



## **Soil carbon sequestration and food security in Sub-Saharan Africa: Synergies and Trade-offs**

Short documentation of the online panel discussion

Day 1 (24<sup>th</sup> of March 2022), panellists: Dr. Gatien Falconnier (CIRAD, Mali), Dr. Lydie-Stella Koutika (CRDPI, Congo), Dr. Bernard Vanlauwe (IITA, Kenya), Dr. Wellington Mulinge (KALRO, Kenya), Dr. Rolf Sommer (WWF, Germany)

Day 2 (25<sup>th</sup> of March 2022), panellists: Dr. Rattan Lal (Ohio State University, USA – video presentation), Dr. Pauline Chivenge (APNI, Morocco), Dr. Upendra Singh (IFDC, USA), Joseph Moghohgo (Simpson Foundation, Malawi)

Carbon sequestration in nutrient-deprived agricultural soils in SSA seems to hold a great potential to tackle two of the most pressing issues of our time: food insecurity and climate change. Carbon-rich soils increase the resilience of agricultural systems due to their improved water holding capacity, soil aggregation, and nutrient supply and hence, contribute to food security. At the same time, carbon sequestration in soils is regarded as one important nature-based solution to mitigate climate change. Nevertheless, the concepts proposed by scientists, how to improve soil health and soil fertility vary widely, and large discrepancies exist around the need for chemical inputs to quickly increase food and other biomass production. The different approaches might result in potential trade-offs between high levels of crop yields and carbon sequestration. During the two-day online event of the Climate-Soil Community of Practice, experts from science and practice discussed the technical and socio-economical potential of different land management approaches for food security and soil carbon sequestration. The following document presents an outline of this discussion.

A central part of the discussion evolved around the Integrated Soil Fertility Management (IFSM) approach. Most panellists regarded IFSM as the way forward to increase crop yields as well as SOC as a result of higher biomass production. Some panellists argued to focus on increasing crop production through the efficient use of synthetic fertilizers, but in combination with good soil management practices, as a short-term goal, before shifting the focus to carbon sequestration. No consensus was reached, whether the use of artificial fertilizers (especially N fertilizer) should be phased out at a later stage, once the nutrient stock in degraded soils has built up.

In the second line of reasoning, some panellists stressed that it is possible and advisable to increase food production and build up soil organic carbon at the same time. They argued that the combination of organic residues and synthetic fertilizers leads to the highest increase in crop yields, which allows bringing back more and more biomass into the soils to build up SOC. Such an approach is especially important on non-responsive soils, which are degraded to a stage where fertilizer use efficiency is very low.

Nevertheless, limited availability of organic materials was regarded to be one of the main obstacles for soil carbon sequestration and the implementation of low-input production systems. Retaining crop residues is key to maintaining certain SOC contents or increasing SOC contents in soils. But, competition for biomass is wide spread, as biomass is often used as fodder or fuel and, thus, cannot be applied to increase SOC. At the same time, one panellist pointed out, that interrupting crop-

livestock systems, in which cattle are left to graze on the fields after harvest, might impede crop production when the fertilizing effect of the cattle manure is missing. Both was seen as argument to focus on increasing crop yields first.

Effectively, most farmers across SSA already use some form of ISFM, though often at fertilizer application rates that are well below recommendations and residues are mostly of low quality. Nevertheless, one panellists showed that on the long term, organic matter quality did not influence SOC build-up. Yet, yield increases were found to depend on the quality of organic matter, especially on inherently nutrient-poor sandy soils. When organic residues were applied in combination with inorganic fertilizer, highest increases in yield were found under the application of organic residues of intermediate quality. This was explained by the fact that high quality organic residues quickly supply a high amount of nutrients to the soil even when they are not combined with inorganic fertilizers.

Nevertheless, views amongst the panellists and in the audience differed regarding the viability of green manure. While there was an agreement on the positive effect of green manure on soil fertility, there were different results regarding overall crop yields, when the green manure was cultivated in rotation with staple crops. Some argued that overall yield only increased compared to cultivation with very limited synthetic fertilizer inputs. Others showed that the increase in yield was evident even if the land was taken out of cultivation during the green manure rotation. Intercropping of legumes was seen as a viable option.

Agroforestry was frequently mentioned as an agricultural practice that offers strong synergies, improves food security and helps to store carbon above and below ground. N-fixing trees further improve to soil fertility. Nevertheless, due to ex-ante investments and labour intensity, uptake of this practice is still limited. Furthermore, the lack of knowledge regarding the design of agroforestry systems in their ecosystem context was seen as an obstacle for successful adoption. One panellists stressed the importance of parklands, as an easy to implement agroforestry system, which leaves enough area for crop production. He advocated for the protection of these old agricultural systems even if SOC sequestration is less than under alley cropping systems, etc.

Views differed regarding the effectiveness of conservation agriculture. The panellists agreed that conservation agriculture significantly increases SOC contents, when all three principles (minimum/no-tillage, residue management and intercropping or crop rotations) are followed, while no-tillage alone was not found to increase SOC contents. In the audience, there were some strong voices on the positive effects of conservation agriculture on food security and SOC built-up. Generally, conservation agriculture was seen as an important approach regarding climate change adaptation and erosion control in drylands.

There is a high spatial variability in smallholder systems in SSA so that any advice or training for farmers needs to address this variability between plots and neighbours. One panellist introduced a decision support tool that addresses this issue.

There was a consensus amongst the panellists that climate change mitigation is not only about sequestration of carbon, but also about reducing SOC losses resulting from the current soil management practices and land conversion. They further stressed that also carbon storage in above ground biomass is important and should be considered.

A lively debate evolved around the questions if agriculture can become net negative regarding GHG emissions. Part of the panellists argued that agriculture in SSA could not become net negative, as an increase in fertilizer use is mandatory to increase productivity for food security as well as SOC built-up. One panellist even stated that carbon storage in soils as a path to mitigate climate change was only a

myth. Others argued that agriculture on the long run could become carbon neutral or even offer a potential for carbon sequestration, if good management practices were applied.

The panellists also addressed carbon crediting as an instrument to enable and incentivise efforts for carbon sequestration. They stated that a robust crediting is crucial, but still very difficult as the monitoring is not exact enough and often not possible for smallholders. One panellist argued that environmentally sound land use practices and not solely SOC should be credited and financed. Another panellist expressed his concern that under current carbon certification schemes, companies will rather rely on carbon offset than maximise their ambitions to reduce greenhouse gas emissions.

As a bottom line, the panellists concluded that food security was the main issue for countries across SSA and that agriculture needed to increase crop yields, in order to feed a growing population. Climate change mitigation by soil management practices is high on the agenda, but should be a co-benefit to better food security. Enhancing productivity and crop yields was seen as the key to increasing soil organic carbon and, thus, improving soil health, as higher productivity delivers the biomass, which is needed to build up SOC.

***Further information:***

All presentations as well as further reading material is accessible via the Climate-Soil Community of Practice Wiki-space at <https://wiki.afri.org/pages/viewpage.action?pageId=132325573>.

If you would like to register for the Climate-Soil CoP, please follow this link:

<https://wiki.afri.org/display/4COP2/Registration+for+the+Climate-Soil+Community+of+Practice>