The Decision-Making Processes of the Agents belonging to the Biodiesel Production Chain in Southern Brazil

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Executive Summary:

The aim of this paper is to present and analyze the factors, motivations and criteria considered in the decision-making processes of the actors belonging to the biodiesel production chain in Brazil, and confirm or otherwise, the existence of alignment in the decision-making process.The biodiesel production chain consists of three main agents the farmers, the soybean processing plants and the oil refienery/distributor. For the farmers organzied in cooperatives the central decision is whether to sell oil-bearing crops for the production of biodiesel. In contrast, for the soybean processing plants that convert the crops into vegetable and/or biodiesel, the decision to produce this fuel is based on the wish to expand their market portfolio. Government tax incentives strongly influence both decisions regarding which oil-bearing crop to use and the amount of vegetable oil to be trandsformed into biodiesel. Finally, the oil refinery/distributor is obliged by law to mix the biodiesel with the mineral diesel and percieves this as a liability. The results show the existence of different characteristics linked to the decision-making process and a significant lack of synchronicity in the aims and motivations behind the agents' decisions. This state of decisional misalignment leads to heightened uncertainty regarding the sustainability of the Brazilian biodiesel production program.

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Keywords: Biofuels, Biodiesel, Decision-Making Processes, Productive Chain, Southern Brazil.

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Introduction

It is quite apparent, either from past political-economic crises, such as the oil crisis of the 1970s, or from the current debate within the international community on climate change, that alternatives are needed for the non-renewable energy sources, such as petroleum oil. Accordingly, in recent years there has been an increase in research into the use of biomass for energy purposes, mainly in the production of fuels.

Experiments with alternative fuels are not new. In Brazil, the first alternative fuel production initiatives date from the 1970s, with the Brazilian Ethanol Program (*PROÀLCOOL*), which began to produce ethanol from sugar-cane. More recently, biodiesel has become part of the Brazilian energy matrix with the creation of a regulatory standard contained in Law 11.097/2005, which instituted the *Programa Nacional de Biodiesel* (PNB) (National Biodiesel Program) (Brazil 2005).

The Brazilian biodiesel production program was established in order to create the institutional bases necessary for the organization of the entire productive chain (farmers, cooperatives, unions, research institutions, mills, refineries and distributors). With the PNB, the use of B3 (3% biodiesel per volume of diesel oil) became obligatory in 2008 and this proportion will rise to 5% (B5) as from 2013. This resulted in the need to produce 1.2 billion litres/year of biodiesel in 2008 (ABIOVE, 2005). The launch of the PNB led to the rapid organisation of biodiesel production chains involving different agents within the chain, as schematically shown in Figure 1.

