in its overall decentralized systems design. The complexity of certification systems and access to the market are well documented in multiple sources. Certification is also shown to not be farmer-friendly despite programmatic outreach, and even PGS-India is shown to have costs for smallholder farmers (Hattab et al., 2025; Ghadiyal et al., 2024; Gupta et al., 2021). It is also the case that current organic certification mechanisms focus mainly on cultivation and do not address social and ecological aspects of sustainable food systems (Hansmann et al., 2020) . Interestingly, the research published in 2014-16 to address these critical aspects of enabling market access remains a complex

Table 1 - Comparison of Certification systems and CETARA-I

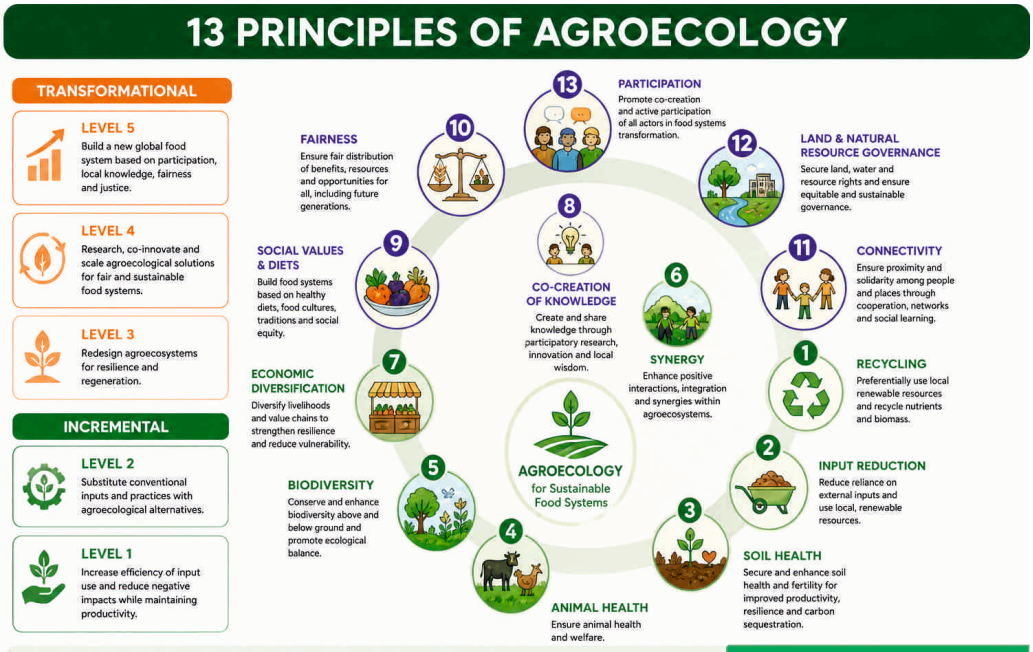
Feature	PGS-India	CETARA-I	Third-Party (NPOP)
Primary Focus	Participatory Certification of Organic Practices. Suitable for Domestic Markets	Agroecology and Food Systems transformation. Certified Evaluation of Natural Farming Practices; based on production profiling, self -declared and peer reviewed sustainability practices; Tool for Policy/Program Measurement. Suitable to highly localised - domestic markets;	Formal Certification of Organic Practices - Mainly for Exports and satisfying G2G/Inter - Country requirements
Nature of Assurance	Assures adherence to organic standards through peer review and community participation - Decentralized	Participatory, farmer -based evaluation with involvement of extension officers and stakeholders . Assures the quality and reliability of the automated evaluation process for nat ural farming;	Assures adherence to NPOP organic standards through independent audits and inspections
Certification/Evaluation Outcome	Results in a PGS certificate (Organic/Green)	Results in a CETARA -I certificate with a star rating based on production profiling; Data can be aggregated for policy and program assessment	Results in an NPOP organic certificate
Emphasis	Product/Process conforming to organic standards	Evaluation process and competence of the certified automated system in assessing natural farming; impact of natural farming practices on various indicators	Product/Process conforming to NPOP organic standards
Participation	Strong emphasis on farmer and stakeholder involvement in verification and decision-making	Farmer involvement in self-assessment; Data collection through the technology platform; Potential for broader stakeholder participation	Limited direct farmer participation in the certification process itself; Focus on compliance with NPOP standards
Evaluator Role	Farmers, local groups, and stakeholders act as peer reviewers and verifiers	The certified algorithm within the technology platform conducts assessments based on the defined methodology	Independent, accredited certification bodies conduct audits and inspections
Standard/Methodology	Based on national organic standards and PGS guidelines	Uses a specific framework and scoring system for evaluating natural farming practices; Methodology is evaluated and certified by experts on a participatory basis between State and Central government.	Based on the NPOP standard for organic production
Scope	Primarily focused on on-farm activities (crop production, processing, livestock, wild); difficult to change methodology	Can encompass a broader range of natural farming practices, methodologies and potentially include off -farm aspects; Designed to provide data for measuring program effectiveness; Possible to handle future methodologies within framework flexibly.	Can cover a wide range of organic products and processes, including on -farm and off -farm activities; complex to change methodology without approval at International level

Certificate Issued?	Yes (PGS Organic/Green Certificate)	Yes (CETARA -I Certificate with Star Rating)	Yes (NPOP Organic Certificate)
Use for Policy/Program Measurement?	Limited direct use	Designed specifically to provide data for policy and program monitoring and evaluation	Limited direct use for broad policy measurement; Focus on certifying individual operators
Evaluation Process	Participatory, peer -review based - verified by Regional Council	Automated, technology -driven, algorithm -based; Evaluation Methodology is certified - Open Participation	Independent audits and inspections by accredited bodies
Human Intervention	High	Primarily automated; Human interv ention for complex cases and methodology Seeding; Remotely accessible even for peer review process.	Primarily conducted by human auditors and inspectors - Complex Technology - Tracenet
Policy Feedback Interface - Food Systems Transformation	No	Yes- Provides decentralized data for policy and program monitoring. Drill down to State-District-Block level	No
Cost and Complexity	Requires PGS Regional Councils, adding complexity and cost to the system. Average Costs to farmers. High cost to exchequer.	Simplifies the process by eliminating the need for Regional Councils or Accreditation Agencies. Free of Cost to Farmers. Minimal Cost to exchequer.	Requires Accreditation Agencies, adding complexity and cost to the system. High Cost to Farmers. High Cost to exchequer.
Language Flexibility	Available in Hindi and English	Framework allows the interface to be in any vernacular as required by the state.	Available in English only
Centrality	Highly Centralized Top -Down System - Proactive - States to Follow	Decentralized Bottom -Up - Evolved system - Reactive - Participatory for State Governments	Highly Centralized Top -Down System (Foreign - Led System)- ProActive - States to follow

Source: Authors' compilation

2. Basis of Certified Evaluation - Agroecology

Agroecology represents a dynamic concept that has achieved prominence in scientific, agricultural, and political discourse over recent decades. A fundamental tenet of Agroecology is its strong commitment to producer self-reliance. Consequently, the practice strongly encourages producers to also generate their own inputs. As agro-chemical inputs are acquired from external sources, producers utilize local natural biomass, recycling it from their local geographies. This plant and animal biomass is then employed to establish a circular loop within crop production. The natural farming systems, as implemented in India, fundamentally incorporate this characteristic (Shraddha et al., 2023; Sharma et al., 2025).



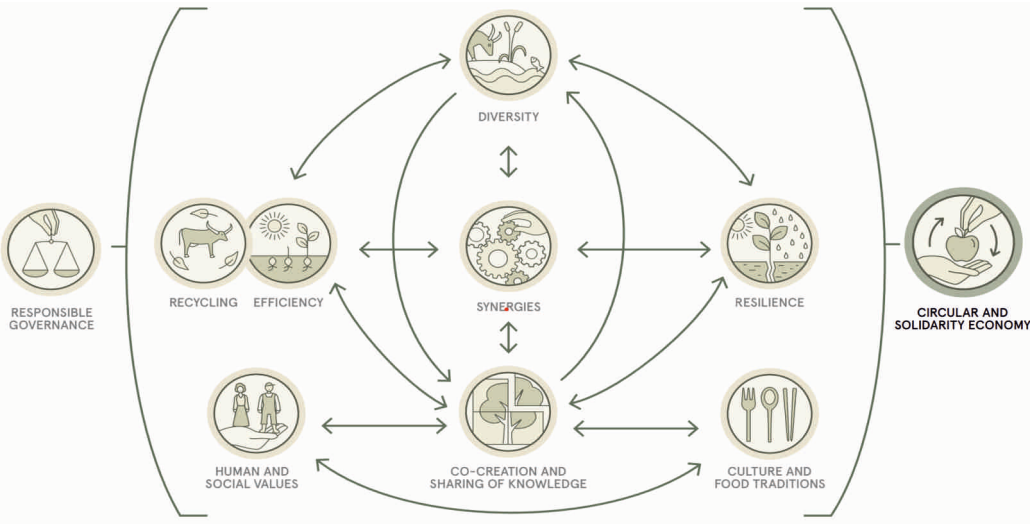
THE FIVE LEVELS OF TRANSITION TOWARDS SUSTAINABLE FOOD SYSTEMS AND THE RELATED 13 PRINCIPLES OF AGROECOLOGY

Source: Gliessman, 2017

It is advocated for its capacity to contribute to the transformation of food systems by applying ecological principles to agriculture, ensuring the regenerative use of natural resources and ecosystem services, and simultaneously addressing the requirement for socially equitable food systems where individuals can exercise choice over their diet and the methods and locations of production. In the Indian context, Natural Farming has progressively evolved as a system that enables producers, particularly smallholders, to demonstrate self-reliance through the

reduction of input costs while simultaneously preserving ecological balance (Laishram et al., 2022; Divyanshu et al., 2025a; Divyanshu et al., 2025b).

It now represents a transdisciplinary field that includes all the ecological, sociocultural, technological, economic and political dimensions of food systems, from production to consumption scales. A consolidated set of 13 principles constructed from the literature on agroecology as manifest as a science, a set of practices and a social movement High Level Panel of Experts in 2019 (HPLE, 2019) were found to be well aligned and complementary to the 10 elements of agroecology developed by FAO (FAO,2018).



Source: Food and Agriculture Organization United Nations, 2018

The successful utilization of agroecology's potential for agricultural and food system transformation necessitates a structured framework for coordinated action and inter-actor collaboration. Given that agriculture in India is constitutionally a state subject, individual states formulate development policies in accordance with their prevailing farming systems' characteristics and the needs and aspirations of their farming communities. The central government is currently prioritizing the reduction of farming systems' input capital intensity, aiming to diminish producers' reliance on market-sourced chemical inputs. To achieve this objective, the government is promoting the widespread adoption of natural farming practices across the nation through financial provisions within various dedicated promotion schemes.

