United Nations
Convention to Combat Desertification

ACTION GUIDE 2

RESTORING SOIL HEALTH FOR NATURE-POSITIVE FOOD PRODUCTION

A pathway for safeguarding human and planetary health

ACTION GUIDES FOR THE FOOD SYSTEMS SUMMIT

The goal of the UN Food Systems Summit Action Track 3 is to boost nature-positive food production at the scale needed to meet the fundamental human right to healthy and nutritious food, while at the same time restoring balance with nature. Together with farmers, pastoralists, fisherfolk, indigenous peoples, local communities, policymakers, scientists, extension agents and the private sector, Action Track 3 will co-design game-changing solutions and collective actions that simultaneously work for nature, people, and the climate.

This series of Action Guides introduces agroecological approaches and regenerative practices that make food production systems more sustainable and resilient. The strategies and actions presented in these Action Guides are evidence-based, proven to be effective, and can be adapted to diverse settings.

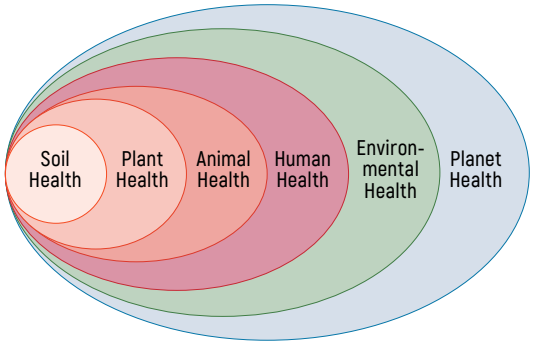
Each Action Guide focuses on key elements that influence the social, economic, and environmental dimensions of food production: soil, gender, tenure, youth, drought and water scarcity, livestock and pastoralism, among others. Collectively, the series offers a systems perspective to guide regenerative actions for both small and large producers to promote nature-positive transformation.

THE ISSUE

Soil is often seen as little more than the shallow layer of dirt on the Earth's surface. Its role in providing almost all our food calories, regulating water supplies, supporting biodiversity, and helping stabilize the global climate is widely overlooked and frequently undervalued.

The current methods used to produce crops and livestock have contributed to a worldwide decline in soil health. However, agroecological approaches and regenerative practices recognize that healthy soils are the foundation of human development.

Adopting a sustainable soil management approach will restore soil health and functions and help reduce the negative environmental footprint of current food production systems, while simultaneously improving livelihoods, delivering ecosystem services, and boosting food security.



DATA SNAPSHOT

IMPACTS OF FOOD PRODUCTION ON SOILS

Soils are home to an estimated

25%

of the world's biodiversity

Source: FAO, ITPS, GSBI, SCBD, and EC. 2020. State of knowledge of soil biodiversity - Status, challenges and potentialities, Report 2020. FAO, Rome.

A teaspoon of healthy soil contains up to

1 billion

individual bacteria and several meters of soil fungi

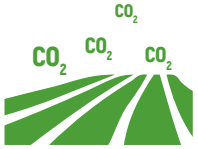
Source: Bultman, M.W. et al., 2013. The ecology of soil-borne human pathogens. In Essentials of Medical Geology, pp. 477-504. Springer, Dordrecht.

Crop and pasture lands caused an estimated

54%

of global soil erosion by water in 2015

Source: Borrelli, P. et al. 2020. Land use and climate change impacts on global soil erosion by water (2015-2070). PNAS, 117(36), pp.21994-22001.



Most agricultural soils have already lost between

25-75%

of their original store of organic carbon

Source: Lal, R., 2013. Intensive agriculture and the soil carbon pool. Journal of Crop Improvement, 27(6), pp.735-751.

By 2050, global cropland expansion is estimated to loose

11.3 Gt

of soil carbon stocks

Source: Molotoks, A. et al. 2018. Global projections of future cropland expansion to 2050 and direct impacts on biodiversity and carbon storage. Global Change Biology, 24(12), pp.5895-5908.

