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A Holistic Approach: Regenerative Agriculture for India's Future

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Introduction

Regenerative agriculture (RA) is increasingly recognised as a transformative approach to farming—one that seeks not merely to sustain, but to actively restore soil health, enhance biodiversity, and improve ecosystem services. In India, where agriculture underpins the economy and the livelihoods of hundreds of millions, the adoption of regenerative practices is gaining momentum as a viable response to the compounding pressures of soil degradation, water scarcity, and a rapidly changing climate.

Conventional farming systems, which have long relied on synthetic inputs, intensive tillage, and monoculture cropping, have delivered impressive short-term productivity gains yet exacted severe ecological costs. Declining soil organic carbon, rising greenhouse gas (GHG) emissions from the agricultural sector, and the erosion of agrobiodiversity collectively threaten the long-term viability of India's food systems. Regenerative agriculture offers a fundamentally different trajectory: one anchored in ecological principles, systems thinking, and, crucially, the lived knowledge of farming communities.

This article explores the current landscape of regenerative agriculture in India. It synthesises evidence from recent research and illustrative case studies to examine how practices such as agroforestry, organic farming, conservation agriculture, and indigenous land-management traditions are being deployed to rebuild soil health, sequester atmospheric carbon, and strengthen agricultural resilience. It also acknowledges the challenges—conceptual, institutional, and practical—that constrain the wider uptake of these approaches, and concludes with reflections on the policy and research investments needed to scale regenerative agriculture across India's diverse agroecological zones.

Principles and Conceptual Foundations

The principles underlying regenerative agriculture centre on minimising ecological disturbance while actively rebuilding the biological capital of farmland. As Giller et al. (2021) articulate, the approach emphasises minimal soil disturbance, diverse crop rotations, permanent soil cover through cover cropping, and the integration of livestock—practices that collectively strengthen soil structure, promote microbial diversity, and enhance the capacity of agricultural systems to cycle nutrients efficiently.

In the Indian context, these principles take on particular salience given the country's extraordinary agroecological diversity, spanning tropical coastlines, semi-arid Deccan plateaux, Himalayan foothills, and the deltaic floodplains of the northeast. Each zone presents distinct soil types, rainfall regimes, and cropping traditions, demanding place-sensitive interpretation of regenerative principles rather than blanket prescription. Critically, regenerative agriculture in India is not simply the importation of a Western agronomic concept; it draws deeply on centuries-old traditions of polyculture, mixed cropping, and soil stewardship that predate the Green Revolution and persist, often under threat, in marginalised farming communities.

Despite growing interest, a notable challenge persists around definitional clarity. Olsson et al. (2022) observe that the absence of a consensus definition for regenerative agriculture creates ambiguity in both research and policy contexts, complicating the development of standards, metrics, and enabling frameworks. Efforts to construct a collective Indian definition—one that is ecologically grounded, culturally sensitive, and practically applicable—remain an active area of scholarly and policy dialogue.

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Agroforestry: Trees as Ecological Infrastructure

Among the suite of regenerative practices, agroforestry—the deliberate integration of trees and shrubs into agricultural landscapes—has attracted particular attention in India for its multifunctional benefits. Agroforestry systems simultaneously produce food, timber, and non-timber forest products; improve soil health through deep-rooted nutrient cycling and organic matter inputs; increase on-farm biodiversity; and sequester significant quantities of atmospheric carbon (Brown et al., 2018).

In Tamil Nadu, agroforestry has been successfully adopted across smallholder farms, where the combination of timber trees with food crops has demonstrably enhanced soil carbon stocks and improved farm yields (Murali, 2023). The shade provided by tree canopies moderates temperature extremes, reduces evapotranspiration, and creates microhabitats that support beneficial insects and birds—yielding a more ecologically resilient production system.

The northeastern states of India present another compelling case. Research by Sharma and Srivastava (2024) highlights the importance of combining conventional agricultural techniques with traditional agroforestry and forest-garden systems that indigenous communities have maintained across generations. These integrated approaches support local biodiversity, preserve indigenous botanical knowledge, and contribute to land degradation neutrality—an increasingly urgent goal given the susceptibility of northeastern hill soils to erosion under intensified land use.

The Indian government's National Agroforestry Policy (2014) and subsequent programmes have sought to mainstream agroforestry, recognising its potential to contribute to climate mitigation and farm income diversification. Yet the pace of adoption has been uneven, constrained by limited extension support, fragmented land holdings, and the long time horizons associated with tree-crop systems that can deter short-term investment.

Organic Farming and Soil Fertility Restoration

Organic farming constitutes a second major pillar of India's regenerative agriculture movement. By eliminating synthetic fertilisers and pesticides and relying instead on compost, green manures, biofertilisers, and crop rotations, organic systems reduce agricultural GHG emissions, improve soil biological activity, and contribute to a closed nutrient cycle essential for long-term fertility (Jain, 2024; Krithika, 2023).

India is home to the world's largest number of certified organic farmers, and the government has actively encouraged the sector through schemes such as the Paramparagat Krishi Vikas Yojana (PKVY), which supports cluster-based organic farming certification, and

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the Mission Organic Value Chain Development for North East India (MOVCDNER). These initiatives recognise that organic farming addresses not only environmental goals but also growing consumer demand for chemical-residue-free produce and the need to reduce smallholders' dependence on costly external inputs (KONER, 2024).