Establishing a methodology for the Certified Evaluation of natural farming production systems within each state and Union Territory is paramount. This is essential not only to ensure farmer profitability but also to cultivate consumer confidence and trust in the authenticity of the produce. Consequently, each state

interested in advancing natural farming may wish to develop a distinct evaluation methodology for its crop produce. While some of these methodologies may align with those of other states, others may be considerably divergent, potentially leading to conflicts of interest among diverse stakeholders nationwide. To accommodate these possibilities while upholding India's federal structure, it is proposed that an analytic system be incorporated within the National Framework Mechanism for Certified Evaluation Tool for Agro-ecology Resource Analysis—India (CETARA-I). This system will facilitate the convergence of methodologies, ultimately developing a singular, evolved system informed by the contributions of various states. Housing disparate methodologies under a unified framework, alongside their temporal convergence through suitable analytics, will require a central authority. This central body shall be tasked with harmonizing the proposed certification methodologies over time to satisfy the diverse stakeholders across the nation. Such efforts are expected to significantly contribute to the sustained and widespread adoption of this environment and farmer-friendly crop production system throughout the country. Therefore, the overarching aim is the creation of CETARA-I. This initiative simultaneously enables the development of a system based on advanced analytics, facilitating linkage with the measurement and evaluation of carbon sequestration, and the subsequent generation of carbon/green credits and advanced metrics of agricultural sustainability.

This section contains the fundamental basis of a pan-India certified evaluation system such as agroecology. Towards this, the globally acceptable definition of Agroecology is represented through two mechanisms—

13 Principles of Agroecology—as propounded by the High Level Panel of Experts

10 Elements of Agroecology—as defined by the FAO

This is also useful since, at a global level, it is agreed that this contributed positively to the Sustainable Development Goals (SDGs) (Tittonell, 2018). It is on the basis of these aspects of agroecology that the methodologies from across the states in India are proposed to be tested.

While the overall framework of CETARA-I may adapt to diversity in methodologies applicable over wide geographies, in this document we limit its usage to the case of natural farming as it is developing in different states of India.

3. Natural Farming and its Principles

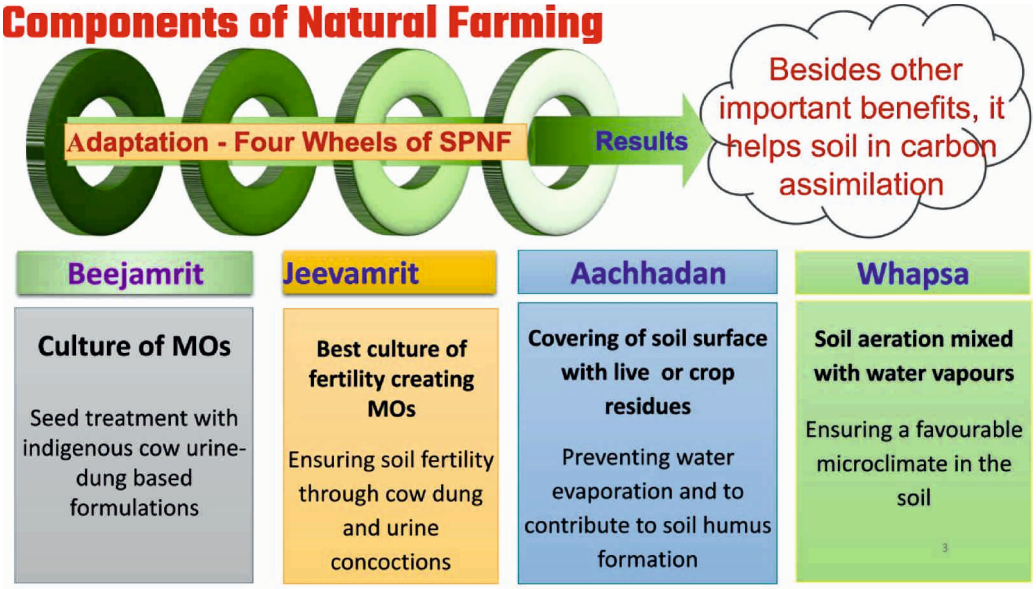
Natural Farming (NF) is positioned as a pivotal, chemical-free agricultural paradigm within the national policy framework, leveraging indigenous resources, particularly livestock (Vashishat et al., 2021). This methodology is congruent with India's agrarian heritage and natural ecosystems, strictly prohibiting the use of synthetic fertilizers and chemical pesticides. NF aligns with globally recognized principles of agroecology and serves as a strategic intervention to bolster the economic resilience of agricultural producers while simultaneously internalizing the environmental costs often associated with conventional, chemical-intensive agriculture. As a cornerstone of sustainable agricultural policy, NF equips the farming community to effectively mitigate the impacts of climate change and decisively addresses critical national environmental challenges, including groundwater depletion, loss of biodiversity, land and soil degradation, and high greenhouse gas emissions. The operational policy focus of Natural Farming is centered on the holistic improvement of soil health through diligent management of soil organic matter and biological activity, optimization of water use efficiency, maximized biomass recycling, and the comprehensive enhancement of on-farm biodiversity and biological interactions (Kumar et al., 2025; Vashishat et al., 2022).

3.1. Components of Natural Farming

Nutrient Management

Natural farming, as championed by Padma Shri Subhash Palekar, who has significantly popularized the practice in India, advocates for components such as *Beejamrit, Jeevamrit*, Mulching, and *Whapasa*. Complementing these are plant protection *kashayas*, including *neemastra*, *agniastra*, and *brahmastra*, which are formulated using indigenous cow dung and urine, along with medicinal plants, to manage insect pests (Yankit et al., 2024).

Biological stimulants like *Jeevamrit* (applied through irrigation water) or *Ghanjeevamrit* (available in liquid and dried forms for application during the sowing period) are prepared from a mixture of cow dung, cow urine, jaggery, pulse flour, water, and uncontaminated soil, ideally sourced from areas where chemical cultivation has not been practiced. This fermented microbial culture functions as a catalytic agent, enhancing the activity of beneficial microorganisms and earthworms in the soil to improve the bioavailability of essential nutrients (Chandel et al., 2023).



Source: Authors' compilation

Beejamrit, a preparation of water, cow dung, cow urine, lime, and soil, is utilized for seed treatment. Mulching involves covering the soil surface with either live crops or straw (dead plant biomass) to promote moisture conservation, reduce soil temperature around plant roots, prevent soil erosion, minimize runoff, and inhibit weed growth.

Whapasa refers to the soil's microclimate, which is essential for soil organisms and roots to obtain the majority of their moisture and a portion of their nutrients. This practice enhances water availability, improves water-use efficiency, and builds resilience against drought conditions.

Pest management is achieved through the use of various decoctions, such as *Neemaster, Brahmastra, Agniaster, Dashparni Ark*, and others, prepared from cow dung, cow urine, various plant leaves, and water, which are applied for the control of insects and pests.

Dynamic Innovation System: Beyond these fundamental principles, innovative agricultural practices are continuously developed by farmers in the field, adapting to factors such as cropping patterns, climatic conditions, altitude, soil quality, and the severity and variability of insect and pest infestations. These innovations include Pre-Monsoon Dry Sowing (PMDS), green manuring, and the application of Farm Yard Manure (FYM), vermicompost, etc., in conjunction with the components of natural farming. In locales where a native breed of cow is unavailable, inputs are being prepared using the dung and urine of any available livestock. Furthermore, some farmers have implemented automation for the preparation and application of natural inputs. Consequently, these types of innovative practices, which are

grounded in the principles of natural farming, will be considered for natural farming certification following on-site validation and field visits. These validated practices may subsequently be recommended for inclusion in the standardized package of practices. India possesses the largest number of organic farmers globally, approximately over 4 million. It is pertinent to note that in current policy discussions and estimations, a clear distinction between organic farmers and natural farmers is absent, and there is no dedicated certification system for naturally farmed produce. A certified evaluation program for produce grown naturally or under a traditional agricultural system is imperative, given that increasing consumer awareness regarding health and environmental issues has prioritized the production of safe food through natural and organic farming. With the escalating demand for naturally grown food in both national and international markets, it has become necessary to ensure that agricultural products labeled as "natural" comply with the foundational processes of the natural farming system and that the entire production process is publicly verified on a participatory basis involving the government.

In the wake of the above, organizations such as Dr YS Parmar University of Horticulture and Forestry have collaboratively initiated a natural farming certification framework, i.e., a certified evaluation tool for agroecological resource analysis in India (CETARA-I). This initiative involves intensive engagement with a network of over 2,00,000 farmers to ensure that the system operates effectively and is regularly monitored. This innovative certified evaluation tool for natural farming is designed to meet the needs of small and medium-sized farmers. In addition to offering a certification, it is also a tool for tracking, monitoring, and evaluating a sustainable food systems transformation in India. The primary goal is to provide an affordable and straightforward certification process for farmers, while also instilling consumer confidence in natural products. This happens in participatory collaboration with state governments from across India. Thus, the system is an innovative and unique perspective to enable smallholder farmers to connect to the markets towards such a transformation based on agroecology.

3.2 PGS-NATURAL and CETARA-I

As of 2026, the National Center of Organic and Natural Farming NCONF has also instated the basic methodology of CETARA-NF as developed for Himachal Pradesh and expanded its scope for application to all over India as a system for PGS-NATURAL certification (NCONF, 2025). It is interesting to note that in the current version of PGS-NATURAL leaves the concept of assigning weights and indicators for the future. It is also here that CETARA-I provides a viable analytical framework for the same.

The PGS-NATURAL system, as operationalized under the Natural Farming Certification System (NFCS), marks a transformative shift in India's agricultural quality assurance by integrating the participatory trust of traditional PGS with the technological rigor of the CETARA-NF pilot. CETARA-I provides the essential framework for this convergence by standardizing the evidence-based, three-tier grading mechanism (One, Two, and Three Stars) across India, ensuring that local agroecological variations are respected while maintaining national market credibility. By leveraging digital tools such as geo-tagging, real-time self-declaration, and blockchain-enabled traceability, CETARA-I bridges the logistical gaps that previously hindered smallholder participation in remote terrains. This framework effectively harmonizes state-led initiatives with national standards, creating a scalable, transparent, and farmer-centric ecosystem that empowers producers to transition towards chemical-free agriculture without the burden of third-party certification costs.

4. Key Principles - CETARA - I

This section contains the basis by which the Principles of CETARA-I map to agroecology based on the International Definitions and understanding. This allows the system to provide an umbrella mechanism for convergence at all levels—local, regional, national, and global. CETARA-I proposes to follow key principles to ensure that the methodology is based on a solid design foundation. At any point in time, if changes to the system should go against any of these principles, then the changes should be rethought and not be implemented without causing changes to the fundamental principles. This leads to designing a system based on proper understanding of conditions in India while ensuring that suitable global paradigms are also aligned. Accordingly, these principles are:

Participatory in nature and simple for the farmers: this shall allow each state to ensure that the system so created is based on harmony among the producer community and localized to the cultural system of the state. One possibility is for each state to create access in the local language and English.

