SOWING SUSTAINABILITY:

AGROECOLOGY AND SUSTAINABLE LAND MANAGEMENT IN SYNERGY

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Friedrich-Ebert-Allee 32 + 36
53113 Bonn

T: +49 228 44 60-0
F: +49 228 44 60-17 66

E: info@giz.de
I: www.giz.de/en

Global Programme Soil Protection and Rehabilitation for Food Security (ProSoil)
E: soilprotection@giz.de
I: Conserving and rehabilitating soil to promote food security and climate protection - giz.de

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Authors
Tabitha Nekesa, Stephanie Jaquet

Review
Fergus Sinclair, Stephanie Katsir, Rudolf Sämann, Vivian Vollmann Tinoco

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List of Abbreviations

AATD	Agricultural Technology Development Centres
ADP	Animal draft power
BMZ	Federal Ministry for Economic Cooperation and Development, Germany Bundesministerium für wirtschaftliche Entwicklung und Zusammenarbeit
BNF	Biological nitrogen fixation
BRC	Bioresource Centres
CFL	Local Land Charter
CRP	Community resource persons
CVD	Village Development Council
EU	European Union
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HLPE	High Level Panel of Experts on Food Security and Nutrition
N	Nitrogen
ProSoil	Global Programme Soil Protection and Rehabilitation for Food Security
SLM	Sustainable Land Management
WOCAT	World Overview of Conservation Approaches and Technologies

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About

Germany's Federal Ministry for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, BMZ) has made significant investments in sustainable land and soil management as well as adaptation to climate change and exploring co-benefits with carbon sequestration in Africa and India. The Global Programme Soil Protection and Rehabilitation for Food Security (ProSoil) is part of BMZ's special initiative Transformation of Agriculture and Food Systems, implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, is a Consortium Partner of the World Overview of Conservation Approaches and Technologies (WOCAT). ProSoil supports smallholder farmers in Benin, Burkina Faso, Ethiopia, India, Kenya, Madagascar and Tunisia through training and capacity building in sustainable land management (SLM) and has promoted the adoption of SLM practices in its partner countries. The programme collaborates with local governments, and public and private sectors in the advancement of sustainable food and agricultural systems. The European Union (EU) is co-funding the programme's work in the field of agroecology in Kenya, Ethiopia, Madagascar and Benin. Another co-funder is the Bill & Melinda Gates Foundation in Ethiopia.

WOCAT is the global network on sustainable land management (SLM) that promotes the documentation, sharing, and use of information and knowledge to support adaptation, innovation, and decision-making in SLM. WOCAT supports governments and their development partners in effective knowledge management and decision-support tools and processes. WOCAT's Consortium Partner, the Alliance of Biodiversity International and the International Center for Tropical Agriculture, supported the coordination and collection of SLM practices in partner countries where ProSoil is deployed.

This compilation consists of ten selected SLM practices that contribute to improved soil fertility and enhance soil health for the sustainability of food and agricultural systems.

Acknowledgements

We express our gratitude for the invaluable contributions of the farmers who are actively implementing sustainable land management (SLM) technologies and approaches. Their efforts are instrumental in disseminating knowledge of SLM practices, promoting sustainable soil use, facilitating the rehabilitation of degraded soils, and contributing to sustainable food and agricultural systems.

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Foreword

Soil is the foundation of food security and maintaining soil health is one of the 13 principles of agroecology, set out by the UN Committee on World Food Security's (CFS) High-Level Panel of Experts on Food Security and Nutrition (HLPE) in their 2019 report. This new and innovative ProSoil publication illustrates that practices and approaches to soil protection and rehabilitation may also be relevant to the other 12 agroecological principles.

No single practice or approach embraces all the principles, and the fact that a practice contributes to addressing a principle does not necessarily mean that this is all that is needed for that principle to be fully addressed. In this publication, ProSoil highlights 13 practices in seven countries, each relevant to a different agroecological principle, showing that taken together, these practices touch on all of the principles.

It is easy to see how rhizobial inoculation in Tunisia reduces the use of industrially produced nitrogen (N), or how soil rehabilitation following removal of the invasive *Lantana camara* in India contributes to biodiversity conservation. Less obvious is how soil-focused approaches also touch on governance issues, as in Burkina Faso where a land charter is used to establish rules for fair use of common land along riverbanks; or how social values and diets are addressed in Kenya by enabling women to process seeds of the soil-improving cover crop velvet bean to make them palatable.

Practices often need to be bundled together to have an impact. The use of biological nitrogen fixation (BNF) to substitute for industrially produced N, as with rhizobial inoculation, exemplifies the bundle impact. Crop diversification is required to integrate legumes with staple crops and soil conditions need to be managed for the rhizobia to fix N efficiently (control of pH, ensuring sufficient phosphorus and potassium levels). Using BNF is, therefore, more knowledge-intensive, requiring innovative extension approaches embracing co-creation. If farmers adopt BNF they are empowered by owning the means to produce N rather than having to purchase it and reduce their contribution to greenhouse gas (GHG) emissions and to N pollution. What initially appears to be a technology decision at the field level, cascades to impact major social and economic dimensions of the whole food system, including keeping humanity within planetary boundaries.

This publication is timely given the emerging debate around the relationship between agroecology and regenerative agriculture. Can a focus on maintaining soil health, which is the foundation of regenerative approaches, achieve the whole food system transformation that agroecological approaches consider necessary to address the interrelated global challenges of ending hunger; halting and reversing biodiversity loss and degradation of land and water resources; while reducing GHG emissions and adapting to effects of climate change? What we learn from this publication is that soil-focused practices and approaches can contribute to addressing all the agroecological principles. However, it requires explicit efforts to combine practices, not all of which will be soil-focused, for all the principles to be addressed sufficiently to effect food system transformation needed to overcome the global challenges.

Fergus Sinclair

Director of Agroecology at the Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF) and co-Convenor of the Transformative Partnership Platform on Agroecology (TPP)

Introduction

Global food systems grapple with challenges that demand urgent attention and innovative solutions. The world's population is projected to reach 9.7 billion by 2050, with significant growth in sub-Saharan Africa and Southern Asia,[1] implying more pressure on agricultural land, water resources and food production systems. Increasing urbanisation[2], leading to the concentration of populations in cities, affects food security and equitable access to nutritious food for urban residents. Moreover, changing dietary preferences, driven by urbanisation, income growth and globalisation, are contributing to the rise of resource-intensive diets high in animal products and processed foods.[3] This shift not only strains agricultural resources and exacerbates environmental degradation but also fuels health crises related to obesity, malnutrition and diet-related diseases.

Food systems face the challenge of adapting to the impacts of climate change,[2] including shifting weather patterns, extreme weather events, and changing pest and disease dynamics. Climate-related disruptions threaten agricultural productivity, disrupt supply chains, and exacerbate food insecurity, particularly in vulnerable regions already struggling with poverty, conflict and resource constraints. Additionally, food systems are threatened by soil and water degradation, and biodiversity loss,[4] undermining their resilience and the provision of ecosystem services.

The application of conventional agriculture, characterised by intensive monoculture cropping, chemical inputs and mechanisation, falls short in addressing the multifaceted needs of a rapidly changing world. While conventional agriculture has historically contributed to increasing food production and alleviating hunger, its reliance on resource-intensive practices has led to environmental degradation, loss of biodiversity and social inequities.

Agroecology and Sustainable Land Management

Agroecology and sustainable land management (SLM) stand as beacons for securing agriculture and food systems. SLM consists of practices that aim to protect, conserve and enhance the productivity and resilience of land resources while maintaining or improving environmental quality and social well-being. The application of these practices enhances biodiversity, soil health, water conservation, financial sustainability and climate adaptation,[5] thereby promoting the resilience of food and agricultural systems. On the other hand, agroecology offers a holistic approach to agriculture that integrates ecological principles with social and economic considerations[6]. It represents a paradigm shift that recognises the interconnectedness of food and agricultural systems with the environment and society,[7,8] going beyond

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[1] Danan Gu, Kirill Andreev, and Matthew Dupre. "Major Trends in Population Growth Around the World - PMC." (2021). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8393076/.

[2] HLPE. "Agroecological and Other Innovative Approaches for Sustainable Agriculture and Food Systems That Enhance Food Security and Nutrition." *CSIPM* (blog), (June 21, 2019). https://www.csm4cfs.org/summary-recommendations-hlpe-report-agroecology-innovations/.