Cover crops can lock up over

0.4 Gt

CO_2-e as soil organic carbon annually

Source: Bossio, D.A. et al. 2020. The role of soil carbon in natural climate solutions. Nature Sustainability 3, pp. 391–398.

CURRENT OVERVIEW

Soils remain largely neglected

Poor management practices and resource-intensive farming have damaged vast areas of agricultural land. Annual cropping and tillage have significantly reduced soil organic matter and the capacity of soils to store carbon, retaining less moisture and fewer nutrients for crops and vegetation. Heavy machinery and excessive livestock numbers have compacted soils. Soils are further vulnerable to wind and water erosion, surface sealing, poor infiltration, and increased risk of flooding.

Coupled with the often indiscriminate and overuse of agrochemicals and other contaminants, many cultivated soils are inhospitable to below-ground biodiversity — the billions of tiny organisms that support ongoing soil formation and other ecological processes essential for producing food. Degraded soils contain fewer macro- and micro-nutrients, resulting in a downward spiral in yields, nutritional quality, and food safety.

One response to falling soil productivity has been the rapid expansion of agriculture into natural ecosystems, releasing billions of tons of carbon dioxide into the atmosphere in the process. Today, the global food system is responsible for around one-third of anthropogenic greenhouse gas emissions. Deforestation and conversion of land has also contributed to biodiversity loss, desertification, changing weather patterns, natural resource conflicts, and forced migration.

Sustainable soil management can be adapted to both small- and large-scale food production systems worldwide. By rebuilding soil organic matter and healthy living soils, soil carbon can be retained for potentially long periods of time. Degraded land can be rehabilitated and restored by agricultural practices themselves. Healthy soils produce abundant and nutritious food while regulating the water cycle and supporting a rich community of soil biodiversity needed for other essential ecosystem services.

Sustainable soil management provides a high return on investment by fueling a virtuous circle of ecosystem services and agricultural production.

Soil management strategies are scalable and effective

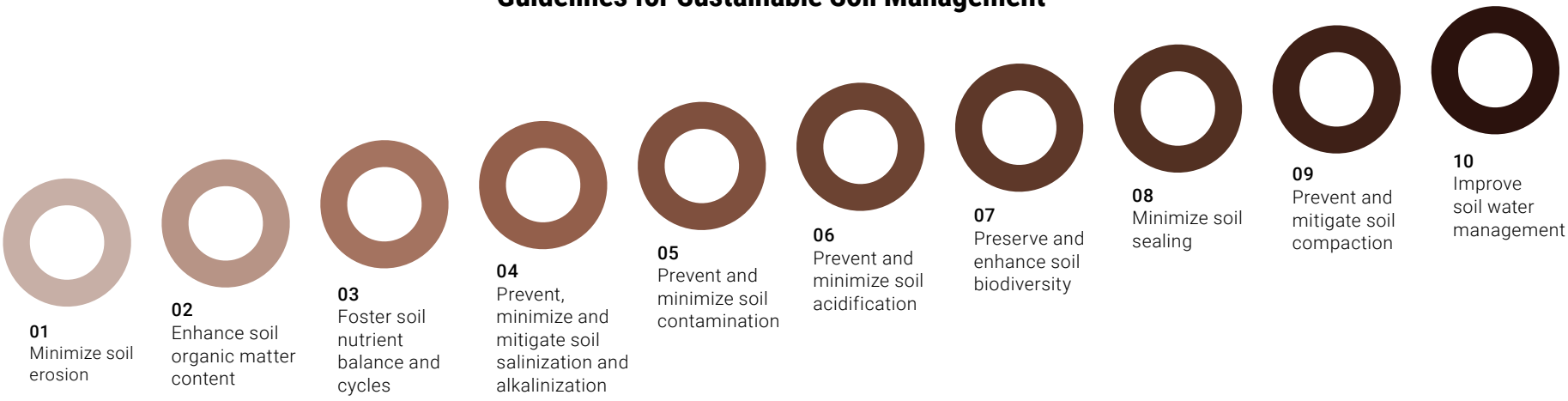
A regenerative and sustainable soil management approach to food production is a scalable and effective strategy to achieve food security along with other actions to protect, manage, and restore agricultural land.

