

Governance in agricultural value chains in Tamaulipas, Mexico.

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Abstract

The objective of this study is to determine the type of governance of the four main agricultural value chains in Tamaulipas, northeast of Mexico. For the preparation of this research used a qualitative design, using a questionnaire and semi-structured interviews to a sample of representatives of the four selected chains. The results showed that in all the studied networks, control and coordination capacity is limited by the influence that has a link on the rest of the chain. In all cases, was that the industrial link is who leads the chains and exert control over the rest of the links. The results showed that, when the industrial link is located close geographically to the rest of the links (chains of rice and sugar cane), the chains showed a hierarchical type, where the industrial exercised dominion over the rest of the links and captures most of the income. On the other hand, in chains where control is exercised by links that are outside the territory (chains of soybeans and sorghum), they function as captive chains, putting the rest of the chain to its influence and control.

1. INTRODUCTION

In Mexico, during the last 20 years, the agricultural production has had a very irregular behavior (Mella and Mercado 2006). The agro-industrial complex stimulated by a neoliberal economic model, reinforced by the North American Free Trade Agreement, did not cause the expected effect of modernization of Agriculture. Many of the trans-nationalized agro-alimentary chains were limited to its capitalization in the industry without causing a “dragging” effect towards the rural sector, which has maintained a low growth rate and a technological delay, despite the stimulus that the industrial demand represents.

The state of Tamaulipas, located in the northeastern of Mexico and bordering Texas, has an agricultural sector with an intensive production and a vast variety of products. In Tamaulipas, the Department of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA), has registered a total of 55 products. Some of them such as sorghum, soybeans, aloe, lemon, sunflower and canola occupy the first place in the national ranking of total production, sugarcane places as the fifth one at national production while kenaf and popcorn are only produced in this state (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016). Those products are set in value chains that have few stages in the region (soybeans and sorghum with only two stages; sugarcane and rice value chains go all over the industry). The sugarcane and rice receive value added process in the region, being the most complex chains with industrial transformation stages.

The agricultural value chains in Mexico, from a governance perspective, have not been widely studied. The aim of this paper is to distinguish and identify the governance typology of four of the main agricultural value chains in the north of Mexico and compare them to determine how the value is distributed and which is the nature of the enchainment processes in each one, individually and as a group.

This study is structured by sections. First, it addresses the value chain theory and the global chains theory, as well as the governance approach in both. The second section presents the methodology and results. On the third section, there is a description of the dominant governance and the

enchainment process in each chain, including a comparison of the four value chain based on the governance variables identified by (Gereffi, Humphrey, and Sturgeon 2005). Finally, on the fourth section the conclusions are presented.

2. RESEARCH BACKGROUND

Enterprises are not isolated from the social and economic context in which they emerge and develop. They maintain stable relations with their networks of suppliers and customers. From these linkages, externalities are generated by providing them with information, inputs, business services and qualified labor (Altenburg 2006). These network relationships provide them a competitiveness unreachable in different conditions. The competitiveness is reinforced as the networks get more solid and developed.

2.1. Value chains

Value chains are key components of networks that enterprises construct consciously. Since the 70's, a variety of disciplinary approaches have addressed the study of business networks. Some of the approaches are: the *filière* analysis of the French Montpellier School (Malassis 1973; Malassi 1979; Raikes, Friis Jensen, and Ponte 2000), Michael Porter's value chain (2002) and Gary Gereffi's Global Value Chain approach (Gereffi 1994; Gereffi 1999; Gereffi et al. 2005). The *filière* analysis by the French Montpellier School of Malassis (Malassis 1973; Malassis 1979), 1979) represents the first study of the agricultural activity with a microeconomic perspective. Malassis and Ghersi (1996) conclude that: "the agri-food system is defined as all the activities that contribute to the formation and distribution of the alimentary products and, consequently, to the fulfillment of the function of human food in a given society" (p.26). The French School points out the importance of analyzing, for each product, the exchange flows that are established between the components of the system (Kaplinsky and Morris 2000). With this purpose, the notion of *filière* agri-food was coined to point out the itineraries through which a specific product passes within the production-transformation-distribution system, as well as its different linkages. The most recent critique to the *filière* analysis belongs to Kaplinsky and Morris (2000), who argue that the first works of the French School emphasized the local economic multiplier effects on' input-outputs relationships in firms and concentrated on the

profits of efficiency resulting from economies of scale, transaction costs, transportation costs, etc. On the other hand, late works by Malassis and Ghersi (1996) incorporate the institutional factor to the quantitative technical analysis, which according to the first ones, merges to the recent analysis of the value chains. In general, Kaplinsky and Morris (2000) consider that the scope of *filière*, as it analyzes the relations in a specific moment of time, tends to have a static nature, besides it leaves aside relations beyond national borders.

Porter (2002) proposed the concept of value chain for the analysis of enterprise efficiency, considering all the activities or functions developed inside an organization. Porter's model decomposes the firm into a set of strategic activities to interpret the behavior of the costs and sources of differentiation, both existing and potential. Each of the firm's activities in the model incorporates value to the final good, from conception and design, through its production, distribution and marketing to the recycling after usage or end-of-life. From this approach, the production is one step on a series of steps in added value.

Porter (2002) distinguishes between primary activities and support activities. The first ones include the functions of logistics, operations, marketing and sales, and services associated to the product. The second ones provide resources and infrastructure to execute the primary activities, such as human resources, supplying, technology and management infrastructure, also general management, accounting and finance. This approach about the sources of competitive advantage and the role of the value chain analysis, has had a wide diffusion in economic and administrative matters. In contrast to other perspectives, the author identified how the value structure in organizations, at the time of decomposition, allows orientation of the organization towards those activities that perform in a cheaper way or better than its competitors. In practice, value chains are more complex and incorporate further strategic activities and links (Kaplinsky and Morris 2000).

