SECURE

Soil ECological function REstoration to enhance agroABSYS services in rainfed rice cropping ABSYSs in agroecological transition

ABSTRACT

Agriculture is at the heart of many international concerns and at the center of social, economic and environmental issues. This is particularly true for countries in sub-Saharan Africa like Madagascar where the majority of the population lives of agriculture, in great poverty. It is therefore urgent and necessary to transform agriculture to improve productivity, sustainability, food security and the standard of living of farmers. One of the paths to success is to ecologically and sustainably intensify this agriculture by increasing the provision of ecosystem services. This involves in particular developing strategies for the sustainable management of natural and renewable resources, whether it be the organic fertilizers available to farmers or soil biodiversity. The other path to success is to build innovative practices with farmers and political support. This involves research projects combining many disciplines with the same objective.
The objective of the SECuRE research project was to improve the fertilization practices of rainfed agriculture, on slopes, in small farms in the highlands of Madagascar, based in particular on a better management of organic fertilizers and soil biodiversity. The intensification of soil ecological functions, provided by soil organisms, indeed offers significant potential for improving agricultural productivity and sustainability, but also for the mitigation of climate change by storing carbon in the soil or for the reduction of soil losses by erosion. This transdisciplinary project therefore aimed to: (i) understand fertilization practices and the level of intensification of small farms, (ii) study the role of certain key soil organisms in relation to the soil and growth of cultivated plants, with rice as a model, (iii) study the potential of assemblages of (organic, mineral, rock-based) fertilizers, (iv) test innovative practices in the field and share them with farmers so that they can guide practices, (v) inform politicians of the potential for ecological intensification of agriculture in Madagascar, and finally (v) disseminate knowledge so that it is known to the greatest number, for a sustainable development of African agriculture.
The project has notably enabled, thanks to a vast survey, an in-depth knowledge of the functioning of family farms in the Highlands of Madagascar. More than 320 farms were surveyed, in two contrasting regions. A great deal of information has been acquired on the farms themselves (size, composition, sources of income, typology of farms), on fertility management practices (practices, materials used, biomass flows) and on economic performance. At the same time, experiments in the laboratory or in the field have made it possible to clarify our knowledge of the role of key soil organisms on soil properties and plant response. In the very infertile, multi-deficient, unresilient soils of the Highlands of Madagascar, our research has clarified the need to strengthen soil biodiversity to intensify the ecological functions it fulfills: recycling of nutrients, decomposition of organic matter, soil structure maintenance and regulation of populations of pathogens and diseases. Our work has shown in particular the role that earthworms can play in the fight against rice blast disease, and the need to choose varieties of cultivated plants capable of "interacting" with soil organisms. Our work has also considerably improved the choice of possibilities in terms of fertilization. The work carried out within the framework of M. Raminoarison's thesis showed the interest of mixing different local fertilizing materials (organic, mineral, rock-based) to fight against multiple soil deficiencies, promote the availability of nutrients for plants and support soil life. Field trials have made it possible to test a set of innovative practices and to compare them with peasant practices in terms of agronomic performance and ecological functioning of soils. All of these innovative practices were shared and discussed with farmers who were able to assess and develop them.
It is still difficult to assess the impacts of such a project. Farmers have always been very present and associated with the project through socio-economic surveys, various workshops on fertilization practices, and reference farms. They have probably realized the possibility of ecologically intensifying their agricultural production for better productivity, greater sustainability and increased income. A survey showed early mechanisms of learning with reference farmers, mainly relying on exchanges of information inside and outside of the networks of reference farms. Malagasy politicians (represented by

different Ministries), donors and various NGOs were also informed of these scientific advances during a feedback seminar and by the presentation of documents.

Keywords : Madagascar, , Madagascar, Local farmers knowledge, Co-learning and dissemination, Agroecological performances, Soil functional biodiversity

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GOAL

The importance of soil ecological processes and functions for plant growth and other ecosystem services makes soil an essential component of sustainable agroecological systems. Soil (ecological) Function Restoration, i.e. the intensification of these ecological processes, during agroecological transition, is the core of our project. The overall objective of the SECuRE project is to provide Soil Function Restoration (SFR) practices based on local and scientific knowledge, in order to increase both agronomic, socio-economic and ecological performances of agroecological agrosystems in a tropical context.

ACTION

SFR aims to optimize current farmer’s practices and propose innovative practices that will promote soil habitat in order to intensify associated soil and plant functions.
We aim to (i) assess local knowledge and farmers' interventions on SFR, (ii) improve our scientific knowledge of SFR on diverse plant functions, (iii) test at field level various SFR practices, (iv) evaluate the impact of SFR practices in terms of agronomic, socio-economic and ecological performances, and (v) disseminate our results.

RESULTS

Different outputs will be provided by our project:
Update information on farmers' practices and knowledge on soil function restoration
Update knowledge on the soil-plant interactions following different restoration practices;
Characterize the joint agronomic and ecological performances of agrosystems and more specifically on SFR practices;
Disseminate the ‘best’ restoration practices, ‘best’ meaning the ones improving both agronomic and ecological performances;
Organize annual farmer visits of field trials;
Publish in peer-reviewed journals;
E-learning and training of Master and PhD students.

PERSPECTIVES

A better inclusion of SFR practices based on traditional and scientific knowledge in tropical agroecological systems will likely improve agronomic performances and the provision of agrosystem services ensuring Human well-being such as nutrient cycling, carbon sequestration, farmer’s livelihood, and food security.