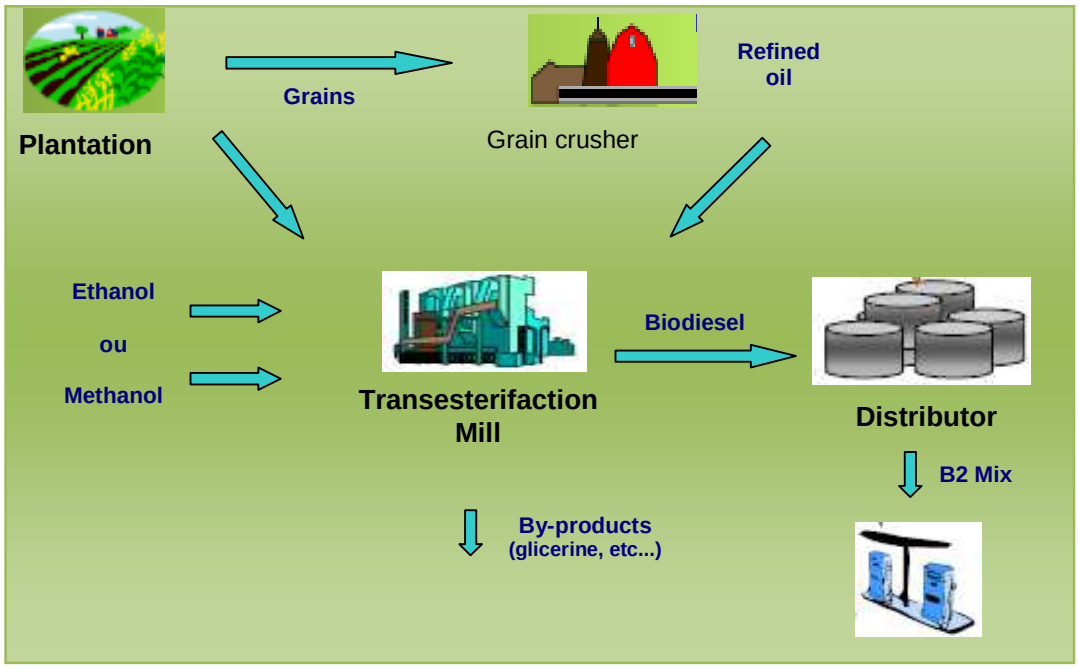

Figure 1: Brazil´s biodiesel productive chain.

Source: MME, 2006.

The introduction of biodiesel into the Brazilian energy matrix increases the alternative uses for the oil-bearing crops. Since the oil-bearing crops now have to take into account a greater number of market alternatives, the decision-making processes of these actors becomes more complex. Regarding this, Christopher (1992) shows that in emerging production chains one of the most common pitfalls in their development results from the decisionary misalignment in the supply chain, which often means that manufacturers do not receive the raw materials they need for their production processes. Therefore, the alignment both in the strategies and in the objectives of the actors and firms participating in the most diverse stages of a production chain are fundamental to its effectiveness.

These factors, together with the multiplicity of aspects encompassing the biodiesel production chain (BPC) in Brazil, require that the study of the decision-making includes the largest possible number of variables, such as: the characteristics of the decider (typology and decision-making experience) and of the decision (types of decision and the level of information), decision-making process, factors and motivations behind the decision, social-economic environment, production structure, location among others.

While taking these characteristics into account, the objective of the present study is to identify, characterize and analyze the factors and motivating influences behind the decision-making process of the actors in the BPC, that is, of the rural producers organized in cooperatives, the processors and refiners that produce the biodiesel and the oil refineries that blend and distribute the fuel.

Methodology

To begin with, in order to elaborate a research instrument (questionnaire) to be applied to the actors in the BPC, an analytical framework was developed to consolidate the following theoretical elements: 1) Simon's Decision-making model (1977); 2) Characteristics of the decision-makers; 3) Decision´s characteristics; 4) Factors and motivations that influence the decision-making process; 5) Aspects linked to the specific nature of production chains based on agricultural commodities and; 6) Transaction Costs Economics.

The construction of the proposed analytical framework was divided into two analytical nucleuses, the first being the analytical level of the factors and motivations linked to the decision-making process. The premises present in these references, to a greater or lesser degree, directly affect the factors and motivations that influence the decision-making process, which may be distinct for each chain´s link, chain´s actors, depending on the individual objective to be achieved.

In the second analytical nucleus, denominated the analytical level of the characteristics linked to the decision-making process, the theoretical elements indicate that it is directly influenced by the previous level. Within this there is the nature of the decision and of the decision-maker, which are subdivided, respectively, into types of decision and level of information, as well as the style and experience of the decision-maker.

The biodiesel production chain in the State of Rio Grande do Sul (RS) was used as a research object due to its level of representativity within the PNB (National Biodiesel Program), as it is the productive base with the greatest participation in terms of sales in the 14 auctions made by the National Agency for Oil, Natural Gas and Biofuels (ANP), with more than 65% of the total biodiesel auctioned (ANP, 2008).