The Global Value Chain approach (GVC) was developed by Gary Gereffi (1994, 1999). The influence of globalization processes on business activities is in the origin of the GVC concept, which is oriented to the study of relations between companies that participate in fragmented value chains, in a double dimension: functional and spatial. The origin of this approach is the proposal of Gereffi (Gereffi 1994, 1999) of “global production chains” (GPC). According to Gereffi (1999) the GPC proposal differs from Porter’s approach by incorporating the international dimension and establishing the power relations exercised by the leading companies on the different links of the chain, being responsible for the organization and coordination of the later. This is how GPC incorporates coordination throughout the chain as a main source of competitive advantage that requires the use of networks as the strategic asset, thus the possibility of generating growth trends within a chain will be in function of the governance professed by the leading company in it. At this point, Gereffi (1999) considers organizational learning as one of the most critical mechanisms that firms incorporate in order to improve or consolidate their position on the chain.

In the GVC theory, the theory of transaction costs has become important. According to this approach, when transaction costs are low or zero, economic agents will go to the market to execute their transactions. If the costs are high and the specificity of the assets are high, firms will prefer to organize them internally, integrating their activities, instead of outsourcing them (Williamson 1991).

The GVC approach developed by Gereffi (1999) establishes that chains have four dimensions or determinant factors. There are: input-output, geography, governance and institutions. The author insists that the governance is the central element in the analysis of GVC.

2.2 Governance in value chains

The study of governance in the context of value chains is relatively new. Neither Malassis nor Porter took this concept explicitly into account. Coase (1996) started the debate on considering price and authority as mechanisms of coordination of the economic system in open markets. He argues that the assignment of productive resources in the economic

organization is also a result of the coordination of the agents and that such transactions could occur in the markets, through contracts, and inside the firm; making it necessary to consider the costs incurred both in the search of information and in the contracts negotiation.

This analysis was retaken later on by Williamson (1996) giving birth to the Transaction Costs Economy, whose basic budget is the limited rationality of economic agents and the opportunism incurred in their actions that motivates them to look for potential contractual forms to diminish the cost and facilitate the operationalization of transactions from one sector to another (Leite, Zanella, Ribeiro Serra, De Marco and Tomaselli 2010). Williamson (1996) emphasizes the need to look for the economy of the transaction costs, to obtain the higher efficiency in adapting the productive system to the changes in the economic environment. He argues that the interaction between the firms and the market will generate alternative ways to organize production and productive efficiency will depend of the way the economic activities are also organized.

Due to the fact that a firm is composed by an articulated group of humans, technological, material and financial resources, along with an institutional and organizational culture, set in an enterprise environment, it is possible to infer that the governance structures are conditioned to the same enterprise environment and are a result of the search to diminish transaction costs by economic agents. In this scenario, transaction costs are the mechanism to evaluate the interactions, as the negotiations between firms and counterparts. Therefore, the governance structure is the institutional framework in which transactions occur, this is the group of institutions and types of agents directly involved in the transaction itself, and the governance mechanism is the administrative instrument used to set a transaction (Williamson 1996)

From this point of view, the theory of transaction costs explains the adaptation of a firm to its institutional environment. According to Gibbons (2005), this explains the different forms of coordination (market, hierarchy or hybrid) and choosing one depends on the specificity of the assets, the frequency of transactions, and the uncertainty.

According to the authors, governance is a result of the need for coordination of the producers' activities by the leading firm. The influence of the leading firm along the chain occurs through the definition of what and how it will be produced (Gereffi et al. 2005). In the same study, the authors explain that GVC are governed and change owner by the following three criteria: the complexity of transactions between the companies, the ability to codify these transactions, and the capacities of producers to comply with the buyers' requirements.

The complexity of transactions refers to the difficulty of transferring information or knowledge, necessary to execute a transaction, in relation to the specifications and processes of the products that the leading firm demands from the other firms in the chain. According to Gereffi et al. (2005), this transactional complexity is reduced through the definition of technical and process norms. The authors consider that the ability to code the transactions can secure an efficient transmission of knowledge by, for example, establishing standards, certifications, sanitary regulations, etc. Finally, the capacities of the producers are related to their potential to comply the requirements of delivery sources transacted according to the demands of the buyers, in this case, the leading firm may influence the decisions made to produce internally or to outsource (Gereffi et al. 2005).

Based on these three criteria, Gereffi et al. (2005) identified five types of governance that have been adopted in the GVC literature: market, modular value chain, relational value chain, prison value chain and hierarchical. These types concentrate a wide ranging from a low level to a high level of explicit coordination and asymmetries of power between producers and buyers.

From these studies, literature that addresses GVC has identified several elements required to understand the governance relations in between the actors of the chains, either as part of the structure or as part of the governance mechanisms (Dolci and Maçada 2011). It is fundamental to point out the current coincidence of many authors in considering elements such as collaboration, cooperation, trust and commitment, in the studies of governance in value chains.

3. MATERIALS AND METHODS

3.1 Target area

Tamaulipas is a state located in the northeastern of Mexico, with borders on the north with the state of Texas and on the east with the Gulf of Mexico. It has a very special productive specialization, because the northern border is a region with a high concentration of foreign industrial factories integrated in global chains. On the other hand, the rest of the state, with the exception of the agglomeration of petrochemical companies in the urban area of Altamira, is a region highly specialized in agricultural production.

The unit of analysis are the value chains studied (sugar cane, soybean, sorghum and rice), located in the municipalities of the state of Tamaulipas: Altamira, Matamoros, González, El Mante and San Fernando. As they concentrate most of the cultivated area and generate the highest value of the production of the crops involved. The observed units were the members of the chains: producers, marketers, distributors of inputs and transporters. Experts were consulted to access specialized information on the operation of the chains in the territory.

3.2 Research design

For the development of this research, we used a qualitative design of a descriptive nature, seeking to identify the variables and dimensions that would allow us to characterize and acknowledge the types of governance of the value chains analyzed. Due to the nature of the study, an intentional type sampling was used, which can be justified by the size of the sample and the specialized information that the selected individuals have regarding the chains under study (Izcara Palacios 2007; Tashakkori and Teddlie 1998).

