Soil Protection and climate change adaptation: How can a healthy soil help combat the impacts of climate change?

BACKGROUND

Climate change is a major threat to agricultural production. Africa is particularly affected. Since 1961, total agricultural productivity growth in Africa has been reduced by 34 per cent due to climate change. These negative effects are likely to increase. The yields of staple cereals and legumes in the tropics are expected to decline by 5 per cent for every degree Celsius of global warming. Yield reductions and harvest failures are undermining food security and increasing hunger. Depending on the climate scenario, up to 80 million additional people could be at risk of hunger due to climate change (IPCC 2022).

Soils are important in mediating the impacts of climate risks such as yield losses due to drought or crop damages caused by waterlogging. Globally, up to 40 per cent of land is degraded (UNCCD 2022). Agricultural production based on degraded soils with low fertility, water infiltration, and holding capacity is more vulnerable to adverse weather events and unfavorable seasonal conditions. This results in declining and unreliable yields, lower quality of produce, and a higher need for external resources to stabilize production, e.g., in the form of irrigation.

Through adaptation strategies, some of the damages from climate change can be limited if farmers have access to the knowledge and resources to implement them. Particularly, smallholder farmers and pastoralists have a strong need for adaptation as their livelihoods are vulnerable to the impacts of climate change. They often also face high barriers to adaptation, such as lack of access to finance, infrastructure, or knowledge.

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THE GLOBAL PROGRAMME IN BRIEF

As part of the German special initiative „Transformation of Agricultural and Food Systems", the Global Programme "Soil protection and rehabilitation for food security" (ProSoil), supports and advises smallholder farmers in Ethiopia, Benin, Burkina Faso, India, Kenya, Madagascar and Tunisia on agroecological and climate-smart agricultural practices and transformation processes focusing on sustainable land management. Alongside the respective government agencies of each country, stakeholders from the scientific community, civil society and the private sector are also actively involved in the measures. The Global Programme is commissioned by Germany's Federal Ministry for Economic Cooperation and Development (BMZ) and co-funded by the European Union (EU) and the Bill & Melinda Gates Foundation. Since the beginning of the Global Programme in 2014, soil degradation has been reversed on more than 949.000 hectares of land. This results in an average yield increase of 44 per cent, directly benefitting the lives of 2.5 million people.

Why the topic is important?

Soil protection and rehabilitation (SPR) aims to maintain and enhance soil functions and the productive capacity of soils by halting degradation and restoring degraded soils. SPR comprises a set of practices that are combined and adapted to local contexts, such as integrated soil fertility management, vegetative erosion control, or conservation agriculture.

SPR reduces the vulnerability of agricultural production systems to adverse climatic conditions by improving soil health, fertility, water holding and infiltration capacity, as well as soil biodiversity. Many practices also introduce diversification of products, making rural livelihoods more resilient and supporting households that depend on them. Some SPR measures, like erosion protection, also directly address climate impacts such as increased water erosion from more frequent and intensive rainfall events.

Many SPR approaches and practices are low-cost and low-tech, making them particularly suited for small food producers facing barriers to accessing finance, technology, and markets. Additionally, SPR is often climate-smart, meaning that it increases productivity and enhances resilience while contributing to climate mitigation, for example, by building up soil organic carbon and vegetative biomass.

However, there are limits to SPR's impact on climate adaptation. In the case of prolonged extreme events or fundamental changes in seasonal climatic conditions, more transformative approaches to adaptation are needed. This could include geographically shifting locations where specific crops are grown and comprehensive risk management, including social safety nets, disaster preparedness[1], and risk transfer.

Challenges

Smallholder food producers are highly dependent on seasonal climate and weather conditions as well as functioning ecosystems for their livelihoods. Land and soil degradation undermines ecosystem functions and thus the livelihoods depending on them. Climate change increases the risk of lower yields and crop failures. At the same time, smallholders face particularly high barriers for climate change adaptation such as lack of access to finance, inadequate rural infrastructure, insufficient extension services and missing market access. Public investment in these is often limited and inadequate.

Some adaptation actions at the landscape level, e.g. within a watershed, go beyond individual farms and require collective action based on the engagement of various stakeholders. Local institutions, whose role it is to provide a frame for this, often face capacity challenges for anticipating climate risks, coordinating and planning interventions at this level. At the macro level, economic evidence for the adaptation benefits of SPR to inform policy making is scarce.

How to overcome the challenges?

The core approach of ProSoil is to enable farmers to increase their yields. This includes to promote practices suitable for climate change adaptation such as conservation agriculture, agroforestry, soil and water conservation, or the cultivation of drought resilient crops. The program strengthens local extension models including agro-climate advisory services and supports the establishment of business models which facilitate agro-ecological inputs for adaptation (e.g. organic

1 In India, for instance, onion growing smallholder farmers reported that the agro-ecological farming approach enabled them to manage precipitation peaks of 60 mm/day, which can lead to total harvest losses for conventional farmers. However, they assume this advantage might have its limits when faced with precipitation peaks of 80 mm/day or more, requiring additional strategies e.g. for enhanced erosion control to improve climate resilience.

fertilizers or small machineries). ProSoil also promotes the development of local markets as a pull for adaptation practices (e.g. cassava, non-timber forest products or millet). A participatory assessment of the adaptation benefits based on climate projections guides interventions.

