

Transfer of Brazilian Technologies to West Africa

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Summary

Brazil provided technical assistance to Cotton-4 (C-4) countries in West Africa, namely, Benin, Burkina Faso, Mali and Chad through a project that was implemented during 2009-13. The project was designed and implemented with the purpose of transferring environment-friendly cotton production technologies from Brazil to enhance yields and fibre quality in Africa. The Project was an initiative of the Government of Brazil through the Brazilian Cooperation Agency (ABC). The Brazilian Agricultural Research Corporation (EMBRAPA) was designated as the technical back-stopping agency due to its success in revolutionizing agricultural production technologies in Brazil and establishing novel tropical agricultural paradigms based on science and knowledge. The project was implemented in active collaboration with agricultural research organizations of the recipient Governments, namely: The *L'Institut d'Economie Rurale* (IER, Mali), *L'Institut pour l'Environnement et Recherches Agricoles* (INERA, Burkina Faso), *L'Institut Tchadien De Recherche Agronomique Pour Le Développement* (ITRAD, Chad) and *L'Institut National des Recherches Agricoles du Bénin* (INRAB, Benin). The thematic areas for Project development were: Soil conservation, Integrated pest management (IPM), and cotton varietal development through germ plasm exchange and breeding. The project was designed with a philosophy that the traditional top-down approach would not be followed for transfer of technologies. Instead, a participatory approach would govern every single Project activity. There would be no pre-empted solutions to any problems, rather, everyone would work together to find solutions through an over-riding principle throughout the Project, that "a community that learns together grows together". In French, the concept was called "la famille forgeron" or the blacksmiths. Care was taken to ensure that the project met the specific needs and interests of the collaborating partners. As part of the overall management strategy, a Regional Project Coordinator was deputed from EMBRAPA to West Africa and a project steering committee was established with wide representation from the donor and recipient governments. The Project headquarters was established at the Sotuba Experimental Station, of

IER, in the outskirts of Bamako, wherein activities related to demonstration plots, training and upgrading of the station facilities were initiated. A very strong training program was set up with EMBRAPA researchers visiting Sotuba and researchers and technicians from the member Countries



Project banner on display in the C-4 countries



The Project team with farmers in a demonstration field

visiting Brazil for intensive training under the ‘train-the-trainers’ part of the project. The first batches of trained staff went back to their respective countries and shared the newly acquired skills and knowledge learnt either in Brazil or in Sotuba. By the end of the project, Sotuba facilities were up-graded; cadres of researchers and technicians from the four countries were trained locally and in Brazil; and several publications in French were prepared and distributed. The project results on the three thematic areas were disseminated to selected farming communities, thereby resulting in higher productivity. The project was extended into its second phase in 2015, with the inclusion of Togo and funded by the Brazilian Cotton Institute (IBA).

Background

Cotton is the most important cash crop for agricultural development and poverty reduction in West Africa. It represents 30, 80 and 85% of the total value of agricultural exports of Benin, Burkina Faso and Mali, respectively (FAOSTAT, 2013). It is estimated that more than 10 million people depend directly on the cotton sector in West and Central Africa as source of labour and income (AGRITRADE, 2014). The cotton value chain also brings many other benefits to rural and urban areas in the form of jobs, trade, transport etc., (Theriault and Serra, 2013). Although not always perceived, cotton plays a very important role in the food security throughout the region as source of cooking oil, cotton cake for dairy cows and for the basic food crops produced in rotation with cotton. Thus, cotton supports food-security and livelihood of large populations of West Africa and other countries.

Several cotton growing countries and the C-4 member Governments of Benin, Burkina Faso, Mali and Chad supported Brazil in the ‘subsidies case’ arbitrated by the World Trade Organization (WTO). In a reciprocal gesture, the Government of the Federative Republic of Brazil offered a project to the C-4 countries, to transfer ‘cotton production technologies’ developed by EMBRAPA. Created in 1973, EMBRAPA is credited for the development of genuine agricultural technologies for the tropics that revolutionized agriculture in Brazil (Correa and Schmidt, 2014).

