german cooperation
DEUTSCHE ZUSAMMENARBEIT

Standing on climate resilient ground

What can agroecology do for climate change adaptation and food security?

The case of soil protection and rehabilitation

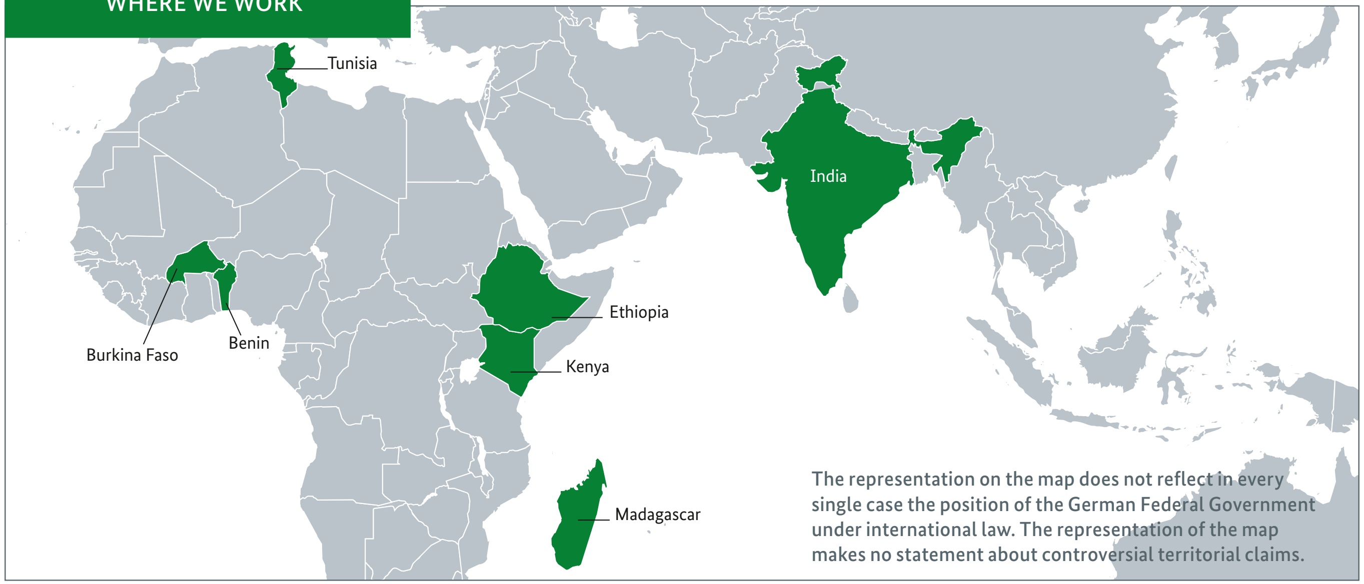
Implemented by:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Climate change, agroecology and soils

Climate change impacts agri-food systems and undermines food and nutrition security in many parts of the world, as it increases the frequency and severity of droughts, floods, heatwaves, and other extreme weather events. In addition, overexploitation as well as unsustainable use of resources push natural and agricultural ecosystems to their limits. Smallholder farmers and agro-pastoralists are particularly affected because their livelihoods often solely depend on their own agricultural production. At the same time, they face high barriers for climate change adaptation, such as limited access to financing and inputs. Adapting to changing climatic conditions and building resilience is a key challenge not only for farmers and agro-pastoralists, but entire agri-food systems.

There is no universal solution to tackling climate change and building the resilience of smallholder farmers and pastoralists. Instead, integrative approaches that holistically view agri-food systems should be developed. Agroecology (AE) is one systemic approach that links food production at farm level with the broader social-ecological system. It is recognized as an important transformative approach for agri-food systems in the scientific and political discourse. It aims to increase productivity and efficiency per unit of land, while conserving soil and water resources as well as biodiversity. AE offers great potential for climate change adaptation while being recognized as a solution for improving food security and rural livelihoods, as many climate impacts on agricultural and pastoral production manifest themselves at the soil and water interface. Many AE projects already specifically target more resilient land use systems by strengthening ecological principles, one of which is the promotion of soil health through soil protection and rehabilitation (SPR) measures.

