

## The Role of Trust, Knowledge Diffusion and Contracts in Sunflower Production Chains in Brazil

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### ABSTRACT

The replacement of animal protein by plant protein is a trend in human nutrition and sunflower appears as a promising raw material. Dealing with innovation in the food industry requires attention not only to the product development process, but to the whole production chain related to it. Within this context and in face of the potential participation of Brazil in the business of sunflower protein food ingredients, this study aims to describe and analyze the operational dynamics of sunflower production chains in Brazil. To deal with this issue, we adopted the multiple-case study approach based on three production chains of sunflower oil in Brazil. Transaction cost economics and social network are the theoretical background for the analysis. Our findings suggest an environment with high transaction costs in the operation of the production chains of sunflower oil in Brazil. The processing company is the chain coordinator agent, being responsible to attract the farmers to the business of sunflower, using the strategies of crop promotion and verticalization. Crop promotion is in some degree the pattern of chain operation for all cases. It refers to a set of actions generally coordinated by the processing company aiming to encourage and assist farmers in the growing of sunflower. Moreover, it serves as a trust building and supervision strategy. Regional features influence the chain operation in terms of crop promotion applied by the processing company and the role of agents from farm supply retail stores (FSRS). The strategies of crop promotion and verticalization have not been sufficient to easily guarantee the provision of sunflower to the processing companies. Our findings show that if investments in the production of sunflower protein food ingredients are to be made in Brazil, it is necessary to consider the complex institutional arrangements in which the sunflower production chains operate, seeking to guarantee the necessary provision of raw material for the processing company.

**Keywords:** *Animal protein; case study; food industry; plant protein; sunflower; transaction costs; trust*

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### Introduction

The replacement of animal protein by plant protein is a trend in human nutrition, which has influenced innovations in the food industry. The driving forces for this change include: i) growth in population (2-billion over the next four decades) and in income, which will lead to an increase in food demand (60% more in 2050 than the current level) (FAO, 2013); ii) insufficient capacity of meat supply and the negative environmental effects of livestock production (Bonte-Friedheim, 2008); iii) concerns on animal welfare; and iv) higher cost of animal protein in comparison with plant proteins (Frost & Sullivan, 2010). Consequently, research and development investments have been applied in direction to new sources and methods of food protein

production (Wu et al. 2014), with emphasis in the use of plant proteins rather than animal proteins (González-Pérez and Vereijken, 2007).

Currently, soybean is the major source of vegetal protein (Frost & Sullivan, 2010). However, the growing use of genetically modified soybeans varieties has led many manufacturers in Europe to search for alternative food proteins to soy (Pickardt et al. 2015). In this sense, sunflower appears as a promising raw material for food proteins due to its availability, the high protein content (40-50% in the sunflower meal), the low level of antinutritional components; a high intrinsic solubility, which is a prerequisite for many functional properties, and the absence of toxic substances (Gonzalez-Perez et al., 2002; González-Pérez and Vereijken, 2007; Pickardt et al., 2015).

Within this context, the joint research project SunflowerProtein<sup>1</sup> has analyzed a novel sunflower processing that enables the recovery of high quality protein meal and concentrates for human consumption, instead of low value residues from conventional de-oiling process, usually destined for animal feed. SunflowerProtein evaluates the cultivation of sunflower and the possibility of the development of sunflower food protein ingredients in Brazil. Notwithstanding, the producing and processing of sunflower are still limited and concentrated in Brazil. The producing area ranged from 47,792 ha, in 2005, to 111,803 ha, in 2015 (IBGE, 2017). Although increasing, the area of sunflower represented 0.73% and 0.35% of the producing area of corn and soybean, respectively, in 2015. Moreover, this area is very concentrated. In 2015, for instance, the three regions focus of this study were responsible for 98.6% of the Brazilian producing area of sunflower – Mato Grosso (76.5%), Goiás and Minas Gerais (19.6%) and Rio Grande do Sul (2.5%). Furthermore, the municipality of Campo Novo do Parecis, in Mato Grosso, concentrated 43.6% of the overall national sunflower area. In the same way, the processing of sunflower in Brazil is limited to a small number of companies, which operate in the producing regions.

