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## A cultura agrícola da cana-de-açúcar no Brasil: contribuição ao estudo dos territórios rurais e suas contradições e conflitos

### Agricultural culture of sugarcane in Brazil: contribution to the study of rural territories and their contradictions and conflicts

### Cultivo agrícola de la caña de azúcar en Brasil: contribución al estudio de los territorios rurales y sus contradicciones y conflictos

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#### Resumo

Este artigo discute as modificações introduzidas na agricultura brasileira e o modelo de desenvolvimento econômico e político adotado no país desde o início do processo de industrialização na primeira metade do Século XX. Propõe discussão teórica sobre o processo de modernização da agricultura e a dinâmica atual do agronegócio sucroenergético. A metodologia utiliza-se de revisão bibliográfica, bem como a construção de referencial teórico para compreensão e construção de narrativa a respeito do tema. Partindo da análise da cultura agrícola da cana-de-açúcar na formação sócioespacial brasileira e do desenvolvimento agroindustrial canavieiro e as sucessivas crises neste setor, procura-se evidenciar a configuração territorial do setor sucroenergético, seus avanços e retrocessos no cenário nacional e suas relações com o setor de produção de commodities.

**Palavras-chave:** Modernização da agricultura. Agronegócio Sucroenergético. Commodities.

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#### Abstract

This article discusses the changes introduced in Brazilian agriculture and the model of economic and political development adopted in the country since the beginning of the industrialization process in the first half of the 20th century. The article proposes a theoretical discussion on the modernization process of agriculture and the current dynamics of sugar-energy agribusiness. The methodology uses a bibliographic review, as well as the construction of a literature review for understanding and building the narrative behind the topic. Starting from the analysis of the sugarcane agricultural culture in the Brazilian socio-spatial formation and of the sugarcane agro-industrial development and the successive crises in this sector, we seek to highlight the territorial configuration of the sugar-energy sector, its advances, and setbacks in the national scenario and its relations with the commodity production sector.

**Keywords:** Modernization of agriculture. Sugar-energy Agribusiness. Commodities.

## Resumen

Este artículo discute los cambios introducidos en la agricultura brasileña y el modelo de desarrollo económico y político adoptado en el país desde el comienzo del proceso de industrialización en la primera mitad del siglo XX. El artículo propone una discusión teórica sobre el proceso de modernización de la agricultura y la dinámica actual de los agronegocios de energía azucarera. La metodología utiliza una revisión bibliográfica, así como la construcción de un marco teórico para comprender y construir una narrativa sobre el tema. Partiendo del análisis de la cultura agrícola de la caña de azúcar en la formación socioespacial brasileña y del desarrollo agroindustrial de la caña de azúcar y las sucesivas crisis en este sector, buscamos resaltar la configuración territorial del sector azucarero, sus avances y retrocesos en el escenario nacional y sus relaciones con El sector de producción de productos básicos.

**Palabras clave:** Modernización de la agricultura. Agroindustria azucarera. Productos básicos.

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## Introduction

Since the 16th century, with the introduction of sugarcane in Brazil, the production of this plant in the country has been mostly associated with the international market's demand. It was during the 16th and 17th centuries that sugar started to gain economic relevance, in a historic period known as the "Sugar Cycle" (PRADO JÚNIOR, 1963, FURTADO, 2005). During this period, some regions have become epicenters for sugarcane-related activities, such as in the Northeast of Brazil, especially in Zona da Mata and Recôncavo Baiano, followed by Maranhão, Rio de Janeiro and São Paulo (VIEIRA, 2017).

Sugarcane plantation and its use for sugar production were one of the first economic activities implemented by Portugal in the Brazilian colony. The first sugar cane seedlings were brought from Madeira Island (Portugal) by Martim Afonso de Souza, responsible for the installation of the first mill in São Vicente (nowadays the state of São Paulo), in 1532. However, the main sugarcane producers in the colony were on the Northeast coast, especially in Pernambuco and Bahia, and used to base their activity in slave labor, predominantly prevented from Africa (ANDRADE, 1986).

The proximity to the European consumer market, the wind that facilitated navigation, the fertile dark clay soil (massapé), the tropical climatic conditions, and the presence of several rivers

that ended in the coast were favorable conditions for the expansion of this activity in the northeast lands. (FERLINI, 1998).

Since the implementation of sugarcane as a large-scale commercial activity, the changes associated with its production has influenced and transformed the structures in agriculture and the territorial use by the subjects involved with this type of economy. Therefore, from the colonial period until now, sugar cane has been an important part of Brazilian territorial and social formation.

Sugarcane is cultivated in more than 100 countries on several continents (America, Africa, Asia, and Oceania), but despite the high number of producing countries, 80% of world production is concentrated in only 10 countries. FAO (2019).

