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Agroforestry systems in Mozambique as part of a South-South cooperation project

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Abstract

It is reported the elaboration process and field performance of a triangular-type international South-South technical cooperation partnership encompassing Brazil, Mozambique and donor agents from the northern hemisphere. The project was part of "The Agricultural Innovation MKTPlace" platform, coordinated by Embrapa, in partnership with Brazilian Federal University of Viçosa, MS Foundation, and the Mozambican Institute for Agricultural Research (IIAM). The framework of the evaluated technology was based on Agroforestry Systems envisaging the integration of both food and biomass for renewable fuels production as a driver to sustainable development of local family agriculture, by increasing availability of foodstuff and wood fuel sources for self-consumption and income. In such a system, it is expected improvements of soil properties and increasing awareness towards conservation agriculture practices. The project was executed around the City of Nampula, Nampula Province, Northeast of Mozambique, in two sites: a local IIAM (on station) area, and an area belonging to a Small Farmers Association Mapwane, in Anchilo Community (on farm trials). Partners get together in the build-up of the proposal and all activities related to fieldwork. In the first two years of the project, main difficulties were legal aspects for a planned transference of Macauba palm (*Acrocomia aculeata*) genetic material from Brazil to Mozambique; low engagement of participating farmers, despite initial goodwill; trials with tree species with a long development cycle; lack of commitment from some initial partners; the instability of climate conditions. On the other hand, positive achievements of the project for both farmers and local technical team were the participative construction of the project, which resulted in a good exchange of experiences among technical partners; good integration among the teams during fieldwork; female presence in the leadership and execution of the project; legacy of the agroforestry systems implemented; and the building up of knowledge on conservation agriculture among the farmers. It is concluded that the cooperation was effective to strengthen ties between these nations of the South-South axis, effective exchange of experience among technical partners, as well as showing in the practice the innovative potential of agroforestry systems for the improvement of small farmer's livelihood.

Keywords: international cooperation; gender equality; food production; biofuels; smallholder's agriculture; sustainability.

Introduction

International cooperation implies, mostly, full financing and support from a developed country towards a developing country, within the so-called North-South programmes. On the other hand, there is growing programs within the so-called South-South programs, with developing countries from Africa, Asia, Latin America and Middle East cooperating among themselves to share experiences in financial, social and environmental issues, encompassing different governmental and civil actors (Liu, 2016; Amanor & Chichava, 2016). The interaction of both programs, the Triangular Cooperation, expands their advantages and capabilities, being considered the best way to identify, select, transfer and adapt technologies, helping to achieve a better economic development and fulfil ONU´s Sustainable Development Goals to eradicate poverty in the world (UNDP, 2019).

Brazil is a country that has benefited from international cooperation programs in agriculture. The best known is PRODECER, financed by Japan. It begun in 1979, and up to its closure in 2001, helped to create the technological base that made its Savannah-like central area, the Cerrados, one of the largest food producing area in the country, backing up national and international food prices and availability (Hosono & Hongo, 2016).

After that, the successive gains in agricultural productivity in the country are result of the development and adoption of conservationist practices such as crop rotation, minimum and zero tillage, as well as integration of crops with husbandry or forestry. Such successful experience in tropical agriculture may be useful for sharing with African countries with similar environmental conditions. This report stresses a project within the Agricultural Innovation MKTPlace" (Mktplace, http://www.mktplace.org/site/). This is a Triangular Cooperation programme run by Embrapa, and sponsored mainly by Bill & Melinda Gates Foundation, and Department for International Development *(*DFID/UK). The objective of the project was to exchange experiences to promote innovation in the traditional productive system in the Northern Province of Nampula, Mozambique, aiming the improvement of the local livelihoods by agricultural production gains in terms of biofuel and food security through agroforestry systems, encompassing food and nonedible crops for self-consumption and surplus.

Material and Methods

The project was build up in a participative way, with discussions between technical partners from Embrapa, the Institute for Agricultural Research of Mozambique (IIAM) and local Mozambican rural extension. Once a main line of research was delimited, local farmers from Mpwane Farmers Association of Anchilo, Nampula, were included in the discussions. Their main demands were: a) sources of fuel to run a water pump for irrigation, since there is a small water dam in the area; b) higher production of food, enough for their own needs and surplus to increase their incomes; c) soil amelioration; and d) firewood availability.

