Restoring soil fertility *and sustaining agropastoral systems* in sub-Saharan Africa *using organic fertiliser*

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In sub-Saharan Africa, where soil fertility is deteriorating while the price of fertiliser increases, the use of organic fertiliser as a sustainable alternative appears easy to implement. To enhance the production and use of these fertilisers, experiments involving local and scientific knowledge have been conducted in four agro-pastoral savannah areas. The economic and ecological impacts of these innovations are difficult to measure, but they have yielded encouraging results in terms of yield and intervillage trade.

The declining soil fertility observed in this region of Africa is due to the spread of continuous cultivation and the abandonment of fallowing. The crops of cotton, cereals or maize that are grown are demanding in terms of mineral elements; but the price of mineral fertilisers is up, while the price of cotton is down. In this context, farmers are showing increasing interest in organic fertiliser, but the value they place on it is variable by area.

The technical solutions and models proposed by researchers do exist, but are being ignored by farmers. The purpose of the project "**Valorising local knowledge on crop-livestock integration for the sustainable management of sub-humid savannah ecosystems in Africa**" was to increase the involvement of stakeholders in the field and enable them to adapt their practices. The project experimented with a participatory action research (PAR) process designed to improve the use of organic fertiliser, taking the greatest possible advantage of farmers' knowledge and expertise.

Restoring soil fertility *through participatory* action research

The project took place in savannah areas in the agropastoral systems based on the triad of cotton, cereal and livestock, which places high anthropogenic pressure on agro-forestry-pastoral resources.

The project involved scientists and local stakeholders from nine villages in Mali, Burkina Faso, Chad and Cameroon, where there is a wide range of agropastoral situations and farmers have widely varying knowledge and expertise in crop-livestock integration.

The project aimed to improve soil fertility and sustainable use of village territories' farmland, pasture and woodland resources, in particular through the characterisation, evaluation and enhancement of local knowledge, capacity building and management information, and the establishment of PAR. To achieve this, the project set itself the following objectives:

- To co-construct the soil fertility problem with local stakeholders starting from their local knowledge and expertise;
- To identify with them the possible options for improving the production and use of organic fertiliser to restore soil fertility;
- To pilot these innovations with them on their farms and assess their effect on the sustainability of the production system.

The PAR approach seeks to formalise a joint project wherein scientists work with local stakeholders who are involved at all stages of the research: diagnosis of the problematic situation; the contracting phase (development of the governance system, problem definition and work programme); the phases of completion (implementation through experiment) and of review and dissemination of the findings. •••

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▲ *The declining soil fertility observed in this region of Africa is due to the spread of continuous cultivation and the abandonment of fallowing.*

Pooling of knowledge *based on exchange and* contracting

Depending on the country, consultation frameworks between local stakeholders and scientists have taken different forms. In some villages, a transitional structure has formalised the link between local socio-professional organisations (SPOs, or farmer/producer groups) and researchers. That structure comprised a Village Coordination Committee (VCC) for liaison between researchers and the SPOs, a steering committee (VCC representatives, researchers) to manage the project, and a scientific guidance committee. On the basis of that organisation, local stakeholders and researchers identified research topics aimed at strengthening crop-livestock integration in production units through two experimental foci: improved production of organic fertiliser and its rational use in the field.

Organic fertiliser production generated considerable excitement, with an increase in the number of volunteers as soon as the work began. Meetings of the project coordinating committee, involving scientists and farmers, led field teams to compare notes on their experiences in order to develop protocols, present results, organise joint activities (intervillage exchange) and debriefing meetings. The scientific committee played a strategic role in methodological adjustments.

Such a participatory approach must balance the various stakeholders' time scales so that learning processes will be successful. It must rely on good facilitators, mediators and translators to ensure that information will circulate.

In order to make farmers aware of the techniques used elsewhere in similar conditions, but also to train them in some theoretical aspects, the project established intervillage exchanges and training sessions. Through these exchanges, farmers realised that a change in organic fertiliser enrichment practices was both desirable and achievable at the community level. Similarly, experimental approaches and innovation opportunities emerged.

In the villages of Koumbia and Kourouma (Burkina Faso), technical training given in the Dioula language at farmers' request appeared to have a less decisive impact than intervillage exchanges. The training did however enable discussions to be held with farmers on the biological mechanisms involved in the development of quality fertiliser, regeneration processes and loss of fertility, supplementing indigenous knowledge to some extent.