For decades Brazil was the world's largest producer of sugarcane and derivatives, but the country lost this position for India which is on the lead since 2017 FAO (2019). At that time, the production and cultivation areas decreased, due to the water crisis and the decline of Chinese imports, the main buyer of this commodity. Despite those issues, sugar-energy production has been achieving productivity gains.

According to the National Supply Company CONAB (2020), in the harvest of 2019 there was an average increase of 4.9% on productivity per hectare when compared to the previous year. The planted area decreased by 1.35% between 2019 and 2018, reaching 8.5 million hectares. From the 642.7 million tons of sugarcane milled in Brazilian power plants, 65% were used for anhydrous and hydrated ethanol production and the 35% remaining were for sugar production.

The sugarcane sector is part of the modern Brazilian agricultural production for exportation. The use of machinery and irrigation techniques, pest control, and increased productivity, place this sector in the complex set of activities of Brazilian agribusiness. THOMAZ JÚNIOR (2010).

As mentioned by Ferreira (2016), the technical evolution of the sector can be analyzed by the use of terms that have changed together with the expansion of the sector. In the first half of the twentieth century, it was called the sugarcane sector, a term that referred exclusively to the production of sugar and ethyl alcohol for human consumption. After that, with the oil crisis during the 1970s and the adoption of new policies, the term changed to the sugar-ethanol sector, referring to the use and production of ethanol, a biofuel added to gasoline to reduce the use of oil derivatives. From the 1970s on, with the implementation of technological innovations, the rejects from sugarcane production, such as the sugarcane bagasse, started to be used for electric energy production, changing the concept for the sugar-energy sector.

Nowadays, the sugarcane industry is one of the main examples of agribusiness, as it has a highly technological agricultural production, with the presence of inputs, agricultural implements, and modern machinery. Moreover, the sugarcane industrial process transforms the raw material into various products, such as sugar (VHP, crystal, refined K, organic), ethanol (anhydrous, hydrated, gel), energy (from sugarcane biomass: straw), yeast, etc. Beyond that, there is all the supply chain involved before and after production, such as transport, logistics, promotion, groceries, and also all the capitalist and power relations involved in the process. FERREIRA (2016, p.58).

According to Santos (2009), with the large expansion of cane fields, the Brazilian State created in the early 1930s the Sugar and Alcohol Institute – IAA, in order to develop and control sugar production in the country. To do so, IAA determined quotas of production by federation units and power plants, regulating the production and value of products (sugar and ethanol fuel).

It was also due to IAA that ethanol became very important on the national scene because there was a concern to maintain the internal balance between sugarcane crops and sugar consumption, [...] in this sense, issues such as the damage caused by stock speculation and the excess of exports were solved with the mandatory use of part of sugarcane for ethanol production (SANTOS, 2009, p.109).

Another key program related to the sugar and ethanol sector was the Proálcool. That program provided all the infrastructure needed for sugar and ethanol production and plant processing. Especially during the 1970s, it was focused on direct public and private investments in this segment. Over time, the sugarcane sector came to be seen not only as a source for sugar and ethanol production but also as an important raw material for the energy sector.

The Proálcool program was created during the military regime and had as main objective to expand the production of ethanol fuel and to encourage its use in cars made in Brazil. The project was responsible for intensifying the cultivation of sugarcane in the country and boosting the modernization process in the industry, by increasing the number of distilleries and allowing financing sources to implement new production units. Proálcool enhanced the technological development in this agribusiness sector, especially when promoted in the country the use of ethanol over gasoline (LIMA, 2009).

The program had three phases, the first, between 1975 and 1979, promoted the infrastructures, adding distilleries attached to the power plants to produce anhydrous alcohol as a gasoline additive. The second phase, from 1979 to 1986, aimed at encouraging the production of hydrated alcohol, prioritizing the consumption of vehicles powered exclusively by ethanol. The

third phase, from 1986 until the end of the 1990s, was known as the sector's slowdown and crisis, because of a series of factors, such as the stabilization of oil prices in the international market. Also, the suspension of financing and the cut of subsidies generated imbalances between supply and demand and the prioritization of sugar production over ethanol fuel. This scenario accelerated the deregulation of the sector influencing price and product release for free competition.

Currently, the production of sugarcane and its derivatives places Brazil in a relevant position on the global market. The entry of transnational capital consolidates the use of ethanol as an alternative fuel source in Brazil and its acceptance in new markets, such as the European Union, South Korea, the United States, Japan, and the Caribbean (Unica, 2008). Furthermore, Brazil has the lowest cost production among the main competitors of the international market and is on the lead of sugarcane biotechnology knowledge, together with Australia and South Africa.

