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Biodiesel and the "Social Fuel Seal" in Brazil: Fuel of Social Inclusion?

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Abstract

In 2005, the Brazilian government started the commercial production of biodiesel through the implementation of the National Program for Production and Use of Biodiesel (PNPB). From that year until 2012, the country became one of the largest biodiesel producers in terms of volume. The present study aims to critically analyze the Social Fuel Seal (SCS) established in PNPB as well as lifting the scenario on the effective participation of family farming in the program. This work is characterized as qualitative and exploratory, whose technical procedures were adapted to the literature search and data collection in government agencies involved with the program. The survey showed the following results: i) the modification of the law of SCS to promote the production of biodiesel has not provided positive results for the North and Northeast; ii) the acquisitions of family farming performed by biodiesel plants SCS presented a rather uneven performance among Brazilian regions; iii) the gross income per family in the Northeast during the study periods were low; iv) there are discrepancies in the figures one of the accredited program between regions cooperatives. In summary, despite the advancement of inclusion of biodiesel in Brazil's energy matrix, this work shows that the SCS presented a scenario contrary to what was planned by the government, ie, the more developed regions have benefited most.

Keywords: biodiesel, Social Fuel Seal, social inclusion, regional development, PNPB, Brazil

1. Introduction

Initially, we observe that the relationship between economic and social development with the energy matrix are extremely complex and poorly understood. In the twentieth century, fossil energy, especially oil, has formed the main pillar of the global primary energy supply, because they are abundant and capable of various applications. Points guided to global warming and global unrest around the environmental issue put the energy debate in the global political agenda and represent hopeful opportunities for diversification of energy sources and new markets (Marchetti, 2012).

Renewable energy is increasingly gaining importance in the global energy scene causing governments, businesses and civil society to discuss the insertion and/or increase of their participation in their energy mix (Timilsina et al., 2013).

The World Energy Outlook 2013 published by the International Energy Agency (IEA), is quite emphatic in assuring that the increase in energy demand exceptionally held by developing countries where population growth shows strong acceleration and the consumption of energy per capita, is well below the developed countries. Therefore, much attention is being focused on the development of public policies of the so-called BRICs (Brazil, Russia, India and China) with respect to the energy issue, as regards the management of energy resources and emissions of greenhouse gases (GHG) (IEA, 2013).

In Brazil, a country famously known on the international scene by having a diversified energy matrix, the use of renewable energy sources accounted for 42.4% of its domestic energy supply in 2013, thanks to the use of sugarcane biomass with 15.4%; hydraulics and electricity with 13.8%; firewood and charcoal with 9.1%; and other renewable with 4.1% (EPE, 2013).

In this scenario, we highlight the National Program for Production and Use of Biodiesel (PNPB) created in 2005 to enter and control the market of biofuel, as well as establishing a trajectory of reserve increases for its commercial use in the country, according to Law No. 11.097/05, known as the "Law of Biodiesel" (Brasil, 2005a).

The National Energy Policy Council (CNPE) anticipated in three years the goal of adding 5% biodiesel in diesel in 2010, where this mixture, called B5, was required by law for 2013. Anticipation is the great advancement and success of PNPB. In 2013, there were 2.9 billion liters of biodiesel consumed to a mixture of 5 % (Note 1) considered one of the largest producers in the world (ANP, 2014).

The implementation of PNPB was based on economic arguments, with fluctuations in oil prices and the need to reduce dependence on petroleum diesel; environmental, to assist in reducing emissions of gases causing the greenhouse effect and social, for the opportunity to reduce regional inequalities (Torres el al., 2006; Quintella et al., 2009; Arent et al., 2011; Rathmann & Schaeffer, 2012; Souza & Seabra, 2013).

Of the three aspects mentioned, PNPB emphasizes is the social question or the inclusion of family farmers in their supply chain. In this context, social inclusion was highly emphasized because it was expected that the PNPB should stimulate marginal and poor agricultural production and development areas in the country, as is the case in the North and Northeast (FGV, 2010; MDA, 2011a).