WHERE WE WORK



Healthy soils are the foundation of agri-food systems as well as the livelihoods of smallholder farmers and agro-pastoralists. Fertile soils support nutritious and stable crop yields, while diminishing soil quality may lead to land degradation and increase vulnerability to climate change. SPR measures show great potential to increase the quality and fertility of soils as well as combat land degradation. Practices such as compost application, soil and water conservation as well as agroforestry are able to increase the organic matter of soil and improve its ability to hold and absorb water. This ultimately strengthens the agri-food systems that sustain them against the impacts of climate change and reduces the vulnerability of smallholder farmers and agro-pastoralists. SPR creates further benefits, such as food and nutrition security, climate change mitigation, ecosystem restoration, improved water management and biodiversity conservation. However, in many parts of the world, soils are degrading due to unsustainable land and soil management as well as the severe effects of climate change. Therefore, greater attention must be paid to the protection and rehabilitation of soils in order to prepare agri-food and land use systems for the future.

ProSoil objective and intervention areas

The Global Programme Soil Protection and Rehabilitation for Food Security (ProSoil) connects these objectives by implementing climate smart SPR measures at scale to improve food security and resilience against climate change. It is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). ProSoil works in the partner countries Benin, Burkina Faso, Ethiopia, India, Kenya, Madagascar, and Tunisia. As a result over 1.5 million people benefited from the application of adaptation relevant farming practices and improved their climate resilience. ProSoil contributes to the objectives of the Paris Agreement to limit global warming to well below 2°C and to foster climate resilience by improving soils as a carbon sink. The project additionally aims to share experiences across countries and to produce detailed information on the climate smartness of SPR measures regarding both adaptation and mitigation.

Adaptation monitoring and evaluation

Adaptation monitoring is important to leverage SPR for enhanced climate change adaptation, as it displays the program's impacts and provides feedback for learning and adjustments. The results provide targeted support to farmers, inform public extension services, and advise ministries on strategies for addressing the impacts of climate change. Furthermore, results between countries or regions can be compared. The overall goal is to identify good practices and share experiences. Evidence is also important for accountability and is a condition for adaptation finance. However, adaptation monitoring is challenging because adaptation is always context-specific. SPR measures must respond to specific climate risks and must be also suitable to the local biophysical as well as social conditions in order to support effective adaptation.

A monitoring and evaluation approach was developed and implemented in the ProSoil partner countries in order to assess the contribution of the employed SPR measures to successful adaptation. The tool is primarily geared towards rural development projects wanting to evaluate and improve their effectiveness in terms of climate change adaptation as well as local feasibility. The systematic approach is used to identify relevant climate risks and evaluate the adaptation effectiveness of SPR measures as well as their local feasibility.

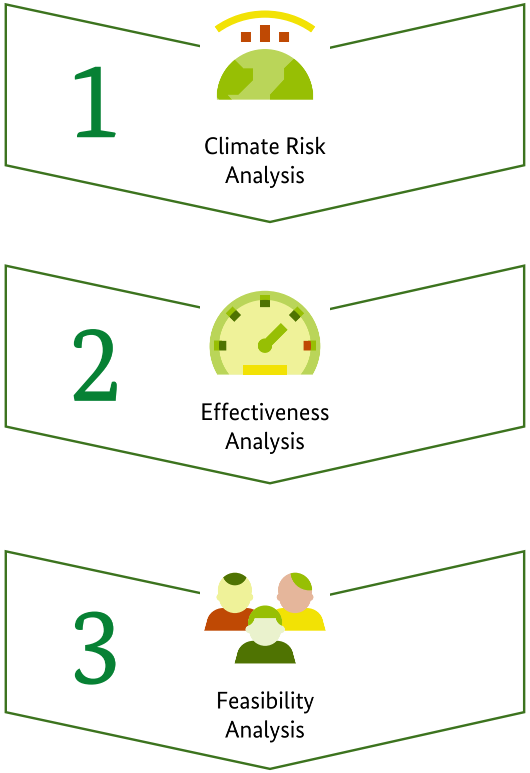
Assessing soil protection and rehabilitation measures with a three-step multi-stakeholder approach

To assess the effect of SPR measures on climate change adaptation, implementers should follow the three questions:

1. What climate risks do we face and how will they evolve?
2. Are the SPR measures effective in response to these risks?
3. Are the measures feasible in the local context?