The raw material used in sugar manufacturing is now used for ethanol and bioelectricity production. As such, the second and the third generation<sup>3</sup> of ethanol and production of biopolymers<sup>4</sup> came to be known as the “sugar-energy sector”, mainly due to the high level of investment in technology and the increasing diversification of the sector (Macedo, 2007; Schenberg, 2010).

The new benefits to developing production, together with the discourse of the environmental and energy crisis, and the productive restructuring based on technological and regulatory innovations, made the production of sugar, ethanol, and energy to spread especially the interior of Brazil (Cerrado areas). This new spatialization marked a period of reorganization in the Brazilian territory (BACCHI and CALDARELLI, 2015).

Since the beginning of the 1990s, there are transformations in the sugar cane agroindustry in Brazil, when the deregulation of Proálcool resulted in the free competition of prices even with the agents struggling for the program to survive. However, the signs of growth recovery came with the production of biofuels when Brazilian ethanol fuel became more competitive in the global market.

Especially in the last decade, there was a great incentive for ethanol production, mainly because of bi-fuel vehicles (*flex*<sup>5</sup>) in 2003 and 2004, which have increased internal demand for the use of hydrous ethanol. Also, the rise in the price per barrel of oil, the debates about global

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<sup>3</sup>Transport biofuels can be categorized as first generation, composed of food crops (wheat, sugar cane, beet and oilseeds), second generation, composed of lignocellulosic materials (cereal straw, corn stalks, etc.), and third generation, composed of algae (McCormick, 2010).

<sup>4</sup> Biopolymers are biocompatible and biodegradable materials that aim to replace the use of plastics of petrochemical origin partially or totally (Schenberg, 2010).

<sup>5</sup> Cars that can run on ethanol and gasoline, or a mixture of both.

warming, and the environmental impacts of fossil fuels generated crucial changes in perspectives of the sugar-energy sector.

Within this framework, the present paper aims to discuss the changes introduced in Brazilian agriculture and the economic and political development model adopted by the country, since the beginning of the industrialization process, in the first half of the 20th century. Furthermore, the study proposes to conduct a theoretical review of the modernization process in agriculture and the current dynamics of sugar-energy agribusiness.

First, the bibliographic review was oriented to understand the dynamics of the topics approached and how direct and indirect studies build their literature review. Second, document analysis was carried out in libraries, digital repositories, and scientific journals, books, dissertations, theses, databases, and articles about the theme. For this purpose, data from national and international reports related to the sugarcane sector (e.g. production, the financial-economic situation of companies) were also used, as the example of the Agricultural Census and databases of the Brazilian Institute of Geography and Statistics (IBGE, 2017).

### **From the sugar civilization to the sugarcane agribusiness in Brazil**

Sugarcane has been planted and processed in the Brazilian territory since the colonial period, and has been for a long time responsible for maintaining the economic, political, and social domain of the agricultural sector on the national scene. During the 16th century, this activity was oriented to produce sugar as a commodity item for international trade, which generated high incomes for the Europeans. According to Simonsen (1969), it was in the middle of the 15th century, that Portuguese first cultivated sugar cane in Madeira Islands and São Tomé and Príncipe, and in 1532 implemented this cultivation in the Brazilian colony. Until the first half of the 17th century, sugar cultivation, manufacture, and commercialization was the main activity in the colony. It's relevance only decreased when the Portuguese turned their attention to the gold exploration in other parts of the territory, where nowadays are the states of Minas Gerais, Goiás, and Mato Grosso.

According to Simonsen (1969, p. 142), 'Governor' was one of the first mills built in the Brazilian territory, in 1532. It was located in São Vicente captaincy and belonged to the Portuguese grantee Martim Afonso de Sousa until the 19th century. Most of the Sugarcane production was concentrated on the coast of the Northeast region, in 'Zona da Mata', where nowadays are the states of Pernambuco, Paraíba, Sergipe, Alagoas, Rio Grande do Norte, and

Bahia. The predominance of sugarcane production in the Northeast coast was mainly due to the natural characteristics favorable to its cultivation, such as the tropical oceanic climate, regular rains, high insolation rates, and the massapé soil which was fertile. Also, the proximity to European big centers used to be a benefit in times when ships were not so developed as nowadays and used to face hard navigation conditions. The mills were strategically implemented next to rivers to facilitate sugar transportation to the ports, from where the ships left towards Portugal.

The “civilization of sugar” was described by many classic Brazilian authors, such as Caio Prado Júnior (1963), Gilberto Freyre (2001), Sérgio Buarque de Holanda (1936 and 1961), Darcy Ribeiro (1995) and Manuel Correia de Andrade (1986). They narrated how sugar formed the socio-spatial organization in the Northeast Region of Brazil, the country's initial urban centers, and the complex networks in the Brazilian field, in the Northeast and other Brazilian regions.

