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► **To cite this version:**

Yuri Lima, Silvia Morais, Luis M. Araujo, Daiane Da S. A. Castelo Branco, Irenilza De A. Nääs. Collaborative Production Chains: A Case-Study of Two Agri-Food Companies in Brazil. IFIP International Conference on Advances in Production Management Systems (APMS), Sep 2019, Austin, TX, United States. pp.123-128, 10.1007/978-3-030-30000-5\_16 . hal-02419221

**HAL Id: hal-02419221**

**<https://inria.hal.science/hal-02419221>**

Submitted on 19 Dec 2019

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# Collaborative production chains: A case-study of two agri-food companies in Brazil

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**Abstract.** A collaborative production chain is often understood as having a known degree of relationship among members of the chain to share risks and benefits that result in higher commercial performance than individual organizations. The current study aimed to analyze two production chains of cashew and honey in Northeastern of Brazil which work collaboratively. Characteristics of the chains were learned from interviews with technical personnel from agricultural extension office and farmers. Results indicate that despite the best harvest cashew farmers might have when the crops are pollinated by bees both partners are not fully satisfied with the collaboration. A partner might benefit from management items that help to assess collaboration performance more effectively such as joint efforts, sharing activities, collaboration value, adaptation, trust, commitment, continuous improvement, coordination, and stability. Supply chain collaboration improves the performance advantage and has a significant influence on firm performance; however, such an initiative needs to be understood as a win-win association by the partners to achieve the expected success.

**Keywords:** collaborative supply chains; cashew crop; honey production

## 1. Introduction

A collaborative production chain means that two or more independent companies work in association to plan and execute production operations more successfully than when acting alone. This concept is often used in the supply chain, suggesting a known degree of relationship among members of the chain to share risks and benefits that result in higher commercial performance than individual organizations [1]. One of the ways collaborative chains work is through the sharing of research [2]. Resource sharing refers to the process of influencing skills and leveraging assets in the supply chain partners. Resources may include physical resources such as area, manufacturing equipment, facilities and technology [3].

The interaction between the actors of the business environment, acting cooperatively and sharing the same vision, reduces efforts, such as greater agility, flexibility, quality of products and services offered to customers. The maturity and efficiency of the operationalization of the strategy between two or more companies present a strong

relation and direction of the efforts, that together cooperate in the co-creation of value [4]. The collaborative initiative of a supply chain often comes from integrated solutions that result in economies of scale that eventually reduce costs and increase revenues. In some cases, there is a common base of needs or even a way to solve a common problem. Using IT, for example, can be a good example of collaboration. Often IT associates supply chain collaboration with inter-organizational process improvements along with information systems, allowing chain members to effectively deliver products to end customers at minimal cost [5].

Value food chains are the financing of income for small farmers in most developing countries. Authors present an innovative model for improving the maize value chain in India [6]. The open innovation business model approach can strengthen farmers identified weak links. The business model explicitly developed promotes information sharing, innovation, collaboration and feedback cycles within the value chain, as well as support cases from similar approaches. Another form of collaboration was discussed in perishable foods in agribusiness in Tanzania [7]. The authors' findings show that, in a fragmented value chain of preprocessed fruits and vegetables, actors are aware of each other, but very little formal cooperation occurs, and the transactions are market-based and price-driven. The business strategy is the creation of a chain that provides values and that works from a multiplicity of diversified processes [8].

About one-third of the world's food crops depend on varying degrees of pollinators - including management bees (*Apis mellifera*) and native bees [9; 10]). Pollination is considered an important ecosystemic service, essential for food production, favoring the production of higher quality fruits, weights and seeds [11]. Mainly in large areas of monocrops, whose pollination services offered by ecosystems are not always able to meet the high demand for pollination of the target crops [12]. The potential of pollination as an ecosystem service can be highlighted when associated with food production. [13] estimated between US\$ 235 billion and US\$ 577 billion. In Brazil, it is estimated that pollination related to agricultural production has an annual value of US\$ 12 billion [14]. In the U. S., the market for pollination services has grown so much in the past decade that beekeepers now receive a larger share of their income from pollination services than from honey production [15]. Pollination is crucial for the whole of flowering fruit plants. As cashew is highly pollinated by insects mainly bees, its activities in cashew intensive production play a vital role in increasing yield.

In Brazil, unlike the U. S. and European countries, the use of bees for pollination is quite scarce. In the Northeast region, it is common practice to rent hives for pollination of the melon, and in the South with the pollination of the apple. This fact, scarce pollination, can be explained by the diversity and presence of natural pollinators in Brazil, which has been decreasing considerably in recent decades due to deforestation, the use of agrochemicals and the lack of knowledge about the real importance of insects in pollination of crops [12]. The primary challenge of current beekeeping is the adoption of sustainable management practices appropriate to the different seasonality of the environmental conditions faced by these bees in most localities.

The present exploratory study aimed to investigate the collaborative production chain of two agricultural products (cashew and honey) in the semi-arid region of the state of Piauí, in the Northeastern region of Brazil.