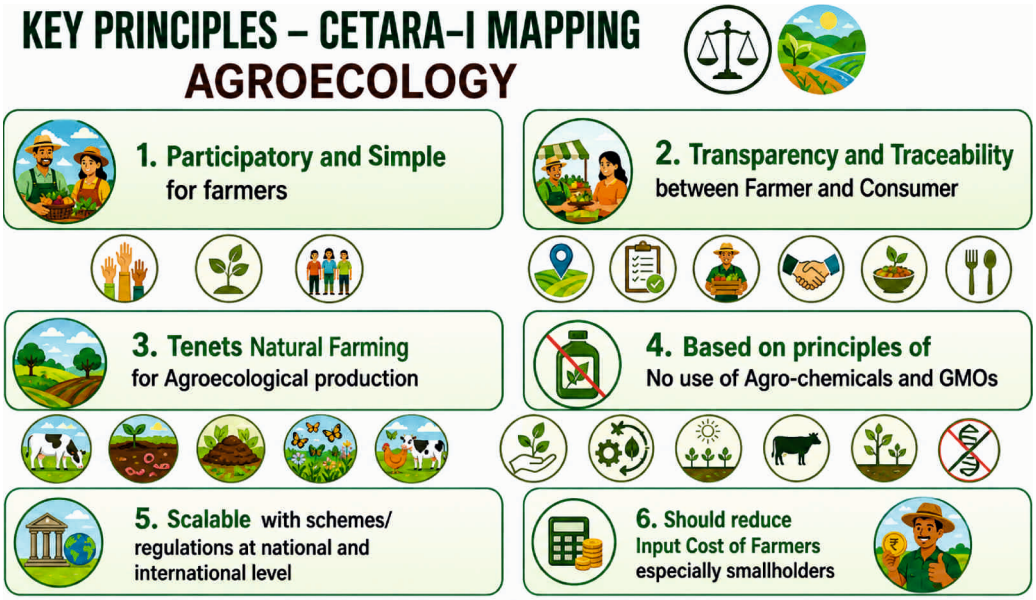
Tenets of Natural Farming for Agroecological Impact: this ensures that the methodologies are aligned towards agroecology and for the purpose of natural farming.

Scalable to Market Linkage Systems at National/International Level: This ensures that the systems designed as part of CETARA-I are compatible to allow producers to access all available market options and thus not inhibitive of them.

Transparency and Traceability between Producer and Consumer: This ensures that the nature of market linkage and transactions encourages traceability of the producer in favor of the consumers and transparency in favor of the producers.

No Use of Agrochemicals and GMOs:This ensures that only those methodologies that ensure no use of agrochemicals and GMOs are permissible. This is to ensure that only those methodologies that are inherently principled towards agroecology are included and any kind of greenwashing is disallowed.

Reduced input production costs of the producer: this ensures that the methodologies are developed to reduce input production costs for the producers, which is also as per the Principles of Agroecology.



Source: Authors' compilation

Thus, this ensures that agroecology is a core part of the systems design and all the methodologies follow these common minimum principles across India.

5. Proposed National Platform - CETARA-I

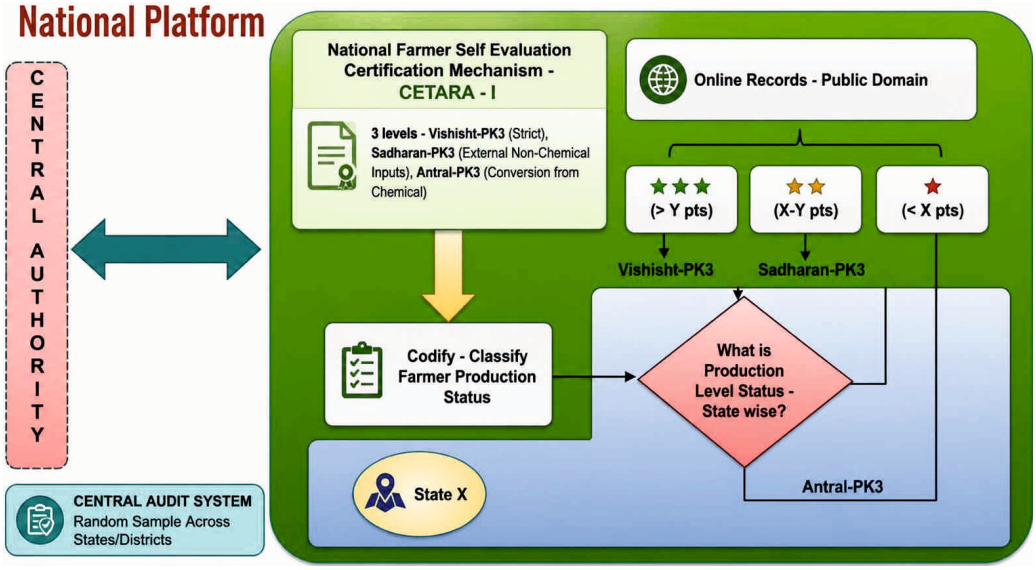
This section contains the proposed platform at the national level, which performs the role of launching a certified evaluation system for natural farming practices for the farmers in various states and Union territories of India. The certified evaluation system will ultimately classify the farmers' production status into three categories, i.e., *Vishisht* (3 stars), *Sadharan* (two stars), and *Antraal* (1 star). The central authority constituted for this purpose will ensure that various farmer categories across the states have uniformity in various indicators selected for the classification of the farmers.

5.1. National Level Farmer - Self Declared Certified Evaluation

Based on this overall architecture, the Department of Agriculture, Government of Himachal Pradesh (GoHP), has launched a novel certified evaluation system for natural farming based on the needs and requirements of small and medium holder farmers in Himachal Pradesh. This certification process under the natural farming program of the state is a self-assessment certified evaluation methodology. It has been named the Certified Evaluation Tool for Agriculture Resource Analysis-Natural Farming (CETARA-NF). Similarly other states and UTs of India can broadly adopt one of the following certified evaluation methodologies for their producers practicing the agroecological/natural farming techniques for the crop production:

- Design and develop new certification and/or evaluation methodologies based on the principles and components of the agroecology adopted at the international level and indicators of the agroecological/natural farming crop production techniques of their states.
- Adopt certification methodologies developed by other states that meet the needs and expectations of their farming communities and production systems.
- Alter the components of certification methodologies developed by other states to tailor it according to the needs of their states and to reflect the prevalent agroecological practices of their states.

The certification methodology being suggested by the various state/UT governments shall broadly follow the basic principles set of the CETARA I system. Based on the above, this shall potentially generate multiple but similar methodologies, each flexible, allowing states to cater to the production scenario in their respective geographies. Thus, this will produce a constellation of the



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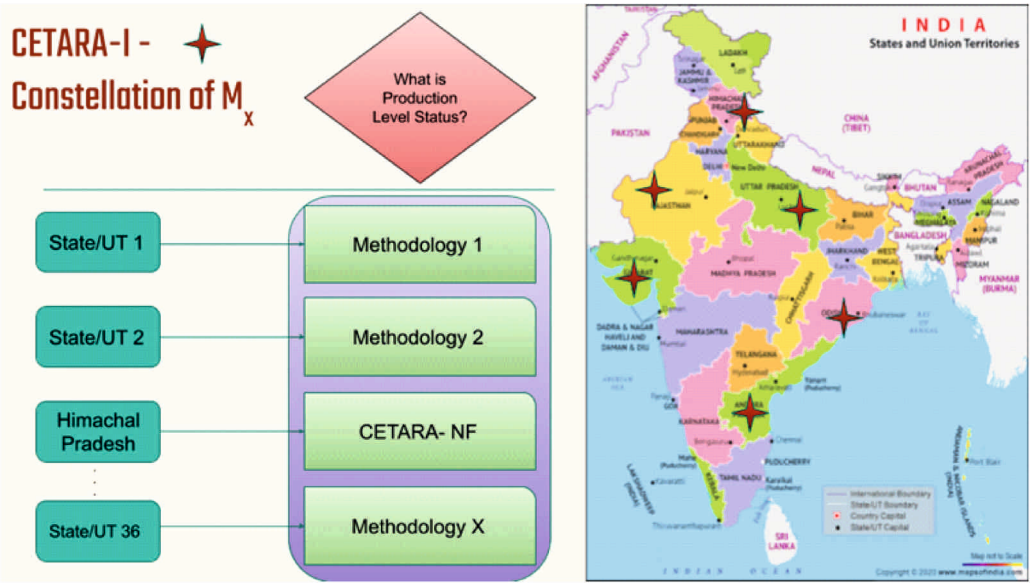
methodologies developed by various states and Union territories of India based on the needs and characteristics of their farming systems. Overall the system remains that of a star rating; however, each state shall have its methodologies to offer this rating. At the central level it shall be ensured that the methodology submitted by each state is coherent to the system of agroecology and is equivalent to existing methodologies. CETARA-I has built-in analytics to check against such coherence and equivalence, such that the constellations of these methodologies harmonize with time. This aspect of CETARA-I is unique and innovative while respecting the federated system of agricultural production in India as per the Seventh Schedule State List (List II). CETARA-I thus has a self-equilibrium-achieving algorithm that eventually settles towards one common methodological system with time. In the sections below, the framework for CETARA-I is explained along with an example of how one of the states, i.e., Himachal Pradesh, shall help seed such a system.

5.2 CETARA-I - Constellations of Methodologies

5.2.1. Diversity Coherence and Equivalence Process

This section details the process by which diverse methodologies shall be accommodated within the CETARA-I umbrella through means of suitable process analytics. Over time this shall allow the system to learn and converge into a single workable framework, allowing for a common heuristic mechanism. This is the most innovative aspect of CETARA-I working in unison across India, building upon its strength from the grassroots up. Perhaps the first-ever system, globally, to rebuild from the strength of the production systems in a bottom-up method .



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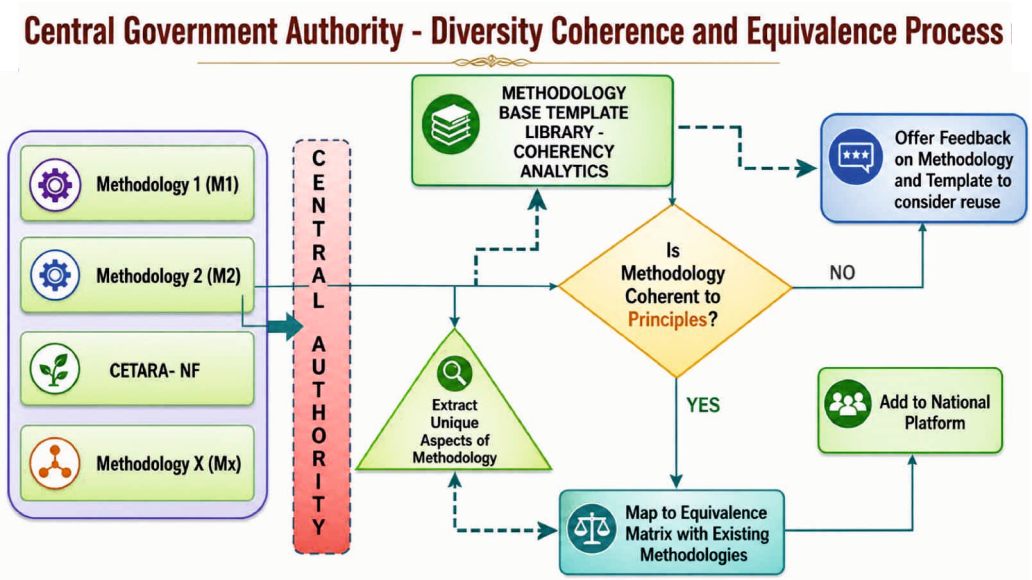


Source: Authors' compilation

The certification methodologies proposed by the different states should be yielding the results that are easy for the understanding of the consumers spread across the state. At the minimum, each methodology shall be coherent to the principles of agroecology via measured analytics. The states shall be free to self-declare the methodology based upon perusal of existing methodological templates for easy definitions.