Although the development of plant protein ingredients is led by the food industry and research institutes (Wu et al., 2014), the large scale implementation of such innovations, which rely on specificities of agricultural raw materials, involves and depends on others agents, such as farm suppliers (e.g. seed industry) and especially farmers. Therefore, dealing with innovation in the food industry requires attention not only to the product development process itself, but to the whole production chain related to it.

Against this background, and in face of the potential participation of Brazil in the business of sunflower protein food ingredients, this study aims to describe and analyze the operational dynamics of sunflower production chains in Brazil, guided by two research questions. RQ1: How do the agri-food chains of sunflower operate in Brazil? RQ2: Why do they operate in certain way(s)? To deal with this issue, we adopted the multiple-case study approach. Each case focused on a production chain of sunflower in the main producing and processing regions, covering the states of Mato Grosso, Goiás, Minas Gerais and Rio Grande do Sul. The findings of this study serve to academics and practitioners, since it contributes to the theoretical understanding on agri-food chain operation and governance, and at the same time, it provides decision supporting information for possible investors in the business of sunflower food protein ingredients.

This introductory section is followed by the sections of methodology, results, conclusions and the references.

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<sup>1</sup> Sustainable cultivation and novel processing of sunflower seeds for simultaneous production of sunflower oil, solid fuel and protein-rich food ingredients. An international cooperation research between German and Brazilian institutions, granted by the "National Research Strategy BioEconomy 2030" – Federal Ministry of Education and Research (BMBF) of Germany and the "National Counsel of Technological and Scientific Development" (CNPq) of Brazil.

## Methodology

This study adopted a qualitative research approach by means of multiple case studies. The case study research method is appropriated since this study seeks to understand a complex social-economic phenomenon in its real-world context, over which the investigator has no control (Yin, 2014) – the dynamic of operation of production chains of sunflower in different regions of Brazil.

To compare the heterogeneity among these regions and draw more precise conclusions, this study used a multiple-case embedded design. In this framework, more than one case is conducted and within each case (unit of analysis) different embedded units of analysis are considered (Yin, 2014). The units of analysis were selected seeking to cover all major producing and processing regions of sunflower in Brazil. In that sense, three production chains of sunflower were selected as case studies – one in the state of Mato Grosso (case MT); a second one that comprises the states of Goiás and Minas Gerais (case GO/MG); and a third one in the state of Rio Grande do Sul (case RS). Given that a production chain is mainly composed by agents from the segments of inputs (I), farmers (F) and processing (P), these were the embedded units of analysis considered in each case (Figure 1). In the three cases, the business of sunflower is focused on sunflower oil, with sunflower meal as a byproduct. The oil is sold to the food industry and final domestic consumers, while the meal is sold regionally as animal feed.