[3] Silene Casari et al. "Changing Dietary Habits: The Impact of Urbanization and Rising Socio-Economic Status in Families from Burkina Faso in Sub-Saharan Africa." *Nutrients* 14, no. 9 (April 24, 2022): 1782. https://doi.org/10.3390/nu14091782.

[4] Haley Zaremba et al., "Toward a Feminist Agroecology." *Sustainability* 13, no. 20 (January 2021): 11244. https://doi.org/10.3390/su132011244.

[5] Tabitha Nekesa et al. "Fields of Harmony: Pulses and Sustainable Land Management." (February 8, 2024). https://hdl.handle.net/10568/139357.

[6] Wezel A, Gemmill Herren B, Bezner Kerr R, Barrios E, Gonçalves ALR and F Sinclair. "Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review." *Agronomy for Sustainable Development* 40: 40 (2020). https://doi.org/10.1007/s13593-020-00646-z

[7] Steve Gliessman, Harriet Friedmann, and Philip H. Howard. "Agroecology and Food Sovereignty." (July 30, 2019). https://doi.org/10.19088/1968-2019.120.

[8] Rachel Bezner Kerr et al. "Can Agroecology Improve Food Security and Nutrition? A Review." Global Food Security 29 (June 1, 2021): 100540. https://doi.org/10.1016/j.gfs.2021.100540.

mere farming techniques to embrace a comprehensive understanding of the complex relationships within these systems[9]. Agroecology can be perceived as a scientific discipline, a set of farming practices, and a social movement,[2,10] these can be in the context of food sovereignty.[7]

Agroecology as a science

Agroecology is a scientific discipline that seeks to understand the ecological processes underlying food and agricultural systems. It draws on principles from ecology, biology, zoology, agronomy, crop physiology, sociology, anthropology, economics and other scientific fields.[2] Agroecology examines the interactions between biotic and abiotic factors within agricultural ecosystems such as plants, animals, soil, water and climate. This scientific dimension of agroecology provides the foundation for developing ecologically sound farming practices and strategies to enhance the sustainability, resilience and productivity of agricultural systems. The application of scientific knowledge to the design and management of farms optimises resource use efficiency, minimises environmental impacts and improves the long-term health of agroecosystems.

Agroecology as a social movement

Agroecology is a socio-political movement that advocates for transformative change in food and agricultural systems. At the core, agroecology seeks to challenge the dominant industrial model of agriculture,[10] characterised by monocultures, chemical inputs and corporate control. Instead, agroecology promotes principles of food sovereignty,[7] social justice, local identity and culture,[10] and agroecological democracy, aiming to empower small-scale farmers, consumers, and communities to reclaim control over their food systems. This socio-political dimension of agroecology emphasises the importance of grassroots organising, collective action, and policy advocacy, in creating enabling environments for agroecological transitions. These dimensions of agroecology address systemic issues such as poverty, inequality, and environmental degradation, while promoting a more equitable, resilient and sustainable food future.

Agroecology as a set of practices

Agroecology encompasses a set of locally adapted practical techniques and strategies that embody ecological principles. These include practices such as crop diversification, intercropping, agroforestry, organic farming, integrated pest management, and conservation agriculture. These practices enhance ecological and biological processes in agroecosystems, promoting biodiversity, soil health, water conservation, and pest and disease regulation, while reducing reliance on external inputs[10] such as synthetic fertilisers and pesticides. Specific solutions to agricultural challenges are co-created with farmers by supporting local innovation.

[9] Sinclair, F., Wezel, A., Mbow, C., Chomba, C., Robiglio, V., and R. Harrison. "The contribution of agroecological approaches to realizing climate-resilient agriculture." Background Paper, Global Commission on Adaptation, Rotterdam, (2019). https://gca.org/reports/the-contributions-of-agroecological-approaches-to-realizing-climate-resilient-agriculture/.

[10] GIZ. "Agroecology." (2020). https://www.giz.de/en/downloads/giz2020_en_Agroecology_SV%20Nachhaltige%20Landwirtschaft_05-2020.pdf.

Principles of agroecology

The High Level Panel of Experts on Food Security and Nutrition (HLPE) consolidated 13 agroecological principles, grouped under three operational principles: strengthening resilience, improving resource efficiency, and securing social equity/responsibility.[2]

Table 1: The 13 agroecological principles[2]

Strengthen resilience		
1	Biodiversity	Maintain and enhance diversity of species, functional diversity and genetic resources and thereby maintain overall agroecosystem biodiversity in time and space at field, farm and landscape scales.
2	Synergy	Enhance positive ecological interaction, synergy, integration and complementarity among the elements of agroecosystems (animals, crops, trees, soil and water).
3	Soil health	Secure and enhance soil health and functioning for improved plant growth, particularly by managing organic matter and enhancing soil biological activity.
4	Animal health	Ensure animal health and well-being.
5	Economic diversification	Diversify on-farm incomes by ensuring that small-scale farmers have greater financial independence and value addition opportunities, while enabling them to respond to demand from consumers.
Improve resource efficiency		
6	Input reduction	Reduce or eliminate dependency on external inputs and enhance self-sufficiency.
7	Recycling	Preferentially use local renewable resources and close as far as possible resource cycles of nutrients and biomass.
Secure social equity/responsibility		
8	Co-creation of knowledge	Enhance co-creation and horizontal sharing of knowledge including local and scientific innovation, especially farmer to farmer exchange.
9	Social values and diets	Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally and culturally appropriate diets.
10	Fairness	Support dignified and robust livelihoods for all actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment, and fair treatment of intellectual property rights.
11	Connectivity	Ensure proximity and confidence between producers and consumers through promotion of fair and short distribution networks, and by re-embedding food systems into local economies.

12	Land and natural resource governance	Strengthen institutional arrangements to improve sustainable management of natural and genetic resources, including the recognition and support of family farmers, smallholders, and peasant food producers as sustainable managers of natural and genetic resources.
13	Participation	Encourage social mobilisation and greater participation in decision-making by food producers and consumers to support decentralised governance and local adaptive management of agricultural and food systems.

Agroecology and food systems transformation

Achieving sustainability, starting from an industrial agricultural and food systems model, has been characterised as operating at five levels, as outlined in Gliessman's framework for transforming food systems. The first three levels outline measures implemented by farmers to shift away from industrial or conventional systems. Levels four and five include the broader scope of food systems, such as community, regional and global scales.[7] This transition is related to the agroecological principles summarised in Table 2, but will be different according to context. Many farmers in Africa, for example, where the Green Revolution has failed, require an agroecological intensification pathway where they can increase yields through crop diversification without using environmentally disruptive agrochemicals.

Table 2: Gliessman's levels link to agroecological principles

Gliessman's agroecological levels	Agroecological principles
Level 1: Increase efficiency of conventional/ industrial practices and inputs	Biodiversity, synergies, soil health, animal health, economic diversification, input reduction, recycling
Level 2: Replace industrial/conventional inputs and practices with alternative methods	
Level 3: Restructure the agroecosystem according to a new set of ecological principles	
Level 4: Re-establish links between food producers and consumers	Co-creation of knowledge, social values and diets, fairness, connectivity, land and natural resource governance, participation
Level 5: Rebuild the global systems through equity, participation, democracy, and justice for restoration/protection of earth's life, and sustainability	

Source: Created by the authors

Synergies and considerations of agroecology and SLM

Agroecology and SLM offer integrated approaches to sustainable agriculture and food systems, fostering synergies between the ecological, social and economic dimensions of sustainability. Both agroecology and SLM have the following considerations:

1. **Environmental Conservation:** Both agroecology and SLM prioritise the conservation and sustainable use of natural resources, such as soil, water and biodiversity. They promote practices that enhance ecosystem health, resilience and functionality, contributing to climate change mitigation, habitat preservation and soil fertility.

2. **Community empowerment:** Agroecology and SLM empower local communities to actively participate in decision-making processes related to land management and agricultural practices.
   They emphasise inclusive governance, knowledge sharing and capacity building, fostering social cohesion, resilience and cultural preservation.

3. **Economic viability:** Agroecology and SLM aim to improve the economic viability and livelihood security of farmers and rural communities.
   They promote sustainable agricultural practices that reduce input costs, enhance productivity and create diversified income opportunities, including capturing more value of production locally, contributing to long-term economic resilience and poverty alleviation.