For the methodological construction - variables and dimensions - the Gereffi et al. (2005) proposal was followed. Other proposals (Andablo Reyes, Hernández Moreno, and Catalán Dibene 2015; García-Jiménez and Gandlgruber 2014), were reviewed, which from the point of view of methodology, approach the object of study and enrich this work. The determinants

of governance are (Gereffi et al. 2005): the complexity of transactions, that refers to the type of relationships that is established between the participants by links, presence of inputs, actors-producers-with other participants and the dominant schemes and types of transactions; codification of the information, referred in this case to the standardization of the product and the knowledge that it incorporates; incorporation or not to new actors with capacity to reproduce the productive process based on suppliers' ability to cover product demand to the next link (Andablo Reyes et al. 2015); and generation and collection of income in the chain by the participants in each link (Table 1).

Table 1. Description of variables and dimensions considered in the analysis.

VARIABLES	DIMENSIONS	CHARACTERISTICS
Complexity of transactions	Type of relationships Price setting	Forms of integration and articulation between the actors in each of the links on the chain. Power of negotiation from the producers (UARSET, UECLC) in the establishment of the prices.
Codification of information	Product Features.	Quality, variety, physical characteristics and production conditions. Standardization.
Base of suppliers (producers)	Local productive capacities	Ability to supply demand
Income		Participation in the revenues generated in the links of the chain (in this case in the southern region of Tamaulipas)

Source: own elaboration based on Gereffi et al. (2005); Andablo Reyes et al. (2015).

3.3 Data collection and analysis

The qualitative research techniques used to collect information are: group dynamics (mainly panel), questionnaire and semi-structured interviews (Campoy Aranda and Gomes Araujo 2015). Regarding the panel technique, working groups were formed in the municipalities of southern Tamaulipas: El Mante and Altamira. The groups were composed from experts, professional staff from different instances and actors from the chain available in the territory of the study. Their location was subject to the condition of proximity and easy access of all actors. In the work meetings of both groups, personnel from the National Institute of Forestry, Agriculture and Livestock Research (INIFAP) and experienced producers from each of the

selected chains participated. Its composition included actors and agents linked to the different linkage of the chains: producers, suppliers of raw materials, representatives of companies that sell machinery and technology in the region, transporters, and leaders of the two largest producer organizations: Communal Union Path to Freedom of Rurals -*Unión de Ejidos Camino a la Libertad del Campesino* (UECLC)- and Southern Region Agricultural Union of the state of Tamaulipas -*Unión Agrícola Regional del sur del estado de Tamaulipas* (UARSET). Officials of the municipal governments and representatives of SAGARPA also participated. These work meetings allowed a characterization of the production system, implementation of the technological package, diversity and accessibility of inputs, access to distribution channels and marketing. The information obtained was submitted to a second round of panels, where the experts validated the information obtained.

The data compilation was also done through documental observation and interviews with the members of the chain links in the territory. These techniques were used to obtain additional information about the structures of the chains and to identify and characterize the transactions between the segments.

4. RESULTS AND DISCUSSION

After exposing the methodological proposal that addressed the analysis about the governance of the four chains, obtained results are presented below. Initially they are presented one by one, independently. At the end, an overall analysis is made to compare and extract lessons from the current situation.

4.1 Governance in the soybeans value chain

Mexico is one of the major actors in the soybeans market as one of the largest importers in the world, after China. The expansion of the domestic soybean market has been an ongoing process since the late 1970's, because of the expanding demand of the processing industry, for both, human and animal consumption. In 2014 Mexico was the third largest importer in the world, with an expenditure of 1,762 million dollars. In addition, soybean is the second

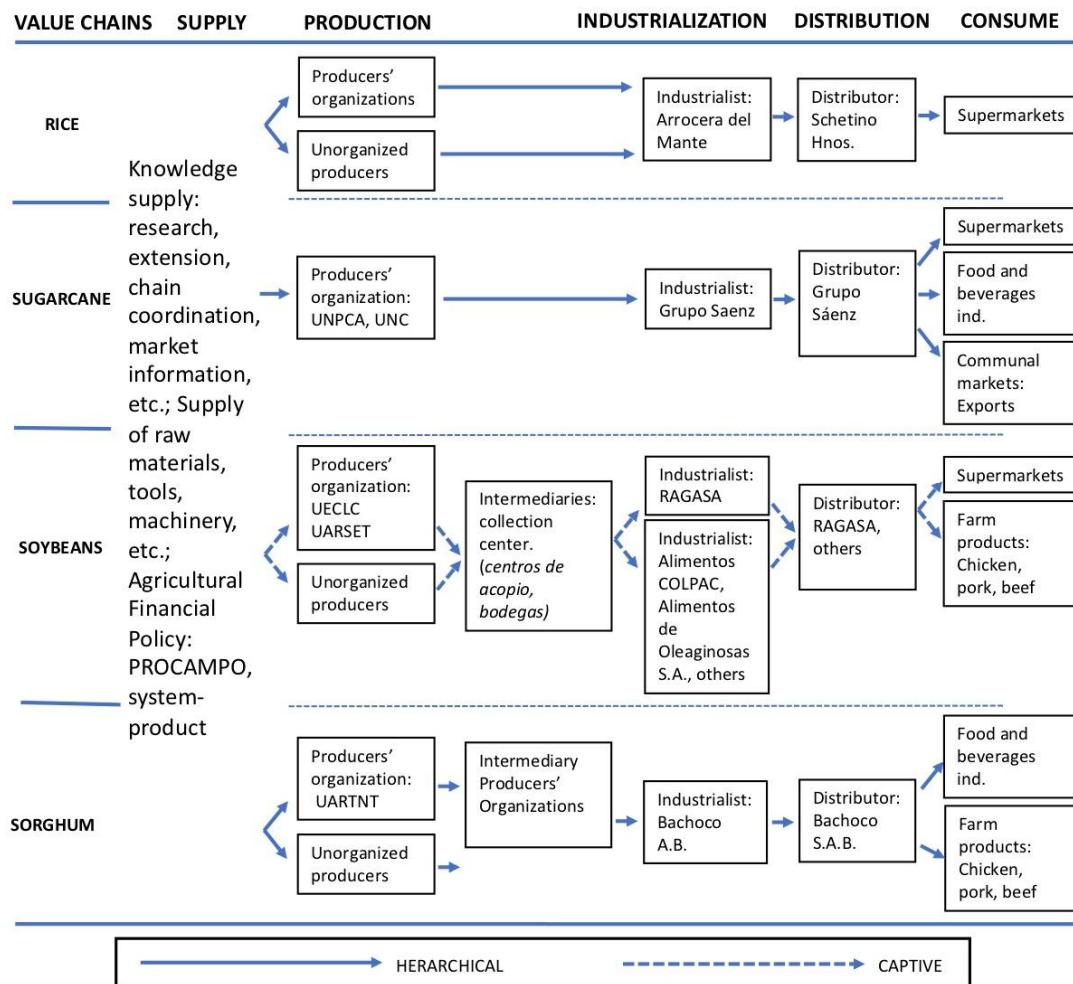
agricultural product imported in order of importance by the unexpended value (FAOSTAT 2018).