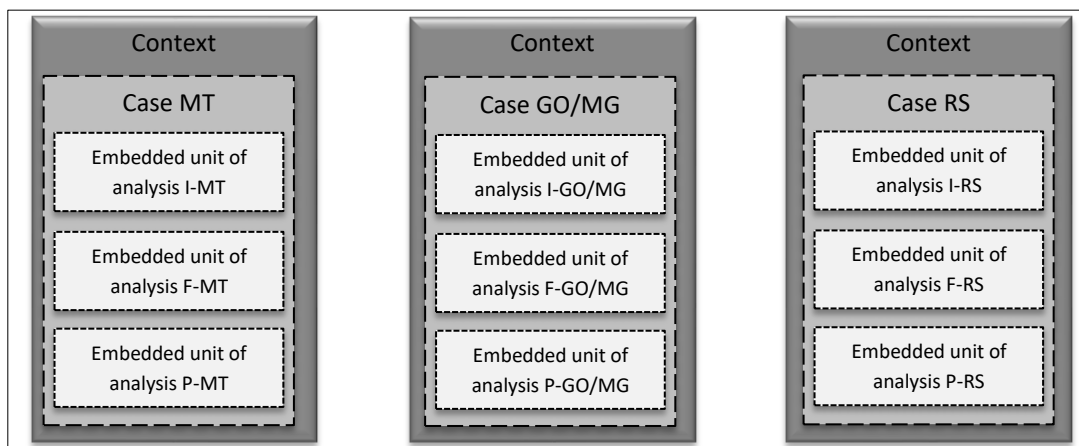


Figure 1. Multiple-case embedded design adopted in this study

Source: Adapted from Yin (2014)

Each producing and processing region was visited and then contacts with sunflower processing companies, farmers and input representatives were established. The field work took place between April and August of 2016. During this time, interviews were done with agents related to the production chains of sunflower (Table 1). It includes interviews with actors from the research segment, which is not considered a chain segment or a subunit of analysis, but contributes to the comprehension of the contexts in which the production chains of sunflower are involved. Most of these interviews were recorded, except one with an agent from the input sector in the case GO/MG, which was answered by e-mail. Moreover, relevant information was gathered by means of direct observation (Yin, 2014), including informal conversations, visits to farm supply retail stores, farms and processing companies, participation in farmers' activities (a farmers' field day in Mato Grosso). One way of direct observation however stood out from the others – the opportunity to closely accompany agents from the processing and input segments in the work of farmers' assistance.

Table 1. Agents interviewed across the production chains of sunflower oil in Brazil

Chain segment	Case MT	Case GO/MG	Case RS	National level
Input	7	5	4	
Farmers	14	11	9	
Processing	1	3	1	
Research	2			2

The recorded interviews were transcribed and the software MAXQDA assisted the process of analysis. Together with the evidences from the direct observation, the study's analysis followed a cross-case approach to identify and analyze common patterns in the operation of the production chains of sunflower in Brazil. Considering that economic transactions are underpinned by social relations, we build our analysis on two complementary theoretical bases – transaction costs economics (formal governance structures and coordination mechanisms) (Williamson, 1979; 1985) and social network (trust) (Furlong, 1996; Uzzi, 1997; Keefer and Knack, 2005; Galaskiewicz, 2011; Trienekens, 2011).

## Results

Our findings suggest an environment with high transaction costs in the operation of the production chains of sunflower oil in Brazil. This fact stems from the high level of uncertainty, given the low number of sunflower buyers and unstable number of growers. When a farmer grows sunflower, he or she has very few buyers (sometimes only one) available in the region. This is an entrance barrier, as there are several traders willing to buy competing crops such as corn. Furthermore, selling sunflower to other regions is not profitable due to high transportation costs. These facts make farmers in most cases dependent to a single processing company acting in the region. For the processing company in turn, besides the relatively low number of sunflower suppliers, the uncertainty is enhanced due to asset specificity reasons. On the one side, the farmer, who already grows soybean and corn, can use the existing structure and personnel to grow sunflower. Basically, only an adaptation in the agricultural platform for corn harvest is required, with relatively low cost and that can be executed in the farm (Castro et al., 1996: 29). This low level of asset specificity results in low entry/exit costs for farmers. Consequently, it makes easier for the farmer the decision to leave the crop in face of typical difficulties related to non-established crops, as is the case of sunflower in Brazil. For the processing company the assets specificity is higher and it is verified more in terms of intangible assets. Despite some differences in the processing stages, the same processing plant is able to run with other oilseeds besides sunflower. Therefore, the main loss in case of closure of the sunflower business would be related to market knowledge, once the sunflower sector can be considered a niche market within the edible vegetable oil sector in Brazil.

