Farmer Field School on nutrient management

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The decline of soil fertility on smallholder farms is probably the main bio-physical cause of falling food production in Sub-Saharan Africa. One approach to halting this decline is Integrated Nutrient Management (INM). In Kenya, INM is being used to make the best use of local resources and to optimise the effects of external inputs. The project "*Integrated Nutrient Management to attain Sustainable Productivity increases in East Africa farming systems* (*INMASP*)" uses the Farmer Field School (FFS) approach in working with farmers to develop technologies that can contribute to ensuring reasonable levels of soil fertility and improve food security in the major farming systems in Kenya, Uganda and Ethiopia.

Agro-Ecosystem Analysis session in Mbeere District in Eastern Kenya. Photo: Davies Onduru

The INMASP approach is inter-disciplinary and involves socio-economic as well as agro-technical and environmental issues. INMASP projects seek to involve stakeholders at all institutional levels and its strength lies in stimulating an active and participatory approach to identifying farmers' needs and their experiences with soil fertility management. Farmer Field Schools (FFS) have become a key activity in working with farmers to develop and integrate INM technologies into small-scale and communal agriculture (see *LEISA Magazine* Vol 18 No 3).

Although there are over 1000 FFS in operation in Kenya, not many focus on INM or on the integration of livestock into mixed cropping systems in order to enrich nutrient cycles. Munyaka FFS is one of the schools created under the INMASP project. This FFS is situated in Mbeere, a district that lies in the dryland area of Eastern Kenya. It has been in operation for just one season and work is being done to integrate INM into local farming practices. The FFS is developing, testing and evaluating technologies based on the use of local organic resources (farmyard manure and *Tithonia* sp.) and mineral fertilisers (diammonium phosphate, DAP). The Munyaka FFS has 31 farmer members, 77% of whom are women.

Soils in the area are well drained and range from shallow to quite deep and include loamy sand and sandy clay loams, although some places are rocky and stony. Everywhere, however, there is evidence of depleted fertility with low levels of nitrogen, phosphorus, and organic matter due to erosion, limited use of inputs and poor management practices. Rainfall averages between 150-450 mm per year, with about two-thirds falling between October and November.

Smallholder farmers at the FFS site practise mixed farming. Their crops include maize, beans, cowpeas and sorghum and a number of other subsistence crops. There is some livestock - mostly indigenous breeds - including cattle, goats, and poultry.

Developing and testing interventions

During the FFS, activities to arrest soil degradation were developed through the following steps: literature review on soil fertility constraints in the FFS site; participatory identification of production resources, farming system constraints and priorities; experimental design workshop; regular FFS learning sessions on INM (special topics); Agro-Ecosystem Analysis (AESA) framework in the central learning plot; end-of-season participatory evaluation of experiments; and further data analysis for sharing with wider scientific community.

A survey was carried out to identify production resources. This included collecting details of farmers' socio-economic circumstances including the ownership of productive assets, farming practices, broader livelihood strategies, current opportunities, challenges of soil fertility management and farmers' indicators of soil fertility management. The findings of this diagnostic exercise were used to develop a FFS curriculum with farmers and to identify possible INM technologies for trials.

Soil fertility constraints were further diagnosed through soil sampling and analysis. During the FFS, the results of the analysis were presented to farmers in a clear, visual way and this stimulated a great deal of discussion. Farmers gained a better understanding of the current fertility status of their soil and in particular that levels of soil nitrogen, phosphorus and organic matter were low. Technologies jointly proposed by farmers and FFS facilitators as options for improving soil fertility included manure, mineral fertilisers, mulches, terracing, incorporation of crop residues into the soil, using leaves as fodder, agroforestry, slurry, *Tithonia* sp., composting, rock phosphate, green manuring and zero-tillage (conservation agriculture).

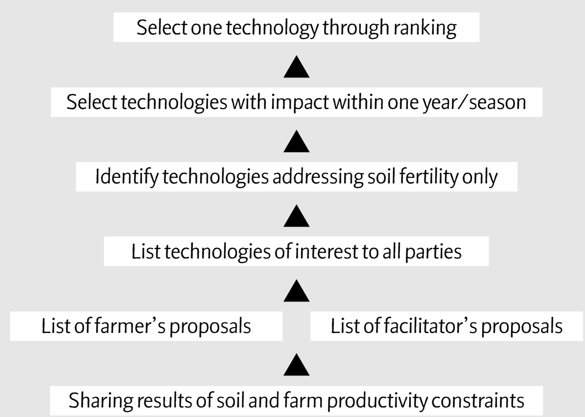

Figure 1: Process adopted for choosing technologies for experimentation

Results of surveys and assessments were discussed with farmers and used to select the technologies that would be tested in FFS central learning plot (Figure 1). The monitoring indicators to be used during the FFS were also selected. Table 1 shows the treatments that were selected through this participatory process.