Upon these demands, the technical team envisaged two strategies, considering short and long time span for local development. Firstly, the incorporation of fast-growing species, that could provide immediate energy sources. Second, the establishment of slower-growth, high-density and multipurpose (energy and organic matter for soil amelioration) plant species. Since is necessary to keep the food production, Agroforestry Systems (AFs) were chosen as the best way to fulfil these demands. Thus, the perennials Gliricidia and Eucaliptus were intercropped with staple foods (peanut, sesame, corn, pigeon pea and cassava) in 2016/17 and 2017/18, and Crambe, a nonedible oily species, to provide oil for biofuel production and to run a stationary water pump engine. The systems were set up in a way to allow observations over a long term, considering that the effects of the forest component (shadowing, contribution to soil fertility, etc.) far extrapolates the project timeline. Trials were set up in Muriaze, IIAM´s experimental area (on station), exclusively for IIAM technicians operation; and in Anchilo area (on farm), with participation of the local smallholders from Mpwane association. Field evaluations encompassed annual crops productivity, establishment and early development of the forest species and complete soil analysis.

Farmers participating in the project (representing 25 family units belonging to Mpwane Association) and technicians were in contact during all phases of the project, with exchanging of experiences and capacitation towards novel technologies to them. After two years of the project commencement, a socio-economic survey was applied to the members and nonmembers of Mpwane Associaton. Four communities (128 familiar units) in Anchilo area encompassing 772 people in total. The questionnaire provided a good baseline of local current conditions, and it will help to distinguish any change occurring over time due to the present intervention.

Results and Discussion

Soil sampling at the beginning of the field trials indicated that soils from Anchilo and Muriaze areas are of poor natural fertility, especially in relation to organic matter availability. Soils in Anchilo are slightly fertile than those in Muriaze. The full analysis performed would be useful in the future to check out improvements eventually resulting from the introduction of AFs.

Financial resources arrived late in the rainy season, hampering the first cropping season by constraining preparation of tree seedlings. Low precipitation that season compromised the trials even more.

Due to intercountry genetic transference difficulties, the multipurpose Macauba Palm (*Acrocomia aculeata*), which was supposed to be the forestry component was substituted by Eucalyptus, species that technicians had previous experience with. At the same time, the introduction of the new crop (*Crambe abssinica*) directly to the farmers did not went well, because of the lack of experience to deal with it by both the extension technicians and the farmers. This is a reminder that it is always necessary to do the introduction of new species via “on station” evaluation, releasing it only after its validation by local technicians.

Despite these hurdles in the first year, the second year of the project went well (Figure 1), indicating that the basis for a long-term influence of the innovative SAF programme was established. In the meantime, farmers and local extension service technicians were educated with good agronomic practices related to the production of vegetables, annual and perennial crops, as well as the management of AF (Figure 1). Farmers were also trained towards good practices of the management of their Association. The trial areas were also a spot for capacity building of students from local agricultural schools, indicating to be an interesting ground for learning and later dissemination of this production system. In all cases, there was a successful link between international and local team, sharing their expertise under a strong female leadership.

Figure 1. View of the field experiment area in the cropping season 2016/2017 (A, B) and 2017/2018 (C, D), and interactions between project leaders (E), technicians (F) and farmers (G) capacity building and students internship (H).

Some of the main findings so far are the results of the survey to evaluate how effective transference of knowledge to the farmers was. Eighty-five % of those from Mpwane area answered that they know what AF systems are, in comparison to 25% similar responses from the other three communities out of the project boundaries. Seventy-six % of the interviewed project partners affirmed that they are using AF in their farm, against 1.5% among the other group. Seventy % of farmers collaborating with the project affirm they learned techniques within the project, such as the use of Gliricidia as green fertilizer and fodder source, mulching, intercropping trees and annual crops, and avoiding burning to remove previous cropping leftovers and renew their crops, using it instead as mulch. They also demonstrate their intention to keep planting in line, using mulching use, SFs, among other good practices of conservation agriculture.

Conclusions and Outlook

The essence of the initial project design was indeed shared through the participation of local communities and technicians.

The implemented agroforestry systems allows the continuity of knowledge building about SAF's beyond the closure of this project.

The main gains were the strengthening of IIAM's R&D team with strong female participation and the awakening to a new conservationist multipurpose production system by technicians and farmers.

The lessons learned refer to the construction of goals even more linked to the local baseline knowledge and infrastructure to reach the intended innovation.

There is significant signaling that local smallholders learned the message that came along with the field implemented agricultural systems and capacity buildings offered by IIAM, reaching far beyond the agroforestry systems aimed in this project.

The project was effective to fulfill the strengthening of the South-South cooperation, showing the innovative potential of the transferred technology for improvement of local farmer's livelihoods.

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