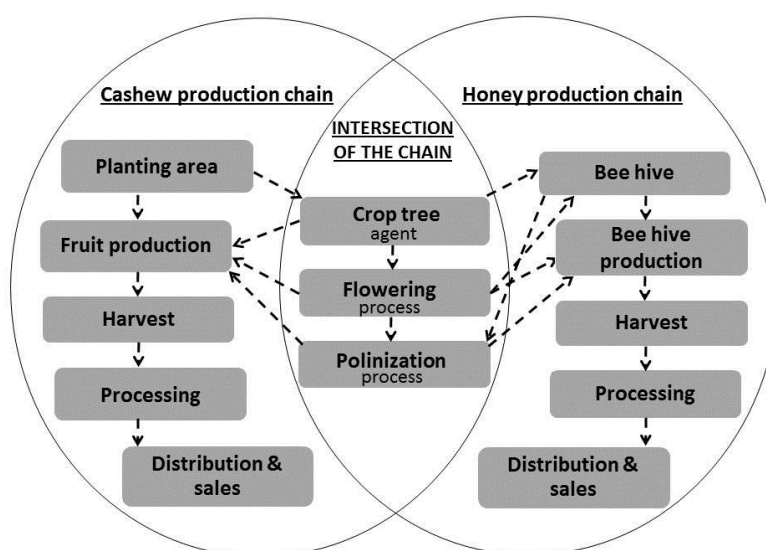
## 2. Methods

A qualitative case study was carried out, through the analysis of a scenario and interviews to identify, categorize, and analyze the collaborative chains of cashew and honey productions in the Northeastern of Brazil.

A scenario of the production chains (cashew and honey) that was the goal of the current study was draw-up based on bibliographical research. The scenario was compared with data collected directly from interviews of the representatives of the producers of these crops (4) and technicians from public agencies of assistance to the rural producer (2). In the interview questions related to the collaboration terms and satisfaction of the partners were asked.

## 3. Results and Discussion

Piauí is in the second rank amongst the Brazilian states with the most significant number of businesses focused on cashew and in the fourth rank with the largest number of establishments focused on beekeeping. The scheme of interface of the production chains is shown in Figure 1.



**Fig. 1-** Scheme of the two studied collaborative production chains cashew and honey.

Interviews with producers (4) and technicians (2) from the region's Technical Assistance and Extension Institute (EMATER) reported that the association between cashew production and honey production and that the percentage of honey production in this condition represents only 5% of all honey production the state. Such an issue is that because the costs are high. There are few beekeepers, classified as medium or large producers, and who has enough resources to cover the expenses of migratory

beekeeping. While in the U.S. every winter (January to March), beekeepers move up to 55% of their bee colonies [16].

The movement of bee colonies throughout the country is driven mainly by two reasons: the provision of pollination services in different parts of the country (1) and the search for fodder to produce honey and guarantee the survival of the colonies in the winter (2). Farmers who grow crops that require or benefit from pollination (e.g., almonds) pay beekeepers to pollinate their crops [15].

Most of the income earned by beekeepers in the U. S. comes from pollination services that receive a higher share of their revenue from pollinating services than from honey production [10; 15].

In the Northeast of Brazil, especially in the states of Ceará, Piauí, and Rio Grande do Norte, there are large areas of cashew (*Anacardium Occidentale*) crops both for internal consumption, and export (nut and peduncle). Because it is an attractive crop for bees, it is possible to produce monofloral honey from this flower [17]. Collaboration between the cashew producer and the beekeeper is critical to a win-win outcome. Such an interaction between those involved in the business, working collaboratively, reduces efforts and can improve the quality and quantity of products that will be offered to customers.

Studying the same crops in Benin [18], the authors found that between 25 and 72% of cashew flowers were not pollinated in nature because of the limitation of pollinators and also stated that an increase of 157.8% would be possible if the flowers received adequate pollen. Honey production and pollination services are activities that do not always go in collaborative ways [16]. One of the main obstacles to the development of the pollination market has been the results obtained with the use of bees as pollinators since beekeepers do not care about the pollinating efficiency of their hives, but only in producing as much honey as possible. Pollination results usually fall short of what would be expected. The insignificant results mean that farmers do not incorporate pollination services as factors of production of their agricultural activities, nor do they attract other farmers to use pollinators in their crops. The concern of beekeepers to adopt rational pollination programs that considered these and other factors would certainly significantly increase the efficiency of pollinating agents and the demand for their services [15; 16].

The results from [2] indicate that supply chain collaboration improves the performance advantage and has a significant influence on the company's performance. The authors emphasize the fact that the production chain partners adapt to achieve appropriate synergies and create superior performance.

In the present case study, the collaborative initiative occurred aiming the improvement of the chains' production performance. The results from [2; 5; 7] indicate that supply chain collaboration improves the performance advantage and has a significant influence on the firm performance. The authors emphasize the fact that the production chain partners trend to adapt to achieve appropriate synergies and create superior performance.

#### 4. Final Remarks

Despite the achievement on other urban-industrial collaborative supply chains, the key behavioral factors to enable an effective collaboration system for sustainable agri-food supply chains to require joint efforts, sharing activities, collaboration value, adaptation, trust, commitment, power, continuous improvement, coordination, and stability. The agri-food supply chain collaboration might benefit from these management items that help to assess collaboration performance more effectively.

It has been evident from the review of previous studies in the cashew production matter, that such collaboration has a broad scope to raise current cashew yields by supplementing pollination. Thus, learning from the success of beekeeping in other countries (The US, Benin, and Ghana), pollination can be complemented by the inclusion of beehives in the field to increase productivity.

#### Acknowledgments

The authors wish to thank Mr. Paulo Henrique Miranda, Mr. Jonas Alves dos Santos, and Mr. Eberson Alves dos Santos for the available information regarding the cashew-honey collaborative chain.

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