



RETHINKING FOOD SYSTEMS AND LAND MANAGEMENT: SOIL HEALTH & PASTORALISM

Healthy soils sustain regenerative food systems by supporting productivity, resilience, and ecosystem functions. Pastoralism provides one of the clearest illustrations of how this transformation can be achieved in practice, particularly in drylands.

Caring for soil health can transform food systems

Soil health is the continued capacity of soil to function as a vital living ecosystem and a healthy soil sustains plants, animals, and humans, along with their associated microbiota. Bridging agricultural and soil science with policy, stakeholder priorities, and sustainable supply chain management, soil health is not merely a technical or environmental concern; it is a framework for reimagining sustainable food systems, from production and distribution to consumption. Rather than focusing on short-term productivity, the soil health paradigm challenges us to consider how food systems interact with ecosystems. These challenges lay the foundation for a systemic, regenerative, and inclusive framework that forces us to move beyond sectoral approaches and address the interconnected challenges of food security, ecosystem sustainability, and resilience to climate change.

This transformation begins with rethinking how we interact with soil, not as a resource to exploit, but as a living system that both shapes and is shaped by food systems.



▲ Dromedaries drinking from a well in Walata, Mauritania ©Virgilio Balmas

From extractive agriculture to regenerative food systems

Current food systems are still largely shaped by extractive agricultural practices that treat soils as inert providers of resources. A soil health perspective offers an alternative pathway, shifting from extractive agriculture toward regenerative food systems that restore ecological processes while sustaining food production, livelihoods, and resilience.

Preserving biodiversity in soils, and simultaneously maintaining nutrient cycling, productivity, and sustainability, are not opposing goals, but can be mutually reinforcing. Rather than viewing ecological integrity and food production as competing objectives, a soil health approach demonstrates that they can support one another. Healthy soils improve soil structure and water retention, reduce vulnerability to drought and crop failure, enhance nutrient use efficiency, and contribute to more resilient and sustainable food systems.

The transition to healthy soils implies moving beyond practices that maximize short-term yields at the expense of long-term ecosystem functioning. By restoring biological activity and natural soil processes, regenerative approaches strengthen the capacity of food systems to adapt to climate change while maintaining the productive potential of land for future generations.

A soil health perspective therefore exposes the limitations of extractive agriculture and provides a practical pathway toward regenerative food systems that reconcile agricultural production, ecosystem integrity, and human well-being.

◀ Soil Profile, Benin © IRD - Roger Fauck



A Nexus approach for global challenges

The concept of soil health underlies research and actions that jointly address multiple global challenges: functional biodiversity, food security, climate mitigation and adaptation, and human well-being. It highlights the interconnections between these issues, exposing the limitations of disconnected policies. For example, healthy soils act as carbon sinks, globally storing up to 1,500 gigatons of carbon (to a depth of one meter) more than the atmosphere and vegetation combined, demonstrating how climate mitigation and food production can be aligned rather than traded off. A single gram of healthy soil can host thousands of microbial species which, together with soil macro-organisms, support plant growth and ecosystem functioning. Soils rich in organic matter also retain water more effectively, reducing soil erosion and the need for irrigation, helping to mitigate the impacts of drought. Furthermore, nutrient-rich soils produce more nourishing crops, which can help combat effects of hunger and poverty, such as deficiencies in vitamins, amino acids, iron and zinc.

The Nexus approach pushes us to design food systems that address multiple crises simultaneously.

Breaking down sectoral silos

Conventional food systems often treat agriculture, the environment, and health as separate domains, leading to fragmented and ineffective solutions. Mobilization for soil health will foster cross-sectoral collaboration by linking farmers, livestock breeders, foresters, scientists, and policymakers around shared goals, such as achieving Land Degradation Neutrality. Mobilization will integrate traditional knowledge, for example on rotational grazing, herding, seasonal transhumance, fallowing and agroforestry, with modern, science-based innovations to create sustainable solutions. The soil health concept also aligns with global frameworks, including the UN Sustainable Development Goals (SDGs), the UNCCD Land Degradation Neutrality (LDN) targets, and the Paris Agreement, ensuring that local actions contribute to global objectives.