During the colonial period, the mill was the main structure for sugarcane production. The monoculture latifundium was based in a large cycle of slave labor exploitation, that influenced the organization of the rural areas in the Northeast Forest Zone. The “sugar mill’s lords” owned large portions of lands and represented local economic and political power. They were the rural aristocracy in a patriarchal society, marked by hierarchy between different social classes: the owners of the land, slaves, the clergy, free men, independent workers, merchants, and military personnel.

But in the 17th century, the Dutch and the French invasions in the Northeast of Brazilian territory influenced the disputes for sugar production in both captaincies, Pernambuco and Maranhão HOLLAND (1961). However, when the Portuguese reconquest the territories, Dutch and French moved sugar cane production to their colonies in the Caribbean, which created direct competition with the sugar produced in Brazil and contributed to the decline of this cultivation for centuries.

### **The creation of the Sugar and Alcohol Institute and the first territorial and productive restructuring of the sugar cane sector**

Over history, sugar cane has passed through several technical and political-normative changes, especially after 1930. The main event in this regard was the creation of the Sugar and Alcohol Institute - IAA in 1933, which marked a strong period of State regulation of the sector FERREIRA (2016). The creation of IAA aimed to protect and strengthen internal and foreign markets through the adoption of planning and control measures (prices and offers), incentives to

production, and distribution and commercialization of sugar and ethanol, in order to overcome the Great Depression that started in 1929.

To mention some of the institution's attributions:

Contribute to improve the conditions of the national sugar agroindustry and to solve sugar overproduction as an incentive to ethanol production, through the price-fixing of sugar and the construction of new distilleries equipment. (BRAY, FERREIRA, RUAS, 2000, p.19)

The creation of the Sugar and Alcohol Institute shed light on the complete subordination of agriculture to industrial supplies, equipment, purchase and production.

The Sugar and Alcohol Institute fundamentally aimed at dealing not only with the sugar issues, but also to intervene and control the ethanol economy. As such, it influenced the commercialization prices and the technical and financial assistance to power plant owners interested in anhydrous fuel alcohol production (BRAY; FERREIRA; RUAS, 2000, p.19-20)

During the Second World War there was a reconfiguration of sugar cane occupation in the Brazilian territory, due to the formation of a new production pole in the interior of São Paulo state. According to Szmrecsányi & Moreira (1991), there were supply problems in the Center-South<sup>6</sup> region with sugar prevented from the Northeast, because of the risk of submarine attacks on vessels traveling along the Brazilian coast. However, the production and processing of sugar cane in some other states helped to remedy the situation. At that time, there were several state measures to stimulate the sector, and the conditions also contributed to a favorable scenario. The proximity to large consumer markets, the financial capacity for investments, the modern and diversified industrial park, and a relatively consolidated transport and energy infrastructure were crucial factors that promoted a spatial concentration of plants in São Paulo, in large areas that were previously used for extensive farming and coffee plantation (SZMRECSÁNYI, 1979).

After that, in the 1950s, the first innovations were implemented with the introduction of a new technological model for rural production, based on exportation of industrial commodities.

[...] Even with several conflicting views, the modernization of the agriculture was planned by the State to boost the country's production. That process started in the South of Brazil during the 1950s and, rapidly, reached other regions. "In a little more than ten years of state investments to modernize the Brazilian fields the

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<sup>6</sup> Central-South Region is a Brazilian territory composed of the geographic macro-regions of IBGE, South, Southeast and Midwest. This regionalization is widely used in the sugar-energy sector to differentiate this area from the North-Northeast region, based on variables such as the harvest calendar, the modernization process, among others.

results started to appear, especially on the production of commodities” (MATOS, 2011, p. 78).

By the end of the 1950s, sugarcane cultivation expanded based on incentives given to the industrial production of goods, such as equipment, facilities, and the acquisition of goods and services to produce commodities. Considering there was a concentration of lands for cultivation, the modern model to produce commodities was replicated in other Brazilian regions. That model emphasized large-scale lands as a necessary condition for production, influencing the formation of the territories where the sugarcane monoculture was predominant and establishing new and contradictory relationships that could be of precarious or formal work.

The productive restructuring driven by sugarcane was only possible through the national and transnational capital investments made in articulation with the Brazilian State in several instances (Union, states, and municipalities). Those investments configured and integrated a complex sector that included direct and indirect goods and services related to the sugarcane, such as industries of tractors and machinery, irrigation systems, trucks for transportation, power plants, and distribution of chemical products, biotechnology, and agricultural pesticides.