A fact-finding mission by the Brazilian Cooperation Agency (ABC) and EMBRAPA, visited Benin, Burkina Faso and Mali during the year of 2006 and interacted with government officials, cotton growers associations and other stakeholders to understand the most important technical constraints in cotton production in West Africa (Pereira and Morello, 2006). The fact-finding mission identified a few key constraints such as degraded soils, inadequate varieties and recurrent pest damage that required attention. Therefore the C-4 project focused its activities in three important thematic areas: 1. Soil conservation and soil health management coupled with



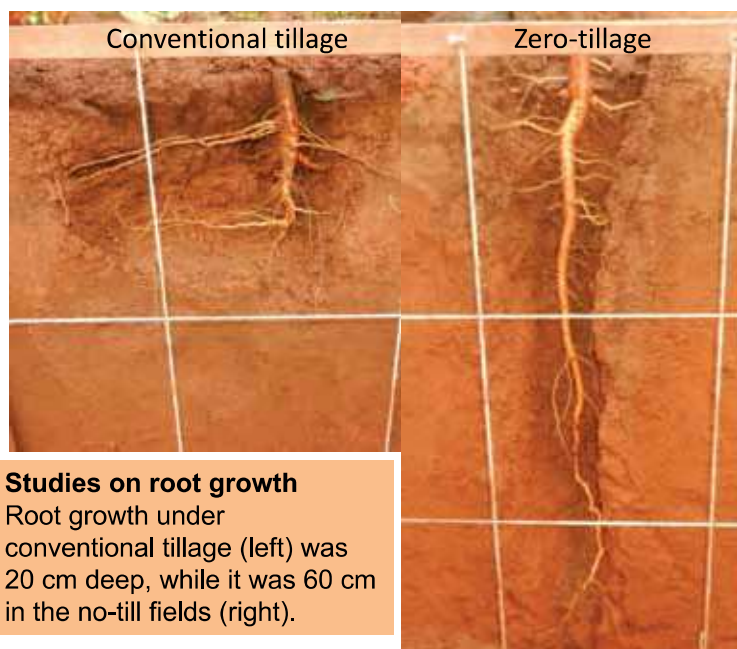
Field training



Root growth studies in the field pits



Laboratory training



introduction of concepts and practices of zero-tillage, crop rotation and cover crops 2. Integrated pest management (IPM) with emphasis on biological control and 3. Cotton breeding, involving germplasm exchange and varietal development. The mission also recommended up-gradation of the existing research facilities.

The second author of this paper, (Dr. Barbosa, then retired from EMBRAPA), was hired in 2007 by ABC to draft the project document in consultation with EMBRAPA, ABC officials and representatives of the C-4 countries. After visiting Benin, Burkina Faso and Mali, it was decided to set up the project headquarters at the Sotuba Experimental Station, of the Institute of Rural Economics (IER) of Mali, located outside the capital city, Bamako. Another mission-team comprising of officials from ABC and EMBRAPA visited Bamako and met with representatives of the research organizations of the C-4 countries (Mali-IER, Benin-INRAB, Burkina Faso-INERA and Chad-ITRAD). During this visit, the draft C-4 project document was revised, incorporating suggestions made by all the participants. At the end of this meeting, the project was signed by the Minister of Agriculture

of Mali and sent to the ministers of the other C-4 countries for their signatures (ABC, 2009). As Brazil did not have official representation in Ndjamena, a special visit was made to Chad. At the project signature ceremony in Bamako, ten EMBRAPA cotton cultivars were presented to the Minister of Agriculture of Mali, symbolizing the official initiation of Project activities.

The Project

The project “Support to the Development of the Cotton Sector in the C-4 Countries – Benin, Burkina Faso, Chad and Mali” (or, simply, The C-4 project), was initiated with a total budget of US\$ 5 Million for a duration of 5 years (2009-13). The project was designed to focus on adaptive research by transferring Brazilian cotton technologies developed by EMBRAPA to assess their suitability and adaptability to the ecological conditions of the C4 countries with the objective of increasing yields and improving the quality of cotton. Furthermore, the additional income and jobs resulted from cotton

yield enhancement and crop rotation with food crops would greatly contribute to mitigating food insecurity in the C-4 region. The Project aimed to address the main constraints of cotton production in the C-4 countries as identified by the fact-finding mission by ABC and EMBRAPA, namely: degrading soil health, pestilence and inadequate varieties. The main objective was to improve competitiveness in the cotton supply chain. Other aims were to transfer knowledge in cotton genetic improvement (new varieties), enhancing soil health, zero-till farming and Integrated Pest Management (IPM). The Project was coordinated by ABC and executed by EMBRAPA.

The project became operational in 2009. As a consultant hired by ABC, the second author initiated the project activities at the Sotuba experimental Station by maintaining contacts with the Brazilian Embassy, the UNDP office, IER management and the Sotuba staff. A field area was identified to validate research findings and to conduct demonstration plots. Mr. Geovando Pereira, of EMBRAPA, was designated as Project Coordinator for the first 6 months of the project activities. Subsequently, the senior author of this paper, Mr. J. G. Di Stefano, succeeded as the Project Coordinator for remainder of project's duration.