Soil health serves as a common anchor, pushing us to transcend disciplinary boundaries and adopt a holistic perspective on food systems.



▲ A flock of sheep in Berchidda, Sardinia, Italy @ Antonio Pulina



▲ Herd in Diawling, Mauritania @Virgilio Balmas

Economic and social justice

Soil health also aligns with global frameworks, including the SDGs, the LDN targets, and the Paris Agreement, ensuring that local actions contribute to global objectives and act as a catalyst for equity within food systems. Smallholders, who produce 80% of the food in developing countries, gain tools to compete with industrial agriculture through soil-regenerative practices. Healthy soils are tied to access rights which protect pastoralists and indigenous communities from displacement and land grabbing. Practices like composting, cover cropping, livestock effluent management, corralling, herding grazing animals and transhumance are labor-intensive, creating rural jobs and stimulating local economies. Additionally, soil health initiatives can support gender equality by empowering women, who often play a key role in soil management, with leadership opportunities and access to resources.

Soil health can redefine economic and social structure, ensuring that food systems are not only sustainable but also equitable.

A pathway to systemic change

Soil health is more than a technical solution; it represents a paradigm shift in how we view and manage food systems. This paradigm prioritizes long-term sustainability over short-term gains, recognizes ecosystems as the foundation of food production, and promotes circular approaches in which organic waste, crop residues, and livestock effluents become valuable resources for soil regeneration. Such a perspective invites us to reconsider the very principles of our food systems: can they be designed to regenerate rather than extract and deplete? Can they sustain both people and the environment?

Pastoralism provides one of the most compelling examples of this transformation in practice.

Pastoralism as a living example

Pastoralism exemplifies how soil health can redefine food systems, notably in fragile ecosystems. Mobile herds naturally fertilize soils through fecal and urine excretions, enhancing soil carbon and nutrient contents without the need for chemical inputs. Pastoral grazing management includes rotational grazing by sedentary livestock keepers as well as the daily grazing circuits and seasonal transhumance practiced by pastoralists. In arid regions, sustainable pastoralism maintains soil cover, reduces erosion, and supports carbon sequestration, making it a climate-smart land management strategy. Pastoral systems also provide 30–60% of animal protein in many regions, ensuring food and livelihood security while preserving soil health.

By relying on mobility, ecological processes, and adaptive management, when practiced in a sustainable manner, pastoralism offers a compelling alternative to static, input-intensive livestock production systems. It demonstrates that mobility and adaptability are not constraints but key assets for achieving long-term sustainability.

Because mobility is the foundation of sustainable pastoralism, policies should safeguard safe and predictable transhumance corridors, including across administrative and international borders, even in contexts affected by conflict and insecurity. Enabling such mobility through cooperation and inclusive governance is essential for resilient livelihoods, sustainable rangeland management, and the achievement of Land Degradation Neutrality.



▲ Pastoralism, Morocco © IRD - Geneviève Michon

CONCRETE EXAMPLES: Pastoralism in action for soil health

In Mongolia and the Sahel, pastoralism shows how soil health can redefine food systems in practice.

In Mongolia, pastoralism faces pressures from climate change (temperature enhancement, increased frequency of extreme events), sedentarization, and land privatization, but it also offers key solutions for rethinking food systems. Traditional practices such as seasonal mobility allow soils to recover by preventing overgrazing and promoting organic matter accumulation through effluent deposition. Promoting local woody shrub species enhances soil structure and water retention, while adapted nomadic practices (breed selection, mobility calendars) ensure that grazing pressure aligns with the regenerative capacity of arid and semi-arid soils. These efforts demonstrate that food systems can be designed to work with, rather than against, natural ecosystems.