National production has had a very slow and lagged growth relative to the increased demand. It expanded until 1985, when it reached its peak of production volume and surface. From that moment its decline, which hit rock bottom in the 2001-2002, started. On 2003 began a slow recovery of national production, both in volume and surface with the addition of new producing states. In 2014 national production - 388,000 tons covered only 12% of national consumption (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016).

Tamaulipas is the main soy producing entity in Mexico. In 2014, it produced 40.5% of the total value and occupied 57% of the land area devoted to soy (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016). The main producing municipalities in the state were González, Altamira and El Mante, located south of the state; these three municipalities together represent 88% of the planted area and total production of Tamaulipas.

This analysis of the value chain of soy in Tamaulipas, is based on the functional and spatial relationships between the different links in the chain, and includes the whole process of value creation, from the raw material supply to the final customer. The length of the chain is five links (Figure 1). It is evidenced that the relations between links are integrated mainly from distribution to the industrialization. These links deal with the coordination of relations and encourage the integration of producers with national firms.

Figure 1. Integrated map of soybeans, sugarcane, rice and sorghum value chains*



Source: own elaboration based.

*UNPCA: National Union of Sugarcane Producers; UNC: National Union of Sugarcane Workers (They are the two most important cane producer organizations in Mexico). UECLC: Communal Union Path to Freedom of Rurals. UARSET: Southern Region Agricultural Union of the state of Tamaulipas. UARNT: Regional Agricultural Union of Northern Tamaulipas (The main association of sorghum producers in the state).

Industrialization companies, due to their own characteristics and assumed risk position, exert a leadership and control effect on the rest of the links, their control participation extends to the distributor, retaining most of the value created in the chain. This concentration in the industry and the distribution work as an oligopoly market that constitutes a center of power and coordination of the soybeans chain in the south of Tamaulipas, assuring them the mastery of knowledge of the market and the habit of consumers. That condition raises uncertainty for

the producers, because the industry defines the contract terms and functions as a barrier of entry to new producers.

The chain is articulated partially by the initiative of industry and distribution, through contracts and agreements signed. Downstream, the chain presents better integration, which reinforces the asymmetries related to information management, the advantages of negotiation and the regulation to acquire raw materials, by the set of quality standards. Upstream, the asymmetry is more attenuated, and it is only partially offset when producers integrate themselves into communal leaderships or producer organizations in order to rise its power of negotiation, improve their transaction costs and their opportunities for financing.

The main producer's organizations (UECLC and UARSET), act as leaders in the primary link and try to balance the position of asymmetric dependence in relation to the leaders of the chain. Other producers outside these organizations often conduct independent transactions through its partnership with other community leaders, negotiating directly with large customers (assemblers, distributors and industry).

The upstream of the chain is made by those links in the base, the supply network, producers' network and regional transportation. Producers are organized around communal leadership or villages (*ejidos*), which are the main supporters of the producers to improve conditions of commercialization, transportation and, in general, improving the benefits perceived by the production link. The downstream is made by the distribution, industrialization and further consume facilitators. Value adding is concentrated mostly in the industrialization which has a further integration towards distribution, taking advantage of direct communication channels and higher use of information technologies, along with a higher market development.

Governance in the soy chain is expressed by transmitting the quality standards required to producers, implementing a high level of transactions' codification through technical specifications; the establishment of prices through production contracts, levels of products, quality of seeds and redistribution of added value in the chain (Figure 2). Given that the

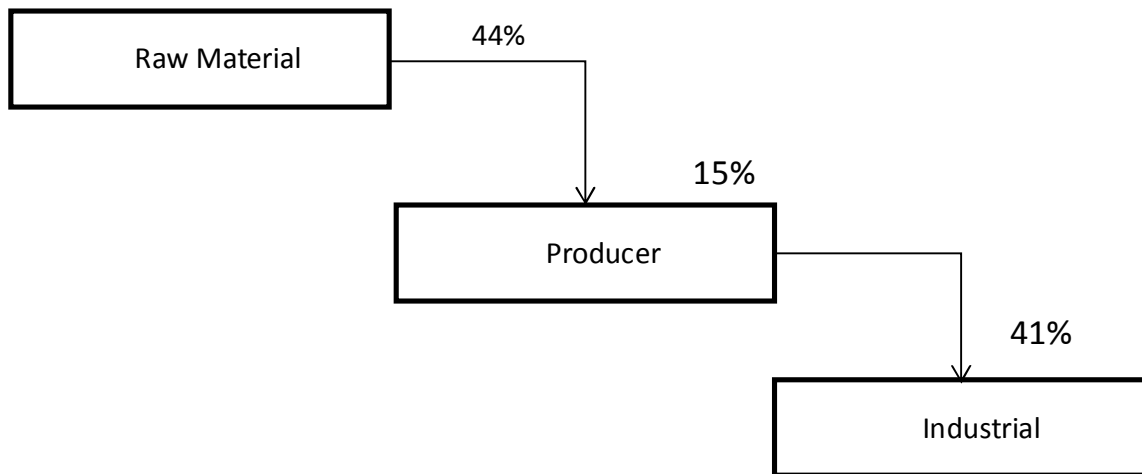
national production remains as a deficit, the producers have a reduced capacity to satisfy the industrial demand.