In this context of high transaction costs, trust and contracts play an important role in the chain governance. Trust works as a substitute for non-contractible elements of the supplier relationship between farmers and buyer. In other words, a trustworthy environment appears as a precondition for the establishment of the transaction, done by means of contracts. The use of contracts in turn is a condition demanded by farmers and processing company in face of the high uncertainty level verified.

The critical point for the operation of the production chains of sunflower oil in Brazil is the interest of farmers to grow sunflower. In general, some reasons explain the lack of farmers' interest to enter (and remain) in the business of sunflower: i) the uncertainty and the low entry/exit costs commented earlier; ii) the fact that sunflower usually represents a small share of farmers' income, which is mainly derived from soybean and corn; iii) crop competition, especially with corn, which has more liquidity due to the high number of buyers; iv) the low level of sunflower cropping knowledge observed among farmers; and, v) the low level of research and technology for sunflower in comparison with consolidated crops. This scenario implies in certain dependence

of the processing company in relation to its suppliers and contributes to explain the dynamic of operation of the production chains of sunflower oil in Brazil (Figure 2).

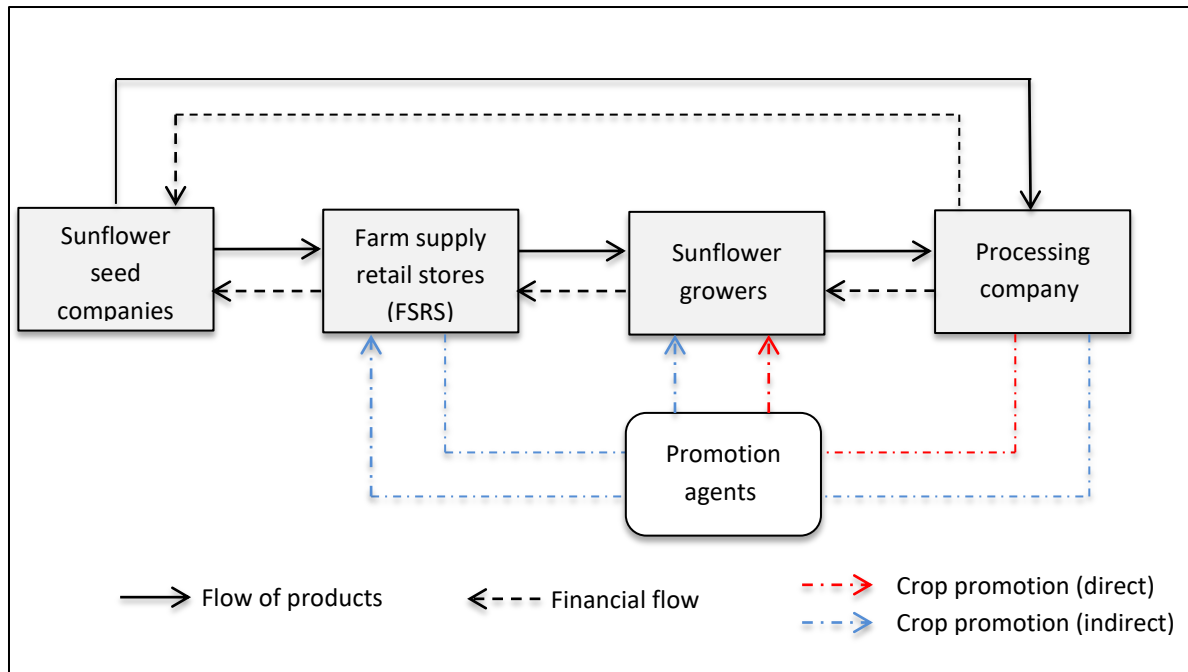


Figure 2. Dynamic operation of production chains of sunflower oil in Brazil<sup>2</sup>

The processing company acts in all cases as the chain coordinator agent, being responsible to attract the farmers to the business of sunflower. In this sense, it seeks to meet the farmers' requirements of profitability, knowledge, and price and purchase guarantees. In doing so, the processing company sets up a trustworthy atmosphere favorable for the transactions with farmers, which are established by means of contracts. Within this context, two strategies have been used to engage farmers in the production chains of sunflower oil in Brazil. The first one is the crop promotion, which is in some degree a pattern of chain operation for all cases and, therefore chosen to be detailed in this study. The second strategy is verticalization, in which a group of farmers establishes a processing company. The last strategy is found only in the case of Mato Grosso. In both ways, trust and contracts are essential elements.