▼ Pastoral life, Mongolia © pexels-lovesa-chang



In the Sahel and Sub-Saharan Africa, pastoralism plays a critical role in sustaining soil health in degraded landscapes. Despite challenges like wind and water erosion - often worsened by restricted livestock mobility, integrated agro-pastoral systems and shared resource management agreements (such as in Niger and Senegal) help restore fast nutrient and carbon recycling. By facilitating livestock movement, these practices enhance soil organic carbon, reduce soil crusting, and improve water infiltration, showing that food systems can restore rather than deplete ecosystems.



▲ Fulani herders, Benin. © IRD - Moubarakou Liadi

Policy Recommendations

To harness soil health and pastoralism as tools for transforming food systems, policymakers should:

Strengthen integrated policies for sustainably practiced pastoralism and soil health

- Align national strategies with global targets such as the UNCCD Decision 19/COP.16 and the Sustainable Development Goals, explicitly recognizing pastoralism as a key strategy for achieving Land Degradation Neutrality (LDN).
- Develop cross-sectoral policies that link pastoral livestock breeding, soil health, food systems, climate adaptation and biodiversity conservation.
- Secure grazing rights for pastoralists and smallholders to ensure their access to grazing lands, water sources and transhumance corridors, fostering inclusive governance of shared resources.

Scale pastoralism-based nature solutions

- Promote local and regional grazing mobility, rotational grazing and agro-pastoralism as core practices for soil regeneration, carbon sequestration and biodiversity conservation in arid and semi-arid regions.
- Invest in revegetation programs for degraded rangelands, prioritizing drought-resistant and native species that support both livestock feeding and soil health.
- Encourage the adoption of corralling livestock on croplands and composting crop residues with domestic organic wastes and livestock effluents to enhance soil organic matter and water retention in agro-pastoral systems.

Build knowledge and capacity for pastoral systems

- Support collaborative research on the carbon balance of pastoral and agro-pastoral systems and their role in mitigating methane emissions, clarifying their contribution to climate goals.
- Establish localized soil health monitoring systems tailored to pastoral ecosystems, tracking indicators like functional biodiversity, organic carbon and water retention.
- Facilitate South-South knowledge exchange between pastoral communities (such as Mongolia and Sub-Saharan Africa) to share best practices in soil and water management, mobility strategies and adaptive grazing techniques.
- Analyze legal constraints that limit «best practices» for sustainable land management and use, and identify ways to reduce these barriers.

Mobilize finance for pastoral soil health

- Direct climate finance (e.g., LDN Fund, Green Climate Fund) toward pastoral soil health initiatives, including restoration of degraded rangelands and sustainable land management in pastoral regions.
- Develop economic incentives such as payments for ecosystem services (PES) to reward pastoralists for carbon sequestration, biodiversity functionality, and soil regeneration.
- Encourage private sector investment in pastoral value chains, including certification and labeling for regenerative pastoral products (e.g., meat, dairy, wool) to create market incentives.

Foster inclusive and equitable pastoral systems

- Empower women and youth in pastoral and agro-pastoral communities by ensuring their access to resources, land and livestock ownership, training, and decision-making roles in land management and soil health.
- Strengthen community-based resource management to resolve conflicts over land and water use between pastoralists, farmers, and other stakeholders.
- Promote cooperation among the Global South countries for the sharing of experience, technologies, and innovations in pastoral soil health, such as water management techniques, rangeland access strategies and veterinary services.

Conclusion

COP17 provides a timely opportunity to place soil health at the heart of the implementation of the UNCCD. By promoting a transition from extractive agriculture to regenerative food systems, Parties can strengthen the contribution of healthy soils to sustainable food production, ecosystem functioning, and rural livelihoods. As a living example of this transition, pastoralism demonstrates how working with ecological processes can sustain both productive landscapes and healthy soils. The policy actions proposed in this brief provide practical directions for integrating soil health and pastoralism into national and international efforts to achieve Land Degradation Neutrality while supporting the transition toward regenerative food systems.

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