Project Philosophy

The C-4 project became the first Brazilian technical cooperation project of a large scale. When he first thought of the project idea, Mr. Olyntho Vieira, of ABC, was keen to develop an infrastructure project with long-lasting impact,



The C-4 Project Centre



Discussion in class rooms on lessons learnt in the fields

far beyond its duration. However, it was increasingly felt that the project would have to do something for the cotton sector, which would be different from what others had done in Africa before. Therefore the project was designed to have a different attitude by sharing knowledge and experiences with African counterparts to benefit the cotton sector. The project was designed on the principles of knowledge sharing, adaptive research and implemented all through by adhering to the basic philosophy of participatory learning.

The basic guiding principle of the project that the “top down approach should not be accepted” was deeply incorporated into the project functioning, with the arrival of its second coordinator, Mr. Di Stefano. The project soon became ‘the community that learn together’. There were no pre-fabricated solutions; it was the birth of the “famille forgeron” or the blacksmiths. Researchers, extension agents, technicians and farmers (men and women and even children) would sit around a table, with a farming tool, a bag of seeds, a plant, an insect etc., and would decide together the next steps to be taken. Banners showing the project guiding principles and results became commonplace; and the field became the school, under the sun or the rain. Knowledge became the main incentive to

everyone and the project participants felt empowered to carry out their responsibilities.

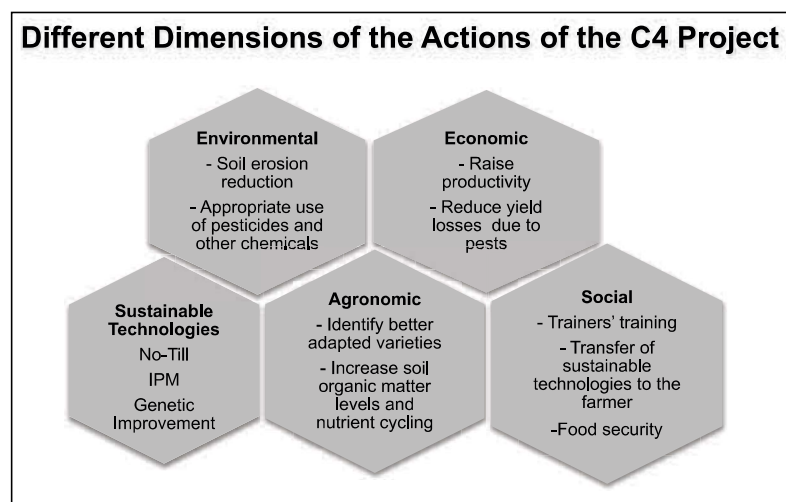
Project Strategy

The appointment of a project coordinator from EMBRAPA and the creation of a Steering Committee were two important steps that ensured the success of the project. The project coordinator was responsible for everyday project activities. Additionally, he also liaised with the Brazilian Embassy, the local UNDP office and with government officials to ensure smooth operation of the project. The Steering Committee opened the necessary space for dialogue among the partners and gave the countries an opportunity to either simply proceed with activities as defined in the project document or review them together with the other partners when changes were required. The presence of the Committee gave the project much credibility and differentiated it from other existing projects.

Training was first conducted in Brazil (train the trainers) for researchers and extension agents who, upon returning home, would share the acquired knowledge, skills and experiences with their colleagues in Benin, Burkina Faso, Chad and Mali. In addition, EMBRAPA scientists went to Sotuba to train scientists, extension agents and farmer leaders from the C-4 countries, for which adaptive research was conducted and demonstration plots were set up in farmers’ fields. As the project progressed, training and demonstration plots were also organized and conducted away from Sotuba and Mali. As listed in the project document, two representatives of each country were invited to attend the Brazilian Cotton Congress, traditionally held once every two years.

Project Activities

- Formation of the Project Steering Committee with the nomination of representatives by ABC, EMBRAPA, INRAB, INERA, ITRAD and IER, to conduct meetings and implement recommendations.
- Upgrading the Sotuba experimental Station in Bamako-Mali, including the refurbishing of some of the existing laboratory and field facilities; procurement and purchase of laboratory and field equipment; and building of the C-4 Center and the *Trichogramma* laboratory.
- Organizing the missions by EMBRAPA specialists in the C-4 countries and visits of C-4 researchers, extension agents and farmer leaders to EMBRAPA facilities and cotton growing areas of Brazil, including participation in the Brazilian Cotton Congress.
- Conducting adaptive research and organizing demonstration plots in Sotuba and in other sites of Benin, Burkina Faso, Mali and Chad in Project thematic areas.