4. **Resilience and adaptation:** Both approaches focus on building resilience and adaptive capacity to environmental changes, including climate variability, extreme weather events and market fluctuations.
   They encourage flexible and diversified farming systems that can withstand shocks, minimise risks and maintain productivity under changing conditions.

5. **Food security and nutrition:** Agroecology and SLM prioritise food security and nutrition by promoting diversified cropping systems, local food production and equitable access to resources.
   They emphasise the importance of culturally appropriate, nutritious diets, and support sustainable food systems that provide sufficient and healthy food for all.

6. **Knowledge sharing and innovation:** Agroecology and SLM emphasise participatory approaches to research, innovation and knowledge sharing, involving farmers, scientists, policymakers and other stakeholders.
   They encourage the integration of local knowledge, traditional practices, and modern science to develop context-specific solutions and promote continuous learning and adaptation.


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India – Biodiversity: Community-based Soil Rehabilitation for Grassland on Common Lands after Eradication of the Invasive Lantana Camara

Biodiversity refers to the variety of life forms on earth, including plants, animals, fungi and bacteria, as well as their genetic material and the ecosystems they form.[11,12] Biodiversity is crucial for human existence by maintaining the balance of ecosystems and the overall health of the human environment. It supports essential, regulating ecosystem services[13], such as pollination, soil fertility, water purification and climate regulation. Additionally, biodiversity provides numerous provisioning and cultural ecosystem services to humans, including food, medicine, and cultural, religious or spiritual and recreational values. For these reasons, biodiversity is essential for agriculture and agro-allied industries,[11] which are the mainstay of the Indian economy, but also to the country's socio-cultural activities. Inevitably, the socio-economic development of nations is dependent on the availability of bioresources. Thus, the protection and conservation of biodiversity are imperative for sustaining human life and ensuring the welfare of future generations.

Lantana camara, commonly known as lantana, originating from tropical and subtropical regions of America,[14] belongs to the Verbenaceae family. Despite its ornamental appeal[14] and use as a hedge[15] in India, it has become a notorious invasive species, colonising disturbed areas like forest edges, roadsides and agricultural lands, forming dense thickets and outcompeting native vegetation. Encroachment by lantana in natural habitats has resulted in extensive biodiversity loss. It has invaded most of the 13.2 million hectares of pasture lands in the country, in addition to forested and fallow areas.[14] Its allelopathic properties further exacerbate biodiversity loss by inhibiting the growth of neighbouring plants,[12,16] promoting the homogenisation of ecosystems, where diverse native flora is replaced by monocultures of invasive lantana. Lantana's invasion of agricultural land challenges biodiversity[15] as well as productivity and livelihoods, as farmers struggle to control lantana infestations and mitigate its negative impacts on crop yields and land productivity. The shrub has also been reported to cause poisoning in buffalo, sheep, goats and cattle, as its leaves and seeds contain triterpenoids, which lead to poisoning and photosensitivity.[14,15] Lastly, being flammable,[14] lantana poses a significant fire hazard especially during periods of drought or in fire-prone environments, threatening both natural ecosystems and human settlements.

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[11] Prabodh Maiti and Paulami Maiti. "*Biodiversity: Perception, Peril and Preservation.*" PHI Learning Pvt. Ltd. (2023).

[12] Sheela Gupta. "India's Loss of Biodiversity and Ecological Consequences." *International Journal for Research in Applied Sciences and Biotechnology* 6, no. 4 (July 31, 2019): 34–38. https://www.ijrasb.com/index.php/ijrasb/article/view/364.

[13] Penelope R. Whitehorn et al. "Mainstreaming Biodiversity: A Review of National Strategies." *Biological Conservation* 235 (July 1, 2019): 157–63. https://doi.org/10.1016/j.biocon.2019.04.016.

[14] Girish C. S. Negi et al. "Ecology and Use of Lantana Camara in India." *The Botanical Review* 85, no. 2 (June 1, 2019): 109–30. https://doi.org/10.1007/s12229-019-09209-8.

[15] Sushree Sangita Barik, Rinu Priya Sahoo, and Sushree Sonalika Barik. "Lantana Camara L.: An Emerging Threat to Native Flora and Livestock: A Review." *Journal of Pharmacognosy and Phytochemistry* 9, no. 5 (2020): 2363–66. https://www.phytojournal.com/archives/2020.v9.i5.12697/lantana-camara-l-an-emerging-threat-to-native-flora-and-livestock-a-review.

[16] Hisashi Kato-Noguchi and Denny Kurniadie. "Allelopathy of Lantana Camara as an Invasive Plant." *Plants* 10, no. 5 (May 2021): 1028. https://doi.org/10.3390/plants10051028.

ProSoil India promotes biodiversity by eliminating lantana and rehabilitating the lands previously occupied by the shrub. The 'cut rootstock' method is employed, involving cutting the root of the plant three inches below the ground and uprooting the bush upside down to prevent regrowth. This method is carried out between July and September, when the soil is sufficiently moist for uprooting, and before fruiting to prevent seed fall, which can cause recurrence for up to three years. Additionally, perching trees are identified, and saplings are removed from under its canopies and along nearby surface run-off zones to further control lantana spread. Regular monitoring and follow-up actions are essential for the long-term success of this method.

In efforts to prevent future recurrence, a series of measures are put in place: continuous monitoring for three years, planting and seeding in areas with fewer lantana rootstocks, and sowing grass species. Indigenous grass species' seed balls are dispersed before the monsoon season, enabling them to sprout and thrive during the rainy period, thus creating unfavourable conditions for lantana establishment. Revegetation initiatives entail the careful selection and cultivation of tree species resilient to grazing, fire and water, establishing a three-tiered forest ecosystem that offers sustainable provisions of food, fuel wood and fodder. Annual biomass assessments are undertaken to evaluate progress, and the results are disseminated within the community to encourage compliance with village institution regulations. The technology has enhanced rehabilitation and access to common lands, fodder and green grass for livestock, while promoting biodiversity.

More to know:

Learn more about ***soil rehabilitation*** after eradication of lantana in India on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

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Madagascar – Synergy: Intercropping Maize and Cowpea

Synergy in agroecology fosters biodiversity by promoting the coexistence of various organisms which enhances resilience against pests, diseases and environmental stresses. Agroecological/SLM practices like intercropping and crop rotation take advantage of the physiological and anatomical differences amongst crops: by choosing the right combination of crops, plants cover more soil and enable a more favourable microclimate due to complementary light requirements and spatial configurations, while neighbouring roots access complementary soil space and resources. This way, soil erosion is mitigated, water is conserved and nutrient cycling in the agroecosystem is enhanced without the use of synthetic fertilisers. Harnessing synergies through agroforestry also boosts climate adaptation and mitigation.[17,6] Furthermore, intercropping can reduce the dependence on chemical pesticides as vermin cannot just spread from plant to plant, and chemical compounds mutually allure or deter them. Lastly, synergies enhance agricultural productivity,[2] improving food security and increasing financial returns.

Intercropping maize with cowpea in Madagascar has the potential to boost agricultural productivity while tackling various challenges. By leveraging the biological nitrogen fixation (BNF) capabilities of cowpeas,[18] maize benefits from improved soil fertility and increased nutrient availability. This is particularly crucial due to limited access to mineral fertilisers by smallholder farmers and low soil fertility in some parts of Madagascar. Further, intercropping with cowpea has the potential of reducing weed proliferation. Maize-cowpea intercrop has been reported to significantly reduce the density of wandering jew *(Commelina benghalensis)*. Improved soil fertility, nutrient availability and weed management offer the potential for better yields. Moreover, the reduced need for synthetic fertilisers mitigates soil degradation and promotes soil health. In the long run, this assures agricultural and environmental sustainability.

More to know:

Learn more about how ***intercropping maize and cowpea*** boosts agricultural productivity in Madagascar on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

In addition, intercropping maize with cowpea contributes to dietary diversification and improved food security. Cowpea serves as a rich source of protein, vitamins and minerals,[18] complementing the predominantly carbohydrate-rich diets based on cereals. Access to more balanced meals further mitigates malnutrition. Apart from improved household food and nutrition security, intercropping maize and cowpea can generate income opportunities. This diversification improves financial resilience of households through their sale. As such, diversified income streams boost financial resilience of farming households, reducing their vulnerability to external shocks and market fluctuations.