Research confirms that the transition to organic management enhances soil organic matter content over time, improving water-holding capacity, aggregate stability, and resistance to erosion—all of which carry downstream benefits for watershed health and rural water security. However, the transition period—typically three to five years during which yields may temporarily decline before the soil biology recovers—represents a significant economic risk for smallholders who lack financial buffers or access to credit. Bridging this transition gap through targeted subsidies, crop insurance, and assured procurement mechanisms is critical to broadening organic farming's reach.

Conservation Agriculture and Climate-Smart Practices

Conservation agriculture (CA)—characterised by minimal soil disturbance, permanent organic soil cover, and diversified crop rotations—has been promoted across South Asia as a response to soil degradation and rising input costs. In India's Madhya Pradesh, research by Raghuwanshi (2024) documents the positive effects of no-tillage practices on soil organic carbon levels in Vertisols—heavy black clay soils that are widespread across central India. Maintaining continuous crop cover and avoiding inversion tillage preserves soil structure,

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reduces carbon mineralisation, and progressively builds organic matter, with measurable benefits for both soil health and crop productivity.

In Haryana, the adoption of zero tillage and crop residue retention—replacing the environmentally damaging practice of post-harvest stubble burning—has been shown to improve soil quality and reduce net GHG emissions at the field scale (Datta et al., 2022). These practices align with the broader climate-smart agriculture agenda promoted by national and international development agencies, and they offer practical entry points for farmers transitioning away from input-intensive Green Revolution systems.

The challenge of transitioning out of monoculture is perhaps most acute in Punjab, where decades of rice-wheat monoculture, supported by heavily subsidised water and fertiliser inputs, have led to alarming declines in soil organic carbon and groundwater levels (Murali, 2023). Reversing this trajectory demands not merely agronomic change but a reconfiguration of the incentive structures—including minimum support prices, free electricity for groundwater pumping, and fertiliser subsidies—that have locked farmers into ecologically damaging cropping systems.

Indigenous Knowledge and Community-Led Regeneration

Perhaps the most distinctive—and undervalued—dimension of India's regenerative agriculture landscape is the repository of indigenous ecological knowledge held by farming and tribal communities. The Chuktia Bhunjia tribe of Odisha offers a compelling example: their traditional agroforestry-based land management system integrates forest, fallows, and cultivated plots in a dynamic mosaic that sustains soil fertility, conserves water, and supports diverse plant and animal communities without recourse to synthetic inputs (Sabar & Midya, 2022).

Similarly, the community-led natural farming initiative in Andhra Pradesh—known as ZBNF (Zero Budget Natural Farming)—has demonstrated that localised, farmer-driven approaches grounded in agro-ecological principles can achieve significant carbon sequestration while maintaining agricultural productivity for smallholders (Murali, 2023). By working with natural biological processes rather than against them, ZBNF practitioners reduce input costs, improve soil biology, and build household food security.

The broader lesson from these cases is that indigenous and traditional farming knowledge is not merely a cultural heritage to be preserved; it is a living repository of site-adapted ecological intelligence with direct practical relevance to the challenge of building sustainable food systems. Formal research institutions and policy frameworks have historically marginalised this knowledge, prioritising instead the products of Green

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Revolution science. A regenerative agriculture paradigm demands a more reciprocal epistemology—one in which scientists, extension workers, and policymakers engage communities as knowledge partners rather than passive beneficiaries of top-down technology transfer.

Challenges and the Path Forward

Despite the accumulating evidence in favour of regenerative agriculture, significant barriers to widespread adoption remain. The lack of a universally agreed definition—highlighted by Olsson et al. (2022)—creates difficulties in developing coherent policy, monitoring frameworks, and certification systems. Without clear standards, the term risks being co-opted by interests seeking to greenwash conventional practices with minimal ecological benefit.

Structural economic barriers also loom large. Smallholder farmers, who constitute the majority of India's agricultural workforce, face capital constraints, limited access to markets for premium regenerative produce, and inadequate extension services capable of supporting complex ecological transitions. The predominance of short-term tenancy arrangements further reduces incentives to invest in long-term soil improvement. And in water-stressed regions, the provision of alternative livelihoods and assured market access will be essential to persuade farmers to shift away from water-intensive monocultures.

What is needed is a systemic policy response: reformed input subsidy regimes that reward ecological outcomes rather than input volume; investment in participatory research that co-develops knowledge with farming communities; expanded public procurement of regeneratively produced food; and robust monitoring systems that can track soil carbon, biodiversity, and emission reductions at scale. International climate finance—particularly through mechanisms such as REDD+ and voluntary carbon markets—could provide an important additional revenue stream for farmers who adopt verified regenerative practices.

Conclusion

Regenerative agriculture represents a compelling and ecologically grounded pathway for transforming India's food systems in the face of climate change. The evidence reviewed here—from the agroforestry landscapes of Tamil Nadu and the northeast, to the conservation agriculture fields of Madhya Pradesh and Haryana, to the community-driven natural farming initiatives of Andhra Pradesh and Odisha—demonstrates that regenerative approaches can simultaneously rebuild soil health, sequester carbon, conserve biodiversity, and sustain agricultural productivity.

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Realising this potential at scale will require sustained commitment from researchers, policymakers, development organisations, and, above all, farming communities themselves. It demands honest engagement with the structural and economic constraints that limit adoption, and a willingness to reform incentive systems that continue to favour ecologically destructive practices. India's extraordinary diversity of agroecological zones, farming traditions, and indigenous knowledge systems is not an obstacle to this transition—it is its greatest asset.

With coordinated investment in research, policy reform, and farmer empowerment, regenerative agriculture can move from the margins to the mainstream, helping India meet its climate commitments while securing the food and livelihood foundations of its rural majority.

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