Research work with TSBF-CIAT in eastern Kenya

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In 2000, collaborative research on potential of integrated nutrient management for soil fertility improvement in the smallholder farms of eastern Kenya involving the Kenya Agricultural Research Institute (KARI), the Kenya Forestry Research Institute (KEFRI), TSBF-CIAT, Kenyatta University and the World Agroforestry Centre (ICRAF) was started in Chuka, Meru South District, Kenya. This project, consisting of 13 soil fertility improvement technologies to be compared with farmers' practice (no input), was set up at Kirege Primary School and demonstrated the use of sole or combined organic and inorganic resources as nutrient sources as well as growing legumes cover crops. During subsequent field days, farmers were asked to evaluate the performance of the technologies and adopt on their farms any that they preferred.

Legumes form a major component of the diet of people in the eastern part of Kenya. In an on-station experiment at the KARI Regional Research Centre in Embu, researchers are evaluating different bean varieties to recommend appropriate farmer management practices for high yield production.

The major findings from this project show that leafy tree biomass from *Leucaena leucocephala, Calliandra calothyrsus* and *Tithonia diversifolia* was effective in reducing the rate of soil fertility decline and in improving maize yield. Integration of organic and inorganic nutrients produced better yields than the farmers' practice. Farmers had expressed interest in trying out the soil fertility improvement technologies, and by the 2002/2003 short rains some 206 of them

were practising these approaches on their farms.

The project is also showing resource-poor, smallholder farmers how to produce improved fruit trees (mangoes and bananas) for increased food production and income generation. All these activities are implemented with financial support from the Rockefeller Foundation.

Farmers in Kirege location are modifying the hedgerows on their farms by planting multiple hedgerow species together. This farmer has planted a hedgerow of calliandra and napier grass. This helps to alleviate the problems of organic resource scarcity and to provide additional high quality fodder for livestock.

(Above) Grafted mango varieties such as Van Dyke have gained popularity in Chuka and Machanga areas of eastern Kenya for their high yields and early maturity.

(Right) In addition to soil fertility improvement research, alternative food crops such as bananas are grown in the experiment at Kirege Primary School as a way to diversify the means to achieve self-sufficiency in food production.

Farmers have reported better crop performance with application of manures than with no inputs. The maize plot in the background received manure inputs, while the one in the foreground was a control.

AfNet in West Africa

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In August 2003, staff of the coordination office of the African Network for Soil Biology and Fertility (AfNet) visited the network's trials in Burkina Faso, Côte d'Ivoire, Ghana, Niger and Togo. The trials visited were in Ayoum, Kwadaso and Sataso in Ghana; Davie in Togo; Farakoba in Burkina Faso; and Sadore, Karabedji, Gobery, Gaya and Banizoumbou in Niger. Most of these trials were initiated in 2002 with financial assistance from the Rockefeller Foundation. The main aim of the trials is to strengthen AfNet's capacity to combat soil nutrient depletion in West Africa. The other countries involved in this research are Cameroon, Mali, Nigeria and Senegal. Some of the observations from the visit are highlighted here.

Legume-cereal rotations in Burkina Faso

There is great potential for improving food production through rotations of legumes and cereals. In Burkina Faso,

This sorghum-groundnut rotation in Burkina Faso produces better crop than continuous sorghum cropping (inset).

rotating sorghum with groundnut has increased yield of the sorghum, which benefits from the nitrogen-fixing ability of the groundnut. This has proved superior to the farmers' practice of continuous growing of sorghum.

Optimum nitrogen and phosphorus management in legume-cereal rotations

Although the combined application of organic resources and mineral inputs form the technical backbone of the integrated soil fertility management approach, procuring sufficient amounts of organic matter of the desired quality is very often a problem farmers face. In-situ production of organic matter is an attractive alternative to technologies promoting the harvesting of organic resources from sites within or outside the farm. In addition to long-term trials at Farakoba in Burkina Faso and Karabedji in Niger, experiments were established at Zaria in Nigeria, Kumasi in Ghana and Davie in Togo to assess the contribution of herbaceous and grain legumes to nitrogen supply and, where relevant, the impact on the overall yield of using phosphorus during certain phases of the rotation. Sorghum and millet yields in on-farm and on-station trials in Burkina Faso and Niger have tremendously been improved through either rotation or intercropping. Herbaceous or green manure legumes usually leave

Rotating a few rows of millet with cowpea every season (like in 'mbili-mbili' intercropping) has improved yields in farmers' fields in Karabedji, Niger.

shown to supply nutrients to the succeeding sorghum crop as well as acting as a source of cash for farmers. The farmer is usually advised to grow up to one hectare of pure cowpea for rotation with cereal crops.

Besides fixing nitrogen, certain legumes are also known to access the not-so-easily available phosphorus pools, alter the soil pest spectrum or improve soil biological properties. These benefits are often considered as non-nitrogen benefits.

substantial amounts of nitrogen in the soil, but when they are left to grow to maturity, harvesting their seeds may substantially reduce the net nitrogen input into the soil. 'Traditional grain legume germplasm has a large nitrogen harvest index, indicating that even though a significant part of the nitrogen taken in by the legume is certainly fixed from the atmosphere, more nitrogen is taken away during grain harvest, resulting in a negative net nitrogen input. However, dual-purpose germplasm is now available, for example for cowpea and soybean, that produces substantial amounts of haulms in addition to grains and has a relatively low nitrogen harvest index. In Burkina Faso, cowpea has been

Combining water-harvesting techniques and integrated nutrient management

In Mali, an experiment to investigate the effect of ridge tillage along contour lines is being carried out by AfNet in collaboration with the Institut d'Economie Rurale (IER) and the ICRAF Sahel Programme. The trial was set up in 2003 at Siribougou, a rural village about 35 km west of Ségou. The main research hypothesis being tested is that combining water-harvesting techniques with effective nutrient

Planting cowpea (in the foreground) as a cash crop is becoming popular in West Africa.

management will result in higher efficiency of resources and increased profitability of the investment in water harvesting.

Results have shown that using ridges reduced runoff by about 20-40 percent, in addition to providing a deeper wetting front (from 1.2 to 2 metres). Other benefits with ridging included increasing soil water content from 10 to 30 percent and pearl millet yield by 30 percent with water harvesting alone and 50 percent with water harvesting and mineral fertilizers.

Water harvesting using ridges has beneficial effects on crop production, as shown in this study in Siribougou, Mali.