The project also helped network a group of scientists conducting research on the dynamics of cropping relative to livestock production in agro-pastoral systems of West and Central Africa. Further, it promoted a strengthening of research institutions' capacity through student training. Scientific publications completed the otherwise limited and incomplete information available. Dissemination of the findings, via the production of technical documentation for local stakeholders, still remains to be done.

Fertiliser typology *and characteristics*

Analytical work on indigenous knowledge performed at Dentiola (Mali) and Koumbia and Kourouma (Burkina Faso) has identified many different types of fertiliser, their characteristics, the risk factors associated with each, and how they are managed.

In Mali, four types of organic fertiliser are recognised by farmers: manure, household garbage, nightsoil and field composting.

▼ *January 2006, Kourouma, Burkina Faso. Participatory mapping workshop.*

The latter is relatively well- developed and has the advantage of turning biomass fertiliser to account without transport.

Farmers tend to apply fertiliser in a rational manner. Some, having very little fertiliser, will even locate specific places in the field found deficient in fertility.

In Burkina Faso, most manure sites are located near dwellings, in the form of household compost heaps and compost pits. Biomass produced in the field (e.g. cotton stalks) is burned, and straw residues from range pasturing are left in the fields.

Organic fertiliser *production and local* application techniques

To perform the experiments, the VCCs selected farmers according to criteria set out in a specification. The plot and the crop to be used for the experiment were chosen by the farmers. A technician and a village farmer were responsible for follow-up. The farmer undertook to organise visits to his plot by other village farmers.

Farmers took a particular interest in the new mode of fertiliser production introduced: cotton stalk composting. More than half of them have opted to use it.

At Koumbia and Kourouma, the rate of completion of compost pits is satisfactory to date, with 78% of the 18 pits planned having been dug. Fertiliser production is underway and the first pits will be emptied at the beginning of the next crop year.

Measurements on maize plots show a significant increase in grain yield through the application of fertiliser, and seedlings developed better. However, there was no significant difference between the test and control plots as regards straw production and grass cover.

The significant standard deviations are partly attributable to very different climatic conditions in 2007 between the two villages (near normal rainfall in Kourouma and drought in Koumbia).

On the cotton fields, it is difficult to reach a conclusion, as the sample was limited to two farmers. Overall, however, the organic fertiliser did have a positive effect on yield.

Convincing results *but an economic and* environmental impact *that is difficult to assess*

Given these results, it can be concluded that the main objectives of the project were achieved. However, it is difficult to say what the project's economic and ecological impacts may be, as it was conducted for too short a time and with too limited means to achieve significant impact in the nine villages.

Nevertheless, the results are very encouraging. It paved the way for the conduct of further research on the promotion of sustainable development in agro-pastoral systems in sub-Saharan Africa, for the methods employed are clearly applicable on a broader scale, in other areas of agriculture (e.g., animal husbandry and ecosystem management: seeds, soil, livestock, production unit economics, farmland, pasture and woodland, climate change…) but also in other contexts (drylands, wetlands, urban agriculture…). ■

Partnership

Lead organisation: International Centre for Animal Husbandry Research and Development in Sub-humid Regions (CIRDES, Burkina Faso)

Partners: *Association Tchadienne des Acteurs de Développement Rural* (ATADER), *Bureau d'Études et de Liaison des Actions Caritatives et de Développement* (BELACD, Chad), Agricultural Research for Development (CIRAD, France), *Commission Régionale des Utilisateurs des Résultats de la Recherche* (CRU, Mali), *Institut d'Économie Rurale (IER, Mali)*, *Institut de l'Environnement et de Recherches Agricoles* (INERA, Burkina Faso), Institute of Agricultural Research for Development (IRAD, Cameroon) Chad Agricultural Research Institute for Development (ITRAD, Chad) Regional Applied Research Centre for the Development of Central African Savannahs (PRASAC) Support for Local Development (SADEL EIG, Cameroon) *Union des Sociétés Coopératives d'Éleveurs Producteurs de Lait du Houet* (UEPL, Burkina Faso), *Union Nationale des Producteurs de Coton du Burkina* (UNPCB, Burkina Faso), *Union Régionale des coopératives de la Filière Bovins Viande de Sikasso* (URFBV, Mali), *Union Régionale des Jeunes Professionnels Agricoles des Hauts Bassins* (URJPA HB, Burkina Faso)

Countries involved: Burkina Faso, Cameroon, Mali, Tchad

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