Farmers and researchers *join forces to spur West African* agriculture through *symbiotic microorganisms*

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To improve agricultural crop production in West Africa, a study on crop inoculation with microorganisms was carried out, with very promising results in terms of yield. The project confirmed that this green technique is a good substitute for chemical fertilisers that poor farmers can ill afford. More generally, it opens up new prospects for marginal agriculture in arid regions.

In West Africa, there are many constraints on agriculture: poor soil, salinity, lack of water… The results are low productivity, poor farm incomes, and food insecurity. The solutions usually recommended, such as chemical fertiliser applications, the use of new seed varieties, or water control, are unsuited to this vulnerable part of the world because not everyone can afford them and they may harm the environment.

Other research-based solutions exist but have not become widely known in West Africa, in part because of researchers' limited knowledge of farmers' organisational dynamics (and vice versa). Hence, the project **"Facilitating Western African farmers' adoption of inoculation technology using microorganisms to improve plant production"** helped remove those constraints by having farmers' organisations use microorganisms to improve plant production.

Microorganisms *to bring soil to life*

Scientifically speaking, the project relied on the fact that soil contains naturally occurring microorganisms (bacteria and fungi) that live in symbiosis with plants. They are involved in plants' uptake of water and minerals, while the plants provide them with energy through photosynthesis.

Inoculation, a massive injection of selected bacteria and fungi, can compensate if there are no naturally occurring ones, or too few. It improves soil fertility and agricultural productivity—two key issues in West Africa.

Two main groups of microorganisms enter into symbiosis with plants. Rhizobia associate with legumes (groundnuts, cowpeas, beans, soy, acacia, mesquite, Pterocarpus…) and allow the plants to assimilate atmospheric nitrogen. Mycorrhizal fungi form a symbiotic relationship with almost all plants, promoting their absorption of water and nutrients such as phosphorus.

In arid and semi-arid areas where plants must cope with a lack of nutrients and severe stress, for example from drought, salinity, and pests, that limit their viability, inocula appear particularly appropriate. The inoculation technique, though well suited to West Africa's soil conditions but also its economic climate, and widely practised the world over for some decades, had up to now been unknown in the region. •••

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▲ *The project led to the creation of frameworks for dialogue between the researchers and farmers involved.*

Empowerment of farmers' *organisations at all stages*

The effect of inoculation was tested on two major crops. The first, soybeans, confirmed the technique's positive and sometimes spectacular effects: in Djimini-Velingara (Senegal), inoculation multiplied soybean seed and above-ground biomass production four- or five-fold. Researchers found, however, that cowpeas did not respond to inoculation. They were unable to obtain convincing results.

During meetings of various stakeholders, farmers present told researchers they were willing to share in the risk of failure. The results, however, proved more than promising, even though they were sometimes achieved by less than academic means. For example, one group of producers, finding that their uninoculated plants were lagging behind the control plot, applied to the latter a dose of fertiliser just high enough to achieve the same yield as the inoculated plot. This showed that inoculation can replace fertilizers. In Mali, fearing that the inoculation of cowpeas would affect their taste, the farmers responsible for the test plots organised tastings, the upshot of which was that the seeds of inoculated plants seemed to be more tender than those of the uninoculated ones.

A better mutual *understanding among* the various stakeholders

The project brought together various players in five countries (Benin, Burkina Faso, Mali, Niger and Senegal): researchers and farmers through national rural platforms belonging to the Network of Farmers' and Agricultural Producers' Organisations of West Africa (ROPPA) and the microbiology laboratories present in each country.

It conducted two main activities. First, it sought to put farmers and researchers on an even footing, to promote familiarity and mutual esteem. It held local, regional and national meetings as well as workshops that acquainted farmers with the scientific work being done in the laboratory. They were invited to look through magnifying glasses and microscopes and to perform microbiology and molecular biology manipulations. The project's second focus was the creation of pilot plots to test the overall effect of inoculation under various environmental conditions and to demonstrate its effectiveness.

The project's primary outcome was the creation of frameworks for dialogue between the researchers and farmers involved. In Senegal, where these frameworks took shape before the start of the project, they created a real rapport between the partners. In Mali, they appeared well established by the end of the project, and Benin was on course to do equally well.

They were more difficult to implement in Burkina Faso and Niger, in part due to the stakeholders' unavailability, but now appear possible following the sharing of experiences in other countries.

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Rapid technology *implementation by* farmers

The positive effect of inoculation, in particular on soybeans, quickly led farmers to seek inoculum supplies. A number of options are under consideration to meet the demand. In 2008 the farmers of Senegal's Kolda region set as an R&D priority the establishment of a local production unit. They may also call on specialised international companies.

Whatever the solutions for inoculum production, all partners agree that it is essential for researchers and users to set strict standards for distribution, in line with the practices developed in the rest of the world but taking into account the specific situation of West Africa.

Networking of key *stakeholders to share* information

To extend the human journey initiated by this study, at the project review meeting in Bamako in late April 2008, representatives from each of the project partners decided to set up the INOCAO (inoculation in West Africa) network. It will be open to other stakeholders (economists, sociologists, lawyers, nutritionists, breeders, environmentalists…), agricultural and rural advisory bodies and policy makers (politicians, media…) and will be mandated to tackle questions related to the integration of symbiotic microorganisms into local agriculture.

Within INOCAO, farmers and researchers will work on various activities: research and development projects but also training projects (Master's in Plant and Microbial Biotechnology in the Sahel at the University of Dakar) and popularisation (an international workshop on learning, production and sharing of innovations that took place in Ouagadougou, Burkina Faso, in October 2008).

Lessons for sustainable *agriculture*

The INOCAO network has set itself two priority areas of activity: promoting the use of inocula and further research on the subject, including studies of microorganisms' diversity and their ecology, specific crop requirements, the future of inocula, their impact on the environment and soil fertility, etc.

A further outcome of the project has been the realisation that, to promote participation by civil society, including farmers' organisations, in the development of agricultural innovations, it is important to:

- create direct links between researchers and farmers;
- establish partnerships with representative organisations, not just individuals;
- apportion financial and technical responsibility between all stakeholders;
- persuade researchers to accept the loss of some of their "power";
- make farmers aware of the research process, not just its findings;
- take advantage of the "snowball" effect of some groups' success to forge a long-lasting cooperative relationship, and also seek to spread the technique of microorganism inoculation to other areas as a real alternative to chemical fertilisation. ■

Partnership

Lead organisation: *Cadre Local de Concertation des Organisations de Producteurs* (CLCOP) *de Keur Momar Sarr* (Senegal)

Partners: Network of Farmers' and Agricultural Producers' Organisations of West Africa (ROPPA), *Conseil National de Concertation et de Coopération des Ruraux* (CNCR), *Institut de recherche pour le développement* (IRD, France)

Countries involved: Benin, Burkina Faso, Mali, Niger, Senegal

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