Crop promotion refers to a set of actions generally coordinated by the processing company aiming to encourage and assist farmers in the growing of sunflower. Moreover, it serves as a trust building and supervision strategy. The actions of crop promotion include: i) presenting the crop to farmers, showing technical, economic and commercial aspects of the sunflower business; ii) providing technical assistance for implementation, monitoring and harvesting of sunflower; and, iii) offering a contract of purchase and price guarantee. Furthermore, the sale of sunflower seeds can be part of the crop promotion, as well as the provision of financial support for farmers. The promotion agents consist of agronomists or agricultural technicians employed by the sunflower processing company and farm supply retail stores (FSRS).

The crop promotion assumes mainly two approaches – direct and indirect (represented by the red and blue dashed lines respectively, in the Figure 2). In the first one, the company's promotion agents are responsible to reach and assist the farmers, while in the indirect approach, the crop promotion is done through

<sup>22</sup> The lines connecting the sunflower seed segment to the processing company are a representation of an inter-segment relation found in the case of Rio de Grande do Sul. There, the processing company is also the sunflower seed distributor.

a FSRS. In the latter, normally the promotion agents from the processing company provide technical and commercial assistance to a FSRS' technical team, which assumes the responsibility for the crop promotion among farmers in its area of commercial coverage. By this partnership, the processing company benefits from the influence that a FSRS has over a large number of farmers, with whom it maintains close and lasting commercial and personal relationships based on trust. The more geographically dispersed are the sunflower producing municipalities, the more necessary is the indirect approach, as is the case of GO/MG.

Crop promotion represents a transaction cost, since it is a prerequisite for the establishment of the transaction, especially if the processing company is not owned by farmers. It includes expenses with personnel, vehicles and related costs, telephone, internet, daily expenses with food and, sometimes, accommodation. In case of direct approach, these costs are borne by the processing company, which try to recover them in the profit margin of the final product. If the indirect approach is applied, most of these costs go to the FSRS, which in turn benefits from the selling of inputs necessary for sunflower cropping. As the FSRS agents work with others agricultural chains, these costs are diluted due economy of scope. The economy of scope is also present in the work of crop promotion done by the processing companies in the cases GO/MG and RS, which also operate in other edible vegetable oil businesses.

The central point of the crop promotion is the provision of technical assistance at farm level. Once the knowledge on sunflower cropping is very limited, price and purchase guarantees only would not be enough for most of farmers to enter in the sunflower business. Besides meeting the obvious goal of knowledge diffusion, the technical assistance is a mean for mutual trust development between the farmer and the promotion agent. Consequently, it contributes to the continuity of the farmer in the business of sunflower. Furthermore, the trust relation lessens farmers' opportunistic behaviors related to intentional contract breach.

Moreover, crop promotion serves as a mechanism of supervision for the chain coordinator, since the promotion agents follow the farmers during the sunflower season. Consequently, the possibility of opportunistic actions by the farmers is diminished and the processing company allows certain flexibility in the contract. If farmers fail to deliver the agreed amount of sunflower, the processing company would know if it was because of some uncontrolled source (seed's problems, diseases, drought, etc.) or due to opportunistic or reckless actions. The application of penalties in the first situation would decrease even more farmers' interest to grow sunflower. In fact, although the contracts provides for penalties in case of non-delivery of the agreed amount of sunflower, in all cases such penalties have not been applied when the causes for that are not under control of the sunflower grower.