The certification system proposed by various states/UTs should classify the

farmers into three categories having similar characteristics as proposed in the CETARA system. If there are huge differences in the number and characteristics of the categorized farmers, then the central government authority, in consultation with the experts of the concerned fields, develops specific equivalence formulas.

Thus, the analytics provide the mechanism to propose, acquire, and converge methodologies on a federated basis from across states in India.

Various methodologies received by the central authority will be tested for coherency with the 13 Principles of Agroecology, as propounded by the High Level Panel of Experts, and 10 Elements of Agroecology, as defined by FAO. Once a methodology is determined as coherent, it is tested for equivalence with existing methodologies. Once the methodology is found to be equivalent, it is measured for correlation against existing methodologies and added to the central Base Template Library (BTL) and declared as equivalent, along with the degree of equivalence, in the public domain.

Each methodology must meet the coherence and equivalence threshold level fixed by the central authority. First, methodology accepted on the basis of minimal threshold levels of coherence and equivalence by the central authority will go to the base template library, and rejected methodologies will be sent back with feedback for their improvement. New methodologies offering improvement over base template methodologies will form new thresholds for other states to follow. Accepted methodologies meeting the threshold will be added to the national platform with their equivalence values based on the indicators of the base template library.

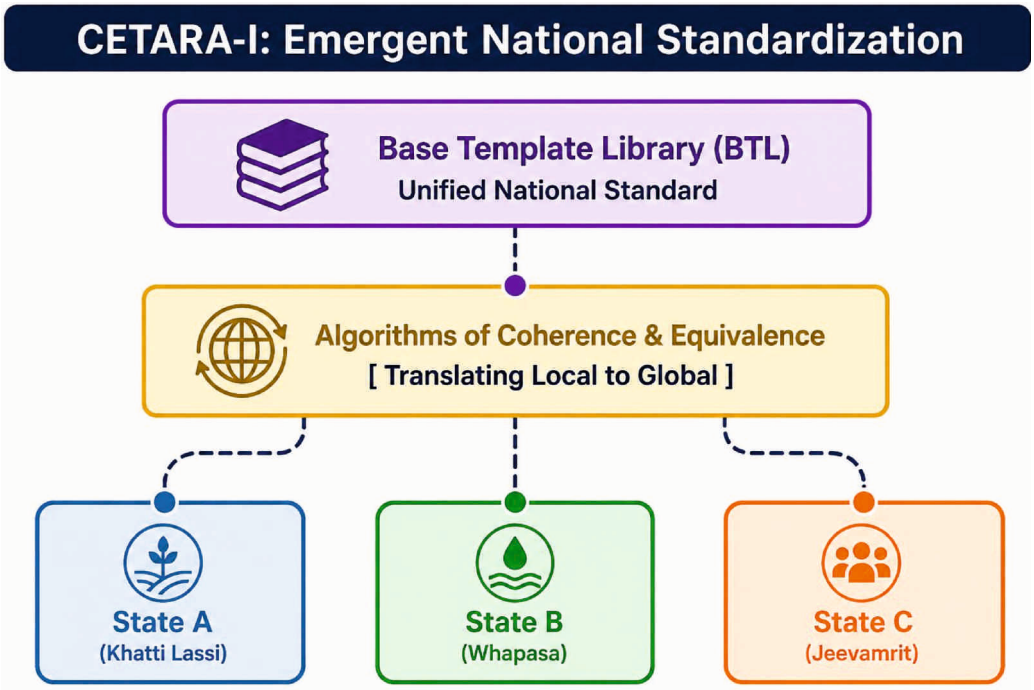
5.2.2. Coherence and Equivalence Algorithms

Various methodologies will be examined under algorithms A_1 and A_2 sections of coherence and equivalence. These algorithms are framed on 13 principles and 10 components of agroecology. Each entry has to justify adherence to its methodology against various elements of the agroecology defined by FAO in analytical section A_1. Various methodologies like the Tool for Agroecology Performance Evaluation (TAPE) (from FAO) may also align to form a base for developing coherence and equivalence algorithms and fix the thresholds of coherence (T_C) and equivalence (T_E) levels. These thresholds are maintained at the central government level and transparently accessible to all the states. These thresholds are maintained at the central government level and transparently accessible to all the states.

The Tool for Agroecology Performance Evaluation (TAPE), to produce and consolidate evidence on the multidimensional performances of agroecological systems (Mottet et al., 2020).

States shall also prioritize the various elements of agroecology depending upon the state-specific farming system needs by assigning higher weightage to the related agroecology elements in the coherence evaluation framework. This allows the states flexibility in expressing the localized forms of agroecology federated as per the production policies in each state. Central authority will fix coherence threshold (T_C) on the basis of various methodologies, and each entry must meet this minimal level to be successful in A_1 section of this algorithm. Unsuccessful entries in A_1 will be sent back with feedback for further improvements and resubmission. This feedback shall be done through a committee of experts analyzing the methodology at the central government level.

Successful entries in section A_1 will now be tested for equivalence with the entries in the base template library of the central authority. Central authority will fix the qualifying equivalence threshold (T_E) level for entry to be a successful entry in A_2 section of this algorithm. At the minimum a Methodology shall need to pass through A_1 to be viable and recognised within the state and domestic markets for traceability between producer and consumer. If the state wishes to achieve equivalence, they must pass through A_2 to be able to allow farmers to be recognized among different states. However, each state must necessarily pass through A_2 to be able to provide traceability between producer and consumer across state boundaries for trade. It is up to the states to accept each other's



Source: Authors' compilation

equivalence or deem the other state to become equivalent to each other based on the methodologies accepted. This also allows states to collaborate with each other to allow trade between their natural farmers. The equivalence allows the states to ensure that the interests of their consumers are protected and traceability is expressed. Accordingly, the states may also declare the transactions between the consumers and producers online, linked with the National Platform, to express transparency in favor of the producers. Those states that do not wish to submit to this process may be considered as having a default algorithm, which is the convergence result of the currently existing coherence process.

Himachal Pradesh is the first state to launch its certification methodology, CETARA NF, in India. This methodology can be the first entry in the base template library of the central authority to form a base for fixing the T_C and T_E level for new entries. T_C and T_E will be dynamic in nature and shall be modifiable in light of the improvements received by newer methodologies . Each new methodology shall also be encouraged to innovate and recommend newer indicators and sub-indicators for existing methodologies in the Base Template Library. This allows the system the opportunity for newer methodologies to continually improve existing ones in the base template library. Every time there are newer entries in the base template library, especially in equivalence, the level for T_C and T_E shall be increased further to ensure that the next set of methodologies shall only cause improvement upon existing ones. Additionally, the other states may also take the benefit of the improved base template library to either choose an existing methodology for their certified evaluation or propose a more innovative one for improvement into the centralized library.

5.2.2.1. Example of Coherence and Equivalence - CETARA-NF

This section provides as an example the methodology from Himachal Pradesh-CETARA-NF when applied to the CETARA-I system. This shows how the process shall be executed by various states to allow for convergence.

5.2.2.1.1. Coherence

Equivalence Evaluation Procedure for CETARA - NF Himachal Pradesh

Evaluation of CETARA NF Himachal Pradesh for coherence with CETARA I has been detailed in the table given above. Natural farming implemented by the government of Himachal Pradesh is based on a holistic system built upon principles of natural farming. This system lays emphasis on the low input cost, improved ecology by enhancing soil health through bio-inoculation, continuous vegetation cover on the farms, and reduced tillage resulting in increased sequestration of carbon in soils. It enhances biodiversity by encouraging the production of traditional crops to ensure food security besides enhancing water

security through optimal soil moisture management and prohibiting chemical inputs. Therefore, efficiency, recycling, resilience, and diversity elements of agroecology have been assigned higher weightages (2) than the other elements. The coherence value has been assigned by the state on the scale of 1-3, with 3 for Maximum and 1 for minimum coherence. The coherence and weights assigned for each element of agroecology have been justified with reasons. The resultant coherence score for the state methodology works out to be 39 out of a maximum of 42 on the basis of coherence and weightages values. This is quite a good coherence score, and central authority can thus fix the coherence threshold (T_C) for other interested states. It can be in the range of 50-60% of the best certification evaluation methodology identified by the central authority.

This high coherence score highlights the robustness and scientific alignment of the CETARA-NF framework with national standards. It demonstrates that state-level natural farming models can be effectively evaluated and harmonized within a unified certification system. The established threshold can guide other states in benchmarking and improving their methodologies. Such standardization will ensure transparency, comparability, and credibility in agroecological assessments across regions. Ultimately, this approach supports the scaling of sustainable agriculture while maintaining regional flexibility and contextual relevance.

5.2.2.1.2 Equivalence

Equivalence Evaluation procedure for CETARA NF Himachal Pradesh

Evaluation of CETARA NF Himachal Pradesh for equivalence with CETARA-I has been detailed in the table given above. Natural farming techniques adopted by the farmers of Himachal Pradesh have various practices for seed treatment, nutrient management, soil and water conservation, diversification, integrated pest management, cultural practices, human resource development, storage facilities, chemical input use restrictions, and gender equality. 15 indicators and 26 sub-indicators of natural farming practices in the state have been identified. Each sub-indicator has been assigned equivalence values and weightage on the basis of importance and do's and don'ts of the natural farming practices. Natural farming practices of the state discourage the use of market-sourced organic inputs to minimize the cultivation cost. Similarly, it also prohibits the use of any type of chemical fertilizers, genetically modified crops, and chemical pesticides for crop production. Therefore, all desirable sub-indicators have been assigned positive weightage while indicators to be discouraged have been assigned negative weightages. However, if central authority wished to include market-sourced organic inputs in the methodologies, then respective weightage can be

assigned positive weightage with lower equivalence value. However, weightage and equivalence value for chemical inputs should be kept higher to ensure only a 1-star or entry-level rating for the farmers using them.