This study deals with the factors and motivations that influence decision-making process among the actors within the Biodiesel Production Chain (BPC), which, as can be seen, consists of three actors that dominate the relations of production, fabrication and distribution of biodiesel

in Brazil, referred to herein as: a) the rural producers of agricultural commodities, in this specific case, the soybean farmers organized within 11 (eleven) cooperatives that have contracts to supply soybean to the processing plants operating in RS; b) the 3 (three) biodiesel production plants operating in the state (RS) and; c) the refinery which blends the biodiesel with mineral diesel oil at a proportion of 2% (B2) and distributes the product.

Regarding the biodiesel production firms, it should be pointed out that in order to present the results they have been classified as Plant 1 (P1), Plant 2 (P2) and Plant 3 (P3), each of which has soybean supply contracts with the farming cooperatives (FCs) loicated in different counties in the state (RS). The structure of the cooperatives-plants supply network is shown below:

- Plant 1 (P1) supply network: Soledade FC (C1), Três de Maio FC (C2), Não Me Toque FC (C3), Espumoso FC (C4) and Água Santa FC (C5);
- Plant 2 (P2) supply network: Tapera FC (C6), Lagoa Vermelha FC (C7), Marau FC (C8), Tapejara FC (C9) and Água Santa FC (C5), the latter cooperative also has a soybean supply contract with Plant P1;
- Plant 3 (P3) supply network: Santo Ângelo FC (C10), Santa Rosa FC (C11), Não Me Toque FC (C3), the latter cooperative also has a supply contract with Plant P1.

The Insertion of Biodiesel in the Brazilian Energy Matrix

The National Biofuel Program in Brazil was established in such a way that it would be possible to follow al the steps necessary for the creation of the organizational bases of the whole production chain. The laws should be designed in order to establish the conditions for the production and the commercialization of biodiesel and attract the most diverse sectors (farmers, cooperatives, unions, research institutions, mills, refineries and distributors) interested in this business. Once the productive base is mobilized and the first investments in biodiesel production plants are made, trade auctions should be held in order to ensure that the mills in operation are able to market their initial production (PRESIDÊNCIA DA REPÚBLICA, 2007).

In line with these objectives, there was successive inclusions and alterations to the laws, until the publication of the Law 11.097 in the *Diário Oficial da União* (Official Federal Government Journal), in which authorization is given for the mandatory introduction of 2% per volume of biodiesel into the diesel oil as from January 2008, 3% in August 2008, and reaching 5% in 2012.

Following the establishment of the regulatory standard, the Ministry of Agriculture (MDA) launched the “Social Fuel Seal”, which is a government mechanism by which the biodiesel production plants acquire a considerable part of their inputs (oilseeds) from properties classified as family farms. With the intention of making the plants aware of the role they have in promoting the social inclusion of the small farmers, the Social Seal is conferred to the plants under different/several conditions. For those plants located in the Brazilian´s North and Northeast regions it is necessary to purchase 50% or more of oil-bearing from this category of farmer; for those plants located in the South and Southeast regions it is necessary to acquire 30% or more from the same category of farmer and; for those plants located in the North and Central-West regions it is necessary to obtain 10% or more of their inputs from such farmers. The seal permits a 15% reduction in the tributes/taxes towards the Programa de Integração Social (Social Integration Program) (PIS) and Contribuição para o Financiamento da Seguridade Social (Contribution towards Social Security Fund) (COFINS), proportional to the cost of acquiring oilseeds from small farms.

Thus, the government promoted the program so as to ensure the necessary supply of biodiesel in 2008. One of the promotion mechanisms used were the biodiesel trade auctions, in

which the plants make bids for the sale of their biodiesel based on a minimum price, with the ANP determining the successful firm. This fact has mobilized the productive base, as there are now 17 plants in operation in Brazil, with another 27 in the process of regularization or construction.