Hence, the chosen approach consists of three steps – a climate risk analysis and prioritization (step 1), an analysis of climate adaptation effectiveness (effectiveness analysis) (2) as well as an analysis of socio-economic feasibility (feasibility analysis) (3). To go through the three steps, a series of multi-stakeholder workshops was conducted across the ProSoil partner countries.

The overall process and possible forms of workshop implementation are described in a guidebook that summarizes the approach developed for the GIZ Programme ProSoil by the consultancy HFFA Research.



Results and case studies from the ProSoil adaptation monitoring 2022

Adaptation monitoring workshops were carried out in partner countries within the ProSoil project. In the context of the climate risk analysis (step 1), there were two risks that all partner countries found relevant for the regions where SPR measures are implemented. These are an increase in drought events and an increase in heat stress for plants and animals. Increasing water erosion, the loss of fertile topsoil and changes in pests and diseases are also prevailing risks in most countries. Global climate projections show an increase in temperature as well as an increase in the frequency and severity of extreme weather events triggered by climate change. Further impacts differ between regions. Also, the ProSoil adaptation monitoring showed that other climate risks, such as bushfires, erosion caused by wind or coastal flooding, are highly context-specific and therefore apply only to individual countries or specific regions. Farming systems across and within the target countries and intervention zones of ProSoil differ greatly in terms of various factors, such as climate risk and agro-ecological factors. However, it is possible to draw some general conclusions from the analyses.

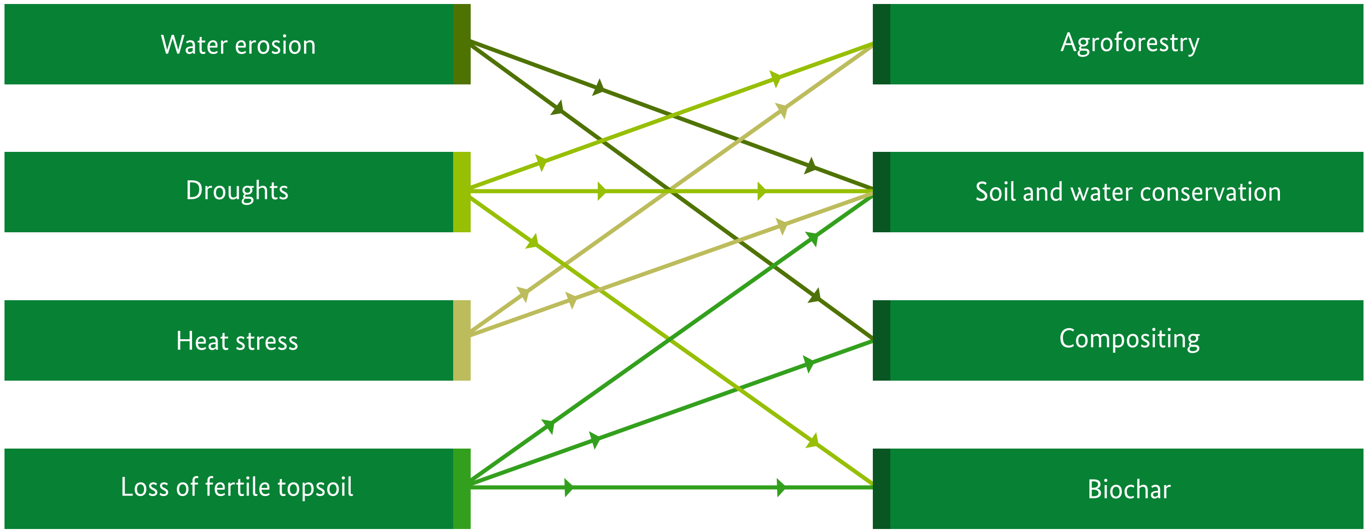


Figure 1: Most effective SPR measures in response to major climate risks (as identified in expert workshops in ProSoil partner countries).

The **effectiveness analyses** show that the ensemble of SPR measures implemented in the partner countries are better suited to combat droughts than heat stress. Measures that are related to water management and harvesting were identified to be most effective in preventing drought events. The concrete measures differ depending on the context and range from water harvesting, storing, and holding techniques, to small scale irrigation, dams and dikes and water spreading weirs. Figure 1 shows a schematic guide with the greatest climate risks identified in the partner countries where an assessment was carried out as well as the SPR measures that were identified to be very effective in response to these risks. The specifics of the individual measures are elaborated further below.