Intercropping maize with cowpea further builds resilience against climate variability and risks[19] associated with monocultures. Spreading risks across multiple crops can mitigate the impact of adverse weather conditions. This risk mitigation strategy ensures food availability for households and reduces the economic impact of crop losses, ultimately enhancing the resilience of farming communities.

[17] Fabio Leippert et al. "*The Potential of Agroecology to Build Climate-Resilient Livelihoods and Food Systems.*" Rome. FAO and Biovision. (2020). https://doi.org/10.4060/cb0438en.

[18] Ana Maria Figueira Gomes et al. "Breeding Elite Cowpea [*Vigna Unguiculata* (L.) Walp] Varieties for Improved Food Security and Income in Africa: Opportunitie, and Challenges." In *Legume Crops - Characterization and Breeding for Improved Food Security*. IntechOpen (2019). https://doi.org/10.5772/intechopen.84985.

[19] Rajneesh Paliwal et al. "Developing the Role of Legumes in West Africa under Climate Change." *Current Opinion in Plant Biology*, 56 (August 1, 2020): 242–58. https://doi.org/10.1016/j.pbi.2020.05.002.

Benin – Soil Health: Harnessing Mucuna as a Soil-enriching Cover Crop

Soil health is the foundation of sustainable agricultural and food systems. It involves complex interactions of physical, chemical and biological factors that determine the soil's ability to sustain ecosystem services, such as plant growth, water retention, nutrient cycling and carbon sequestration.[20,21,22] Healthy soil enhances diverse microbial life, important for nutrient cycling and decomposition, while also enhancing soil structure and stability. Factors such as organic matter content,[20] pH balance and soil structure play a crucial role in maintaining soil health. SLM practices, including crop rotation, cover cropping and minimal tillage, are essential for preserving and enhancing soil health. Apart from food production, soil health is vital for climate change mitigation, as healthy soils sequester carbon dioxide from the atmosphere. The preservation of soil health is imperative for agricultural and environmental sustainability.

In Benin, the utilisation of velvet bean *(Mucuna pruriens)* as a cover crop presents a promising strategy for addressing key agricultural challenges and promoting sustainable food systems. Soil fertility decline and low soil productivity are prevalent in Benin. Low fertility prevails in about 90 per cent of soils in the country,[23] having direct impacts on crop yields. Moreover, having low purchasing power, most smallholder farmers cannot afford chemical fertilisers. Velvet beans' ability to fix atmospheric nitrogen through BNF[24] offers a natural and sustainable alternative to synthetic fertilisers. Additionally, the deep and extensive root system of velvet bean helps to stabilise soil aggregates, preventing erosion caused by wind and water run-off, while it breaks up compacted layers thus improving soil structure. This promotes soil aeration, water infiltration and root penetration, ultimately fostering healthier soil conditions for crop growth. Finally, velvet bean serve as a valuable tool for weed suppression and erosion control. Its dense foliage protects the soil surface, inhibiting weed growth and reducing the need for herbicides. Rotating velvet bean with maize can reduce weed density up to 92 per cent. Thus, incorporating velvet beans into crop rotations or intercropping systems can enhance soil fertility,[25] reduce dependency on external inputs, and improve the long-term sustainability and yields of farming practices.

More to know:

Learn more about how ***mucuna*** is used as a soil-enriching cover crop in Benin on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

[20] Monther M. Tahat et al. "Soil Health and Sustainable Agriculture." *Sustainability* 12, no. 12 (January 2020): 4859. https://doi.org/10.3390/su12124859.

[21] Tabinda Athar and Nafisa Kanwal. "Significance of Soil Health and Soil Life for Sustainable Food Production." *Emergent Life Sciences Research* Vol 8, Issue 1, (June 30, 2022): 1–4. http://www.emergentresearch.org/abstract.php?article_id=13574.

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[24] Tarirai Muoni et al. "Effects of Management Practices on Legume Productivity in Smallholder Farming Systems in Sub-Saharan Africa." *Food and Energy Security* 11, no. 2 (2022): e366. https://doi.org/10.1002/fes3.366.

[25] Tarirai Muoni et al. "Reducing Soil Erosion in Smallholder Farming Systems in East Africa through the Introduction of Different Crop Types." *Experimental Agriculture* 56, no. 2 (April 2020): 183–95. https://doi.org/10.1017/S0014479719000280.

Benin – Animal Health and Welfare: Livestock Grazing

Animal health and welfare are critical aspects of agricultural and food systems with far-reaching implications for human well-being, food and nutrition security,[26,27] economic stability and environmental sustainability. They safeguard public health through the prevention of the spreading of infectious zoonotic diseases[27] and ensure the safety of animal-derived food products.[28] Additionally, food security and a steady income for smallholders are enhanced as healthy animals produce more and higher-quality meat, milk, eggs and other essential food products, while they require less veterinary care.

Promoting animal health and welfare is vital for environmental sustainability as healthy animals contribute to the resilience and balance of ecosystems. Biodiversity is enhanced by healthy animal populations contributing to ecosystem services. For instance, sustainable livestock management practices that prioritise animal health, such as rotational grazing, can enhance soil health and fertility, contribute to long-term agricultural productivity, and mitigate land degradation. Properly managed grazing lands or grasslands can serve as carbon sinks, aiding in climate change mitigation efforts. Animal health also includes proper handling and disposal of animal waste, which are essential for preventing environmental pollution and protecting water quality.

ProSoil farmers in Benin practice controlled grazing of livestock (Borgou oxen) on crop production fields to enhance both soil fertility and animal health. This grazing practice allows for the collection of nutritious cattle manure to be used as organic fertiliser. During the dry season and before planting (between January and April), the oxen are confined within paddocks on the lands from late afternoon to early morning for about 14 hours. The grazing is done rotationally within designated paddocks in the cropping lands for a few days up to two weeks.

This controlled grazing not only ensures that the animals have access to fresh and nutritious forage but also prevents overgrazing, which can lead to soil nutrient depletion and erosion. Preventing overgrazing in turn prevents overcrowding of the animals, which can increase the risk of disease transmission due to closer proximity and higher stress levels among them.[29] Moreover, by allowing the animals to graze on the crop residues and cover crops, the practice contributes to their diet diversity and overall health. The grazing is stopped upon the arrival of the first rains to prepare the soil for crop planting, ensuring that the animals are removed from the fields before they can damage the emerging crops. This practice contributes to the health and welfare of the animals by providing them with a balanced diet, preventing overgrazing and supporting sustainable agricultural practices.

More to know:

Learn more about how ***livestock grazing*** enhances soil fertility and animal health in Benin on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

[26] Rebecca Doyle et al. "The Importance of Animal Welfare and Veterinary Services in a Changing World." (August 1, 2021). https://hdl.handle.net/10568/115115.

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Kenya and Ethiopia – Economic Diversification: Vermicompost

Economic diversification involves broadening the scope of agricultural activities and food-related industries for food and agricultural systems. For instance, introduction of new crops, adoption of innovative farming techniques, exploring value addition opportunities, and promotion of alternative income sources tied to agricultural production. Economic diversification has the capacity to mitigate risks associated with overreliance on a narrow range of agricultural products. For instance, crop and livestock diversification strengthens their resilience against threats such as crop failures, pest outbreaks and adverse weather patterns.[30,31] Furthermore, economic diversification fosters an environment conducive to innovation and entrepreneurship, offering farmers and households opportunities to explore new markets and products. This, in turn, promotes greater food security and improved nutrition by expanding access to a wider variety of nutritious foods. Additionally, economic diversification contributes to poverty alleviation and rural development[32], and by generating employment, increasing incomes, and supporting sustainable livelihoods in rural areas.

Vermicomposting, an integral component of vermitechnology practiced in both Kenya and Ethiopia, involves the use of earthworms to decompose organic waste into nutrient-rich vermicompost. This structured process, characterised by aerobic bio-oxidation and non-thermophilic decomposition, relies on earthworms to fragment, mix and stimulate microbial activity, thereby transforming dead plant material and livestock waste into high-quality manure with nutrients vital for plant growth. Vermicompost plays a pivotal role in reducing farmers' dependency on chemical fertilisers,[33] rejuvenating soil fertility, neutralising acidity and revitalising degraded farmland. Vermiculture and vermicomposting are gaining momentum as effective solutions for organic waste management and sustainable agriculture. Vermicomposting converts organic waste into valuable compost and liquid fertiliser (vermi juice), enriching soil fertility, enhancing crop yields and fostering eco-friendly farming practices.