Table 1: Treatments agreed upon in a PTD process in Eastern Kenya (Munyaka FFS)

Treatment	Description
T1	Farmyard manure (FYM), one handful per planting hole (16t/ha)
T2	DAP, one teaspoon per planting hole (216 kg/ha)
T3	$T_1 + T_2$
T4	$T_1 + T_2$ + Tithonia; Tithonia applied at 3.6 t/ha fresh weight

Results on the central learning plot

The FFS experience in Munyaka showed that INM-FFS not only improved farmers' analytical skills but also provided qualitative and quantitative data that could be used to evaluating the performance and impacts of INM technologies. Besides the farmers' analysis that takes place during each FFS meeting, further agro-economic analyses were done and shared with farmers in later FFS sessions.

At the end of the season, farmers' evaluation of the treatments in the central learning plot showed differences with regard to pest incidences, maize leaf colour, plant health, soil moisture retention, weed incidences and grain yields.

Treatments with combined organic and inorganic nutrient sources gave higher yields than single applications of organic or inorganic nutrient sources. The grain yields also increased with increased nitrogen and phosphorus applications. This suggests that low levels of nitrogen and phosphorus hinder maize production in Munyaka.

An analysis of the results achieved in the farmers' fields showed positive returns to labour for all studied technologies. These returns were higher than the opportunity costs (i.e. what could have been earned elsewhere). The combined application of Farmyard Manure and DAP, and Farmyard Manure, DAP and *Tithonia* sp. proved to be the most profitable practices. Although *Tithonia* grows wild in the area many farmers had not been aware of its potential in soil fertility management.

Farmers rated the combined application of farmyard manure, DAP and *Tithonia* as the best combination. They recognised that widespread adoption of this method would be limited by lack of money to buy DAP. However, a number of farmers have started collecting *Tithonia* cuttings (*Tithonia diversifolia*) from the roadside and nearby bushes to plant them within their farm boundaries.

Farmers also identified and monitored the presence of pests and beneficial insects. They found that treatments that included farmyard manure attracted a relatively high diversity of pests but also beneficial insects.

Impacts of tested INM technologies

Analysis of soil nutrients (the soil nutrient budget) showed that the amount of nitrogen removed from the soil under normal cropping practices was greater than the amount returned to the soil. In other words there was a negative balance in the soil nutrient budget. The combined application of farmyard manure, DAP and *Tithonia* resulted in a less serious loss of nitrogen than the current practice of using a single application of farmyard manure or DAP. This showed a clear benefit in using organic and inorganic inputs in combination. The synergy created had a positive effect on the nutrient depleted soils in the study site.

Communication and information

The INM-FFS have shown that they can provide a forum for strengthening linkages between farmers and other consortium partners with experience, skills and information on soil fertility management. The experience of joint learning and the effective exchange of information in the Munyaka FFS created a sense of ownership amongst farmers which is an important factor in encouraging them to put their newly acquired INM skills into practice.

Joint problem diagnosis during the FFS platforms brought Government and non-governmental organisations together to define priority problems and opportunities for research and extension. It has also provided a strong foundation for on-going cooperation and information flows and exchange. The FFS platforms have also contributed to bridging the gap between agricultural extensionists, researchers and farmers, providing a forum through which these stakeholders come into regular close contact with farmers.

Although FFS on INM is appreciated by both sexes, women in particular seem to value the approach, due to the practical, field based, learning focus as well as the social value of FFS groups.

Conclusion

No single institution can meet all the challenges involved in improving soil fertility management, which can only be overcome by building partnerships between farmers, extension agents, private sector, researchers and policy makers and, more importantly, by enhancing information exchange. Experiences from FFS in the Mbeere district has shown that INM-FFS can be used to stimulate information exchange, design and test INM technologies and increase the pace of technology adoption. The documentation and analysis of quantitative and qualitative data generated during FFS process has created room for wider sharing of FFS outputs both at the farm level, and amongst the scientific and policy communities. Furthermore, the study has shown that there is need to adapt the methodology to maximise the use of local resources (for example, *Tithonia*) and optimise application of external inputs, where available. The challenge is to bring indigenous and scientific knowledge together under one umbrella, which is usually easier said than done.

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