In the State of Rio Grande do Sul (RS) the initiatives to produce biodiesel are already apparent and the established production chain which is subject of the present study will be discussed in more detail in the following section. Figure 2 shows the distribution of these biodiesel production plants in Rio Grande do Sul.

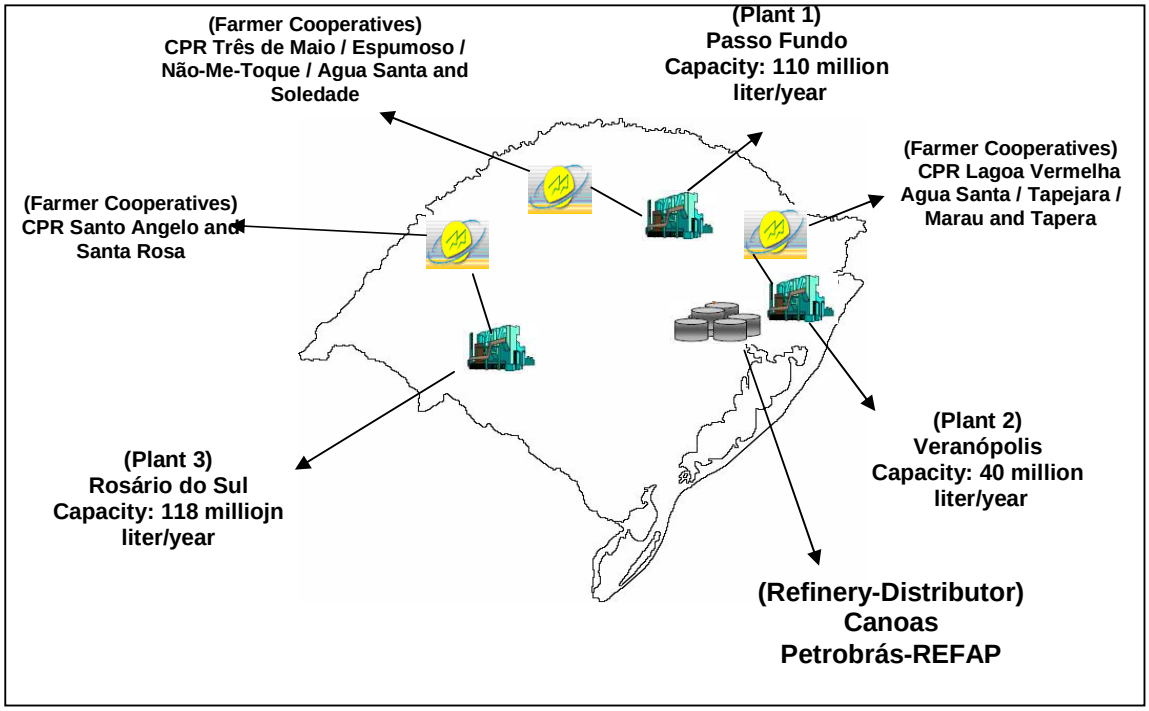

Figure 2: Map of the investments in biodiesel plants in Rio Grande do Sul.

Source: Research data and ANP (2006); MME (2006).

In examining the situation in RS, first it is necessary to look at the actor that exercises the role of governance over the other actors, which is the refinery-distributor based in Canoas/RS. This leadership is based on the fact it is a state monpoply and has been the only refinery and distributor to have acquired biodiesel in the ANP trade auctions. It is the responsibility of the refinery to collect the biofuel from the plants and to transport it to Canoas/RS and mix it with diesel oil at a proportion of 2% per volume of diesel oil.

Further down the line, the Bidiesel Production Chain consists of the plants where the biodiesel is produced, located in the counties of Passo Fundo, Veranópolis and Rosário do Sul, and their suply chains, composed of the farming cooperatives, all of which are situated in the State of Rio Grande do Sul.