It was between the 1960s and the 1970s that the industrialization of Brazilian agriculture advanced, marking the constitution of the Brazilian Agroindustrial Complex - CAI:

This process is fundamentally characterized in Brazil, by the implantation of an industrial sector that produces goods for agriculture. At the same time, a market for industrialized products of agricultural origin was developed or modernized on a national scale, forming a system of agro-industries that was focused on both, the domestic market and exportation (DELGADO, 1985, p. 3435).

In 1965, the National Rural Credit System - SNCR was created to provide agriculture financing and to operate as a specific credit source for supplies and techniques which were aligned with the modernization strategy pre-determined by the State. The integration between the agricultural sector and the industrial sector was articulated by subsidized rural loans at below-market interest rates, which in many cases were below zero. During the 1970s, nominal interest rates were always below inflation:

In addition to the modernization, the crucial point on integrating agriculture into the financial circuit was more than a simple inter-sectoral technical integration. It was the most complete subordination of agriculture to the regulatory power of the

monetary policy by the State, which have placed the financial market as the basic parameter for decision-making by farmers and companies operating in agriculture (KAGEYAMA 1987, p 13).

Within this development perspective, Matos (2011, p.92) analyzes that:

[...] The Rural Credit System - SNCR was the main instrument used to consolidate the modernization of agriculture and livestock. (...) Rather than being a policy to effectively consolidated rural development, it promoted inequalities, due to its selective nature. The selectivity occurred in two aspects: productive areas and producers. It was mainly concentrated in the South and Southeast regions and targeted at medium and large producers.

The SNCR established relations with the interests of industrial capital, the State, and large and medium-sized rural landowners. Those relations result from the modernization process of the national agriculture, however, as they were concentrated in the states of the Central South, resulted in the exclusion of other Brazilian regions and social groups, notably small farmers, indigenous, descendants of slaves (quilombolas) and peasants communities.

[...] powerful instrument strengthened and created by the military government, the SNCR strived to offer primary materials for economic growth and the "modernization" of Brazilian agriculture. Although it was selectively and explicitly focused on the owners of large-scale lands, it made possible the internalization of agriculture for industrial sectors, upstream and downstream. The State, then, made what was known as the CAI Agroindustrial Complex (THOMAZ JÚNIOR, 2002, p. 80).

In fact, the production is concentrated in the interior of the Central and South Regions, covering between 10% and 20% of total rural establishments. In this scenario, the remaining regions and several small rural establishments are decapitalized and excluded, which made them peripheral in the national production context (Ferreira, 2016). The high-scale capacity of large properties to supply the markets, inside and outside the country, create a mass of deterritorialized farmers, which are excluded from the process due to precarious conditions of the rural labor market. Those farmers, who live and work in small rural establishments, are unable to enter the economic circuit and end up by constituting a surplus workforce.

According to Matos (2011, p.116), from the 1970s on, there was an impact of the modernization in areas of the Cerrado biome:

[...] From the 1970s on, many efforts were made by the State and private capital to expand the agricultural frontier to the Cerrado areas in order to consolidate modern agriculture in those areas. The State project implemented in the Cerrado

had as main justification to avoid the economic backwardness and to promote that region's integration with the rest of the country. Government operations have made these areas modernized, urbanized, and integrated into the national and international economy.

Hereupon, the next section will describe the context where the National Alcohol Program (Proálcool) was created, in 1975, to promote fuel alcohol (anhydrous and hydrated) production and consumption during the gas and diesel shortage crisis caused by the "oil shock"<sup>7</sup>.

### **The National Alcohol Program - Proálcool: the sugar cane sector and the oil crises in the 1970s.**

In the 1970s, a set of new agriculture activities were articulated to the demands of the agro-industrial complexes. The convergence between final demand and producers established relationships of production and consumption for specific products. As a consequence, different agro-industrial complexes were built, such as sugar cane, soy, fruit, cotton, coffee, and meat, each of them, presenting different ways to face their dynamics and challenges over the last decades.

The sugarcane complex, specifically, was impacted during the 1970s by sugar price retraction in the international market and the decrease in exports. That situation, which intensified during the first oil crisis in 1973, represented a serious threat to the sector's profitability. Additionally, the successive increases in oil prices impacted Brazilian industrial and agricultural production, inflating the prices of goods and services, decreasing the population's purchasing power, and increasing public debt and inflation. Considering that situation, representatives of the sector defended a program of public subsidies for the sugar and alcohol sector to expand and modernize, aiming to increase the sector's competitiveness in the international market and to amortize the investments made.

That scenario of successive crises (1967, 1973, 1979, 1980) harmed the Brazilian and world economies, reflecting in both agricultural and industrial production and on the population's consumption and purchasing power. Also, the large-scale use of oil as a non-renewable source and the main fossil fuel in Brazil and other parts of the world demonstrated the dependence state of the consumer countries over the producers and transnational oil companies. At that time, the national oil and natural gas production did not fully meet national consumption demand, making the country dependent on imports from producing countries.

