Highlights
CIAT in Africa

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Restoring soil fertility in the East African highlands through participatory research

Land degradation is the principal environmental factor behind declining per capita food production in sub-Saharan Africa. Causes include nutrient mining, soil erosion, poor land management and lack of resources. Rising population pressure often obliges farmers to utilize vulnerable, sloping land with aggravated erosion and degradation (Fig 1).

Fig. 1. Three farms on steeply sloping land in southern Ethiopia with good (2) and poor (1, 3) management. Household no. 2 resides on the farm.

A major concern of many stakeholders in highland areas, besides maintaining the fertility of lands that are still productive, is how to rehabilitate degraded arable lands that are on the verge of going out of production. The Tropical Soils Biology & Fertility Institute of CIAT (TSBF) and the African Highlands Initiative (AHI), working together with the Ethiopian Agricultural Research Organization (EARO) in an action research approach with farmer research groups, has shown that the following methods are effective in implementing integrated soil fertility management in the Areka area of southern Ethiopia.

Step 1. Gaining the confidence of farmer experimenters

We started by bringing together interested farming communities and a team of local researchers and extension staff. Farmers outlined their problems and experiences, researchers explained some results that they thought could help address the farmers' needs, and a farmer research group decided what they wished to test in the first season. Invariably, they asked to evaluate new varieties of the crops they knew – as they later explained, because they thought this the surest way to get something out of a relationship that experience told them could be a short-term one!

After a couple of seasons, these farmers were multiplying seed of some new varieties they had selected, passing seed on to others, and had visited more distant research or demonstration sites to select other technologies for testing. By this time, the participants were discussing ideas to tackle their more serious, long-term problem – declining soil fertility.

Step 2. Implementing integrated soil/ water conservation measures

Research results from the soil conservation research program (SCRP) in southern Ethiopia showed that runoff on crop land with a slope of at least 14% was reduced by more than 80% where soil bunds or grass strips were used. More farmers adopted these measures when fast growing, drought resistant forages, such as Pennisetum species, were used for stabilizing the soil bunds. Farmers were attracted by the extra benefit of the grassed bunds in producing dry season feed; the grass also used serve as a trap crop for maize stalk borer.

The solid grass cover reduced soil losses, improved the availability of organic inputs for soil improvement, and offered animal feed and consequent increase in cash income.

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Fig 2. Effects of three land management practices (hacked vs crop covered, both on 16% slope, and grassland on 40% slope) on runoff and soil loss in the southern Ethiopian highlands (SCRP, 1996).

Step 3. Increase soil organic matter by integrating more legumes into the system

Current organic matter inputs in Eastern Africa are insufficient to maintain soil organic matter. Conventional sources of organic matter –manure, crop rotation and weedy fallows — are becoming scarce as livestock numbers decline on smaller farms and due to competing demands on their use. Our project evaluated an alternative option of integrating legumes into the cropping systems. We offered farmers a range of options and legumes, and found that their decisions varied according to the agroecological niches available on their farms and their socioeconomic situations.

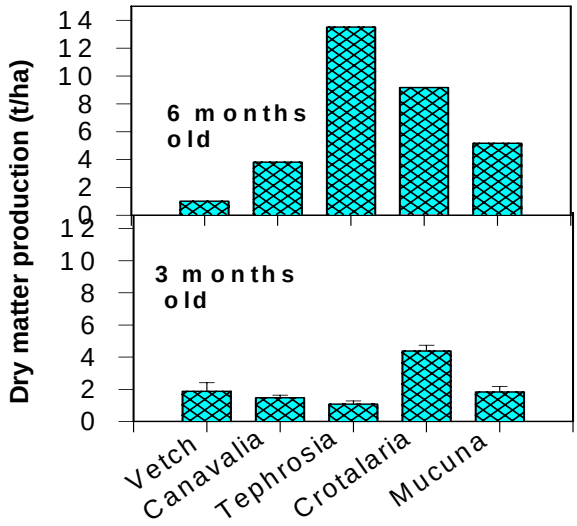

Fig 3. Dry matter production of cover crops in short term (3 months) and medium term (6 months) fallow in southern Ethiopian Highlands

A farmer who needs a fast growing legume cover crop for short-term fallow periods finds that Crotalaria and Vetch are the best options. On the other hand, a farmer wishing to improve his land with a medium-term fallow fares best with Tephrosia or Crotalaria. We found that, as farmers are usually attracted by short-term benefits, the inclusion of field peas and faba beans, as multipurpose legumes having a low N harvest index, improved the levels of adoption. The use of good rotations cannot be over-emphasized.

Step 4. Improve soil nutrient status through judicious application of mineral fertilizers

Organic fertilizers cannot fully cover nutrient demands and therefore need to be supplemented by mineral fertilizers. Nutrients other than nitrogen and phosphorus could be in deficit in organic inputs, so supplementation by mineral fertilizers is required. In some calcareous soils addition of 5 kg/ha zinc could give significantly higher yield than 100 kg/ha of N or P (Marschner, 1995). Moreover, current blanket fertilizer recommendations should be adjusted to specific soils, crops and agroecology so as to improve efficiency in using these nutrients.

Conclusion

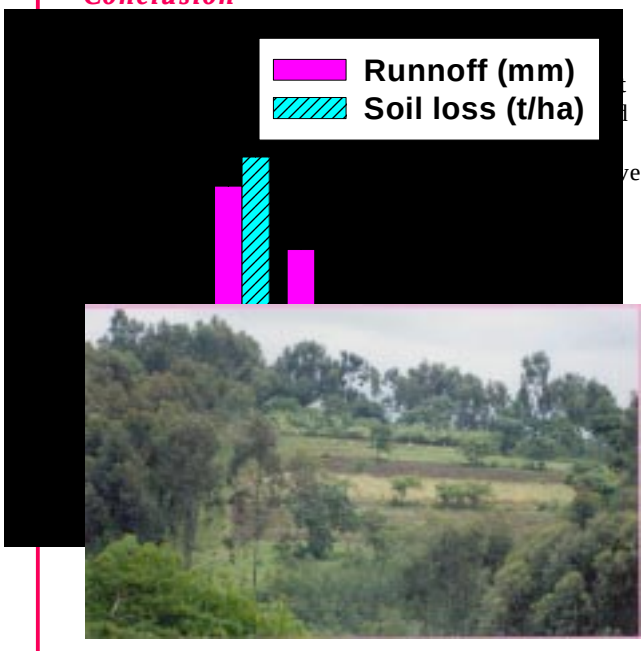

Fig. 4. A well-managed farm in southern Ethiopia with integration of soil conservation measures, trees and high value crops.