The first plant that was visited, here referred to Plant 1, located in Pass Fundo/RS, began operations in June 2007, and has an annual production capacity of 110 million litres of biodiesel. The biodiesel produced in the mill is obtained exclusively from soybean, as this is currently the only oil-bearing seed produced on sufficient scale in RS to meet the demand from the plant. In order to ensure the supply of soybeans for the extraction of the oil, the firm set up a supply chain

by making trade contracts with 05 (five) farming cooperatives (FCs) located in the following counties: a) Soledade CPR (C1), b) Três de Maio CPR (C2), c) Não Me Toque CPR (C3), d) Espumoso CPR (C4) e, e) Água Santa CPR (C5). The amounts of soybean contacted for the year 2007 varied for each cooperative with the delivery of the soybean being the responsibility of the contractee. The deliveries to the plant should take place on a weekly basis at the proportion the total contracted value divided by the stipulated lifetime of the contact in weekly terms. Table 1 shows the contracted volumes and the by Plant 1, Plant 2 and Plant 3.

The biodiesel production mill referred to as Plant 2 is located in the county of Veranópolis/RS, and was completed in March 2007, with a capacity to produce 40 million litres of biodiesel per year. As in Plant 1, the biodiesel produced in Plant 2 is obtained exclusively from soybean, which led to the formation of a supply chain with 5 (five) farming cooperatives located in the following counties: a) Tapera CPR (C6), b) Lagoa Vermelha CPR(C7), c) Marau CPR (C8), d) Tapejara CPR (C9) and; e) Água Santa CPR(C5). The volumes contracted for the year 2007 vary for each cooperative, though in this case the cost of delivering the soybean to the plant in Passo Fundo/RS is the responsibility of the contractor. The volumes of soybean contracted by Plant 2 for the year 2007 can be seen in Table 1.

Lastly, there is the mill referred to as Plant 3, located in the county of Rosario/RS, which entered in operation in September 2007. In terms of volume produced, the firm is leader of the Brazilian biodiesel market, with a participation in the ANP trade auctions corresponding to 56% of the total put out to bid by Petrobras in Brazil. As in Plant 1 and 2, the biodiesel produced at the frim is obtained exclusively from soybeans, for which purchase contracts were made with 3 (three) farming cooperatives (CPR), located in the following counties: a) Santo Ângelo CPR (C10), Santa Rosa CPR (C11) and Não Me Toque CPR (C3). The volumes of soybean contracted for the year 2007, as well as the remaining data relative to these contracts can be seen in Table 1.

Table 1: Demand, volume / contracted values and freight costs of the soybean supply contracts between the cooperatives and the plants in the biodiesel production chain in RS.

Plants	Cooperatives	Demand for soybean from the plant in 2007 (ton)*	Volume of soybean contracted by the plant (ton./year)**	% under total demand	Contracted value (R$/60kg sack.)	Freight cost
P1	C1	304.220	60.000	19.72	Market price at delivery + R$1.00/60 kg. sack for the freight	CIF
	C2		21.900	7.20		
	C3		32.500	10.68		
	C4		55.000	18.07		
	C5		6.000	1.97		
		Total	**175.400**	**57.64**		
P2	C5	86.920	4.000	4.60	32,00	FOB
	C6		15.000	17.26	30,00	
	C7		20.000	23.01	30,00	
	C8		20.000	22.24	30,50	
	C9		25.000	28.76	30,00	
		Total	**118.000**	**95.87**		
P3	C3	695.360	50.000	7.20	Market price at delivery	FOB
	C10		60.000	8.63		
	C11		30.000	4.31		
		Total	**140.000**	**20.14**		

Source: Elaborated by the authors based on the interviews carried out.

The Decision-Making Process of the Agents in the Biodiesel Production Chain

Applying the correlation tests to the sample of farm cooperative managers brought to light elements of varying degrees of relevance for their decisions regarding the sale of soybean to

the biodiesel production plants. Among those elements that most contribute towards explaining the decision of the cooperatives to participate in the biodiesel productio chain (BPC) is, initially, their incomplete decision-making process, which does not include the Simon´s intelligence and conception phases.