The main aspects of soybeans value chain governance in the south of Tamaulipas confirm a captive type, in which important buyers are located outside the region. But as part of a global value chain, they achieve the economic subordination of family production, and even small and medium local producers. The main conditions that explains this type of governance are:

1. The industrial (RAGASA, COLPAC, Unilever, Coral International and Proteínas Oléico S.A.) and distribution links keep control over the entire chain. The leadership initiatives are originated downstream, mainly from outside the region, they are promoted by large buyers of raw material, to which the industry gives part of the control, creating an equilibrium of the relations by the use of direct communication. This chain can be classified, according to Gereffi (1994) as a buyer-driven value chain. Led by large buyers, distributors and traders, which have power on the governance of the chain. This control over commercialization allows them to influence over the purchase price from the producers or local collectors, which in most cases, act as intermediaries between the direct producers and the raw material market.

2. At a segment level, it is possible to observe the necessity of organizing producers in formal groups or into communal leaderships in order to take advantage of the collective force in the negotiations. In this regard, institutional arrangement manifests itself in the mechanisms of collective contracts of production and commercialization, also in the management of information to reduce transaction costs when hiring transport and purchasing inputs.

Figure 2: Added value distribution in the soybeans chain *



Source: Own from interviews with members of the chain of soybeans processing.

*The data were obtained based on the estimated cost of soybeans cultivated hectare in the region and the average yield of 1.35 tons (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016).

The transactional benefits are mainly concentrated in the inputs, because of the costs of raw materials, labor and other inputs; and in the industry segment due to the added value. The producer benefits mainly from two sources: federal subsidies and productivity.

4.2 Governance in the rice value chain

In Mexico until 1988, National production covered the national demand of rice. On the following year, the domestic market presents a deficit, the imports surpass the domestic production and begins a process of reduction of production with the substitution of the national production with the imports. The national consumption gap - difference between imports and domestic production- increased since 2007. Imports currently supply 80% of the domestic market and the rest is covered by domestic production (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016).

Since 2013 a recovery in the domestic production started, which has also led to increase the area of cultivation. Rice production in Mexico is concentrated in 13 states. Campeche, Nayarit, Michoacán and Veracruz produce about 118,677.92 tons, which represents approximately 70% of the total. Tamaulipas, is the only state in northeastern of México that produces rice, occupying the ninth place at a federal level, by value and volume of production (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016). The total state production is concentrated in El Mante, which, due to the natural conditions in the region, such as water supply - Irrigation District 002 - and the technological capabilities accumulated by a group of entrepreneurs in the cultivation and industrialization of the product, has led to position the rice as a product with exploitable potential in the region.

The rice value chain can be divided in four links: supplier, producer, industrialist and trader (**Fig 2**). It depicts a high level of integration towards providers and industry, being the later the one who leads the chain. The first link, the suppliers, has a strong presence in the rice-growing region of El Mante. They supply seeds, herbicides, fertilizers, machinery, fuel, as well as technical support and advisory services. These actors have a noticeable stake, because they facilitate rice producers the necessary resources for the production. Some of the suppliers finance the supplies until the producers get paid by the industrial producer that commercializes the product in regional and national markets.

In the production link, the producers are specialized and know well the technological package, obtaining good yields in production, on average 6.11 tons per hectare. The production process varies depending on the producers' economic capacity, the land conditions and the crop development. The integration with the industry is high, production levels are coordinated from the industry through a regional organization named Rice State Council of Tamaulipas (*Consejo Estatal de Arroz en Tamaulipas*), depending on development plans, industry requirements and market demand. In the same way, the industry coordinates the type, quality and quantity of necessary inputs to execute the annual production.

The agro-industry also intervenes in the production of rice seeds, certified by the production stage. The control of the production levels is determined by the industry, depending on the demand of seed companies and producer organizations in other rice regions in the country. This is only applicable to irrigated areas or zones with irrigation systems.

The industrial link processes all the rice production of the region in a single company, *Arrocera del Mante*, located near the production site, in El Mante region. The main process of the industry is cleaning, brushing and packing. Whole brushed rice, half and grain rice is obtained. These final products are distributed through federal transport means. The industrialist is the only collector and wholesaler of rice in the region. This is the point in which most of the added value is generated in the chain because of the control that the industry has over it.

The commercialization link is made up by wholesalers and retail intermediaries who buy from the industry, sell and distribute rice according to their target markets, such as the brewing industry, livestock feed or creating further added value through branding and packaging. This activity is centralized by the Schetino Hermanos Company. The final product is destined to supermarkets and other end consumers' centers. In this link, the transport agents participate actively, by distributing the product at regional and national levels.

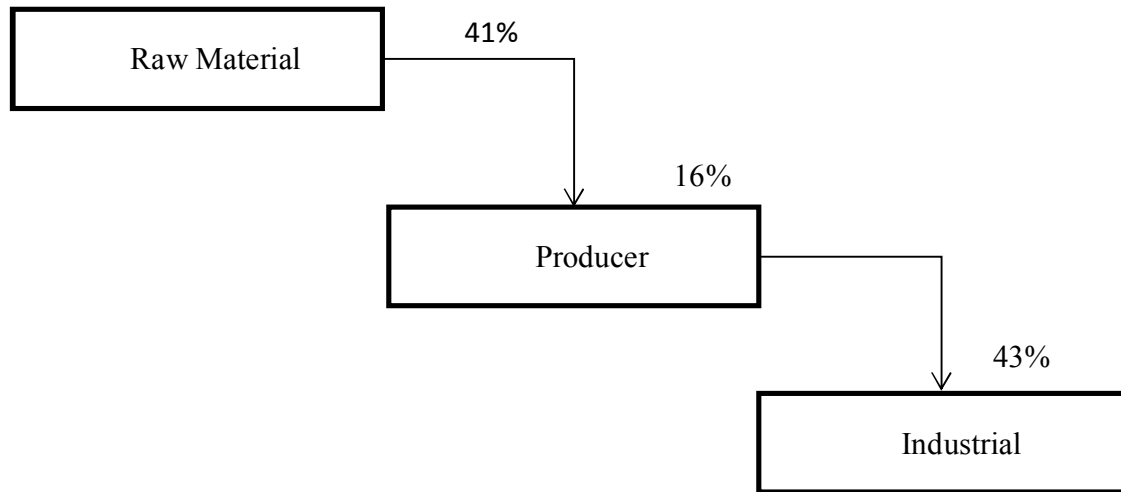
Governance in the rice value chain is controlled by the industrial link. In this agro-alimentary chain, the industrial operates as a monopsony firm, since it is the only buyer of the entire harvest, securing suppliers and their main outputs.