At a higher level ProSoil supports local and regional institutions to carry out climate sensitive planning and to implement landscape-based approaches e.g., for the rehabilitation and productive use of dry valleys in the arid Ethiopian lowlands. The program also aims to facilitate access to finance for climate adaptation e.g., through the voluntary carbon market or by supporting municipalities to access national climate funds. Together with its research partners the program is expanding the evidence base for SPR as an effective adaptation option.

Outcomes

- Global results: 812,000 hectares of protected or rehabilitated agricultural land have increased yields by an average of 32 percent compared to reference areas in the same regions. Study results show that the project's agro-ecological intensification approach leading to these productivity gains directly translates into improved food and nutrition security for smallholders.
- In total over 2 million beneficiaries have directly benefited from the application of soil protection and rehabilitation practices with adaptation benefits. Multistakeholder assessments with key experts and representatives from target groups based on climate projections have confirmed the relevance of practices for adaptation in the intervention areas.
- In Madagascar, for example, the project has introduced mixed crops of cereals and legumes that help to reduce the effects of erosion and increase the region's resilience to the effects of climate change.
- The rehabilitation of degraded dry valleys in Ethiopia, for example enables farmers to control the climate risk of extreme floods and replenish the groundwater resources. This creates new green landscapes that are highly productive and can feed up to 6,000 people per dry valley.
- 48 percent of the 608,415 smallholder farmers involved, 36 percent of whom are women, have implemented project packages of agro-ecological measures that are suitable for adapting to climate change risks.
- The improvement in the soil organic matter content resulting from compost fertilization, which is promoted by the project activities, increases the water holding capacity of the soil and thus acts as a buffer against volatile precipitation.
- Several input supply models for adaptive practices have been established to support agro-ecological intensification: For example, 55.000 tons of urban compost were supplied to farmers in India since 2023 and over 16,000 tree seedlings from local nurseries for agroforestry in Burkina Faso in 2022.

EXAMPLE FROM THE FIELD

Ethiopia: Dry Valley Rehabilitation and Productive Use (DVRPU) approach

Kedir Hanfre, a community councillor in Awra District in Ethiopia's Afar region, recalls a time twenty years ago when the landscape was lush with grass and trees. Today, the once-fertile land is marred by deep erosion channels, and water no longer spreads across the plains. The women of the community also remember when rains came regularly, four times a year, nourishing rich pastures where the grass grew so tall that only the cows' horns were visible above. Now, rains come only once or twice a year, often in heavy bursts of flash floods from the highlands, or sometimes not at all.

Faced with these challenges, the community has adopted the Dry Valley Rehabilitation and Productive Use (DVRPU) approach, which promotes a holistic landscape

management plan to restore ecosystems, improve livelihoods, and build resilience to climate change. By constructing physical structures like water-spreading weirs and drystone walls, the community has learned to control erosion and utilize water more efficiently. These structures help capture and slow down the torrents rushing from the mountains, allowing fertile soils to settle over a wider area. This not only halts erosion but also revives vegetation, with grass once again flourishing along the riverbeds. Improved water retention has dramatically increased access to water – from just two months in the past to six or seven months now – benefiting both people and livestock.

The DVRPU approach goes beyond merely stopping erosion. It integrates water management, soil conservation, and reforestation within a broader landscape-based planning framework. This method views the valley as a whole, recognising the interconnectedness of land, water, vegetation, and human activity. The project collaborates closely with international agricultural researchers to identify crops that thrive in these dryland conditions, ensuring that landscape restoration also supports sustainable agricultural practices. On a policy level, project advisers and national partners are incorporating these successful techniques into national guidelines on soil and water protection. The approach is also being included in the government's strategy for flood-based development in pastoral areas, promoting long-term resilience in vulnerable lowland communities.

Key messages

- Given the importance of soils in agricultural production and the nature of climate risks, soil protection and rehabilitation are cornerstones for adaptation strategies in the agricultural sector and for the resilience of rural areas.
- Enabling farmers to successfully implement adaptation actions, requires access to the necessary knowledge, agro-ecological inputs and markets. Governments and donors should invest in extension service delivery and in developing supply and value chains for agro-ecological inputs and produce.
- Extension services and advisories should integrate climate and soil information and consider the local feasibility of adaptation actions. Targeted interventions through government or development projects can improve the feasibility and facilitate adoption of SPR practices.
- Climate resilience is built both on the level of farms and the landscape. Capacity development for local institutions is important for successful adaptation at the landscape level.
- Innovative approaches are needed to finance adaptation in rural areas. Development cooperation can de-risk to facilitate investments. Sometimes even simply by developing evidence on the effectiveness of practices. Voluntary carbon markets offer a new opportunity to channel private finance into climate smart extension services.
- Additional evidence on the economic effects of adaptation through soil protection and rehabilitation is needed to get the buy in from decision makers and as base for evidence based planning and policy making.

Sources

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