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Review

Biodiesel in Brazil: History and relevant policies

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This study presents a brief review of financial support programs launched by the Brazilian government aimed at substituting the petroleum diesel for fuels from vegetable oils. Although the first attempts were made during the 1970's, it was only in the last five years that the biodiesel industry has presented a significant growth. The National Program for the Production and Use of Biodiesel (PNPB), together with its pertinent legislation has created a considerable national demand for the biodiesel. One of the objectives of this program is to stimulate the production of oleaginous plants (oil plants) by small farmers facilitating their social and economical insertion into the market. This article presents a chronological evolution of these regulatory mechanisms and the potential changes they can cause in this productive chain. This study also focuses on the recent alterations in the requirements of the "social fuel seal".

Key words: Biodiesel, Brazil, policies.

INTRODUCTION

According to Wörgetter et al. (2006), the European countries' domestic production of biofuels will not be enough to meet its demand. Importing biodiesel and biomass will certainly be inevitable for European countries. Therefore, these authors state that it is crucial to identify economic and environmental viable solutions to this issue. Brazil has distinct and unquestionable advantages regarding biodiesel production. One of the main advantages is related to the availability of areas that can be destined to agro-energy activities, which is not common in most producer countries, especially in European countries (Frondel and Peters, 2007). Hass and Foglia (2006) and Wassell Jr and Dittmer (2005) argue that the current costs of biofuel production are not very competitive compared to mineral energy. There are few exceptions such as the case of sugarcane alcohol in Brazil and the biodiesel obtained from residual oils (Peters and Thielmann, 2008). The cost of biodiesel production is the major obstacle to its commercialization (Demirbas, 2007). According to Lensink and Londo (2009), cost reduction depends on emerging technologies to overcome the initial barriers of this productive chain. It is expected that the lack of competitiveness in costs can be compensated by the reduction of greenhouse gas emission (Duer and Christensen, 2009). This could explain why it has been produced under the protection of legislations and specific regulations or subsidies in the form of fiscal tax waiver (Knothe, 2006a, Knothe, 2006b; Peters and Thielmann, 2008; Charles et al., 2007).

In Brazil, The National Program for Production and Use of Biodiesel (PNPB) has created a demand for biodiesel and it has been stimulating the Brazilian production from several different oleaginous plants (oil plants). Besides the primary objective of boosting the biodiesel production in Brazil, the PNPB aims at fostering social inclusion through the generation of income for small producers (Brazil, 2005a; Garcez and Viana, 2009). Therefore, the government program has established incentive policies aiming at promoting the inclusion of family farming in this productive process. This article presents a brief account of the evolution of the biodiesel production in the country, as well as an analysis of the impacts of recent public

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policies in the sector.

A BRIEF HISTORY OF THE BIODIESEL SEGMENT AND THE MAIN POLICIES IN BRAZIL

The first references to the use of vegetable oils as fuels in Brazil date from 1920. Since then, some studies were carried out in universities and research institutes nationwide using vegetable oils *in natura* (pure or mixed with petroleum diesel) and vegetable-derived oil products. Among the centers where the studies were conducted, are the National Institute of Technology, the Agriculture Ministry's Institute for Oil Research, and the Minas Gerais' Institute of Industrial Technology. In the latter, there are records of studies conducted in 1950 on the use of ouricuri oil (*Syagrus coronata*), castor oil (*Ricinus communis*), and cottonseed oil (*Gossypium* spp) (IICA, 2007). There are only a few studies reported in the worldwide literature on the use of vegetable oils in diesel cycle engines in the period between 1940 and 1970 (Knothe, 2001). According to the following studies (Plá, 2003; Souza, 2004; Viscardi, 20005; IICA, 2007), the investigation of alternative sources of energy was only intensified from the 1970's. This was one of the consequences of the likeability of the depletion of fossil energy and the petroleum price instability during the energy crises of 1973 and 1979, which had a serious impact upon the world economy and, consequently, upon the Brazilian economy. At that time, Brazil imported around 80% of the petroleum used in the country.