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<sup>7</sup> The "oil shock" was a crisis generated by successive increases in prices and cuts in oil sales made by the Organization of Petroleum Exporting Countries (OPEC), mainly due to the war conflicts in the Middle East.

Within that context, the National Alcohol Program – PROÁLCOOL was created as a program of the Brazilian government to use ethanol fuel instead of gasoline. It aimed to replace part of oil importation by a local product based on sugar cane derivatives, a renewable raw material that had a large-scale production in Brazil. The discourse at that time was based on a logic of strong state interventionism and availability of public resources through subsidies, in which to invest in alternative energy of a national fuel product was considered the alternative to overcome the oil crisis and to boost national sugar production.

According to Guedes, Gallo, and Martins (2002), the Proálcool was justified by the need for an alternative energy program, capable of replacing imported oil, which at the time represented 80% of the oil consumed.

The rise in oil prices on the international market increased the prices of Brazilian production, the trade balance, and external indebtedness. (BRAY, FERREIRA and RUAS, 2000).

According to the initial projects, 40% of the funds for Proálcool came from the Energy Mobilization Fund, while 60% from the Government's Monetary Budget. In 1979, the Energy Mobilization Fund was the main instrument used by the Brazilian government to finance the Energy Mobilization Program and encompassed a set of measures to encourage the production of oil, coal, shale, electricity, charcoal, and firewood. On one hand, fund resources were obtained from taxing oil products while on the other hand, they came from tax revenues of the former Single Road Rate - TRU.

The program was created by the federal government on 14<sup>th</sup> November of 1975, aiming at promoting ethanol production and commercialization instead of gasoline in order to reduce the dependence on oil exportation and to avoid the leakage of foreign exchange. Thus, PROÁLCOOL intensified the production of ethanol fuel and replacing product imports. For Thomaz Júnior (2002, p. 76):

[...] the Program was launched and strategically planned to produce an alternative energy internally, in opposition to oil dependence, in a period of international product prices increase and sugar prices decrease.

The development of this supply chain also had the potential to generate new jobs and economic growth for the regions producing it.

Despite the high prices at the time, in 1975, the international oil market stabilized, and government authorities reduced interest in the sugar cane complex. It was considered that the macroeconomic environment demanded more urgent measures to minimize international payments

imbalances and the inflationary attack, which lasted until 1979 when the second oil crisis spurred the resumption of Proálcool.

Firstly, the ethanol was used in a mixture with gasoline, but from 1979, hydrated alcohol began to be sold at gas stations. Also, the factories started to produce and commercialize new vehicle models designed to work with that fuel, while the government subsidized loans and the installation of distilleries.

The production of vehicles powered by alcohol is a direct result of Proálcool, and as Table 1 shows, there was an increase in the sale of those vehicles from 1979 to 1985. Additionally, data highlights that from 1982 on, there was an increase in the numbers of passenger cars, light, and heavy commercial vehicles.

**Table 1-** Brazil: Thousands of cars powered by ethanol sold (1979-1985)

Period	Passenger cars	Light commercial vehicles	Heavy commercial vehicles	Total
1979	2,3	0,8	0	3,1
1980	226,6	14,1	0	240,7
1982	212,0	20,7	0,9	233,6
1983	539,8	40,7	2,0	582,5
1984	505,2	60,7	2,6	568,5
1985	401,7	46,7	1,6	449,7
TOTAL	2.016,7	190,6	8,2	2.215,5

**Source:** Society of sugar and ethanol producers. Annals of the VI Econoalcool. São Paulo, 1986.

At the beginning of the 1980s, in order to strengthen Proálcool, the government fixed that the maximum price for ethanol should be up to 59% of the gasoline price. That measure reduced the final price cars powered by ethanol in comparison with the ones powered by gasoline. Therefore, there was a rise in the sales of cars powered by ethanol fuel and the increase in ethanol consumption.

[...] 1985 is considered the milestone for PROALCOOL, because it marked the highest percentage in the sales of vehicles powered by alcohol, with 92.7% of the total vehicles produced and sold domestically. (BRAY; FERREIRA; RUAS, 2000, p. 78).

Difficulties were noted in the implementation of Proálcool, especially regarding issues in the distribution and storage of hydrated alcohol and the lack of technological engines powered by alcohol. The fall in oil prices during the 1980s made ethanol fuel to be more expensive than oil.

For example, in 1981, the price per barrel of oil was US\$ 35.00, while ethanol price per barrel cost about US \$ 80.00 / U \$ 90.00, as a result, the program became unfeasible. BRAY; FERREIRA; STREETS (2000)

Despite the generic regulation of the State, at the end of the 1980s and after the extinction of IAA - in March of 1990, the Brazilian sugarcane complex passed through a progressive deregulation process, that finished with production and commercialization release.

