Promoting soil health and productivity in Eastern Arc mountain ecosystems through collaboration and networks

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Smallholder farmers in the Taita hills and Mount Kilimanjaro recognize the need to conserve soil nutrients of fields and farms located in the upper, middle and lower zones of mountainous areas. These mountain communities depend on rain-fed subsistence agriculture which means that for sustainable subsistence crop production, they also depend on nutrient availability and use efficiency in farming households. A study under way in the area has looked at loss of land cover and infestations of plant pests and diseases and is using this information to raise farmers' awareness of soil fertility and to introduce best cropping practices.

The Taita Hills are located in southeast Kenya. Mount Kilimanjaro, the highest free standing mountain in the world, is located in northeastern Tanzania, approximately 110 km west of Taita Hills, in southeast Kenya. Both Mount Kilimanjaro and the Taita hills are part of the Eastern Afromontane Biodiversity hot spot, and are important hubs for agricultural and economic livelihoods of their mountain communities. Rain-fed small-scale subsistence food production at household level remains the principle source of livelihood for these communities.

In these mosaic crop production systems, farmers plant their crops with few, if any, soil fertility inputs, because many believe that their soils are currently fertile enough to sustain crop production into the future. Crop yield reports by the local agricultural officials however show this belief to be far from the reality of the situation.

Climate change signals in the Taita and Kilimanjaro ecosystems have been experienced through decreased seasonal rainfall amounts, and increased duration of hot months and occurrences of droughts. This has had a negative effect on the ecosystem' natural soil nutrient replenishment process via the carbon (C) cycle. Deforestation has substantially reduced surface biomass accumulations thus accelerated the pace for soil organic carbon and nutrient loss. In the Wundanyi area of the Taita hills, for example, home to tropical indigenous forests more than 100 years ago but converted to agricultural crop production several decades ago, there has been a systematic and drastic reduction in cereal grain yields in the last ten years. Smallholder harvests are so low in the March to April rainy season, regarded traditionally as the "food seasons", that some fields are unable to produce enough seed to compensate for what was planted. Insect pests and disease pressure further devastate whatever little crop material that has emerged in the fields, resulting in total harvest loss.

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The initiative to increase awareness of restoring the fertility of degraded soils in the Taita hills and Mount Kilimanjaro did not start on without outside help. In early 2012, the Climate Change Impacts on Ecosystem Services and Food Security in Eastern Africa (CHIESA) project was launched in Nairobi, Kenya, to study the effects of change in land use/land cover, biophysical and socio-economic status on crop production and food security. Funded by the Ministry for Foreign Affairs of Finland, the project is coordinated by the International Centre of Insect Physiology and Ecology (ICIPE) with several collaborating institutions such as the University of Helsinki (Finland), University of York (United Kingdom), Universities of Dar-es-Salaam and Sokoine (United Republic of Tanzania), Institut de Recherche pour le Développement (IRD – France), among others. In these montane environments, smallholders are disadvantaged in several ways. Low household income and little investment in small- scale farming have reduced the quantity and quality of farm harvests. Additionally, new invasive pest and weed species continue to devastate the popularly grown maize crop, and other traditional value crops.

Thus, researchers and students from partnering institutions have embarked on an intensive campaign to assess the consequences of land cover loss, and accompanying soil physical and chemical deterioration on insect pest dynamic; occurrence, damage and infestation patterns, among other research questions. Results from the study show soils in these mountain ecosystems to be severely lacking in important macro and micro elements such as silicon, phosphorus and nitrogen. Soil organic carbon levels are also critically low in lower- to mid-elevation zones where farming has taken place for the last 50 to 100 years. It is against this backdrop that CHIESA embarked on a campaign to raise awareness of soil fertility and best cropping practices among smallholders.

Designed as informal training sessions involving agricultural, civic and development actors, pertinent issues such as the importance of soil testing and the logistics involved, have been discussed with more than 200 farmers from both ecosystems. Soil nutrient improving inputs, types, usage, timings and mode of application for maximum agronomic efficiency are some of the issues discussed with participants. From CHIESA research activities within the farming communities, simplified maps showing soil nutrients were produced, translated into the local *kiswahili* language, and published as brochures to facilitate farmer-to-farmer sharing. Diversification of farming enterprises to ventures such as honey production and establishment of native fruit and agroforestry tree species have huge potential to curb soil erosion and restore the fertility of degraded fields.



Gender also plays an important role in mountain farming communities, where most important household decisions are made by the man of the house. In Mount Kilimanjaro and the Taita hills, men typically leave their household for work in the nearby Moshi and Arusha towns in Tanzania and the coastal town of Mombasa in Kenya. This rural urban movement often leaves only women, youth and the elderly in the homesteads, usually with women left in charge of the agricultural production. This has an important implication in future awareness campaigns, and cognizance of the need to sensitize mountain community women and youth on the outcomes and impacts of initiatives such as CHIESA.



Simplified map showing organic matter status for the Taita hills, Kenya (P. Catalayud)

Lessons learned

- For some forest lands converted to agricultural lands, it only takes ten years for harvested grain yields to fall to half those obtained immediately after conversion.
- Smallholder farmers in mountain regions need to be aware of strategies available to curb soil nutrient loss from their farms through fertilizer use and economy, soil management and agroforestry practices.
- In mountain environments, women and youth play an important role in agriculture and represent a critical entry point for initiatives seeking to restore and improve ecosystem fertility and productivity.



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In collaboration with the Mountain Partnership Secretariat, the Global Soil Partnership and the University of Turin

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