The elements contained in these phases, which are the view of the market environment, information gathering and processing, and the formulation and analysis of an action plan based on these variables, and which are not seen, constitute a relevant factor in explaining the decision of the cooperatives to offer a large part of their soybean crop for the production of biodiesel. Following this, there is the correlation at the low-level decision-making process of the information used by the cooperative managers. Hence, it can be understood that the incompleteness of the process derives from the small amount of information used in their decision-making process, which is also related to the lack of management experience of the interviewed decision makers. All these factors together also contribute towards the establishment of soybean supply contracts with the plants that are unfavourable in relation to the other alternatives existing in the market, since the prices received are identical to those that could be obtained from other marketing channels, though with less profit, as, generally, the cooperatives are responsible for freight costs.

Lastly, there is the correlation between the institutional motivation, derived from the "subsidies" that the managers claimed to have the right to trade soybean for the purposes of biodiesel production, with their decision to join the BPC. In summary, the explanation for the nature of the nature of decision-making process of the cooperatives' managers lies in these elements, which can be seen to be both fragmented by the issue of the view of benefits that are not conceded to them, and mis-aligned with the decisions of the other actors in the production chain.

Next, the correlation tests were carried out on the sample of biodiesel production plant managers, from which it was also possible to identify elements relevant for the decision to produce biodiesel. Among those that most contribute towards explaining the decision of the plants to join the BCP is, initially, their complete decision-making process. As the managers followed all the elements contained in these phases, which are the observation of the market environment, the gathering and processing of information, the formulation and analysis of the action plan, execution of the action plan, review and feedback during the process, among others, constitutes a relevant factor for the explanation of the decision of the plants to direct their productive capacity towards biodiesel production. It was identified that there is the correlation, both at the decision-making process level and for the decision itself, of the quality and the amount of the information used by the plant managers. This fact results in the completeness of the process, since a great deal of information is used in its conception, which also correlates, though to a lesser degree, with the management experience of the interviewed decision makers. Furthermore, these factors also contribute towards the establishment of soybean supply contracts with the cooperatives, which derives from the view of the managers regarding the need for regularity of the supply of the inputs necessary for maintaining productivity at economically efficient levels.

All the above elements are strongly correlated with the factors and motivations, which are economic and information-based, that guide the plants to direct their resources towards biodiesel production. The insertion in the BPC is due to the higher profitability obtainable in relation to the alternatives in the marketof vegetal oils. Especially when using soybean oil to produce biodiesel, which uses the same production facilities and logistics. This fact derives from both market aspects, such as the tax exemptions and benefits originating from the trade auctions, as well as the characteristics of the decision-makers, who seek to base their decisions on the greatest possible amount of information.

Briefly, the decision-making process of the biodiesel production plant managers can be seen to be both guided by the view that activity represents one more option within their portfolio of businesses (market view) and the benefits from the tax exemption. This approach is mis-aligned with the decisions of the other actors in the production chain, among which are the cooperative managers, who are mentioned in this section.

Finally, the correlation tests were used to analyse the answers given by the manager of the refinery-distributor, which showed that, among the elements that most contribute towards explaining the decision of the firm to join the BPC is, initially, its complete decision-making process. As the manager followed all the elements contained in these phases, from the business environment, the regular gathering and processing of information, the analysis and formulation of action plans, as well as the review and feedback in the process, he acts in order to orientate part of its industrial capacity with the purpose of adding biodiesel to diesel oil.

Once again, for this link there is the correlation, both at the decision-making process level and for the decision itself, of the quality and the amount of the information used by the interviewee. This fact results from a complete decision-making process, which is due to the accentuated use of information in its conception phase, which also correlates, though to a lesser degree, with the degree of management experience of the interviewed decision maker.