Table 2: Coherence - Evaluation if CETARA - NF Himachal Pradesh

Sl. No.	Elements of agroecology	Coherence Value*	Justification	Weight	Weight Justification	Score
1	Diversity	3	Promoting mixed farming	2	Main component of NF in Himachal Pradesh	6
2	Co-creation & sharing of knowledge	2	Farmer to farmer knowledge sharing is the basic extension model adopted under SPNF in HP.	1		2
3	Synergies	3	Four pillars of NF promote synergies between different components of farm sustainable food system	1		3
4	Efficiency	3	Mixed farming and increased biodiversity promoted efficient utilisation of the resources	2	Four pillars of the NF promotes efficient utilisation of soil nutrients, water along with biodiversity of the farm ecology.	6
5	Recycling	3	Endorses the local unused biomass for the mulching	2	Mulching and Nutrient management practices of NF utilises the farm-based waste products.	6
6	Resilience	3	Natural farming increases the human and environmental resilience by discouraging the use of chemical inputs	2	Non use of chemical and market based farm inputs.	6
7	Human & social values	3	Improving rural livelihoods, gender equity and social welfare by encouraging the use of local farm based inputs in crop production and promoting women participation	1		3
8	Culture & food tradition	2	Supporting healthy, diversified and culturally appropriate and nutritional diets by producing chemical free products	1		2
9	Responsible Governance	3	Responsible and effective governance mechanisms at different scales from rural to urban levels	1		3
10	Circular & Solidarity Economy	2	Reconnecting producers and consumers by providing innovative marketing solutions to farmers	1		2
*** Scale 1-3(3 for Maximum and 1 for Minimum coherence)**					**Total score**	39
					Maximum score	42

Source: Authors' compilation

Table 3: Equivalence -Evaluation of CETARA - NF Himachal Pradesh

Sl. No.	Indicator	Sub Indicator (NF practices in HP)	Farmer's declaration	Equivalence Value	Weightage
1	Seed treatment practices	Beejamrit application to seed/seedlings/plants	Yes/No	4/0	1
2	Nutrient management	Ghanjeevamrit in soil	Yes/No	4/0	1
3	Soil and water conservation practices	Dry/Green mulching between rows of plants	Yes/No	4/0	1
4	Soil aeration practices	Whapasa creation	Yes/No	4/0	1
5	Crop diversification	Mixed croping with leguminous crops	Yes/No	4/0	1
6	Experience	upto 3 years	Yes/No	1/0	1
		> 3 years and upto 5 years	Yes/No	2/0	
		> 5 years	Yes/No	4/0	
7	Indigenous livestock	Indigenous Cow	Yes/No	4/0	1
8	Farm conversion to NF	> 75% of total cultivated land	Yes/No	4/2	1
9	Human Resources Development	Participation in NF Training	Yes/No	4/0	1
10	Farm sourced NF inputs	Using self prepared SPNF inputs	Yes/No	4/0	1
11	Integrated pest management	Khatti Lassi	Yes/No	2/0	1
		SaptDhan Ankur Ark	Yes/No	2/0	
		Neemastra	Yes/No	2/0	
		Agniastra, Brahmastra, Dashparni Ark/ Astra's application Not Needed	Yes/No	2/4	
12	Storage facilities	Separate storage facility for NF produce	Yes/No	2/0	1
13	Externally sourced Organic inputs#	Use of bio fertilizers	Yes/No	1/0	-2
		Use of botanical extracts/ bio pesticides	Yes/No	1/0	
		Use of organic manure	Yes/No	1/0	
		Use of vermicompost	Yes/No	1/0	
14	Chemical inputs use*	Fertilizers (Urea etc)	Yes/No	5/0	-1
		Fungicides	Yes/No	5/0	
		Insecticide	Yes/No	5/0	
		Herbicide	Yes/No	5/0	
15	Gender equity	Is farmer a woman	Yes/No	2/0	1
		Max score		**58**	

#Farmer using any Externally sourced Organic inputs will be eligible for 2 star rating
***Farmer using any chemical input will be eligible for entry level or 1 star rating**

Source: Authors' compilation

6. Detailed Development Roadmap for CETARA-I: Key Aspects for Consideration

The foundational framework for the Comprehensive Evaluation Tool for Agroecology and Resource Accounting – Phase I (CETARA-I) requires significant further deliberation and development across several critical areas to ensure its robustness, national applicability, and international relevance. The following aspects form the core of the ongoing work:

6.1. Public Domain Access to Information and Methodological Standardization

Establishing a transparent, accessible, and standardized information architecture is paramount for the successful national rollout of CETARA-I. This involves -

Establishment of a Base Template Library (BTL): This library will serve as the central repository for all officially accepted state methodologies currently in use across India for evaluating agroecological performance and resource accounting. The BTL is the foundational building block for national consensus.

Development of a Comprehensive Correlation Index: A critical step is the development of an index that meticulously maps and quantifies the correlation and degree of overlap among the diverse methodologies accepted within the BTL. This index will reveal commonalities and divergences, which is essential for eventual convergence.

Specification of Technical Parameters (TC & TE): Clear and unambiguous definition and specification of the Technical Coefficient (TC) and Technical Efficiency (TE) values are required. These values must be grounded in empirical data and agreed upon by domain experts to ensure comparability across different regions and methodologies.

Definition of Indicators and Sub-Indicators: A standardized taxonomy must be established, defining the indicators and sub-indicators that are most pertinent and measurable within the context of the BTL methodologies. This ensures that data collection and evaluation are consistent nationwide.

Determination of Weights and Scores: A scientifically rigorous and policy-relevant approach must be used for the assignment of weights and scores to each component of the methodologies. This scoring system will dictate the final performance ranking and must reflect national priorities for sustainability and resource management.

Assessment of Equivalence across Methodologies: A formal process for the assessment of equivalence among the various state and regional methodologies

must be executed. This step moves beyond mere correlation to determine if differing methodologies yield functionally similar and comparable results.

Defining the Time Period for BTL Convergence: A definitive and mutually agreed-upon time period for convergence of the BTL is necessary. Upon successful achievement of this convergence threshold, a singular, authoritative National Standard will be formally adopted to govern all CETARA-I operations across India, replacing the diverse set of initial state methodologies.

6.2. Optional Central Convergence with International Standards (FAO)

To ensure CETARA-I's metrics are globally relevant and comparable, investigation is necessary to also adapt the globally well-researched tools such as FAO's TAPE. A detailed feasibility study must be undertaken to explore the technical and conceptual integration of the Food and Agriculture Organization's (FAO) Tool for Agroecology Performance Evaluation (TAPE). Successful integration would allow for benchmarking India's progress against international agroecology standards.

6.3. Advanced Index Calculation and Data Utilisation

The architecture must be prepared to evolve beyond basic arithmetic to provide deeper insights for feasibility assessment for complex multi-variable index calculations. An assessment is required to determine the technical feasibility and policy utility of implementing more complex multi-variable index calculations. These advanced indices would leverage the rich, granular data collected through CETARA-I to offer nuanced evaluations of systemic performance, going beyond simple aggregation.

6.4. Carbon Sequestration and Advanced Sustainability Applications

CETARA—I must serve as a platform for addressing high-priority national and global sustainability goals.

Development of Carbon Sequestration Methodologies: Building directly upon the foundational data and structure of the CETARA-I framework, specific methodologies must be developed for the accurate and verifiable accounting of carbon sequestration within agricultural and allied sectors.

Integration of an Advanced Sustainability Metric: The framework must incorporate an additional, sophisticated sustainability metric. This advanced metric is intended to facilitate and support emerging policy mechanisms such as True Price Accounting (reflecting the full social and ecological cost of production) and mechanisms for Compensation/Payment for Ecological Services (PES) rendered by farmers.

Future-Proofing for Emerging Ecologial Incentives: The CETARA-I framework must be designed with sufficient flexibility and modularity to seamlessly integrate and accommodate emerging national incentive programs, such as the Green Credit framework, and any similar ecological or sustainability-based methodologies that may be introduced in the future.

6.5. Time Horizon and Criteria for National Methodological Convergence

A clear, quantitative standard for declaring national convergence is required for the determination of convergence timeframe and threshold. The definitive timeframe for converging multiple state methodologies into a singular, pan-India standard will be a policy decision determined at the central government level. Crucially, this timeline will follow—not precede—the measurable achievement of a pre-defined convergence standard. This convergence shall be objectively deemed measurable and achieved once the correlation among all existing methodologies exceeds a predetermined statistical threshold, for example, 70% (or a higher specified percentage as determined by the Steering Committee). This quantitative benchmark ensures that the national standard is unified and statistically robust before final adoption.

7. SDG and CETARA-I Impact

The Certified Evaluation Tool for Agro-ecology Resource Analysis - India (CETARA-I) is designed as a transformation engine intended to build a foundation for measurable progress toward the Sustainable Development Goals (SDGs). The framework's basis in agroecology is globally acknowledged for its positive contribution to the SDGs. By combining grassroots participation with advanced analytics, CETARA-I is set to track and measure systemic change across the agricultural landscape towards sustainable development goals, climate action, carbon sequestration accounting, and resilient agrifood systems.

The CETARA-I framework demonstrates success in supporting the state and India by contributing to 7 SDGs with 15 targets and 18 indicators. This comprehensive impact is achieved by focusing on enhancing soil health, reducing water requirements, increasing biomass recycling, and promoting biodiversity and biological interactions, all of which are key to sustainable food systems transformation.

The following table maps the overall impact of the framework on the Sustainable Development Goals as described in the document.

SDG	UN Target	UN Indicator	Impact of CETARA-I Framework
1: No Poverty	1.4: Ensure that all men and women have equal rights to economic resources, ownership, and control over land.	1.4.2: Proportion of total adult population with secure tenure rights to land, with legally recognized documentation.	Economic Empowerment: CETARA-I digitally records farmer profiles and land details, providing formalized recognition to smallholders. By eliminating the need for expensive chemical inputs, it prevents debt traps and secures farmers' financial stability.
2: Zero Hunger	2.3: Double the agricultural productivity and incomes of small-scale food producers.	2.3.2: Average income of small -scale food producers, by sex and indigenous status.	Income Growth: Increases net income by drastically reducing input costs (using local cow-based formulations) and enabling better price discovery through local MSP and captive markets.
	2.4: Ensure sustainable food production systems and implement resilient agricultural practices that improve land and soil quality.	2.4.1: Proportion of agricultural area under productive and sustainable agriculture.	Core Certification: This is CETARA -I's primary metric. The platform explicitly measures, verifies, and certifies the exact acreage transitioning from chemical to natural/agroecological farming across states.
	2.5: Maintain the genetic diversity of seeds, cultivated plants, and farmed and domesticated animals.	2.5.2: Proportion of local breeds classified as being endangered.	Biodiversity: The evaluation heavily weighs the use of indigenous, traditional seed varieties and the integration of local livestock (like Desi cows), protecting them from displacement by GMOs and commercial hybrids.
6: Clean Water & Sanitation	6.4: Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals.	6.4.1: Change in water-use efficiency over time.	Water Conservation: CETARA -I promotes practices like Whapasa (maintaining a specific soil-moisture-air ratio) and heavy mulching, which significantly reduces irrigation requirements and prevents groundwater depletion.
8: Decent Work & Economic Growth	8.2: Achieve higher levels of economic productivity through diversification, technological upgrading, and innovation.	8.2.1: Annual real GDP growth per employee.	Diversification: Evaluates and encourages multi-cropping, intercropping, and the integration of livestock, forestry, and allied activities, ensuring continuous, year-round productive employment and diversified revenue streams.