The industrialist as a buyer, gives the producer the specification of the rice he requires. In fact, the buyer/industrialist in the region has played a major role in the generation of competitive advantages, which was helped by the favorable natural conditions for rice production, such as wealth in water supply and adequate land. These advantages are complemented by low risk of plagues and illnesses in comparison to the rest of the country.

However, from the perspective of the authors of this paper, the rice core business in the region is based on the willing from the businesspeople of the sector to produce and share knowledge, technology and experience from other parts of the country and the world and applying that knowledge to the local rice production. In El Mante exists an accumulated experience from the businesspeople with more than 10 years in the subsector, which has allowed the adoption of specialized external knowledge. For instance, thanks to the industry's initiative, the services of Research and Development from FAO specialists and other organizations have been hired, services that are centered on the processes of production and harvest, land management, development and use of seeds, all this also being transferred to local producers with efficiency and low costs. This condition has allowed them to build a contract production relation between the industrialist and producers, which has guaranteed stability in the chain on the long term.

According to the governance scope (Gereffi et al. 2005), the chain can be classified as a hierarchical chain. This type of chain means that control/coordination exists from the leading firm. In this case, it is the industrial firm located in the region the one that executes coordination and leadership in the chain, controlling key aspects such as market information access, seed supply, fertilizers, financing, among others. In the region, the industrialist has the advantage to buy at market prices from a monopsony condition (only buyer), in addition to obtain several sub-products from the main rice industrialization, that can be traded independently, such as whole grain, broken grain and scrap. The industrialist retains most of the added value of the chain (Figure 3) yet offers to the wholesaler a part of the total revenue, in order for him to handle trading activities at superior scale of the product.

Figure 3: Added value distribution in the chain of rice*



Source: The data was calculated based on the information from Maldonado Garza (2013); SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural (2016).

*An Average Rural Price of 3,900.00 Mexican pesos per ton and a 6 ton. average yield was considered. Not incorporated other intermediaries, because they bring little added value to the chain (Maldonado Garza 2013)

4.3 Governance in the sugar cane value chain

In Mexico, during 2015, nearly 7 million tons of sugarcane were produced in 57 sugar mills, where also 56 million tons of sugarcane obtained from 900,000 hectares in 15 federative entities (states) were industrialized. 56% of the national production is consumed in the national market, the rest is exported (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016). The Tamaulipas' mills are in the sugarcane region of Las Huastecas and have yields of 10.81%, below the national average. The main municipalities that produce sugarcane in Tamaulipas are: El Mante, Xicoténcatl and Ocampo, Antigua Morelos, Nuevo Morelos and Gomez Farias, which concentrate more than 97% of production (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016). The average surface area of the land is 7 hectares, which is 2 higher than the national average.

The sugarcane value chain has five links (Figure 1), with an established integration that depicts greater force from the industrialization to the commercialization (downstream).

Upstream, the chain is fragmented, although its strength is based in the organizations of group producers and other agents. There is lack of mechanization and high dependence on the industrial. The main agents of the chain belong to the industrial link and are located at the center of the chain; the refining facilities (two in Tamaulipas) and their different firms that distribute components and tools to clients near the commercialization segment.

The industrial link is integrated by the distribution and commercialization activities of the final product. These links promote relations of firms along the chain, both upstream and downstream. These activities control the chain and their firms exercise leadership and retain most of the added value in the chain.

The integration of producers in the chain occurs through their relations with the industrialization and supply links, through processes of codification of the information coming from the producers. The institutional agreements occur through the signing of contracts between industrials and producers. The terms are negotiated by two locals producer's organizations: The National Union of Sugarcane Producers (UNPCA), as a member of the National Farmers Confederation (CNC), and The National Union of Sugarcane Producers, as part of the National Rural Owners Confederation (CNPR). There are quite few non-affiliated producers that negotiate directly with the industrials, however these two organizations work as entry barrier to new, independent producers in the sector.

Nevertheless, as a producer not affiliated or associated with one of these organizations, it is not possible to diminish the asymmetries of power during negotiations that industrials execute over the producers related to transaction costs, financing options of raw materials and technologies, or the selling price of products. The condition of small scale of the production (less than 20 hectares) constitutes the main weakness in negotiations that could not be overcome by sector organizations.