Protect — Halting the conversion of natural ecosystems is an obvious way to protect soil health. This applies to tropical rainforests, on-farm native vegetation, and riparian buffer zones. Maintaining ecosystems, no matter how small, helps protect their soil carbon, nutrients and biodiversity. Adjacent farms benefit from habitat that supports pollinators and wildlife that manage crop pests. Furthermore, protecting and conserving carbon-rich soils (black soils) is key to restoring climate balance.

Manage — For land already under production, sustainable soil management can deliver optimized yields on a long-term basis and reduce pressure to expand further into natural areas. These management practices can be tailored for local conditions and specific risks. For example, by ensuring permanent ground cover and avoiding overgrazing by livestock, erosion and loss of soil structure can be avoided on slopes and hillsides.

Restore — Providing farmers with the right incentives, technical support, and tools can help them to replenish depleted and damaged soils. For example, strengthening the land tenure rights of farmers will encourage the use and management of soils in ways that restore fertility, structure, and capacity to hold moisture. Incentives or payments for the ecosystem services provided by soils could be used to rehabilitate abandoned agricultural lands or restore them to their natural state.

Guidelines for Sustainable Soil Management



Soil health and human health are indivisible

Biodiverse, nutrient- and carbon-rich soils are quite literally the foundation for healthy and nutritious foods, human physical and mental development, and overall wellbeing. Degraded soils result in lower yields and food quality that increase the risk of malnutrition, micronutrient deficiencies, and related health issues (known as 'hidden hunger'). For example, the availability of diverse, nutrient-dense foods helps avoid stunting in infants. While these can be partially addressed using biofortification, sustainably managing soils addresses the soil-crop-human nutrition continuum, offering a comprehensive ecological solution that is people-positive.

As stewards of the soil, farmers play a significant role in catalyzing a 'one health' systems approach. This involves implementing good soil, plant, and animal health practices that increase the nutritional content and safety of food commodities. Well-functioning soils both support and rely on a wealth of biodiversity to mitigate contamination and regulate pests and infectious pathogens. Healthy soil bacteria can help synthesize and eliminate toxic substances and has significant potential to mitigate climate change. It decreases the need to use mineral fertilizers by increasing available nutrients in the soil, and reduces nitrous oxide emissions. By lowering the need for inorganic fertilizers, herbicides, and pesticides, healthy soils help minimize farmer and environmental exposure to agrochemicals.