The **feasibility analysis** of socio-economic indicators shows that most of the SPR measures do not create any negative side effects. This could also be a reason why the indicator quantifying the social acceptance of measures has been rated very high across all countries. Regarding the financial assessment of SPR measures, most countries assessed the overall cost-benefit ratio of the SPR measures as rather high. The actual investment and maintenance costs were rated differently depending on the country. However, they were generally considered to be obstacles. Access to finance is the lowest rated indicator in all countries and may therefore be understood as one of the greatest barriers to implementation. The availability of knowledge, training, material, and technologies are the indicators that are most dependent on context and vary most within both the individual SPR measures and countries. Many SPR practices, however, require rather little technology and therefore allow for knowledge co-creation among farmers, making them particularly suitable for smallholders.

Notably, all countries that assessed agroforestry ranked it as highly effective in response to both drought and heat stress as well as other climate risks. Agroforestry is indeed the only measure that was rated highly effective without exception and irrespective of the context. The practice is widely socially accepted and seems very promising due to its high feasibility in all countries. However, the access of women and vulnerable groups has been evaluated as very low, since women may face particular challenges regarding access to land and finance for necessary seedlings. Generally, the high need for material and knowledge as well as the access to financing and inputs are seen as critical. Similarly, scientific analyses conclude that agroforestry supports adaptation to climate change by providing shade, reducing evapotranspiration, improving the microclimate, and increasing soil fertility and carbon content. Further, it can reduce pests and diseases and lower soil erosion.

The analysis further reveals that soil and water conservation techniques are most effective in fighting soil erosion. Different individual techniques are employed depending on the context. Large-scale physical measures, such as dams and dikes and water spreading weirs as well as contour bunding with stones, are most effective in response to soil erosion. Of the biological and cultural measures, vegetation strips, contour farming and half-moon techniques were assessed as very effective. In addition to the positive effects on soil erosion, the results show that soil and water conservation are also very effective in response to droughts and water shortages. While all soil and water conservation related techniques are generally highly socially accepted and easily accessible to women across all countries, the barriers for implementation are more country-specific. However, generally, physical large-scale measures that are implemented on village level, such as dams and dikes and water spreading weirs, are very costly and labor intense. Hence, the major obstacle in all countries is limited access to finance. However, once installed, these measures have a very good cost-benefit-ratio and only marginal maintenance costs. Due to their high labor intensity, they also have the potential to generate new job opportunities.

Composting is a widely known practice that improves the biophysical properties of soil as well as its water holding capacities. Experts in Burkina Faso, Madagascar and India therefore assessed composting to be especially effective in response to decreasing soil moisture and topsoil erosion and, thus, also in response to droughts. Temperature risks are, however, not very well covered. As composting has a long history and no known negative side effects, it is socially highly accepted across all countries. Compared to other SPR practices, it is a low-cost option that requires little labor and that is easily implemented. Since knowledge on composting is already widespread among farmers, it may be considered an effective low hanging fruit. However, the access of women and vulnerable groups to this tool is low in some countries. One major reason is that women barely own big livestock, which is one of the major sources of raw materials to produce compost. The procurement of raw materials may not only be problematic for women. Generally, the lack of raw material for liquid compost and vermicomposting is seen as the major barrier for implementation.

AGROFORESTRY, SCIENTIFIC EVIDENCE

Scientific studies describe the multiple benefits of agroforestry. For example, in regions in Ethiopia where climate change reduces maize yields, farmers can reduce losses by combining maize farming with growing trees. At the national level, the shade caused by trees reduces climate change induced maize yield losses from 10% to 4% (low emission scenario) or 1% (high emission scenario). These projections solely take the shading effect of agroforestry into account and do not include further benefits, such as increased soil fertility, which may positively affect maize yields. From an economic point of view, agroforestry is also highly beneficial when compared to a no adaptation scenario (maize monoculture without tree shading). According to a cost-benefit analysis, the return on investment is positive after five years of planting trees.