Another factor that influences the conditions of disadvantage of the producer in the negotiation phase is the low intervention, on a larger scale, of the government through economic policies to support producers created in 1994. This environment characterizes the

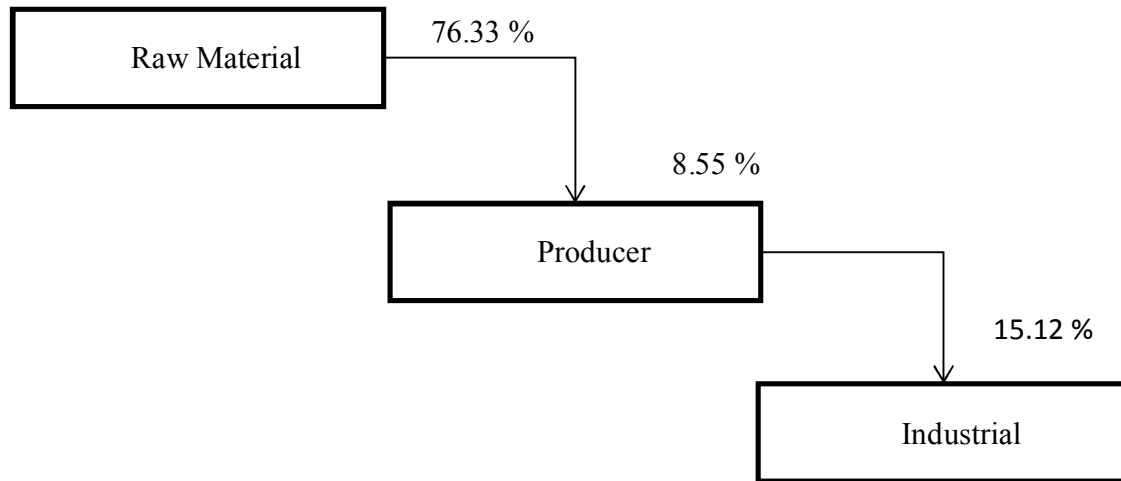
sugarcane value chain, as a monopsony from the industry. The control of the large company, namely industrial or refining facility, is executed by credit or debt, given its condition as main supplier of raw materials and tools to producers.

The complexity of transactions is complemented by a high level of knowledge codification, due to the degree of sophistication of technologies, supplied by the industrial. The raw material processing industry has a state-of-art technology, both in processing and in the generation of energy for its processes.

As an example, sugar and its derivatives are traded by subsidiaries of Saenz Group (*Grupo Saenz*), the owner of the sugarcane refining facilities. Its main clients are beverages, cookies and bread, and bottling companies, as well of communal markets and other industrial firms. An important part of the production is exported to United States. Moreover, the company is supplier of the main supermarket chains in Mexico, that have distribution centers in states such as Aguascalientes, Coahuila, Hidalgo, Guanajuato, Querétaro, Mexico City, Michoacán and Nuevo León.

In this way, the sugarcane value chain of the region can be classified as a buyer-driven chain, according to (Gereffi 1994). In this case, the industrial is the only buyer of the raw material in the chain, in a monopsony market. The consequences of this kind of market imply a high influence of the industrial on the prices and in the distribution of value created along the chain (Figure 4).

Figure 4: Added value distribution in the sugarcane chain*



Source: own elaboration from primary sources and interviews with producers and chain agents.

*This is an estimated calculation taking as a base production cost of 43,000.00 Mexican pesos per hectare and a production of 67.36 tons, a factory yield of 10% with a reference price of standard sugar of 7,099.00 Mexican pesos per ton, and final sell price in communal markets of 8,363.60 Mexican pesos per ton ((SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016).

The sugarcane chain can be classified as a hierarchical chain. The industrial link is controlled by a single firm, the leading company of the chain and vertically integrated on it. Both sourcing and industrialization sub stages appropriate most of the added value that was generated.

4.4 Governance in the sorghum value chain

Mexico is the world's largest sorghum consumer. Despite its production of nearly 10% of the total world production, it is not sufficient to cover the domestic demand (USDA 2018). Tamaulipas is the main producer in the country, however it has yields below the national average: 3.56 tons per hectare against 4.17 tons per hectare of national average. Other major

producing states are: Guanajuato, Jalisco, Michoacán, Morelos and Sinaloa (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016).

In the sorghum value chain, the producers are distributed along the state, with important concentration in the five regions of Tamaulipas state: San Fernando, Border, Center, South and Mante, given the favorable conditions for its production. The producers have important accumulated knowledge and research entities exist in the territory. Even price attractiveness is probably maintained, it has declined by about 50% between, 2012 and the first quarter of 2016, having adverse effects over the conditions of investment and labor in most of the producers (The World Bank 2016).

The sorghum value chain is made up by five links: suppliers of raw materials and tools, producers, distributors (local collectors), industrialists, commercialization and final consumers (Financiera Rural 2011). From these links, in the state of Tamaulipas, only the first three are present (Figure 1).

Upstream, the value chain has a weak integration, because the producers depend on the conditions of sale established by the market, and the distributor (collector). In Tamaulipas, there is a wide network of suppliers for raw materials, tools and machinery, seeds and fertilizers, and more, which goes directly to the producers. This part of the chain shows an asymmetric situation, due to the determinant weight that collectors execute over producers.

Moreover, the supply network has experience in providing solutions to the producers, who use their own means of transport to take the production to the collection centers. The collectors, at the same time distributors, often are producers' organization, but also independent businessmen that execute direct buying to the producers through contracts. The contracts establish a price and conditions that the product must comply in terms of characteristics and delivery, thus these represent a high level of product codification.

It is important to note that not all producers work under contracts, only those who are members of local associations can participate in the ownership of collection facilities. This

condition gives them access to better prices and in general better conditions of sale through the contractual mechanism previously established. Agro-producers of Tamaulipas (*Agroproductores de Tamaulipas*) and Riviera Agroindustry (*Agroindustria de la Rivera*) are sorghum producers' organizations that do not have capabilities to collect and storage, and they negotiate with collectors the production; Rural Association of Collective Interest (*Asociación Rural de Interés Colectivo*), Farmers Troopers (*Guerreros del Campo*), Commercializer of Agricultural Supplies, SA. (*Comercializadora de Insumos Agrícolas, SA*) and Storage Mateo Molina (*CP Mateo Molina Bodega*) are producers' groups of big scales which at the same time are the wholesaler traders and collectors in Tamaulipas.

Other small and medium sized producers, mostly located in the center and southern zone of Tamaulipas, do not have contracts nor other ways of financing towards harvest. Therefore, their transaction costs are high, conducting negotiations in an unfavorable situation and capturing low value from the final product, which directly affects their competitiveness.