12: Responsible Consumption	12.1: Implement the 10-year framework of programmes on sustainable consumption and production.	12.1.1: Number of countries developing, adopting or implementing policy instruments aimed at supporting the transition to sustainable consumption.	Policy Instrument: CETARA-I functions as a national-level policy instrument (guided by the Central Base Template Library) standardizing sustainable production across India.
	12.2: Achieve the sustainable management and efficient use of natural resources.	12.2.1: Material footprint, material footprint per capita, and material footprint per GDP.	Input Reduction: Mandates the substitution of externally sourced synthetic fertilizers and pesticides with farm-produced, naturally recycled bio-inoculants.
	12.8: Ensure people have relevant information and awareness for sustainable development.	12.8.1: Extent to which education for sustainable development is mainstreamed.	Traceability: Provides a transparent 3-star rating system (Vishisht, Sadharan, Antral) and QR codes, giving consumers verifiable data to make informed, sustainable purchasing decisions.
13: Climate Action	13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters.	13.1.3: Proportion of local governments that adopt and implement local disaster risk reduction strategies.	Climate Resilience & Carbon Tracking: Natural farming inherently builds soil organic carbon and mitigates emissions from synthetic fertilizer use. The framework is designed to evaluate these metrics to facilitate potential green/carbon credits for farmers.
15: Life on Land	15.3: Combat desertification, restore degraded land and soil, and strive to achieve a land degradation-neutral world.	15.3.1: Proportion of land that is degraded over total land area.	Soil Restoration: Directly reverses soil degradation by assessing and enforcing practices that increase soil humus, enhance earthworm activity, and restore healthy soil microbiomes.
	15.9: Integrate ecosystem and biodiversity values into national and local planning, development processes, and poverty reduction strategies.	15.9.1: Progress towards national targets established in accordance with Aichi Biodiversity Targets.	Systemic Integration: By evaluating farms based on FAO's 10 Elements of Agroecology (such as Synergies and Biological Diversity), CETARA-I mainstreams biodiversity metrics directly into India's agricultural economic planning.

8. Conclusion

The Certified Evaluation Tool for Agro-ecology Resource Analysis - India (CETARA-I) constitutes a pivotal national policy architecture, deliberately engineered to serve as the technological and policy infrastructure underpinning India's strategic transition toward sustainable, chemical-free agricultural systems. This policy paper formally establishes a comprehensive framework designed to decisively overcome the inherent constraints of conventional certification models. It proposes a scalable, cost-effective, and inclusive national solution to address the critical, systemic challenges of verification integrity, seamless market integration, and broad producer participation that have historically hindered the expansion of the sustainable agriculture sector.

8.1. A Future-Proof System for Agrifood Transformation

The core strength of CETARA-I lies in its innovative, bottom-up design, which is inherently future-proof against the evolving challenges of the agrifood system. Unlike prescriptive, top-down approaches-such as the foreign-led systems or centralized national schemes-that struggle with regional diversity and high operational costs, CETARA-I is built on the principle of federated methodologies. This system acknowledges that agriculture is a state subject in India and that local agroecological realities must drive the evaluation process.

The introduction of the Diversity, Coherence, and Equivalence Process-utilizing Coherence (A1) and Equivalence (A2) algorithms-is the key innovation ensuring its longevity and national applicability. By establishing a Base Template Library (BTL) and allowing states to propose methodologies that are subsequently tested for adherence to internationally recognized agroecology principles (coherence) and functional similarity to existing standards (equivalence), CETARA-I ensures high standards without sacrificing localization. This continuous, self-equilibrium-achieving algorithm dynamically harmonizes a 'constellation of methodologies' into a singular, robust national standard over time. This approach ensures the following:

- **Veracity and Trust:** The three-tier star rating system (*Vishisht*, *Sadharan*, *Antraal*), coupled with digital traceability via the National Platform, provides consumers with transparent, verifiable information at the point of purchase, cultivating trust in "natural" produce labels that conventional systems often fail to deliver.
- **Accessibility and Affordability:** By eliminating the reliance on expensive, external third-party auditors and prioritizing **self-declared certified**

evaluation methods verified by community participation and local agricultural extension (ATM/BTM), the system dramatically lowers the barrier to entry. This makes certification *Free of Cost to farmers-a* critical factor for the millions of small and medium-holder producers.

- **Market Linkage and Scalability:** Equivalence (A2) ensures that a farmer certified in one state (e.g., Himachal Pradesh's CETARA-NF) is immediately recognized in another state or national market, overcoming trade barriers and creating the necessary scale for premium price discovery and access to national/international value chains.

8.2. Driving the Sustainable Development Goals (SDGs) and the 2030 Agenda

The design of CETARA-I is fundamentally aligned with the global 2030 Agenda for Sustainable Development, serving as a powerful, measurable engine for achieving key SDGs. Its basis in the 13 Principles of Agroecology (HLPE) and the 10 Elements of Agroecology (FAO) is not incidental; it is the deliberate foundation that guarantees systemic impact.

The framework's impact, as mapped in the SDG Matrix, is comprehensive and quantifiable, directly contributing to 7 SDGs (including No Poverty, Zero Hunger, Clean Water, and Climate Action) through 15 Targets and 18 Indicators. Specifically, CETARA-I moves beyond rhetorical commitment by

- **Bolstering SDG 2 (Zero Hunger) and SDG 1 (No Poverty):** By mandating the reduction of input production costs through the use of farm-generated inputs (a core principle of natural farming), it increases the net income of smallholders and reduces their vulnerability to debt traps, directly addressing Targets 2.3 and 1.4.
- **Facilitating SDG 13 (Climate Action) and SDG 15 (Life on Land):** The system's focus on enhancing soil organic matter, promoting continuous vegetation cover (mulching), and discouraging chemical inputs provides a verifiable foundation for calculating carbon sequestration and facilitating farmer participation in the emerging Green Credit framework and Payment for Ecological Services (PES). This transforms farmers from mere producers into verified ecological service providers.

8.3. The Imperative of a Grassroots-Up Framework

The decision to develop CETARA-I as a decentralized, grassroots-up framework, rather than a top-down prescriptive system, is critical for sustainable policy success in a country as diverse as India.

1. **Respect for Federalism and Local Knowledge:** A centralized mandate ignores the vast heterogeneity of India's different agro-climatic zones. The CETARA-I structure respects the Seventh Schedule (State List) by allowing states to tailor methodologies. It then uses central analytics to harmonize

these local systems, building national consensus *from* local expertise, not *upon* a central fiat.

2. **Encouragement of Dynamic Innovation:** Natural farming is a dynamic innovation system developed by farmers in the field. A prescriptive top-down system stifles this innovation. By contrast, CETARA-I's BTL structure encourages states and farmers to propose *improved* methodologies, which, upon validation of higher coherence and equivalence, raise the national standard (TC and TE thresholds) for everyone. This ensures the system is continually refined by field-level learning.
3. **Sustainable Policy Adoption:** Policies that lack farmer buy-in eventually fail. By making the process participatory, simple, and affordable, CETARA-I ensures widespread adoption. The system is designed to evolve with the farmer, not against them.

CETARA-I is a foundational investment in India's agricultural future. It is an innovative, technologically advanced, and policy-sound mechanism that solves the certification conundrum by being participatory, scalable, and equitable. Its successful rollout is imperative to unlock the economic potential of smallholder producers, secure consumer confidence, and ensure that India demonstrably leads the global transition toward truly resilient, agroecological food systems in line with the 2030 Agenda. It is the necessary bridge between local, chemical-free practices and global sustainability outcomes.

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Annexure: State Methodology - Himachal Pradesh

About Natural Farming and its Principles

Natural farming is a climate-resilient farming system that advocates farmers to use low-cost, locally sourced, i.e., indigenous cow dung and urine-based on-farm inputs. Natural farming's main emphasis is on enhanced soil conditions by managing soil humus and biological activities, reduced water requirements, enhanced biomass recycling, biodiversity, and biological interactions.

The Government of Himachal Pradesh has implemented natural farming as the 'Prakritik Kheti Khushhal Kisan' Yojana (PK3Y) since May 2018. This Yojana is based on a holistic system built upon principles of zero-budget natural farming, as propounded by Padmashri Subhash Palekar. This has proven to be a scalable model of low-input cost and productive farming output for a positive impact on smallholder producer income systems. This system improves ecology by enhancing soil health through bio-inoculation, continuous vegetation cover on the farms, and reduced tillage resulting in increased sequestration of carbon in soils. The system is successfully supporting the state and India with meeting 7 SDGs with 15 targets and 18 indicators. The program enhances biodiversity by encouraging the production of traditional crops to ensure food security. Through optimal management of soil moisture and prohibiting the use of chemical inputs, it enhances water security. The Yojana has successfully scaled up since May 2018 and is making great strides to cover all 9.61 lakh producers towards 100% chemical-free agriculture through the adoption of climate-resilient production systems. Currently, grassroots systemic change is undergoing scaling out with farmer-to-farmer interconnects through successful formal extension deployment of the ATMA infrastructure. Clear pathways are defined in the program to scale towards market linkage based on traceability and transparency through an innovative sustainable food systems platform for natural farming (SuSPNF). The program is also engaging the trained farmers for three panchayats and also adding synergy to the upscaling of the program. Despite the COVID lockdown challenges, natural farmers successfully linked themselves with consumers in rural and peri-urban centers to continue food supplies and enhance incomes. The robustness of the Yojana has led to the implementation of innovative systems to ensure a grassroots change in sustainable agriculture.

The State Project Implementing Unit (SPIU)-Prakritik Kheti Khushhal Kisan Yojna (PK3Y) of the Department of Agriculture, Government of Himachal Pradesh (GoHP), conceptualized the practices and, through the process of sensitization, local-level training, nearby exposure visits, and phase-wise transformation, expanded the outreach of the program.

Rationale of the concept: It is understood that over 98% of the nutrients that crops require - carbon dioxide, nitrogen, water, and solar energy - are already present in nature. The remaining 1.5-2% is taken from soil, with the help of microorganisms. Hence, nothing external, including industry-based inputs or water, is required from outside the farm system.

Nutrient management of crops*:* The 'four wheels' of natural farming are 'Jeevamrit,' 'Beejamrit,' 'Aachhadan,' and 'Whapasa.'

A. Beejamrit is a seed treatment mixture to protect seeds from diseases and enhance germination. It is a mix of desi cow dung and urine, water, bund soil, and lime that is used as a seed treatment solution prior to sowing.

B. Jeevamrit is a fertility-enhancing decoction. It is a fermented mixture of cow dung and urine (of desi breeds), jaggery, pulse flour, water, and soil from the farm bund. This isn't a fertilizer but just a source of some 30 million to 5,000 million microorganisms that can convert all the necessary "non-available" nutrients into "available" form.

C. Aachhadan, or covering the plants with a layer of dried straw or fallen leaves, is meant to conserve soil moisture and keep the temperature around the roots at 25-32$^{\circ C,}$ which allows the microorganisms to do their job.

D. Whapasa enables the maintenance of moisture and air balance in the rhizosphere. It is providing water to maintain the required moisture-air balance and also achieves the same objective.

Management of pests: The use of '*Agniaster,*' '*Bramhaster,*' and '*Neemaster*'/ '*Paudhaster* concoctions' are prepared from the mixture of cow urine and local plants. They are based on cow urine and dung, plus pulp from leaves of neem, white datura, papaya, guava, and pomegranates—for controlling pest and disease attacks. Further, the pulp of leaves from locally available plants is also used.

Dynamic innovation system*:* Apart from the above basic principles, this innovation continuously evolves in the field of farmers. Based on the altitude, soil quality, and variability of the pests, we are always buzzing with natural farming farmers sharing their experiences and ways to tackle any problem faced in the field. The inclusion of new practices is based on farm visits, validation, and further inclusion in the package of practices. Such learnings are also shared amongst other farmers through communication platforms like WhatsApp groups, periodic meetings, Facebook, and YouTube videos, amongst others.