Vermicomposting contributes to economic diversification by providing income-generating opportunities for small-scale farmers and entrepreneurs. The production and sale of vermicompost and vermi juice create revenue streams, reduce input costs and promote self-sufficiency in soil fertility management, thereby fostering resilience in agricultural systems.

More to know:

Learn more about how earthworms are involved in ***vermicomposting*** in Kenya on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

More to know:

Learn more about how earthworms are involved in ***vermicomposting*** in Ethiopia on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

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[30] Thomas Hertel et al. "Diversification for Enhanced Food Systems Resilience." *Nature Food* 2, no. 11 (November 2021): 832–34. https://doi.org/10.1038/s43016-021-00403-9.

[31] Pratap S. Birthal and Jaweriah Hazrana. "Crop Diversification and Resilience of Agriculture to Climatic Shocks: Evidence from India." *Agricultural Systems* 173 (July 1, 2019): 345–54. https://doi.org/10.1016/j.agsy.2019.03.005.

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[33] GIZ. "Soil Health and Crop Nutrient Management: Building Resilience and Increasing the Efficiency of Nutrient Application." (2023). https://www.giz.de/en/downloads/giz2023-en-Soil-health-and-crop-nutrient-management.pdf.

Tunisia – Input Reduction: Precision Fertilisation

Input reduction in food and agricultural systems focuses on minimising the use of external resources like water, fertilisers, pesticides and energy, while maintaining or increasing productivity. Core to sustainable agriculture, input reduction aims to balance economic profitability with environmental and social responsibility. Strategies include precision agriculture, which uses technology to apply inputs precisely where and when needed, thus reducing waste.[34] Crop rotation and diversity help to improve soil health and reduce the need for chemical inputs. Integrated pest management combines various control methods to manage pests sustainably. Conservation tillage techniques conserve soil moisture and structure, reducing the need for irrigation and fuel. Agroforestry and permaculture integrate trees and perennial crops for multiple benefits, requiring fewer external inputs. Water conservation practices like drip irrigation and rainwater harvesting optimise water use. Energy-efficient technologies and practices help reduce the energy footprint of agricultural operations. These approaches not only decrease environmental impact but also improve economic resilience and contribute to the long-term sustainability of food production.

More to know:

Learn more about how ***precision fertilisation*** contributes to input reduction in Tunisia on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

Rhizobial inoculation of legumes plays a crucial role in precision fertilisation and contributes significantly to input reduction in agricultural systems in Tunisia. In a country where soils are degraded,[35] exhibit salinisation, low organic matter and are prone to erosion, the use of *Rhizobium* inoculants enhances soil fertility[36] and reduces the need for synthetic fertilisers. By forming symbiotic associations with legumes such as beans, chickpeas and lentils, *Rhizobium* bacteria promote nutrient uptake, leading to improved growth, yield[37,38] and disease resistance in these crops. This means that farmers can rely less on chemical fertilisers, reducing both their costs and the environmental impact associated with its use.

The process of *Rhizobium* inoculation involves isolating efficient strains of *Rhizobium* bacteria, multiplying them and applying them to legume seeds just before sowing. This targeted approach ensures that the inoculant reaches the plant-soil ecosystem directly, maximising its effectiveness and minimising waste. Additionally, the use of an adhesive in the inoculum helps to stick the *Rhizobium* bacteria to the seeds, ensuring their efficient colonisation of the plant roots.

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[34] Hannah Duff et al. "Precision Agroecology." *Sustainability* 14, no. 1 (January 2022): 106. https://doi.org/10.3390/su14010106.

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While *Rhizobium* inoculation offers numerous benefits, it is important to note that these bacteria are sensitive to abiotic stresses such as drought and high temperatures. Therefore, proper irrigation is necessary to support their survival and effectiveness, especially in arid and semi-arid climates. Furthermore, farmers must implement good land management practices like crop rotation and appropriate fertilisation[39] to maintain the long-term sustainability of the inoculation effect.

Overall, *Rhizobium* inoculation contributes to the promotion of healthy and fertile soil, increased crop productivity and more resilient cropping systems in the face of climate change. Through reducing the reliance on synthetic fertilisers and promoting sustainable agriculture, *Rhizobium* inoculation plays a vital role in ensuring food security while minimising the environmental footprint of agricultural activities.

[39] Dereje Geleta and Getachew Bekele. "Yield Response of Faba Bean to Lime, NPSB, and Rhizobium Inoculation in Kiremu District, Western Ethiopia." *Applied and Environmental Soil Science* 2022 (June 28, 2022): e3208922. https://doi.org/10.1155/2022/3208922.

India – Recycling: City Compost as a Solution for Waste Management and Soil Health Improvement

In agroecology, recycling is a circular strategy for managing resources within agricultural systems to minimise waste, conserve energy and enhance sustainability. It involves various practices such as composting organic waste materials[40] like crop residues and manure to improve soil health and fertility instead of discarding them. Integrating livestock into agroecological systems allows for the recycling of nutrients through manure deposition, enhancing soil fertility while minimising environmental impacts. Additionally, nutrient cycling through methods like crop rotation and cover cropping efficiently recycles nutrients within the soil-plant system, reducing the dependence on synthetic fertilisers and mitigating nutrient run-off.

Agroecology also stresses the importance of retaining crop residues on fields after harvest to act as natural mulch, which conserves soil moisture and enhances soil structure. Water recycling techniques, such as rainwater harvesting[41] and drip irrigation, play a crucial role in conserving water resources, particularly in regions with limited water availability or prone to drought. Moreover, agroecology seeks to utilise agro-industrial by-products, such as crop residues and processing waste, as valuable resources for soil amendment or renewable energy production, thereby further reducing waste and maximising resource efficiency.

In India, the issue of municipal solid waste management is critical, with a significant portion being disposed of indiscriminately, posing environmental and health hazards. The increasing urban population aggravates the challenge of waste management.[42] Additionally, agricultural sustainability has been compromised due to excessive chemical fertiliser use and monoculture practices, leading to land degradation. To address these challenges, city composting has emerged as a dual solution. Municipal corporations collect organic waste from cities, process it into compost and supply it to farmers as organic matter, complementing traditional farmyard manure. This recycling of organic matter enhances agricultural production and carbon sequestration, while alleviating waste management issues such as landfills.[28]

Overall, making and distributing city compost in India has reduced reliance on synthetic fertilisers and improved soil health, leading to increased productivity. Sustainable waste management poses great potential in nutrient management and environmental conservation at the household and municipal levels.

More to know:

Learn more about how ***city compost*** improves waste management and soil health in India on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

[40] Bhavisha Sharma et al. "Recycling of Organic Wastes in Agriculture: An Environmental Perspective." *International Journal of Environmental Research* 13, no. 2 (April 1, 2019): 409–29. https://doi.org/10.1007/s41742-019-00175-y.

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Kenya – Co-creation of Knowledge: Community Resource Persons in Agricultural Extension

Co-creation of knowledge in agroecology is a collaborative process where diverse stakeholders work together to create, share and apply knowledge for sustainable agriculture and food systems. This collaboration involves farmers, researchers, policymakers and community members, recognising that each brings valuable insight and expertise to the table. Participatory approaches are key in this process,[43] meaning that all stakeholders are involved from the beginning to the end of a project. This involvement ensures that research is relevant and addresses real-world problems faced by farmers. Additionally, local knowledge,[41] including traditional and indigenous practices, is integrated into the process, enriching scientific understanding, and ensuring that solutions are culturally appropriate and effective.[44,45]

More to know:

Learn more about the vital role of ***CRPs*** in promoting SLM practices in Kenya on the WOCAT Global SLM Database!

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Interdisciplinary collaboration is another crucial aspect.[46] Addressing agricultural challenges and exploring opportunities comprehensively involves collaborations of experts from various fields such as agronomy, ecology, sociology and economics. This interdisciplinary approach helps to address complex issues from multiple angles, leading to more effective outcomes. Furthermore, co-creation of knowledge involves facilitating dialogue and knowledge exchange among stakeholders. This exchange of ideas, experiences and insights fosters mutual learning and innovation. It also empowers communities by building their capacity to actively engage in decision-making processes and innovation, ultimately fostering ownership sustainability.