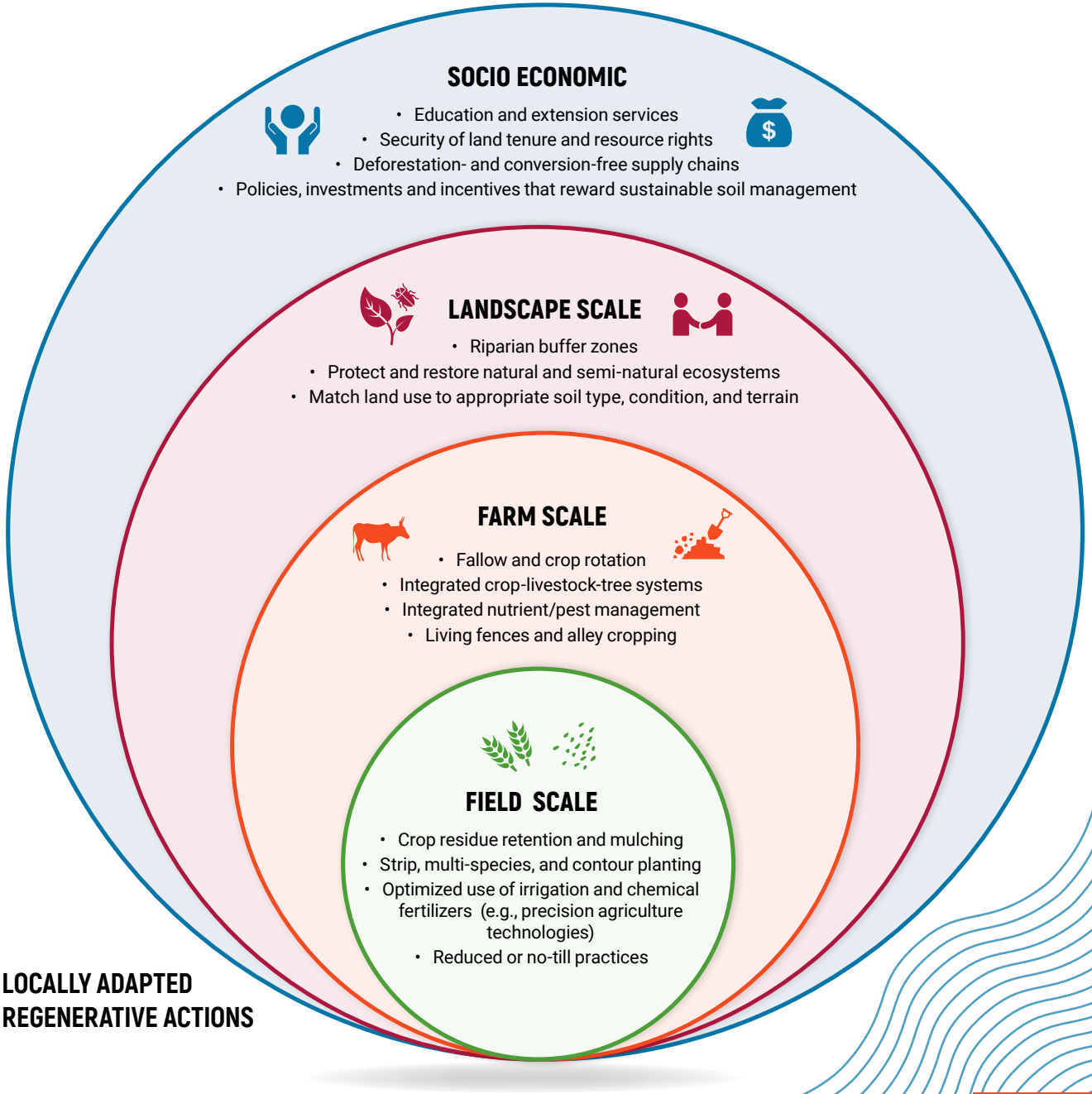
Water quality and availability suffers greatly when soils are poorly managed. Soil pollution and the siltation of waterways can impact water quality and flows in distant freshwater and marine systems. Agrochemicals, often applied in excess of crop needs, pollute groundwater and cause algal blooms and fish die-off in affected water bodies. Nature-based solutions involving soil microorganisms have significant potential to reduce nitrous oxide emissions as well as other forms of nitrogen that contaminate groundwater and coastal ecosystems. Conversely, healthy soils purify water by decomposing contaminants and filtering out particles, providing clean, safe water for humans, livestock, and crops.

Protecting and restoring soil biodiversity

Actions taken at the field, farm, and landscape scales as well as in the socio-economic domain, all play a part in conserving and restoring soil biodiversity. These communities of organisms include earthworms, the ecosystem engineers that help the flow of water, nutrients, and gases; termites that enhance soil fertility, aeration, drainage, and root penetration; springtails and mites that aid litter decomposition and nutrient cycling; algae that help protect the soil surface from erosion; and arbuscular mycorrhizal fungi that promote the uptake of nutrients by plants.

It is estimated that over 10 trillion bacteria live in one cubic meter of soil.