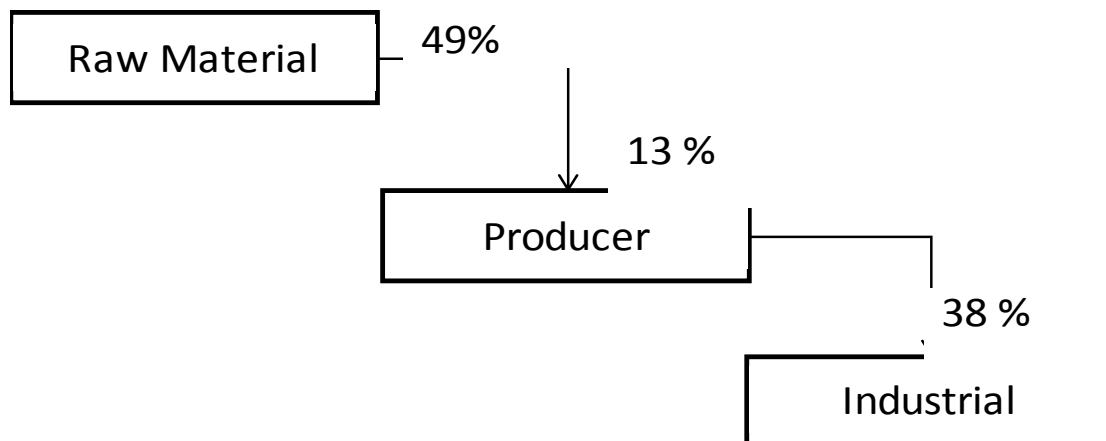
Downstream, the industry buys from distributors or collectors, which sell at international market prices. This link is the one that inputs the most into the value added that it is generated. The industry is concentrated in Guadalajara and Mexico City (Bachoco SAB), and establishes direct, stable and formal relations with geographically disperse distributors in production zones. Through these relations, they access better commercialization conditions, and, in some cases, the producers or independent firms transform sorghum into balanced food, creating added value and incrementing the benefits within the chain (Figure 5).

The commercialization channels offer the product to the intermediary or final consumer; storage facilities and producers maintain an active role in the process (Bachoco SAB and Cargill). According to (Caballero Deloya 2010), the network of the main buyers of sorghum is integrated by the storage partners, producers' groups, national firms and individual groups.

The livestock feed industry has a broader participation in the industrialization, after that there is self- consumption and selling to other storages (Caballero Deloya 2010). Several products have the origin in this, such as cattle feed, human consumption or raw material for further

industrialization. Sorghum producers are integrated in a specialized chain, that serves livestock feed companies and generated added value by producing those kinds of products and have a strategic value for the national economy (Vázquez 2015).

Figure 5: Distribution of value in the sorghum value chain.



Source: own elaboration from primary sources and interviews to producers and chain participants.

*Estimated calculation based on a cost of 3,270 Mexican pesos per hectare, net yield of 90% in the collection site 3.6 tons per hectare on average, sale Price to producer per ton of 1,150 Mexican pesos and reference Price of livestock feed per ton of 6,675 Mexican pesos (SAGARPA, Secretaría de Agricultura, Ganadería, Desarrollo Rural 2016).

4.5 Governance Comparison in the soybeans, rice, sugarcane and sorghum value chains

The analysis of the four value chains indicates their overall capacity to control and coordinate is limited by the influence that an link executes over the rest of the chain. In all cases, the industrialization stage is the one that leads the chain and controls the rest of the links.

In the studied agricultural chains, when the industrial link is geographically located in the same territory, they manifest as hierarchical chains, as they can dominate the rest of the links and capture most of the income, as it happens with rice and sugarcane. The producers receive

codified information and transmitted through contracts while the rest of the chain as a narrow liberty to act, as they work as a monopsony market.

In both chains, in the industrial links, they exist one or two companies located in the region, and through control mechanisms (contracts, indebtedness and price setting), they reached dependency of the producer and other chain members, and by consequence capturing most of the generated income.

On the contrary, in the chains where control is executed by stages which are out of the territory, as it happens with soybeans and sorghum, they work as captive chains. These relations of dependency are established by contracts and the capacity to codify information (table 2).

Table 2: Comparison between the four value chains by their type of governance.

Value chains	Complexity of transactions		Capacity to codify transactions (product characteristics)	Capacity of suppliers (local productive capability to cover demand)	Retention of income (share of the generated income in the chain)
	Type of relations between links	Price setting			
Soybeans	Out of balance and dependent	Imposed/negotiated	High	Low	Low local retention
Sugarcane	Out of balance and dependent	Imposed	High	High	Most of the income retained by industrialist and commercialist
Rice	Out of balance and dependent	Imposed	High	Low	Most of the income retained by industrialist and commercialist
Sorghum	Out of balance and dependent	Imposed/negotiated	High	High	Low local retention

Source: own elaboration from primary sources and interviews to producers and chain participants.

Conclusions

The analysis of governance in the agricultural value chains of the northeastern Mexico shows important lack of incentives for the sector to take advantage of existing potentialities to generate wealth and support economic growth in the state. Since 2010, the primary sector has been heavily affected by unfavorable conditions of public safety and violence linked to drug cartels, in addition to the effects of price reductions in commodities since 2012.

However, the government has implemented public policies that have been in favor to the agricultural sector, partially. Policies such as oleaginousness subsidy, trade incentives, infrastructure development, acquisition of machinery, risk coverage, among others, have been executed by public organisms such as Agency for Marketing Services and Development of Agricultural Markets (ASERCA) and Rural Finance (*Financiera Rural*).

Moreover, according to the conducted interviews with producers of the four types of products, these policies have been insufficient, as they in general do not observe uncertainty reduction nor asymmetries diminish in the chain that can allow them to access a further part of the added value generated in it.

During the last years, several sources of financial aid have appeared from the federal government, through the Secretary of Economy, that in a way have been able to incentive the improvement options (upgrading) and to transit towards higher added value links in the chain, especially in the value chains of sorghum and soybeans.

Conflicts of Interest: The authors declare no conflict of interest.

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