In the 1970's, Brazil launched the Proalcohol and Prodiesel Programs to overcome these crisis periods. In 1980, the Pro-oil program, Plan on the Production of Vegetable Oils for Energetic Use, was created by the National Council of Energy (CNE). The primary objective of this study was to substitute partially the petroleum diesel for vegetable oils in mixtures up to 30% by volume. Thus, the government fostered technological research that could make production feasible in several regions of the country. The primary studies focused on soybean (*Glycine max*), beginning in 1981, followed by colza (*Brassica spp*), sunflower (*Helianthus spp*) (1982), and *dendê* (*Elais oleifera*) (1986) (IICA, 2007). The National Program for Alternative Renewable Energy of Vegetable Origin, created in the 1980's by the Industrial Technology Secretary of the Ministry of Commerce and Industry (STI/MIC), dealt with the Vegetable Oil Program (OVEG), which in turn focused on proving the viability of using vegetable oils in natura in diesel cycle engines (IICA, 2007). Due to the fact that the vegetable oils do not impose great demand on engines and produce high energy yield, it was proved in 1985 that technically they were adequate substitutes for diesel oil (IICA, 2007). It was during that initial stage of the biodiesel production that the Proerg, Energetic Systems Producer, a Ceará state private company, obtained the first Brazilian patent on biodiesel (Parente, 2003). Nevertheless, this substitution was considered economically viable due to the production and transformation costs that are calculated based on the culture of the traditional annually cycled oleaginous plants (oil plants), which at that time were reasonably priced in the internal and external markets. According to IICA (2007), the international prices of vegetable oil/petroleum per barrel in 1980 were 3.30 for *dendê,* 3.54 for sunflower; 3.85 for soybean, and 4.54 for peanut, respectively.

The reduction of the petroleum barrel prices that started in 1986 made these studies less important and the Pro-oil program was abandoned (Pousa et al., 2007). However, the climate changes in the last years due to the global warming and petroleum barrel prices soar, which resulted from politics at a standstill, wars, and speculations have aroused the interest in using biodiesel as a fuel both in Brazil and worldwide (Viscardi, 2005; Knothe, 2006b; Pousa et al., 2007). Therefore, the government restarted investigating the use of biodiesel. Such interest has fostered several studies involving intra-ministry commissions, universities, and research centers (Pousa et al., 2007). Although not only applied for the biodiesel, the law n° 9.991/2000 can be seen as a stimulus for the development of this chain. According to this law, 1% of the net operating revenue of the operating companies, 2% of the transmission companies, and 0.75% of the energy distribution companies in the country have to be invested in research and development of the national electricity sector. Similarly, the Program for Incentive of Alternative Electric Energy Sources (PROINFA), established by the law n° 10.438/2002 (and reviewed by the law nº10.762/2003), aims at finding feasible regional solutions to the use of renewable sources of energy. In 2002, with the directive n° 702, the Ministry of Science and Technology (MCT), instituted the Research and Technological Development Network (Probiodiesel). This network program is aimed at promoting the scientific and technological development of this biofuel originated from ethyl esters from pure and/or residual vegetable oils (Brazil, 2002). In 2003, through the decree n°02/07/2003, a ministerial commission coordinated by the Civil House was created to define the basis for the National Program for the Production and Use of Biodiesel (PNPB). This commission compiled a report that was submitted in December 2003 in order to prepare for the program that would be based on three pillars of sustainability: social, economic, and environmental. The report considered that the biodiesel should be introduced immediately into the Brazilian energy matrix although its use should not be mandatory. Moreover, The PNPB program should not establish routes or raw materials for the biodiesel production. The commission also considered that the biodiesel production should be used as a tool to provide social inclusion promoting social and economic development in the less developed regions in the country.

