Managing soil fertility in Africa – why, where, how, and by whom?

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Why?
There is growing evidence that soil fertility in Africa is declining, as nutrients taken up by harvested crops are not sufficiently replenished by inputs. Reasons for concern are manifold and include crop yield stagnation, looming scarcity of finite nutrients such as phosphorus, declining topsoil carbon stocks, and perhaps the key question: how reversable and costly is this decline? At the same time, population growth in Africa implies a growing food market and opportunities for agriculture to thrive.
Where?
Major differences in soil fertility levels exist in Africa requiring customized management approaches. Fragile sandy soils in the Sahel produce less than the deep red clay soils on the volcanic Rift Valley slopes. Next levels of relevance are toposequence and heterogeneity management, often related to cherishing plots with high value crops. Manure management is an important element. Meanwhile, the more fertile farms in Africa become smaller all the time, gradually falling below household food security levels.
How?
It has become increasingly clear that a combination of organic and mineral fertiliser gives the highest return on investment. The current regenerative agriculture debate turns this too much into an 'either-or' issue. It is necessary to better know soil nutrient levels and crop needs to maximise nutrient use efficiency. Plant analysis should play a more prominent role here. Also a broader Genotype * Environment * Management approach is needed for effective soil fertility strategies. Larger system changes may come into the
picture (e.g., cluster farming), but will meet with loss of employment.
By whom?
Producers, policy makers and private sector interaction is the (not so suprising) answer. The 2024 Africa Fertiliser and Soil Health Summit delivered promises on implementation at national level. The private sector should now see that agriculture in Africa is a growth market. Farmers should be encouraged with knowledge, local business development, and digital tools to keep young people interested. Meanwhile, a lot goes on including large programmes on soil fertility improvement funded by Germany (ProSoil, Soil Matters) and The Netherlands (Soil Values, TRANSFORM, managed by IFDC).

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Assessing the multifunctionality of pastoralism: A holistic framework for resilient rangelands

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Pastoral systems are frequently evaluated solely on economic yield or caloric output, a narrow scope that systematically underestimates their systemic value in arid and semi-arid regions. Addressing this gap, this presentation outlines the multidimensional framework developed under the Global Agenda for Sustainable Livestock (GASL) to capture the true multifunctionality of pastoralism.

The framework evaluates pastoral systems across four core, interdependent pillars:

- Production: Beyond standard economic output, it measures the tangible provision of meat, milk, and hides, alongside the conservation of livestock genetic diversity via specialised local breeds.
- Environmental Stewardship: It assesses critical ecosystem services, including landscape management, biodiversity maintenance, soil fertility enhancement, nutrient fluxes, carbon sequestration, and greenhouse gas mitigation.
- Social Cohesion: It quantifies broader socio-cultural outcomes, including local employment generation, social inclusion, community networks, and the preservation of cultural heritage.
- Local Economic Development: It tracks territorial economic impacts through local income generation, market integration, value-chain creation, and micro-business viability.

Aligned with the UN International Year of Rangelands and Pastoralists (IYRP 2026) and UNCCD COP17, this assessment highlights that pastoralism extends far beyond livestock production – it is a vital mechanism for climate adaptation, ecosystem restoration, and rural livelihood stability. Recognizing and safeguarding these multifunctional foundations is essential for maintaining rangeland resilience against accelerating environmental and socio-economic pressures.

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Multifunctional landscapes for climate-resilient futures: Connecting food, nature, livelihoods and governance at scale

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Agrifood systems must now deliver food, nutrition, livelihoods, climate resilience, biodiversity conservation and ecosystem restoration at the same time. Yet these goals are often pursued through separate projects, policies and institutions. This fragmentation makes it difficult to manage trade-offs or build synergies across land, water, food, markets and governance. The challenge is urgent: 85 percent of wetlands are degraded, around 10 million hectares of forests are lost each year, one million species are at risk, global emissions remain at 50 to 60 gigatonnes of CO_2 equivalent annually, and about three billion people cannot afford a healthy diet.

The CGIAR Multifunctional Landscapes Science Program responds by placing the landscape at the centre of agrifood systems transformation. Its ambition is to sustainably transform landscapes so they can deliver food, climate, nature and livelihood benefits simultaneously and at scale. The programme focuses on the critical space between farms and national or global systems, where decisions on production, restoration, water, biodiversity, tenure, markets and investment come together.

CGIAR MFL uses a participatory, transdisciplinary and integrated socio-ecological systems approach. It brings together five connected areas of work: Agroecology+ Solutions and Innovations; Landscape Optimisation and Inclusive Planning; Markets, Business Models and Sustainable Finance; Governance, Policy, Institutions and Inclusion; and Performance Assessment and Evidence Generation. Together, these areas support context-specific solution bundles rather than isolated interventions.

The programme works through Multifunctional Living Landscapes, which serve as long-term platforms for co-design, implementation, negotiation, monitoring and learning. In these landscapes, researchers, governments, farmers, pastoralists, Indigenous Peoples, civil society, private actors and development partners identify priorities, align land and water management, strengthen governance, mobilise finance and generate evidence for scaling. MFL operates across diverse systems in Africa, Asia and Latin America, including highland-lowland mosaics, forest-savannah transitions, drylands, Sudano-Sahelian systems, Andean-Amazon systems and the Lower Mekong.