I. Scoring in CETARA-NF

Natural farming is an indigenous system based on cow dung and urine, biomass, mulch, and soil aeration. The methodology for the ranking and rating of the farmers will be based on the extent of Subhash Palekar Natural Farming (SPNF)

principles/practices being adopted by the farmer for crop production on his/her farm. Various SPNF practices will be assigned weights based on importance. Prohibited crop production practices will attract penalties and will be assigned negative weights. The proforma and methodology of the certification have been detailed in Annexures I and II. Weights and penalties proposed under this methodology have been discussed and presented in the following paragraphs.

a. **Women empowerment**: Various agricultural operations starting from the sowing of seed/plants to the harvesting of crops had to be carried out by the farming families. Both male and female members are equally involved in these operations. Earlier male members made critical farm management decisions like the selection of crops and varieties to be sown, the purchase of inputs, and marketing channel selection for the disposal of the marketed surplus. Now with the spread of literacy among female members and exposure to various aspects of agricultural production technology through training, women have also started participating in the decision-making process of family agribusiness. To further encourage this process of women empowerment, we have given a weightage of 2 points to those SPNF families where women have a primary/equal stake in the natural farming-related decision-making process of the family.

b. **Exposure to SPNF practices**: SPNF practices were started by farmers across the state after the launch of Prakritik Kheti Khushhal Kissan Yojna (PK3Y) in 2018. SPNF is "regenerative agriculture" for holistic land management practices involving a complete paradigm shift from external input-based green revolution. Therefore, an experienced farmer has a higher chance to ensure qualitative production on his/her farm, and they have been given higher weightage points in this methodology. Presently, farmers have a maximum exposure of three years to these practices. Experience of 2 or more years will be given maximum points, i.e., 4, while the experience of up to 2 years and 1 year will fetch 3 and 1 point, respectively.

c. **Components of SPNF**: SPNF production practices include four important non-negotiable practices: Beejamrit (seed treatment using local cow dung and cow urine), Jeevamrit (applying inoculation made of local cow dung and cow urine without any fertilizers and pesticides), mulching (activities to ensure a favorable microclimate in the soil), and Whapasa (soil aeration). These practices are a must for the realization of the sustainable production potential of the crops and the agroecological objectives of the PK3Y. All these activities have been assigned 4 points each, and farmers should practice them all to obtain higher star ratings.

d. **Intercropping/Mulching**: Increasing functional diversity is a critical principle of SPNF. Therefore, a number of crop combinations for increasing

functional crop biodiversity are proposed under SPNF. Intercropping of the main crop with cover crops of a mix of monocotyledons (like millets) and leguminous dicotyledons (like beans) leads to a symbiotic relationship among them. The monocots provide nutrients like potash or phosphate, while the dicots help in nitrogen-fixing. Straw mulching is also promoted, using dry crop residue. This ensures better health for the soils and is a must for sustaining the productivity levels of agricultural lands. Costs incurred on the main crop also get compensated by income from intercrops, making farming a close to zero budget activity. This activity has been assigned 4 points.

e. **Indigenous cow**: *Bos indicus* (the indigenous humped cow) is the base of Subhash Palekar Natural Farming. Indigenous cow dung and urine have the highest concentrations of micro-organisms, and their formulations are used in SPNF practices instead of chemical fertilizers and pesticides. It has proven to be a miraculous cure to revive the fertility and nutrient value of soil. Urine and dung from one cow are enough for farming 30 acres of land, so cow ownership by each individual farmer is not necessary. But the farmer having his own indigenous cow will be assigned 4 points because he can ensure quality and timely application of the various cow dung- and urine-based formulations. Cross-bred indigenous cows will be assigned 2 points.

f. **Land under SPNF**: Land is the major natural resource impacting the adoption and spread of SPNF practices. A major proportion of farmland holdings should be under SPNF to ensure the supply of chemical-free agricultural produce. This scheme was launched only three years ago, so most farmers are still in the process of converting their farms to SPNF practices. Therefore, different weights have been assigned on the basis of the extent of conversion of farms from conventional chemical-based farm practices to chemical-free SPNF practices. The farmer must cover more than 75% of his landholding under SPNF practices to secure 4 points under this certification, and those having 51-75% or 26-50% conversion under SPNF will get 3 and 2 points, respectively. Farmers having less than 26% conversion will get only 1 point.

g. **Training organized**: SPNF crop production practices represent a complete paradigm shift from conventional practices presently being followed by the farmers. Farmers have little or no exposure to SPNF practices. So, training conducted by the agriculture department is the only source of exposure to SPNF practices. These trainings are of 2 to 7 days' duration, and Sh Subhash Palekar, department officials, and farmers share information about and exposure to various aspects of SPNF production technology in these trainings. Trained farmers have been assigned 4 points in this methodology, as only trained farmers can assure the production of chemical-free

agricultural produce, whereas untrained farmers may unintentionally use inputs that are prohibited in these crop production practices.

h. **Decoctions and plant extracts used**: Pest management is a very critical aspect of crop production technology; otherwise huge losses are inflicted due to the economic losses in the form of damaged farm produce. A number of decoctions and plant extracts acting as natural fungicides and pesticides made from locally available ingredients like neem leaves, chilies, garlic, sour buttermilk, tobacco, etc. are prescribed in SPNF. The use of these formulations as prophylactic measures for guarding or preventing the spread or occurrence of disease or insect infestation ensures minimal or no damage to the farming ecosystem. Their use will fetch 2 points per formulation. However, proper farm management leads to a situation when pest infestation is minimal and leads to any economic losses; such a situation will also be rewarded with 4 points.

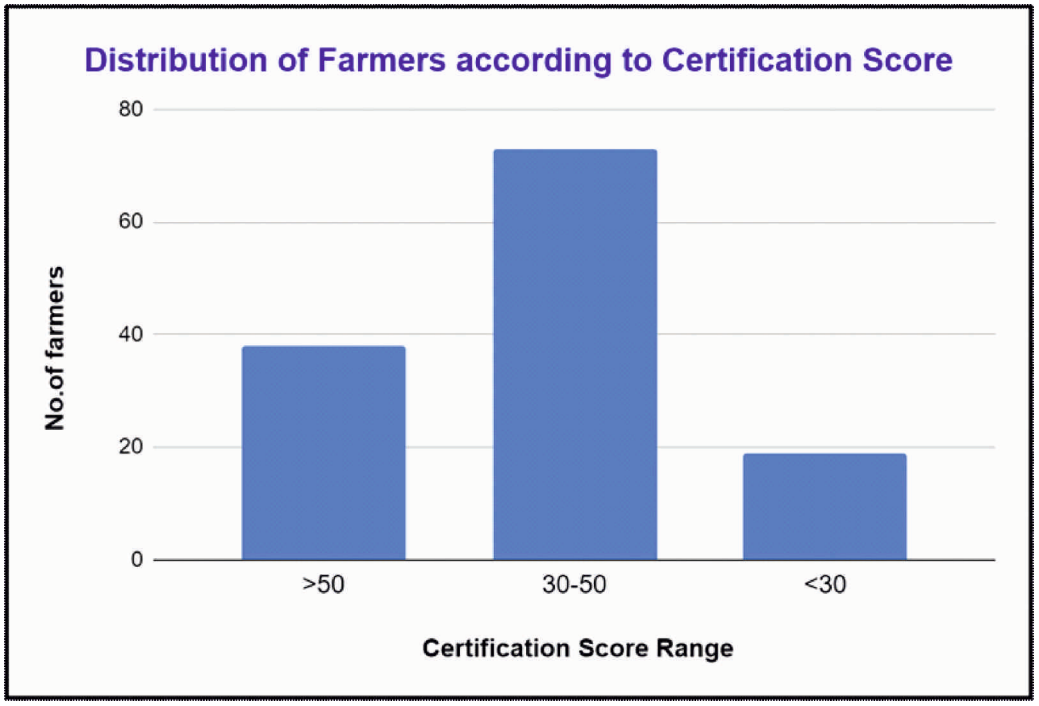
I. **Separate storage facility for SPNF produce**: The majority of the SPNF farmers are practicing both SPNF and conventional farming methods on their lands. Therefore, there are chances of mixing the SPNF and conventional farm produce. Therefore, farmers with separate storage facilities for SPNF and conventional produce will be encouraged and assigned 2 points.

j. **Externally sourced organic inputs used**: SPNF crop production practices don't allow the use of externally sourced organic inputs like biofertilizers, botanical extracts/biopesticides, organic manure/farmyard manure (FYM), vermicompost, etc., because the use of these inputs will make this farming capital-intensive. SPNF promotes the use of inputs available on the farm or in the nearby locality so that the cost of cultivation can be minimized. Therefore, the use of any of the externally sourced organic inputs will attract a penalty of 2 points for each input.

k. **Chemical inputs used**: Use of chemical inputs like fertilizer, pesticides, antibiotics, food additives, etc. is prohibited in SPNF. *Farmers still using any chemical will not be eligible for 3 (Vishisht) and 2 (Sadharan) star ratings and other benefits associated with this certification process.* Such farmers, who have just started SPNF practices, can be assigned only 1 (Antraal) star rating. Use of each category of chemical inputs will attract a penalty of 5 points.

This certification methodology was pre-tested in Shimla, Mandi, and Solan districts on 130 farmers. The results of the certification score achieved by these farmers have been presented in the following figure. Distribution according to the score range finalized in the chart gave the best normal distribution of the farmers. Therefore, this score range was finalized to classify the farmers into different star ratings.

Farmers scoring equal to or more than 50 points in the Self-Declared Evaluation Methodology and cultivating crops entirely with SPNF ingredients and practices will be assigned three stars and labelled as "Vishisht-PK3 (Strict)" farmers. Farmers scoring between 30 and 50 points will be labeled "Sadharan-PK3 farmers (External Non-Chemical Inputs)" and will be assigned two stars. These products can use the word "SPNF Naturals." Both Vishisht and Sadharan will be allowed to display SPNF logos on their products. A third category, less than 30 points, can be labeled "Antral-PK3 (Conversion from Chemical)" and will be assigned only one star. Products Antral-PK3 ranking cannot advertise the word "SPNF naturals" and the SPNF logo on their products to consumers and can only mention this fact in the product's ingredient statement.



Source: Authors' compilation from PK3Y SPIU - 2026

The certification has incorporated the weights to the different components of the certification methodology. In the future, if the need is felt to increase or decrease the role of any component of natural farming practices in certification scoring methodology, then it can be done by changing the weights of that component. The higher or lower weight assigned to any component will increase or decrease the role of that component in the total certification score generated for the farmers. SPIU can incorporate this change without any dependence on the website of the mobile application developer.