In the same year, the government created the Brazilian

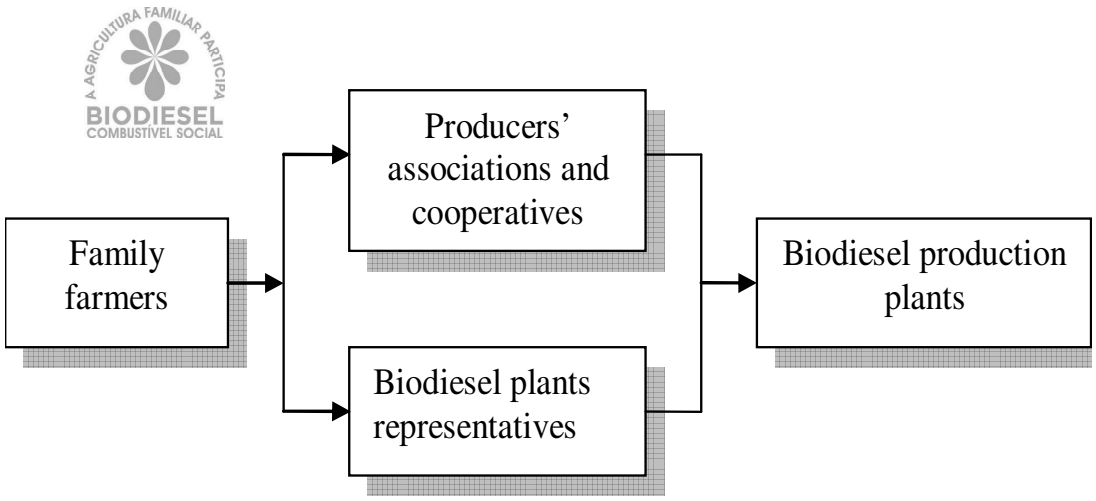

Figure 1. Productive arrangements (commercialization) with family farmers and biodiesel plants through the social fuel seal. Source*:* Elaborated by the Authors

Biodiesel Technology Network (RBTB) comprising research institutions from 23 states in order to concentrate efforts including the several actors involved in research, development, and production of biodiesel. This network sought results that could meet the demands of the sector in order to increase productivity and competetiveness guaranteeing quality and appropriate technology routes and also to generate jobs and regional development (Biodiesel, 2008). The PNPB program was launched by the Ministry of Science and Technology in 2004. The program, which involved 14 ministries, was designed to stimulate a sustainable biodiesel production from several different oleaginous plants (oil plants). Therefore, it focused on guaranteeing competitive prices, quality, and supply (IBICT, 2007).

National program for the production and use of biodiesel (PNPB)

The PNPB program has been focusing on organizing the biodiesel productive chain by defining financial aids, structuring the technological basis, and establishing specific regulations on the new fuel. The operation of this chain has been performed by sectorial policies that have determined the development of this productive chain (Biodiesel, 2008). The most important action taken by the PNPB program was approving the law n°11.097/2005, which established an addition of 2% in the diesel oil produced in Brazil since 2008 (Brazil, 2005a). Since then, the production of biodiesel has met such demand and the sector has been developing rapidly (Figure 1). Nowadays, the mandatory addition content of biodiesel into diesel oil in Brazil is 4%.