[...] the Government stops acting directly on the world sugar market and companies gain autonomy to export their products without the support of the IAA. This scenario marks the end of Proálcool and the passage to a self-regulated sector, which occurred thanks to the deregulation of the state on national sugar and alcohol activities. (CARVALHO, 2002, p. 42).

In addition to that, the sector was pushed by the need for product diversification, differentiation, and better technical conditions of equipments. Those strategies were developed over the decade and generated profound reformulations in the Brazilian sugarcane agribusiness. Table 2 shows the total production of alcohol and sugar in the deregulation and liberalization period.

**Table 2:** Production of ethanol and sugar in the period of deregulation and liberalization of the Brazilian economy

HARVEST	Total in Billions of liters of alcohol	Variation from 90/91	Sugar Million tons	Variation from 90/91
1990/1991	11,5		7,3	
1991/1992	12,7	10,4%	8,6	17,8%
1992/1993	11,6	0,8%	9,2	26%
1993/1994	11,2	-2,6%	9,2	26%
1994/1995	12,6	9,5%	11,7	60,2%
1995/1996	12,5	8,6%	12,6	72,6%
1996/191997	14,4	25,2%	13,6	86,3%
1997/1998	15,4	33,9%	14,8	102,7%
1998/1999	13,9	20,8%	17,9	145,2%
1999/2000	13,0	13%	19,3	164,3%
2000/2001	10,5	-8,6%	16,0	119,1%
2001/2002	11,4	0,8%	18,9	158,9%

**Source:** ALCOPAR, 2019.

The production of alcohol suffered some fluctuations but closed the period with practically the same product as in the beginning, especially in comparison with the sugar production, which had a considerable increase in the period analyzed. Data shown in table 3 refers to the quantity of

sugar and alcohol of Brazilian agro-industries, which decreased by about 22% between 1990/91 and 2001/02:

**Table 3:** Number of sugar and alcohol agro-industries in Brazil

HARVEST	NUMBER OF UNITIES
1990-1991	394
1997-1998	336
2001-2002	306

**Source:** BACCARIN (2005).

The sugarcane complex has been passing through a process of productive concentration and capital centralization that has not been seen in a long time. It tends to reduce production heterogeneity, providing a reduction in the number of units and the increase in the average scale of production.

### **The recent modernization of the sugarcane sector: a new productive and territorial restructuring motivated by the international market**

In the current context, many companies pay attention to new technological strategies as a way to survive in the sector and to gain competitive advantage. The use of advanced industrial technologies and new forms of management highlights the concern in reducing costs and taking advantage of the sugarcane derivatives products.

Concerning the labor market, Guedes, Gallo & Martins (2002) affirm that part of its dynamics is determined by the mechanization of harvest and the intense use of chemicals in production, which affects the number of jobs. For those who were not excluded from the labor market by the automation process, it is required a heavy workload, a high demand for productivity, and gains conditioned to the company's performance.

The choice for producing anhydrous alcohol, hydrated alcohol, and sugar is a decision that is currently taken by the private sector that in general vary according to the relative prices of the products. Although there is an individual limit to this flexibility given the installed production capacity of each producer, it is still another factor in the difficulty and adequacy of supply to demand in a free market environment. The decision on the offer becomes complex as it involves several integrated markets simultaneously.

Some new regions were strongly impacted in their productive activities by the expansion of the sugarcane complex, due to the incorporation of productive innovations. An example is the Northeast region that suffered from the decrease of units, as shown in table 4:

**Table 4:** Sugar and alcohol agro-industrial units in Brazil

Year	Brazil	Center-South	São Paulo	Northeast
1991/1992	-----	269	137	-----
1996/1997	411	281	149	130
1997/1998	340	235	135	105
1998/1999	-----	241	139	-----
1999/ 2000	332	223	136	87
2000/2001	-----	230	127	-----

**Source:** VIAN, (2003).

When analyzing Brazilian harvest data, between 1996/1997 and 1997/1998, there was a significant reduction of 71 production units in South-Center. However, when analyzing Brazil compared to Center-South, the decrease rate was proportional between the 1997/98 to 1999/2000, with one unit more in São Paulo. Although the Northeast productive units have declined from 1997/98 to 1999/2000, they remain proportionally higher than in the other regions.

When considering the specificities of the sugarcane complex in the Northeast, the natural conditions of this region stand out due to the proximity to the European market. Besides, the region benefited from the rise of sugar as the most valuable product in the Brazilian economy, during the 16th century. However, its production has always been based on conservative business logic, with a low orientation to technological progress and no concern with working conditions. Big producers have always prioritized the incorporation of new lands and cheap and abundant workforce, in an extensive production logic that still influences the regional economy.