As part of ProSoil Kenya, Community Resource Persons (CRPs) play a vital role in promoting SLM practices at grassroots level. These CRPs, who are farmers themselves, act as intermediaries between agricultural extension services and local communities, bridging the gap caused by limited access to private extension[47] and low public extension staff-to-farmer ratios. The CRPs are selected from farmers' groups and undergo rigorous training in SLM practices and dissemination strategies facilitated by ProSoil and partners. The CRPs' role is to train and coach fellow farmers. They act as focal points for SLM knowledge dissemination, conducting demonstrations, gathering feedback and reaching out to other farmers in the community. The CRPs manage small groups of farmers (five to seven) and utilise various channels to spread SLM knowledge, including farm visits, community meetings and farmer field days organised by ProSoil partners or local agricultural departments. Their efforts are often voluntary, although some farmers may provide them with rewards for their advisory services. Additionally, CRPs with specialised skills may enter into contractual agreements with project implementers or other institutions, further expanding their role as trainers and advisors. This grassroots approach not only improves farmers' access to agricultural information but also fosters social cohesion and solidarity among community members with different backgrounds and ages.

[43] Alisha Utter et al. "Co-Creation of Knowledge in Agroecology." *Elementa: Science of the Anthropocene* 9, no. 1 (November 3, 2021): 00026. https://doi.org/10.1525/elementa.2021.00026.

[44] Kuria, A. W., Barrios, E., Pagella, T., Muthuri, C. W., Mukuralinda, A., and Sinclair F. L. "Farmers' knowledge of soil quality indicators along a land degradation gradient in Rwanda." Geoderma Regional, 16 (2019), Article e00199. https://doi.org/10.1016/j.geodrs.2018.e00199.

[45] Lamond, G., Sandbrook, L., Gassner, A. and F. L. Sinclair. "Local knowledge of tree attributes underpins species selection on coffee farms." *Experimental Agriculture* 55 (S1): 35-49 (2019). https://oro.open.ac.uk/59327/1/59327.pdf.

[46] Adanella Rossi. "From Co-Learning to Shared Commitment to Agroecology. Some Insights from Initiatives Aimed at Reintroducing Agrobiodiversity." *Sustainability* 12, no. 18 (January 2020): 7766. https://doi.org/10.3390/su12187766.

[47] Henry Muli Mwololo et al. "Is the Type of Agricultural Extension Services a Determinant of Farm Diversity? Evidence from Kenya." *Development Studies Research* 6, no. 1 (January 1, 2019): 40–46. https://doi.org/10.1080/21665095.2019.1580596.

Kenya – Social Values and Diets: Mucuna Value-Addition for Female Farmers

Agroecology emphasises the importance of social values in shaping agricultural practices and diets. It recognises that food production is deeply intertwined with cultural, social and environmental factors. In agroecology, social values extend beyond mere economic considerations to include aspects like equity, justice and community well-being.[3,41,42] This means considering not only how food is produced but also who has access to it and how it affects local communities. When it comes to diets, agroecology promotes diverse, locally adapted food systems that prioritise nutrition, sustainability and cultural significance.[48] This means supporting traditional and indigenous foodways, which often provide more resilient and environmentally friendly alternatives to industrialised agriculture.

Mucuna pruriens, commonly known as velvet bean, holds a significant role in soil protection and rehabilitation. It is used for soil conservation, such as controlling erosion and enhancing soil structure and soil fertility through BNF. However, its seeds are not widely consumed due to their potential digestive issues if not properly prepared. To address this, ProSoil Kenya has strengthened the capacity of women in *Mucuna pruriens* value-addition, further enhancing its adoption. Value-addition in agriculture refers to the process of enhancing the value of agricultural products through various means, such as processing, packaging, branding and marketing.

More to know:

Learn more about the ***mucuna value-addition*** for female farmers in Kenya on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

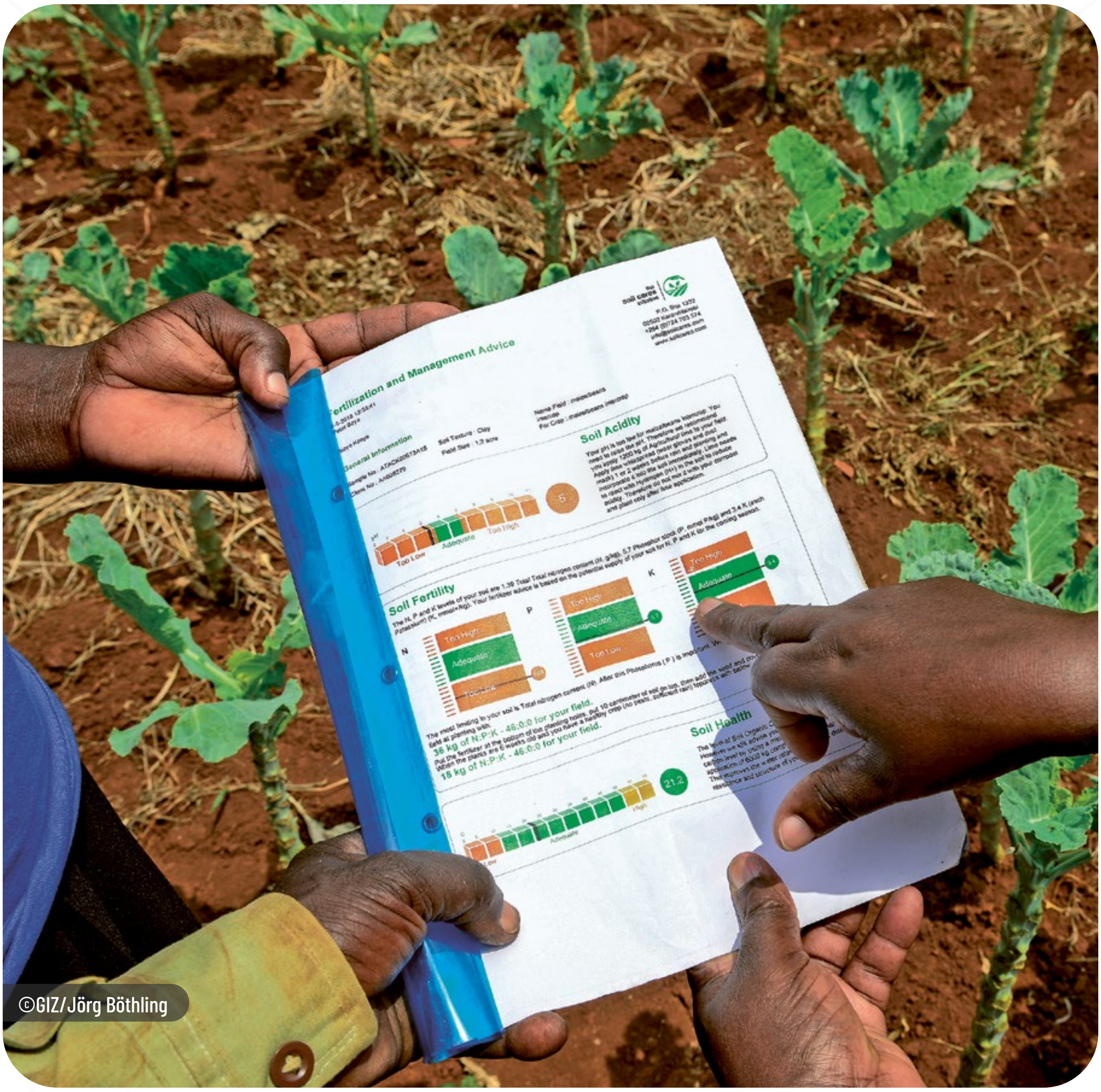
Women's involvement in the value-addition of velvet bean, such as processing it into various products, holds significant potential for enhancing both social values and dietary practices within communities. Economically, engaging in value addition activities empowers women by providing them with opportunities for income generation. Additionally, through their participation in processing activities, women acquire valuable skills in areas such as product development, quality control and marketing. This newfound economic independence and leadership roles can lead to greater autonomy within households and communities, contributing to women's empowerment and decision-making authority.

The creation of products based on velvet bean offers nutritional benefits that can contribute to improved dietary diversity and overall health outcomes. Velvet beans are rich in carbohydrates (43 to 65 per cent),[49] protein (21 to 31 per cent), fibre (5 to 12 per cent) and essential micronutrients, making it a valuable-addition to diets,[5] especially in regions where malnutrition is prevalent. Women processing velvet beans into products like flour, snacks or supplements can contribute to addressing nutritional deficiencies and promoting healthier eating habits, particularly among vulnerable populations such as children and pregnant women.