Managing soils sustainably can nurture the abundant and diverse community of organisms needed for long-term soil health and the sustained production of nutritious foods. Reduced tillage, rotational grazing practices, and minimal inorganic chemical inputs all help soil organisms drive nutrient cycling, soil formation, and other resilience-building ecosystem services. These functions also benefit from regular inputs of organic matter provided by plant-based mulches, crop stubble, and decaying roots from sequential planting and continuous ground cover.



GOOD PRACTICE

Boosting soil fertility using legume crops

Soils that are degraded or have naturally low fertility hold back potential crop and animal yields across much of Africa. A critical first step towards restoring soil health involves building organic matter and nitrogen stores. This leads to increased productivity and yields, more nutritious food for humans and livestock, and higher farm incomes, all while enhancing soil health.

The N2Africa project helped build the capacity of farmers to use a variety of legume species, together with sustainable soil management practices and the use of rhizobium bacteria. These are variety-specific bacteria needed in soils to help legumes fix nitrogen from the air into the soil. As well as adding nitrogen to soils and making it available to crops, legumes add much-needed organic matter in the form of crop residues and decaying roots.

The benefits to soil health achieved by rotating legume and maize crops helped increase maize yield in some countries by up to 1.3 tons per hectare, lessened the incidence of crop failure, and reduced crop pests and diseases. By 2017, N2Africa had reached more than 600,000 smallholder farmers with improved technologies for grain-legume production.

Photo: ©N2Africa/Isaac Chabata

Healthy soils are a shared responsibility

The livelihoods of both small- and large-scale farmers and pastoralists depend on healthy soils. Through their stewardship, soils can support healthy landscapes, rural employment, and provide clean drinking water. Secure access to productive land is critical as it is often the most important asset held in these natural resource-dependent rural communities. With climate change projections that point to an increase in the frequency and damage caused by extreme weather events, the need to maintain healthy soils is even more important.

Cover cropping increases soil microbial abundance by

27%

when compared to bare fallow

Source: *Nakian, K., et al. 2020. Do cover crops benefit soil microbiome? A meta-analysis of current research. Soil Biology and Biochemistry, 142, 107701.*

Soil management practices can boost water use efficiency by an estimated

25-40%

Source: *Hatfield, J.L., et al. 2001. Managing soils to achieve greater water use efficiency: a review. Agronomy journal, 93(2), pp.271-280.*

Soil carbon represents

25%

of the potential of natural climate solutions

Source: *Bossio, D.A. et al. 2020. The role of soil carbon in natural climate solutions. Nature Sustainability 3, pp. 391–398.*

Healthy soils are the foundation of a healthy life.

In many parts of the world, smallholder food producers play a central role in underpinning local food security, providing diverse diets, and contributing to household incomes. Empowering smallholders through more secure land tenure, active extension services, mobile phone-based technologies, incentives and investments will help scale out sustainable soil management strategies, enabling them to be a vital agent of change in a decarbonizing economy.

KEY MESSAGE

Restore soils for human and planetary health

Sustainable soil management can unlock the potential of soils to deliver sustained improvements in the quality, safety and quantity of food produced.

Healthy and well-functioning soils are the basis for healthy plants, animals, people, and ecosystems.

Investing in sustainable soil management provides numerous short- and long-term benefits to food producers, consumers, and the wider environment.

Rethink the skin of the Earth – The way we use and manage soils to produce food needs to better reflect its life-giving qualities, irreplaceability, and role as the basis of human and planetary health. The true value of soil can be embedded in land use planning, incentives that reward good stewardship, farmer outreach, extension and education, and local actions.

Prioritize soil carbon and biodiversity – Taking actions to sequester soil organic carbon will increase existing stocks and help mitigate climate change. It also helps enhance resilience through below-ground biodiversity which underpins water regulation and other services. Avoiding the release of carbon already locked-up in natural and semi-natural ecosystems should be a foremost priority.

Support soil stewardship – Repairing and caring for soils is in everybody's interest. Empowering and rewarding those who manage the land to transition to practices that use the soil sustainably will reduce the pressure to convert carbon-rich forests and grasslands, provide more nutritious food, and preserve water quality and wildlife habitat.

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