In Brazil in the year of 2006, the biodiesel was produced in small scale and with extremely high-costs. This was due to the use of extractive techniques of raw materials and the lack of adequate technologies, which most of the times were being tested (Mello, 2007; Paulillo et al., 2007). In the year of 2007, the production surpassed 400,000 m^3 and in 2008 it reached 1161,202 m^3. The Brazilian production of biodiesel has been increasing and becoming more important rapidly. The law n°11.097/2005 which established a mandatory addition of 2% of biodiesel in the mineral diesel (B2) commercialized nationwide was a major factor to promote such growth. B2 has generated a demand estimated in 800 million liters of biodiesel per year. The resolution n° 2 of the National Council of Energetic Policy (CNPE), published in March 2008, established the mandatory addition of 3% of biodiesel in the diesel oil (B3) beginning in July 2008 consolidating the biodiesel demand (ANP, 2009), and the resolution n°2 of the CNPE from May 2009 established the mandatory addition of B4 beginning in July 2009 (DCR, 2009). The first mandatory increment of 1% in the mixture, B3, represented an increase of around 200 million liters in the year of 2008 surpassing 1 billion liters, which promoted a faster development of the segment raising the productive sectors' expectations. It is likely that the goal of adding 5% (B5) biodiesel to common diesel established for 2013 is anticipated for 2010, which would generate a demand of around 2 billion liters of biodiesel per year. The auctions under the ANP (National Petroleum Agency) responsibility were created to stimulate the biodiesel market before the mandatory B2 (Pousa et al., 2007). Another public purchases' priority through auctions is to forest the integration between the biodiesel producer and family farmers since the access to most auctions is granted only to the companies that have the "social fuel seal". Nonetheless, the objective is to ensure the purchase of the necessary biodiesel to meet the PNPB program goals. Table 1 gives the details of the

Table 1. Results of biodiesel auctions.

Auction date		Number of offered unities/ classified unities	Volume of biodiesel offered/sold by auction (m3)	Average price (R$/ m3)	Exchange rates American dollar (US$)/Brazilian real (R$)[a]	Date of Delivery
1st auction: 11/23/05		4	70.000	1.890,04	1/2.238	Jan - Dec/06
2 nd auction: 03/30/06		8	170.000	1.859,65	1/2.195	Jul/06-Jun/07
3 rd auction: 07/11/06		4	50.000	1753,79	1/2.185	Jan – Dec/07
4th auction: 11/11 and 11/12/06		12	550.000	1.746,66	1/2.191	Jan - Dec/07
5th auction: 02/14 and 02/15/07		4	45.000	1.862,14	1/2.1000	Dec/07
6th auction: 11/13/07		11	304.000	1.867,00	1/1.768	Jan - Jun/08
7th auction: 11/14/07		10	76.000	1.863,00	1/1.738	Dec/08
8th auction 04/10/08	1st Round	24 – 22	473.140/ 343.900	2.722,13		
	2 nd Round	22 – 19	343.900/ 264.000	2.691,70	1/1.682	Jul - Sept/08
9th auction 11/04/08	1st Round	20 – 15	181.810/ 86.350	2.743,75		
	2 nd Round	15 – 13	86.350/ 66.000	2.685,23	1/1.688	Jul - Sept/08
10th auction: 08/04/08		21– 20	347.060/ 264.000	2.604,64	1/1.566	Oct - Dec/08
11th auction: 08/15/08		20 – 18	94.760/ 60.000	2.609,70	1/1.573	Oct - Dez/08
12th auction: 11/24/08		31	449.890/ 330.000	2.387,76	1/2.350	Jan - Mar/09
13th auction: 02/27/09		36 – 25	578.152/ 315.000	2.155,22	1/2.378	Aprl - Jun/09
14th auction: 05/26/09		39 – 38	645.624/ 460.000	2.308,97	1/2.026	Jul – Sept/ 09
15th auction: 08/27/09		38 - 36	684.931/460.000	2.265,98	1/1,867	Out-Dec/09

Source: Elaborated based on data from ANP (2009)
[a] Based on BC (2009)

auctions organized by the ANP for the purchase of biodiesel.