[48] Rachel Bezner Kerr et al. "Human and Social Values in Agroecology: A Review." *Elementa: Science of the Anthropocene* 10, no. 1 (June 14, 2022): 00090. https://doi.org/10.1525/elementa.2021.00090.

[49] Florence Boniface, Washa B. Washa, and Stephen Nnungu. "Comparison of Nutritional Values of Mucuna Pruriens L. (Velvet Bean) Seeds with the Most Preferred Legume Pulses." *Food Production, Processing and Nutrition* 6, no. 1 (January 6, 2024): 17. https://doi.org/10.1186/s43014-023-00187-4.

The incorporation of velvet beans into local culinary traditions preserves cultural heritage and strengthens community identity. Women often play a central role in passing down traditional knowledge related to food preparation and preservation,[50] and their innovation in incorporating velvet beans into local recipes ensures the continuation of these cultural practices. This not only fosters a sense of pride and connection to local food systems but also promotes the consumption of nutritious foods rooted in cultural traditions. Feminist agriculture through women's involvement in the value addition of velvet bean promotes broader community well-being by contributing to sustainable agriculture, food security and social cohesion.



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[50] Chala Gowe Kuyu and Tizazu Yirga Bereka. "Review on Contribution of Indigenous Food Preparation and Preservation Techniques to Attainment of Food Security in Ethiopian." *Food Science & Nutrition* 8, no. 1 (January 2020): 3–15. https://onlinelibrary.wiley.com/doi/full/10.1002/fsn3.1274.

Kenya – Fairness: Improving Farmers' Access to Tools for Conservation Agriculture

Fairness in agroecology is fundamentally about ensuring that all participants in the food system, particularly smallholder farmers, have equitable access to resources, opportunities and benefits. Promoting fairness challenges the prevailing inequalities embedded in conventional agricultural systems. It advocates for fair treatment, empowerment and recognition of the rights of farmers, especially those operating on a small scale and in marginalised communities.

One crucial aspect of fairness in agroecology is equitable access to resources. Smallholder farmers often face barriers such as limited access to land, water, seeds and credit. Agroecology seeks to address these disparities by promoting policies and practices that enable smallholders to access the resources they need to sustainably produce food. Additionally, ensuring that smallholder farmers have control over their own agricultural practices and resources enhances fairness. This includes protecting farmers' rights to save, exchange and develop seeds suited to their local conditions, free from restrictive intellectual property rights.

As part of promoting fairness, fair trade is another important element of agroecology,[3] which aims to ensure that smallholder farmers receive a fair price for their products[41] as well as fair purchase prices for inputs. Establishing direct contacts between consumers and producers enhances fair trade practices, contributing to economic viability and social justice within food systems.

ProSoil Kenya with local partners has taken significant steps to enhance farmers' access to conservation agriculture tools, particularly minimum tillage implements. The promotion of fairness and equity addresses the challenges of high costs and accessibility of tools enhancing the adoption of conservation agriculture.

Local artisans, particularly welders, have been trained to fabricate minimum tillage tools at reduced costs, ensuring that farmers have access to affordable equipment. This not only reduces the financial barrier to adopting conservation agriculture but also stimulates the local economy by providing employment opportunities for artisans. Through partnerships and collaborations with local agricultural institutions and local governing bodies, artisans are trained to fabricate tools such as jab planters, hand-held scrapers, shallow weeders, hand-held subsoilers, animal draft power (ADP) subsoilers, and rippers. Smallholder farmers then access them easily and at reduced cost. Similarly, farmers with large land holdings can access heavy machinery from Agricultural Technology Development Centres (AATDs) within counties at fair prices. This partnership helps bridge the gap between tool manufacturers/organisations and end-users, thus facilitating a smoother adoption process. Promoting fairness in accessibility to minimum tillage has enhanced adoption of conservation agriculture, which ultimately contributes to the sustainability of agricultural systems.

More to know:

Learn more about ***improving farmer's access*** to tools for conservation agriculture in Kenya on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

India – Connectivity: Preparation of Bio-Inputs such as Vermicompost, Biofertilisers, and Biopesticides

Promoting connectivity in food systems involves fostering proximity and trust between producers and consumers, primarily by establishing fair and short distribution networks.[2] This means creating channels that bring locally produced food directly to consumers, reducing the distance between farm and table. By shortening the supply chain, consumers can have more confidence in the source and quality of their food, while producers can receive fairer compensation for their products. Re-embedding food systems into local economies is a key aspect of this approach,[2] emphasising the importance of supporting and prioritising local farmers, markets and businesses. By investing in local food infrastructure and initiatives, such as farmers' markets, community-supported agriculture and farm-to-school programmes, communities can strengthen their local economies, while promoting sustainable and equitable food systems. This not only benefits producers and consumers but also fosters stronger social connections and resilience within communities.

ProSoil India promotes local production of bio-inputs through Bioresource Centres (BRCs). The initiative aims to improve soil health and fertility, manage pests and diseases, and fulfil crop nutrient requirements. The BRCs produce compost, vermicompost, biofertilisers, biopesticides and other bio-inputs from locally available resources, which further enhance waste management and connectivity in food and agricultural systems. To produce these bio-inputs, these community-led establishments utilise locally available inputs and resources. These inputs typically include organic waste materials, such as crop residues, kitchen scraps, animal manure and green waste, which are collected from local farms, households and markets. Other locally sourced materials include earthworms, cow dung, cow urine and various plant materials. Moreover, the producers and consumers (farmers) constitute locals, establishing fair and short distribution networks between the source of the inputs and the farmers. This approach builds confidence between the stakeholders involved and promotes fair trade.

With this, BRCs contribute to re-embedding food systems into local economies by prioritising local production and distribution channels, supporting local farmers and entrepreneurs in producing bio-inputs from locally available resources.[51] The vulnerability of farmers to external shocks and disruptions of large-scale, centralised supply chains is reduced, while also promoting environmental sustainability by minimising the carbon footprint associated with long-distance transportation.

More to know:

Learn more about ***preparation of bio-inputs*** promotes local production in India on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

[51] Alexander Wezel et al. "Agroecological Principles and Elements and Their Implications for Transitioning to Sustainable Food Systems. A Review." *Agronomy for Sustainable Development* 40, no. 6 (October 27, 2020): 40. https://doi.org/10.1007/s13593-020-00646-z.

Burkina Faso – Land and Natural Resource Governance: Local Land Charter Relating to the Management of the Banks of the 'Son' River in the Municipality of Léna

Effective governance of land and natural resources hinges on recognising and supporting family farmers, smallholders and peasant food producers as stewards of these invaluable assets.[2] Empowering these stakeholders entails establishing robust institutional frameworks that grant them legal recognition and rights to access and manage land, water, seeds and other natural resources. Policies should be formulated to incentivise and facilitate the adoption of eco-friendly practices, ensuring they receive the support needed to thrive.

Capacity building equips farmers with the knowledge and skills required to implement agroecological principles effectively. Through training programmes and extension services, farmers can learn techniques, such as crop rotation, intercropping and natural pest management, enabling them to cultivate crops in harmony with nature for sustainability. Additionally, securing land tenure rights is paramount to safeguarding family farmers and smallholders against land grabbing and displacement. By guaranteeing their tenure security, policymakers lay the foundation for long-term investments in SLM practices.[52] Lastly, promoting participatory decision-making processes that involve local communities in natural resource governance fosters a sense of ownership and responsibility. From community land-use planning to the establishment of resource management committees, these initiatives empower communities to shape policies and practices that align with their unique needs and values.

Supported by ProSoil Burkina Faso, the Local Land Charter (CFL) initiative, focusing on the management of the Son riverbanks within the Léna commune, exemplifies a community-driven approach to land governance. By engaging four villages and various stakeholders, including the commune's administration, Village Development Council (CVD), rural producers' organisations, and technical and financial partners, the CFL aims to enhance social cohesion while regulating the protection and sustainable use of natural resources. The CFL establishes guidelines for activities along the Son riverbanks, aiming to prevent conflicts and degradation of soil and water resources. These guidelines include authorised activities such as water harvesting, extraction of non-timber forest products, and planting approved crops.