CASE STUDY 1: **Legumes and cover crops for SPR in Madagascar**

In Madagascar, legumes and cover crops were assessed to be highly effective in response to climate risks, especially related to drought, irregular rainfall, and the decrease in soil humidity. Although the measure is easily implemented because the required knowledge and training are available and the labor intensity is very low, the overall local feasibility is rather low. This is due to other indicators for feasibility. The prices can be very high for good quality seeds of edible legumes, such as cowpea. In addition, legume crops are often vulnerable against diseases, which leads to the negative side effect of using more pesticides. This shows that the results of the adaptation monitoring may diverge regarding adaptation effectiveness and local feasibility. Therefore, it is crucial to assess both, as a very effective measure may have unintended negative side effects or may be costly to implement.

CASE STUDY 2: **Biochar for SPR**

Although biochar is a new and innovative practice, its climate risk effectiveness is evaluated in the middle range. However, with respect to local feasibility, the assessments differ depending on the location. While in India and Burkina Faso, biochar is socially highly accepted because knowledge and training are available, and jobs can be created; in Benin the specific technical knowledge as well as the necessary material remain obstacles. Due to the complexity and the high costs, biochar is considered user unfriendly with a high need for institutional support. This case study shows that local feasibility of the same SPR measures is highly context-specific and that measures that work well in one context may need more support in other contexts. This must be considered when planning SPR activities as project interventions can improve feasibility.

Conclusion and recommendations

- Systemic approaches such as agroecology are needed to sustainably transform food systems and improve food security while adapting to climate change. SPR is a key element of agroecology as it uses natural processes and creates synergies in ecosystems to improve agricultural systems. Therefore, policy makers and implementer need to pay greater attention to soil protection and rehabilitation.

- Analyzing how SPR measures contribute to climate change adaptation is important to improve project interventions. As climate change is a major threat to farmers and agro-pastoralists, all project activities aimed at improving their livelihoods should assess their adaptation impacts in addition to their primary objectives. This will increase the possible adaptation benefits.

- Participatory approaches, such as the one developed by the consultancy HFFA Research GmbH for the GIZ Programme ProSoil, should be used to assess the adaptation effectiveness and local feasibility of SPR measures. Such a participatory approach allows to better include stakeholders' perspective and co-create knowledge.

- Assessments in the ProSoil partner countries showed that the adaptation effectiveness and feasibility of different SPR measures vary. To incorporate these considerations into project planning and implementation, it is recommended to carry out an assessment of climate change adaptation effects during project planning and a monitoring and evaluation during implementation.

- Another major finding from the adaptation monitoring is that, in addition to the effectiveness in responding to climate risks, it is very important to simultaneously assess the local feasibility of SPR measures. Some effective measures can be difficult to implement. A feasibility assessment can provide action points for projects to lower barriers for implementation.

- Agroforestry stood out regarding its adaption potential and feasibility. It has numerous advantages and is highly effective in response to multiple climate risks. It can be implemented in different contexts and has a high return on investment. However, it is also an intervention that takes time and resources. As climate change impacts are already being felt today and will increase in the future, access to finance, knowledge and inputs must be made available to support promising strategies like agroforestry.

- Effective SPR measures should be scaled-up and good practices disseminated locally and globally. Lessons learnt should be embedded in systemic agroecological project planning and action. This would promote and improve resilient and agri-food systems. A prerequisite for this is that policy makers and implementers recognize the importance of agroecology and SPR for climate change adaptation and mitigation, food and nutrition security as well as a sustainable transformation of agri-food systems.

Imprint

Published by the
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany
Soil protection and
rehabilitation for food security
Friedrich-Ebert-Allee 36
T +49 61 96 79-0
F +49 61 96 79-11 15
E soilprotection@giz.de
I https://www.giz.de/en/worldwide/32181.html

Programme / project description
Global programme Soil protection and
rehabilitation for food security

As at
November 2022

Design
Miguel Faber, Berlin

Photo credits
P. 1 © Klaus Wohlmann / GIZ
P. 3 © Klaus Wohlmann / GIZ
P. 5 © Jörg Böthling / GIZ
P. 6 © GIZ; Joerg Boethling / GIZ
P. 7 © Joerg Boethling / GIZ

Text
Sophia Lüttringhaus, HFFA Research GmbH, Berlin;
Juliane Kaufmann, HFFA Research GmbH, Berlin;
Steffen Noleppa, HFFA Research GmbH, Berlin;
Patrick Smytzek, GIZ, Bonn

Contributions and review
Andrea Bender, GIZ, Bonn
Emilie Perrouset, GIZ, Bonn

On behalf of the
German Federal Ministry for
Economic Cooperation and Development (BMZ).