The dynamic of operation of the production chains of sunflower oil in Brazil is based on trust, made possible through knowledge diffusion and established by means of contracts. Nevertheless, regional characteristics influence the chain operation in terms of crop promotion applied by the processing company and the role of FSRS (Table 2). The regional aspects are mainly related to ownership of the processing companies, farms structures, geographical distribution of sunflower production, and seasonality of crops.

Farmers' lack of interest in growing sunflower has been the main concern for the sunflower processing companies in Brazil. The actions of crop promotion and even the verticalization have not been sufficient to easily guarantee the provision of sunflower to the processing companies. Crops competition and the low level of technology applied to sunflower cultivation in Brazil have been major hindering forces for the economic sustainability of the chains. The farmers' decision on which crop to grow is mainly based on the expected profitability of the options available. In this sense, in times of high corn prices, the interest of farmers to grow sunflower decreases substantially. Moreover, the fact that most of sunflower seeds available in Brazil are imported from Argentina or Bolivia have been considered a relevant issue, since the soil and climatic conditions of the Brazilian sunflower producing regions are different.



Table 2. Regional particularities and its influence on the chain operation

	Case MT	Case GO/MG	Case RS
Ownership of processing company	farmers' participation	no participation of farmers	no participation of farmers
Vegetable oil produced by the processing company	sunflower	soybean, corn and sunflower	canola, soybean and sunflower
Geographic distribution of sunflower producing municipalities	concentrated in one municipality	dispersed over municipalities in two states	dispersed within a state region
Sunflower suppliers and producing area in 2016	44 – 13000 ha	130 – 16000 ha	25 – 1600 ha
Crop competition	corn	corn and sorghum	corn and soybean
Predominant farm size	large capitalized farms	medium-size farms	small and medium-size farms
Additional role of processing company	-	-	Sunflower seed distributor
Crop promotion (direct approach)	low level, focused on identifying techniques more suitable for the local growing of sunflower	high level, focused on finding and supporting sunflower growers	high level, focused on: i) finding and supporting sunflower growers; and ii) identifying cultivars more suitable for the region
Crop promotion (indirect approach)	medium level, focused on non-partner farmers and coordinated by a partner of the processing company	high level, focused on finding and supporting sunflower growers in various municipalities	low level, focused on support mainly small suppliers
Role of FSRS in the production chain	providing all the inputs necessary for the growing of sunflower;	i) providing all the inputs necessary for the growing of sunflower;	i) providing the inputs necessary for the growing of sunflower, except seeds.
		ii) fundamental agent for the processing company to be able to guarantee the provision of sunflower	ii) providing technical and logistic support for sunflower growers



## Conclusions

For production chains focused on new crops, the processing company appears to be the agent responsible for encouraging and supporting farmers in the crop growing. Moreover, a high level of uncertainty implies on an environment of high transaction costs, which demands the use of contract as a governance mechanism. However, contracts are not sufficient to guarantee the chain operation. The establishment of trust relationships between farmers and buyer is a relevant issue, since the processing company assumes the task to find farmers willing to adopt a non-established crop. In this sense, the partnership of the processing company with local agents from the input sector appears as a useful strategy to reach a large number of farmers. Moreover, this is a way for the processing company benefits from existing trust and commercial relationships between farmers and those agents. Furthermore, our findings suggest that knowledge diffusion has a central role in the operation of such production chains.

Therefore, if investments in the production of sunflower protein food ingredients are to be made in Brazil, it is necessary to take into consideration the complex institutional arrangements in which the sunflower production chains operate. Trust, as a substitute for non-contractible standards of the supplier relationship, complements formal contracts on the basis of specific knowledge diffusion processes, which is essential for the provision of raw material for the industry. Furthermore, given the specificities in terms of soil and climatic conditions of the sunflower producing regions in Brazil, efforts must be done in order to foster the development of more suitable technologies for cultivation of sunflower in Brazil.

Finally, the introduction of a new product with high added value might contribute to increase the price of sunflower paid to farmers, increasing the comparative advantage of sunflower in relation to corn.

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