Carvalho (2002) states there was resistance from business groups who concentrated the production of sugar cane and alcohol, as such they carried out a process of modernization of the sector, through the introduction of new industrial units in Central South states. Even so, most of power plant owners had to reduce the number of units to deal with the process of changes introduced from the 1990s, which was based on market deregulation and modernization of production and commercialization of sugarcane derivatives.

According to the Institute of Agricultural Economics (2019), the main products of Brazilian agribusiness exportation are soy complex (US\$ 38.71 billion), meat (US\$ 13.40 billion),

forest products ( U\$ 12.73 billion), sugar and alcohol complex (U\$ 6.93 billion) and coffee (U\$ 4.35 billion). They represent 81.7% of Brazilian exports<sup>8</sup>.

Brazil stands out for its technology development and capacity of using renewable fuel as an alternative to oil, being on the lead of domestic and foreign markets. The country is the second largest producer and exporter of sugar and sugar cane (FAO, 2019). Data from the Inter-Union Department of Statistics and Socioeconomic Studies - Dieese (2007), for example, demonstrate the direct and indirect activities related to sugar and alcohol sector generates about R\$ 40 billion per year, that represent approximately 2.35 % of national GDP, and generate more than 3.6 million direct and indirect jobs.

With the new industrial units being introduced, the national scenario suffered a set of changes, including the move of Northeast power plants to other regions and the displacement of workers from the Northeast to the Midwest, the interior of São Paulo and to the Western region of Minas Gerais, known as 'Triângulo Mineiro'.

Furthermore, the power plant owners that processed sugarcane into derivatives products, expanded their production within an area of 80 km distant from the industrial power plants, aiming to guarantee the economic viability of production. The contracts established with the sharecroppers - landowners that lease their lands for production - inhibited agricultural production diversification. In this context, a monotonous landscape is created with a single agricultural product, which in this case is the sugar cane, dominating the scenery.

A conflict created by the sugar and alcohol power plants concerned the loss of diversity in agriculture to favour sugarcane extensive production. In parallel, environmental problems emerged due to waste generation, such as vinasse, a compound used in agriculture but that seeps into the soil and groundwater, polluting rivers and their affluents. Also, although harvest burning is prohibited, there are numerous cases of large fires related to sugar cane production.

Sugar-energy activity dynamizes socioeconomy, but because it is a highly concentrated segment that does not create autonomous networks, it also causes social and economic co-dependence. This dynamic of concentration and dependence in sugar-energy agribusiness contributes to incomplete economic development, and to legitimize socio-spatial and environmental contradictions. ARAUJO SOBRINHO and FERREIRA, (2019, p.76).

The aforementioned dynamic is hidden by the myths of progress and economic development, many times associated with the agribusiness logic. However, it can be easily

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<sup>8</sup> <http://www.iaa.agricultura.sp.gov.br/out/index.php> accessed in February, 2020.

unveiled by the spatial forms, the environmental, social, and economic weaknesses and by the inequalities that can be verified in the producing regions.

## **Discussions and Conclusions**

Since the early 1990s, the Brazilian sugarcane agribusiness model has passed through profound changes in its institutional environment. Those changes have impacted competitiveness and the organization of the productive chain, as well as the form of state political articulation.

That model was consolidated as a symbol of productivity, competitiveness modernity, and progress, based on the premise that to increase the demand for ethanol fuel was the solution to develop Brazilian territories. However, the analysis of sugarcane agribusiness demonstrated this productive complex based on the expansion of the capital in the countryside is one of the main causes of tensions and conflicts that transform and reconfigure rural territories.

The agricultural development model implemented since the 1970s with the creation of Proálcool program, focused on modernizing Brazilian fields and increase the levels of productivity, however, it also brought serious social and environmental issues. Among those issues, there was an intensification on the conflicts between agribusiness and family farming for the legitimacy and consolidation of different development models.

On the one hand, agribusiness concentrates on large-scale production for exportation and financialization of the global economy. On the other hand, family farming focuses on different cultivation and production for national food sovereignty, to fix people in the countryside and to reduce inequalities based on inclusive agricultural practices and the valorization of family production. This dichotomy between both models shed light on the role of territory as a crucial element to the configuration of productive relations of power, which are capable of changing public land-use policies, and influencing the rent of land and the living conditions and maintenance of populations in the countryside.

Although this paper has no pretension to present definitive conclusions on the subject, the study highlights there is a need for further research that discusses and describes the complex sugarcane production and also investigates other elements that may have an impact on sugarcane agribusiness on the Brazilian territory.

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