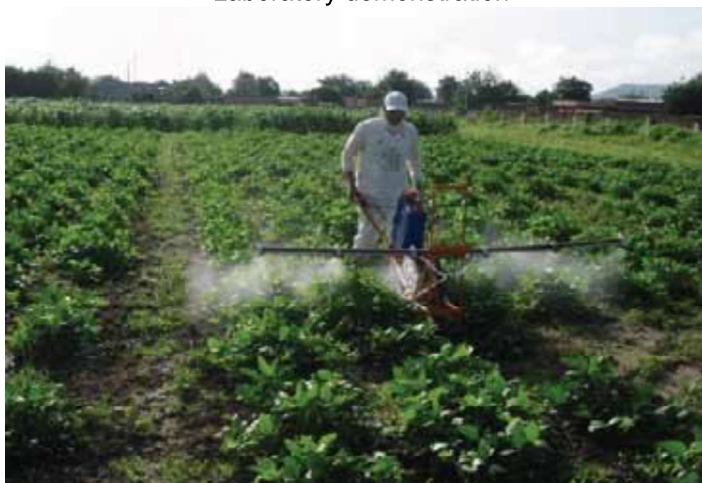
- Intensive training sessions in both classrooms and fields, in cotton genetic improvement (new varieties), soil health management, no-till farming and IPM.
- Design, preparation, revision, production and distribution of manuals and other sources of information on Good Agricultural Practices, in French incorporating the validated and tested technologies in the project's thematic areas in C-4 countries

Project Results

- The C-4 Project became the first Brazilian technical cooperation project of a large scale. It is highly recognized by the Governments of Benin, Burkina Faso, Chad and Mali for its results and impact. It became a model project and reference for future ABC cooperative programs. Its success motivated IBA to fund a second phase, with the inclusion of Togo.
- The Sotuba Research Station, of IER, was upgraded to function as the main C-4 project pilot unit for adaptive research and to conduct demonstrations on innovative technologies. This included the building of the C-4 Center and the *Trichogramma* laboratory.
- The project contributed to empower researchers, extension agents and farmers with new knowledge, skills and field experience especially on newly introduced technologies such as no-till farming. There were cases in which researchers had their salaries and self-esteem increased because of the project.
- Eight 'training-the-trainer courses' were organized and carried-out in both Brazil and Africa on no-till planting for 166 participants (researchers, technicians, extension agents and farmer leaders).
- Eight 'training-the-trainer courses' were organized and carried-out in both Brazil and Africa on Integrated Pest Management (IPM) for 197 participants (researchers, technicians, extension agents and farmer leaders).
- Five 'training-the-trainer courses' on cotton breeding were organized and carried-out in both Brazil and Africa for 62 researchers and technicians.
- The no-till technology was validated in the C-4 countries and incorporated in selected farmers' fields for demonstration purposes (Sissoko et al., 2015).
- Brazilian experts and their counterparts in the C-4 countries jointly developed a manual on Good Agricultural Practices in French.
- Five Technical Documents on different aspects of Cotton Farming Management were produced in French.
- Notable potential for yield and fiber quality



Effect of cover crops on soil erosion:
Laboratory demonstration



Field use of simple instruments for pesticide sprays



Demonstration of simple implements in the field

Table 1: Agronomic features of some Embrapa cotton varieties in comparison with one standard C-4 variety. Sissoko Research Station-Mali 2009/10 (adapted from Yattara et al., 2011).

Varieties	Agronomic features - 2009/10		
	kg/ha (Seed cotton)	% of the test	% lint
STAM 59A (test)	2 217	100	42.7
BRS 286	3 000	135	42.8
BRS 293	2 967	132	43.1
Araçá	2 933	132	41.2
Aroeira	2 183	98	39.7
Buruti	2 217	100	40.7
Cedro	2 917	132	42.7
Safira	2 433	110	34.7
Seridó	2 333	105	37.2
Average	2 562	-	40.7

enhancement was observed in the progeny of Brazilian and C-4 varieties. Researchers from C-4 countries were provided with access to EMBRAPA's cotton gene bank (Table 1, IER 2010, IER 2011).

- A long-term collaborative research network was established between Brazilian and African scientists.
- The C-4 project created a positive scenario for further cooperation in agricultural research between Brazil and Africa.

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Management of Biotic Stress in Cotton

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Introduction

Cotton is a long duration crop and typically takes about 120-160 days to complete its life cycle. Throughout the growth cycle it is exposed to weeds, insect pests and pathogens, which cause economic damage to yields. Cotton yield losses exceed up to 37% due to weeds (Awan *et al.*, 2015) and its long duration as well as slow growing nature (Nalini *et al.*, 2015). Similarly, 50-60% losses are encountered due to insect attacks (Saini *et al.*, 2009) and 30% by CLCuV infestation

(Khan and Ahmed 2005; Khan *et al.*, 2015). Management of nutrients, water, weeds, insect pests and diseases at the critical stage of the crop growth is crucial for obtaining good yields.

Weeds

The competition offered by different weeds to cotton plants results in loss of nutrition available for growth of the crop plant and results in considerable reduction of seed cotton