Social fuel seal and new policies for the next years

In addition to the mandatory addition of biodiesel in the petroleum diesel, the law n°11.097/2005 has also proposed incentive mechanisms to foster the inclusion of family farmers of the National Program for the Improvement of Family Agriculture (PRONAF**)** who produced biodiesel in the less developed regions in the country. The "social fuel seal" was created to concentrate efforts aiming at the development of these regions (Garcez and Vianna, 2009). The commercial relationships between the companies and family farmers are shown in Figure 2. In order to obtain the "social fuel seal" the companies have to reach technical cooperation agreements with small producers' cooperatives or directly with family farmers. The "social fuel seal" brings tributary advantages, allows the companies to participate in ANP auctions, helps them qualify for public bank loans, and can be a positive marketing tool for companies. It is worth mentioning that the law 11.097 (Brazil, 2005a) establishes that the biodiesel should be processed preferably from raw materials produced by family farmers including those resulting from extractive activities. After having gotten the "social fuel seal", which expires within five years beginning on January 1st in the following year, the company must get a minimum raw material percentage from family farmers. This amount is established by the Ministry of Agrarian Development (MDA) and can be differentiated according to the region in which the company is. At first, those values were defined by the normative nº 01/2005 of the Ministry of Agrarian Development as follows: 50% for the northeast and semi-arid regions, 30% for the southeast regions, and 10% for the north and center-west regions (Brazil, 2005b). The regions that demand acquiring smaller percentage of raw materials acquisition from family farmers and the regions where these arrangements are better established become more commercially attractive than those whose biodiesel professionals have to struggle to attract more biodiesel producers. Thus, it is noticeable the entrepreneurship migration from regions with weaker production structure (northeast and semi-arid for example) to more appealing regions where the mandatory shares to be acquired from family farmers are smaller, especially the south, southeast, and center-west regions (César, 2009).

Paradoxically, the initial mandatory raw material purchase quote of 50% from the family farmers by the plants to obtain the "social fuel seal" prevented the success of the projects in the northeast, especially in the semi-arid regions of Brazil. In most cases the fiscal incentives associated to the social fuel seal were not worth the efforts of the biodiesel producer companies at working

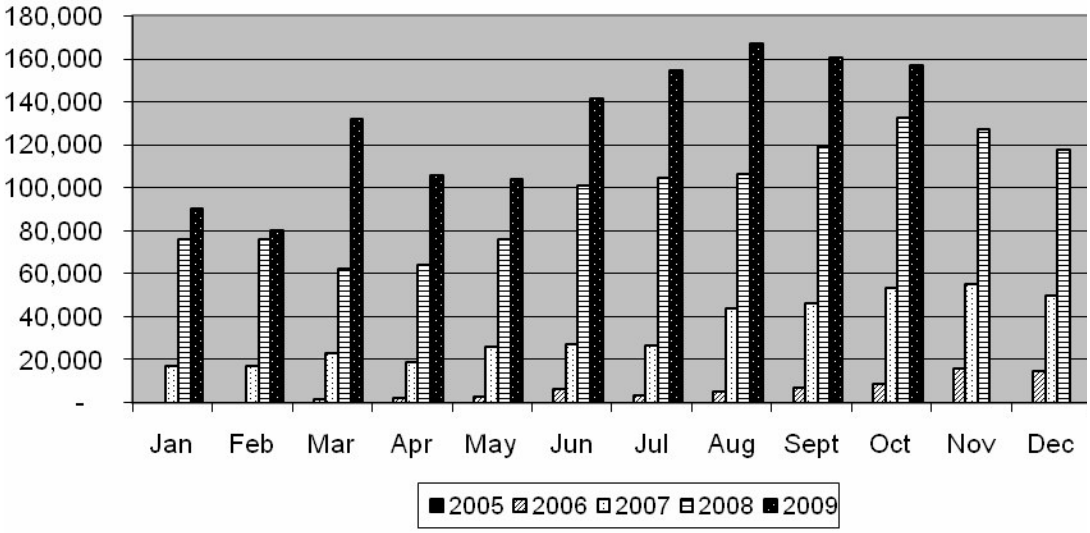

Figure 2. National Production of biodiesel in m^3 in the period between January 2005 and October 2009. Source: Elaborated based on data from the National Agency for Oil and Biofuels (ANP) (2009).

with the precarious productive structure available for this oil plant. Hence, the private investments in production, organization, and management were not enough to guarantee the adequate functioning of these productive arrangements. This is the case of the castor oil plant, as shown by César (2009). According to this author, some companies simply abandoned the projects with castor oil, and others transferred their projects to other regions in the country (sometimes to work with different raw materials), where the risks and the raw material quote originated from the family agriculture was smaller (César, 2009).