For Tropentag's theme on multifunctional agro-ecosystems and climate-resilient futures, CGIAR MFL offers a practical model for connecting science with action. Its projected benefits include improved livelihoods and diets for about eight million people, restoration of more than 15 million hectares, around 800 million tonnes of CO_2 equivalent mitigation, and maintenance or restoration of biodiversity and semi-natural habitats.

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Transforming Asia's rice systems: Integrated pathways to climate-resilient, low-emission, and inclusive futures

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Rice is fundamental to Asia's food security, rural economies, and cultural identity, yet the systems that sustain it are under growing pressure. Climate extremes, water scarcity, environmental degradation, labour shifts, and changing markets are reshaping rice production, rural livelihoods, and the wider food systems in the region.

Meeting these challenges requires more than a series of stand-alone innovations. It calls for coordinated change across crop improvement, water and soil management, climate and digital services, risk reduction, markets, and institutions. IRRI's experience and partnerships across the region demonstrate how research can shape policy, guide investment, strengthen national capabilities, and support the wider adoption of solutions suited to local conditions. Progress will depend on sustained collaboration among governments, researchers, the private sector, and farming communities. The task is to build rice systems that remain productive under a changing climate, reduce emissions, widen opportunities, and protect the natural resources on which Asia's long-term food security depends.

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Living *with* forests: Insights from the past into land 'use' for climate resilient ecosystems and futures

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Land use is one of the most tangible expressions of our intensifying impact on the Earth system in the Anthropocene. This is particularly the case in the latitudinal tropics, where alterations to land cover have impacts on biodiversity, the climate, and carbon cycle which can be felt on regional and global scales. While these human-forest-Earth system relationships are key parts of a number of so-called 'Anthropocene crises' in the 21st century, their origins lie much deeper in the past. In this talk, I argue that the past is key to understanding baselines of change, feedbacks between human activities, land cover, and the Earth system, and historical path dependencies and inequalities which characterise human-forest relationships in the latitudinal tropics today. I highlight how multidisciplinary approaches to historical land use change are providing a tangible, quantitative, and contextualized bases for charting more just and resilient future courses, enabling us to test and validate scenarios of land use change and ecosystem and Earth system response. Moreover, I emphasise how archaeology, history, ethnography and, critically, amplifying the voices of Indigenous communities, can lead us to consider more diverse perspectives to our relationship with land and forests than simply 'use'. In this way the past, instead of being an anecdote, becomes a key landmark for understanding the diversity of ways people not only *have* but also *can* live with tropical ecosystems.

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Resilient crop, livestock and agroforestry systems

Innovation and resilience in smallholder cropping systems

Fruit and vegetable species richness and seasonal availability on smallholder farms in Kilifi county, Kenya

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Fruits and vegetables are important for healthy diets, providing vitamins, minerals and phytochemicals, and could thus contribute to addressing micronutrient deficiencies. However, these crops are highly seasonal, often depending on rainfall patterns. Diversified cultivation of several fruit and vegetable species in an agroforestry system can potentially mitigate the impacts of seasonal food scarcity, a severe problem of many smallholder farming households in sub-Saharan Africa, including Kenya. This study aimed at determining richness and seasonal fruit and vegetable species availability in Kilifi County, Kenya. Four farms that participated in an agroforestry project (AfriNutriForest) were selected and wild and cultivated fruit and vegetable species inventoried. After assessing seasonal availability of the documented fruit and vegetable species in Focus Group Discussions (FGD) with local farmers, harvest calendars were developed.

In total, 37 vegetable species were documented, including 19 wild native ones. Only 10 vegetable species were present on all four farms, including cultivated ones, like spiderplant (*Cleome gynandra*) and *moringa* (*Moringa oleifera*) and wild species, including bitter lettuce (*Launaea cornuta*) and *Oxygonum stuhlmannii*. Regarding fruits, 41 species were recorded, including eight wild species. Nine fruit species were found on all four farms, most commonly coconuts (*Cocos nucifera*), bananas (*Musa* spp.) and mangoes (*Mangifera indica*).

The harvest calendars indicated that availability of mature fruit and vegetable species ran asynchronously throughout the year. Vegetable availability peaked just after the 'long rains' (March-May) in May and June, followed by a lean season in Aug-Sep and a second peak during/after the short rains in Oct-Dec, followed again by lower availability from Jan-March. Contrarily, fruit availability reached a clear peak in Nov-Jan and a less pronounced peak in July-Aug, while from Feb-May fruit availability was low. These asynchronous harvest patterns may help farming households cope with food insecurity, as vegetables were generally available when fruits were not and vice versa, however, only if a diverse set of both fruit and vegetable species are produced on the farm throughout the year. Diversified horticultural production in agroforestry systems could thus be promoted, but more robust data should be collected.

Keywords: Agrobiodiversity, agroforestry, climate resilience, food security

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