Key measures outlined in the CFL include respecting bank and buffer zone easements, obtaining prior authorisation for certain activities, and periodic maintenance of the riverbanks. Furthermore, the CFL prohibits harmful practices such as water pollution, brickmaking in riverbanks, woodcutting and charcoal production. These measures and prohibitions are crucial for safeguarding the integrity of the ecosystem, preserving biodiversity and ensuring equitable access to resources.

More to know:

Learn more about ***governance of managing*** the banks with ***CFL*** of the "Son" River in Burkina Faso on the WOCAT Global SLM Database!

Scan or click on the QR Code below:

[52] Colin Ray Anderson et al. "From Transition to Domains of Transformation: Getting to Sustainable and Just Food Systems through Agroecology." *Sustainability* 11, no. 19 (January 2019): 5272. https://doi.org/10.3390/su11195272.

The implementation process of the CFL promotes inclusive governance,[47] involving scoping meetings, village general assemblies, resource diagnosis, negotiation of management rules and drafting of the charter. This inclusive approach ensures that the interests and perspectives of local communities are taken into consideration, enhancing ownership and compliance with the CFL's regulations. Linking land governance principles to local initiatives like the CFL, communities can work collaboratively to protect natural resources, promote social cohesion, and achieve sustainable food and agricultural systems.


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Ethiopia – Participation: Participatory Rehabilitation of Dry Valleys

Participation in agroecology involves fostering a collaborative environment where stakeholders along the agricultural value chain actively engage in decision-making processes.[2] This approach encourages social organisation by empowering individuals and communities to take charge of their agricultural and food systems. For instance, this has led to formation of farmers' groups and cooperatives. Decentralising governance ensures participants gain a stronger voice in shaping policies and practices that directly affect them, leading to more responsive and adaptable food and agricultural systems.

Participation promotes inclusivity,[47,48] ensuring that diverse voices are heard and respected. Farmers, indigenous communities, consumers and other stakeholders come together to share knowledge, experiences and perspectives. This informs decision-making, leading to more holistic and context-specific solutions that address the unique needs and challenges of different regions and communities. Further, participation in agroecology promotes local adaptive management, allowing agricultural practices to evolve in response to changing environmental, social and economic conditions. Through active involvement in decision-making processes, food producers and consumers become stewards of their local ecosystems, fostering resilience and sustainability in agricultural and food systems.

In the participatory rehabilitation of degraded dry valleys promoted by ProSoil Ethiopia, community participation is at the core of the process. Through consultation and collaboration, local development partners, including agricultural bureaus and relevant stakeholders, work alongside the community at the grassroots level. Technical experts from districts and regions contribute their expertise, conducting surveys and jointly selecting intervention sites based on local knowledge and topographic features. This approach integrates both top-down and bottom-up methods, ensuring that interventions are tailored to the specific needs and conditions of the area. Local agropastoral communities are mobilised by extension agents and educated about SLM interventions. The SLM approaches are scrutinised and approved consultatively.

Throughout this process, community participation is fostered with training and awareness-raising activities, cultivating a sense of ownership and accountability among the stakeholders. Despite challenges, such as the nomadic lifestyle of agro-pastoralists, efforts are made to involve them in decision-making and oversee the implementation of technologies aimed at improving soil and water management in dry valleys. Although their traditional livelihood practices might impede the day-to day participation in manual labour, the involvement of local elders (senior members in the community consulted due to their age, wisdom and experience) reinforces a sense of community empowerment and validates their role as stewards of the land. Ultimately, the participatory approach ensures that interventions are sustainable and responsive to the needs of the people, leading to improved productivity and resilience in dry valley ecosystems.

More to know:

Learn more about ***participatory rehabilitation of dry valleys*** in Ethiopia on the WOCAT Global SLM Database!

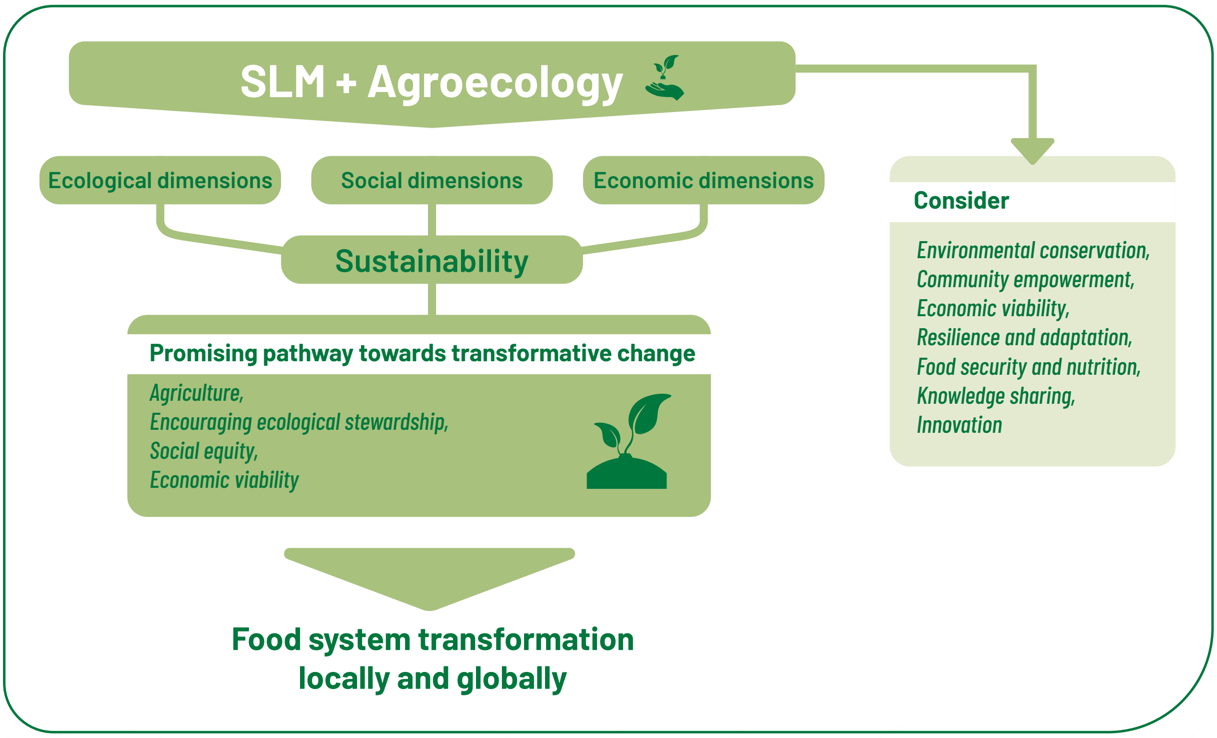
Scan or click on the QR Code below:

Conclusion

Certainly, SLM and agroecology share a close relationship, contributing to more sustainable agricultural and food systems. While it is possible to identify instances where specific SLM practices align with specific principles of agroecology, it is essential to recognise that agroecology operates within a holistic framework that encompasses diverse ecological, social and economic considerations. Attributing individual technologies or approaches to specific agroecological principles provides valuable insights, however, it is crucial to acknowledge the interconnectedness and complexity inherent in agroecological systems. Agroecology emphasises the integration of ecological processes, social dynamics and cultural values, recognising that sustainable agriculture cannot be achieved through isolated interventions alone and that, vice versa, one-sided solutions can be detrimental to unexpected parts of the agroecosystem.

The adoption of SLM practices extends beyond the scope of the Gliessman's Level 1 framework, which focuses primarily on basic agroecological intensification practices. While Level 1 practices are foundational in promoting ecological integration and reducing reliance on external inputs,[5] SLM encompasses a broader range of strategies extending to Gliessman's Level 5 framework[5], addressing various land-related challenges. These include integrated landscape management, participatory approaches, policy interventions and socio-economic considerations, highlighting the multifaceted nature of SLM in fostering resilient and sustainable food systems. Many SLM practices are essential for agroecological intensification, a more appropriate transition pathway for much of Africa than Gliessman's Level 1 emphasis on moving away from industrial agriculture.

Fundamentally, the integration of SLM and agroecology promotes synergies between ecological, social, and economic dimensions of sustainability. Both agroecology and SLM consider: environmental conservation; community empowerment; economic viability; resilience and adaptation; food security and nutrition; knowledge sharing; and, finally, innovation. These common features represent a promising pathway towards transformative change in agriculture, encouraging ecological stewardship, social equity, and economic viability. Moving forward, combining SLM practices within a framework of operationalising the full set of agroecological principles will be imperative for achieving food system transformation locally and globally.



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