In turn, all these mentioned variables are strongly correlated with the factors and motivations, which are institutional and informational, that guided the decision of the refinery-distributor (REFAP-Petrobras) to mix the biodiesel with diesel oil. The participation of the firm in the BPC is due, according to the interviewee, to the obligation on the part of the refineries-distributors, as from 2008, to mix/blend 2% of biodiesel per volume with diesel oil, an activity which is not advantageous for the firm.

According to information collected in the research, the biodiesel production is economically unfeasible, both from the point of view of the plant that produces biodiesel and for the refinery-distributor tha mix it with diesel oil and distributes to consumers. Moreover, the refinery-distributor has a similar product in its portfolio, H-Bio, which provides higher profits when compared with biodiesel. These findings derive from the search by the manager for constantly updated market information, an aspect that is also shown to be significant for the explaining of his decision-making process.

Therefore, put briefly, it can be said that the decision-making process of the refinery-distributor's manager is guided both by the view that biodiesel consists in an economically unfeasible option within its business portfolio, and mis-alaigned with the decisions of the other actors in the production chain, among which are those of the managers of the cooperatives and the biodiesel production plants, so that it appears that the refinery-distributor, as an state monoploly, exercises the governance of the chain only because of the law demands.

Final Remarks

Following an international tendency towards increasing the share of renewable fuels in national energy matrizes, the Brazilian Federal Government has promoted the development of the biodiesel production chain in Brazil, which is reflected in the introduction of the Brazilian Prodiesel Program (PRODIESEL). In order to reduce uncertainty and risk of making investments in the sector, either public or private, the government established the regulatory reference and has been carrying out biodiesel trade auctions, so mobilizing the productive base to designate its resources for these purposes.

The guarantee of a return on the investments made, and therefore the success of these enterprises, requires the effectiveness of the production chain, for which the strategies, objectives and managerial practices of the different agents participating in the different stages of the chain

need to be aligned. However, it is quite possible that the decisions, and moreover, the motivations of each of actor or firm belonging to the production chain may be distinct, which generates asymmetry, opportunism and risk, which, in turn, may lead to bottlenecks that tend to jeopordize the performance of the sytem.

Analysis of the data showed that this situation has occurred in the biodiesel production chain. With regard the role of the cooperatives in supplying the oil-bearing seeds for the production of biodiesel, it can be seen that this decision is based on little information and a short-term view, as well as factors that derive from the very characteristics of the managers, such as their low level of schooling and lack of experience in decision-making. Together these factors contributed to an incomplete decision-making process, which results in a motivational factor for the insertion in the chain that in practice does not exist, which is the opportunity to obtain tax exemptions/benefits to which they have no right.

In the biodiesel production plants, their decision to produce the fuel is motivated by the opportunity to have another product in their market portfolios. This is based on a long-term view and a high level of information, factors that result from the style and decision-making experience of the managers, which together give rise to a complete decision-making process. Of particular note in these companies is the search for economic efficiency, and the benefits of the tax incentives offered by the public policies also play an important role in the choice of the oil-bearing seeds used to prodcue the biodiesel.

Lastly, in the refinery-distributor of the diesel/biodiesel (B2), the decision-making process can be seen to be guided by strategic decisions, a long-term view and a high level of information, while the decision to mix the biodiesel with the diesel oil is related to the institutional aspect, that is, the legal obligation to mix the fuels, once it is a state monopoly.

The results of the present research show the need for a review of the objectives and design of the National Biodiesel Program (PRODIESEL), given that different characteristics linked to the decision-making processes of the actors revealed significant dissynchronisity among their objectives and motivations. This state of decisional mis-alignment, associated with the dichotomy of the public policy, which can be seen in the tax incentive given to only one of the sectors in the production chain, leads to the accentuation of the uncertainty regarding the sustainability of the Brazilian biodiesel production program.

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