II. Forms and Methodology

Data Forms – I – Self-Certification Proforma

Details of farmer					
Name of the Farmer					
Father's name					
Age					
Category (SC, ST, OBC, GEN)					
Village					
Panchayat					
Block & District					
Vidhan Sabha & Lok Sabha Constituency					
Mobile Number					
E-mail id (if any)					
ID (Aadhaar/SPNF ID)					
Particulars	**Data**			**Remarks**	
Gender (M/F)	Male/Female				
SPNF inputs used and practices					
Beejamrit	Yes/No				
Jeevamrit	Yes/No				
Ghanjeevamrit	Yes/No				
Wapsa	Yes/No				
Mulching	Yes/No				
Experience in SPNF					
>2 years	Yes/No				
Up to 2 years but >1 year	Yes/No				
Less than 1 year	Yes/No				
Cultivated land of farmer (in Bigha)	Total:			Under SPNF:	
Land details (Khasra No. /GPS coordinates)					
Cultivated Land under SPNF (%) (Tick)					
Crop rotation (Details regarding Crop name, Area, Companion crops, expected production, and expected marketable surplus)					
Kharif season Crops>					
Area (Bigha)>					
Rabi season Crops>					
Area (Bigha)>					
Fruit crops with mixed cropping. Crops>					
Area (Bigha)>					
Mixed Cropping with leguminous crop	Yes/No				

Indigenous/Crossbred/Exotic Cow	Yes/No	
Training attended:	Yes/No	
If yes, Date		
Venue		
Duration	2 days/5-7 days	
Trainer (Tick)	• Subhash Palekar • ATMA officials	
Using self-prepared SPNF inputs	Yes/No	
Concoctions Applied		
Khatti Lassi	Yes/No	
Sapt Dhan Ankur Ark	Yes/No	
Neemastra	Yes/No	
Other Concoctions		
Agniastra, Brahmastra, Dashparni Ark, etc.	Yes/No	
Above Astra's application is not needed.	Yes/No	
Separate storage facility for SPNF produce	Yes/No	
Externally sourced Organic inputs use		
Use of biofertilizers	Yes/No	
Use of botanical extracts/biopesticides	Yes/No	
Use of organic manure	Yes/No	
Use of vermicompost	Yes/No	
Chemical inputs used		
Fertilizers (urea, etc.)	Yes/No	
Fungicides	Yes/No	
Insecticide	Yes/No	

Verification by neighboring farmers (minimum three farmers)

Farmer's Name	Father's Name	Contact No.
1.		
2.		
3.		

Verification by ATM/BTM

I have personally verified the details provided by the farmer and confirmed it from neighboring farmers.

ATM/BTM

Name.....

Block.....Phone No. .....

Approval By

Project Director (ATMA)

Methodology – Natural Farmer's Self-declared Certified Evaluation - Scoring

Particulars	**Data**	**Weight**/Penalties	**Weightage**	**Score**
		(A)	(B)	(AxB)
Gender **(M/F)**	Male /Female	0/2	1	
SPNF inputs used and practices				
Beejamrit	Yes/No	4/0	1	
Jeevamrit	Yes/No	4/0	1	
Ghanjeevamrit	Yes/No	4/0	1	
Wapsa	Yes/No	4/0	1	
Mulching	Yes/No	4/0	1	
Year of starting SPNF			1	
More than 2 years	Yes/No	4	1	
More than 1 year but less than 2 years	Yes/No	3	1	
Less than 1 year	Yes/No	1	1	
Crop rotation (Details regarding Crop name, Area, Companion crops, Expected production and expected marketable surplus)				
Kharif season				
Rabi season				
Fruit crops with mixed cropping				
Mixed Cropping with leguminous crop	Yes/No	4/0	1	
Indigenous/Crossbred/Exotic Cow	Yes/No	4/2/0	1	
Total land of farmer (in ha):				
Land details (Khasra No. /GPS coordinates)				
Land under SPNF				
> 75% of total cultivated land	Yes/No	4	1	
51-75% of total cultivated land	Yes/No	3	1	
26-50% of total cultivated land	Yes/No	2	1	
<26% of total cultivated land		1	1	
Training attended:	Yes/No	4	1	
Date				
Venue				
Duration				
Trainer				
Using self-prepared SPNF inputs	Yes/No	4/2	1	
Concoctions Applied				
Khatti Lassi	Yes/No	2/0	1	
Sapt Dhan Ankur Ark	Yes/No	2/0	1	
Neemastra	Yes/No	2/0	1	
Other Concoctions				
Agniastra, Brahmastra, Dashparni Ark, etc.	Yes/No	2/0	1	
Above Astra's application is not needed.	Yes/No	4/0	1	
Separate storage facility for SPNF produce	Yes/No	2/0	1	
Externally sourced Organic inputs use				
Use of biofertilizers	Yes/No	-2/0	1	

Use of botanical extracts/biopesticides	Yes/No	-2/0	1	
Use of organic manure	Yes/No	-2/0	1	
Use of vermicompost	Yes/No	-2/0	1	
Chemical inputs used				
Fertilizers (urea, etc.)	Yes/No	-5/0	1	
Fungicides	Yes/No	-5/0	1	
Insecticide	Yes/No	-5/0	1	
Herbicide	Yes/No	-5/0	1	

प्राकृतिक किसान प्रमाण पत्र
प्राकृतिक खेती खुशहाल किसान योजना
कृषि विभाग, हिमाचल प्रदेश सरकार

प्रमाण पत्र संख्या

HP1614002237

★★★

प्रमाणित किया जाता है कि श्रीमती **Dr Jaya Chaudhary** पुत्री/ पत्नी श्री. **Dr Harit Puri**, ग्राम-**Saru (15), CHAMBA, जिला-चंबा** को हिमाचल प्रदेश सरकार, कृषि विभाग की प्राकृतिक खेती खुशहाल किसान योजना के अंतर्गत गैर-रासायनिक, कम लागत और जलवायु अनुकूल 'सुभाष पालेकर प्राकृतिक खेती' पर प्रशिक्षित किया गया है। वह **2 से अधिक** वर्ष से प्राकृतिक खेती तकनीक के अनुसार अपने खेत **35.00** बीघा पर **कीवी, मटर, शिमला मिर्च,बीन्स , रेपसीड और सरसों** उगा रहे हैं और उनकी उपज 100% प्राकृतिक कृषि उत्पाद है।

दिनांक

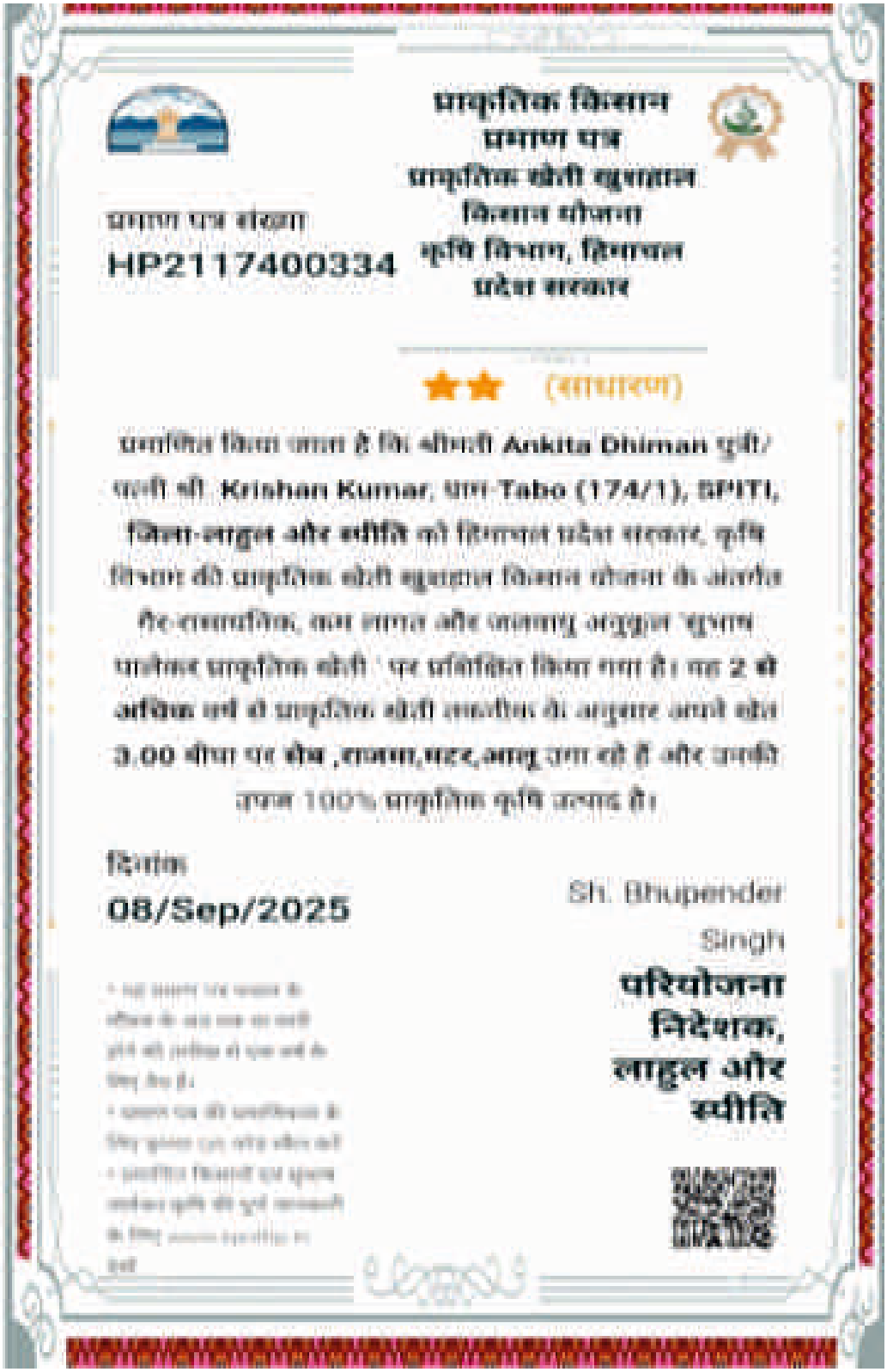
01/Oct/2025

Dr.Jyoti Ranjan Kalia

निदेशक

परियोजना

, चंबा



प्राकृतिक किसान
प्रमाण पत्र
प्राकृतिक खेती खुशहाल
किसान योजना
कृषि विभाग, हिमाचल
प्रदेश सरकार

प्रमाण पत्र संख्या
HP2117400334

★★ (साधारण)

प्रमाणित किया जाता है कि श्रीमती Ankita Dhiman पुत्री/पत्नी श्री Krishan Kumar, ग्राम-Tabo (174/1), SPITI, जिला-लाहुल और स्पीति को हिमाचल प्रदेश सरकार, कृषि विभाग की प्राकृतिक खेती खुशहाल किसान योजना के अंतर्गत गैर-रासायनिक, कम लागत और जलवायु अनुकूल 'खुशहाल पारंपरिक प्राकृतिक खेती' पर प्रशिक्षित किया गया है। यह 2 बी अधिक वर्ष से प्राकृतिक खेती अभ्यास के अनुसार अपने खेत 3.00 बीघा पर सेब ,राजमा,मटर,आलू उगा रहे हैं और उनकी उपज 100% प्राकृतिक कृषि उत्पाद है।

दिनांक
08/Sep/2025

Sh. Bhupender Singh
परियोजना निदेशक,
लाहुल और स्पीति

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