According to Abreu et al. (2009), due to the precarious production conditions where these projects are developed, it would be necessary not only to provide technical assistance, but also to provide a minimum training to the community of producers – such as little instruction and hygiene notions - which would enable them to gain perspective of a better life. According to these authors, those families are generally marginalized, and thus developing an inclusion program would require a great effort in order to promote cultural changes in their communities. The authors argue that this is due to their small social capital. In addition, the notions about cooperativism that predominate in the northeast region - region with the highest concentration of family farmers in the country - are fairly negative. The family farmers cannot rely on these organizations due to politics related to the operation of the cooperatives and frequent corruption cases. Such scenario compromises those families' efforts to efficiently develop the projects supported by the PNPB program and represents greater challenges. According to César (2009), the biodiesel currently produced in the northeast region from family farmers' raw material is not as competitive as that produced in other regions of the country, especially the south and center-west regions. These regions have longer traditions of cultivating soybean, cooperativism, and professional family farming.

This scenario can change due to the new regulations to obtain the "social fuel seal". According to the normative nº01/2009 (Brazil, 2009), the minimal value for the acquisition of raw material from family producers of biodiesel who want to obtain the stamp has changed to 10% up to the 2009/2010 harvest, 15% beginning in 2010/2011 harvest for the acquisitions from the north and center-west regions, and 30% for the acquisitions from the south, southeast, northeast, and semi-arid regions. According to this new law, these percentage values do not depend on the location of the biodiesel plant. Still according to this normative, the value for the acquisition of raw material is multiplied by 1.5 for the alternative raw materials for soybean in order to encourage diversifying this supply chain. It is worth mentioning that raw materials are defined as those that fulfill at least one of the following requirements: are present in the agriculture mapping, are technically recommended by a competent public organ, or are of extractive origin. According to the law nº 11.116/2005, regulated by the decree nº 5.297/2004, the minimum percentage value is calculated based on the cost of raw material acquisition from family farmers or from their cooperatives in relation to the total costs of raw materials acquisition for the biodiesel production. The difference between this new regulation and old policies is that this cost now includes expenses for soil analysis and expenses with the supply of production inputs that do not originate from public resources (there are limitations for seeds and/or seedlings, fertilizers, soil correctives, and machine operation hours and/or fuel). It also includes some expenses with family farmers' assistance and technical capacitating. The normative n°

01/2009 (Brazil, 2009) establishes that the sum of those costs can not surpass 50% for the center-south region, and it is limited to 100% for the northeast, north, and semi-arid regions.

Conclusion

The National Program for the Production and Use of Biodiesel (PNPB) has created a great demand for biodiesel which besides stimulating the Brazilian production from several different oleaginous plants (oil plants) seeks to promote the social inclusion of small farmers. In order to meet the demands of this program, the government has created a set of incentive policies to foster the inclusion of family farmers in the biodiesel production process. The mandatory quotes of biodiesel addition have been adjusted to the sector growth, and currently the biodiesel plants have already reached the capacity to meet the B5 production, which can be anticipated to the next year (2010).

The Brazilian sectorial policies, as well as in other countries, have supported this segment and have stimulated the biodiesel productive chain with the goal of diversifying the national energy matrix and fostering the social inclusion of family farmers in this supply chain. With regard to social development, the mechanisms provided by the government have proved insufficient to promote the effective participation of family farmers in this segment. This situation conflicts with the PNPB program goals, which are strongly based on the social development of family farmers. Nonetheless, the effects of the normative nº 01/2009 should be shown within the next months and years. Such situation can change due to the efforts that have been put in order to make the agreements between biodiesel plants and family producers efficient.

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