Therein, the Brazilian government created an entire institutional structure for management and a set of actions for social advancement program to create and grant a Social Fuel Seal (SCS) to the biodiesel producer who enters the family farmer in production chain (Vaccaro et al., 2010; Watanabe et al., 2012; Bergmann et al., 2013; Nogueira & Capaz, 2013).

Several studies on biodiesel market in Brazil are encouraging (César & Batalha, 2013; Alonso-Pippo et al., 2013), however, uncertainty exists as to the economic and social viability of the program to the extent that the studies indicated that production costs biodiesel is higher than the petroleum oil. It should be emphasized that the learning curve also presents some obstacles. Among these obstacles (Távora, 2012) comments:

Currently, the production of biodiesel is a cloudy scenario: more than half of the production capacity is idle; the country hardly exports anything biodiesel; and existing production is highly concentrated in soy ingredient. The social criterion is still staggering because there is a need to consolidate the participation of family farmers, especially with the use of a wider range of raw materials. Technological costs are still high because the price of biodiesel is higher than diesel and there are no binding targets for the use of biodiesel, which generates costs for society. There are tax incentives for biofuel production - all this together this implies implicitly allocative displacement of resources (Távora, 2012, p.7).

However, after almost a decade since the implementation of PNPB, family farmers, especially those in the North and Northeast regions, still face serious problems to be included in the Brazilian biodiesel market (César & Batalha, 2010).

This paper aims to critically analyze the Social Fuel Seal (SCS) implemented in PNPB as well as lifting the scenario on the effective participation of family farming in the program.

2. Methodology

The methodology is simply that of a formal search procedure based upon reflective thinking, requiring a scientific treatment. It is on track to meet the reality of its subject or to find partial truths (Lakatos & Marconi, 1991). The methodological approach adopted for this study follows the one proposed by (Gil, 2009), which considers how to approach the problem, the objectives and the technical procedures adopted.

How to approach the problem of this research is characterized by a qualitative understanding of the context of the situation studied, enabling the capture and interpretation of phenomena and assign meanings to these (Lakatos & Marconi, 1991). Qualitative research is part of larger issues for understanding the phenomena that are taking shape as work progresses, which requires consultation on different sources for data collection (Gil, 2009). This work is characterized as qualitative and exploratory in presenting an overview of effective participation of family farming in PNPB, within the context of the Social Fuel Seal.

Regarding the way to approach the problem, this research is characterized by qualitative to be possible to understand the context of the situation studied, enabling the capture and interpretation of phenomena and assign meanings to these (Marconi e Lakatos, 2008).

Regarding the objective raised in this article, this research is exploratory due to an increasing familiarity with the problem raised, allowing flexibility for researchers to seek more knowledge on the subject in perspective (Gil,

2009).

The technical procedures adopted in the researches classified as exploratory and qualitative are broad and versatile (Lakatos & Marconi, 1991). In this article the bibliographic and documentary surveys were used, from the consultation of articles, theses, dissertations related to the topic and other documents released by the institutions responsible for promoting PNPB.

The main sources were: Ministério de Minas e Energia - MME (Ministry of Mines and Energy), Agência Nacional de Petróleo, Gas Natural e Biocombustíveis - ANP (National Agency of Petroleum, Natural Gas and Biofuels), Ministério do Desenvolvimento Agrário - MDA (Ministry of Agrarian Development), Instituto de Pesquisa Econômica Aplicada - IPEA (Institute of Applied Economic Research), Fundação Instituto de Pesquisas Econômicas), Empresa de Pesquisa Energética - EPE (Energy Research Company), Instituto Brasileiro de Geografia e Estatística - IBGE (Brazilian Institute of Geography and Statistics).

3. Family Agriculture

In Brazil, family farming encompasses different types of farmers with their own interests and strategies of organization and production, ranging from poor rural establishments using antiquated food production methods, to establishments with a high level of organization, with access to infrastructure and technology and sometimes related to agribusiness (Buainain, 2007).

Given this diversity, Law No. 11,326 of July 24, 2006 classifies the Brazilian family farming by taking into consideration the basic conditions of the production process for funding purposes. Thus, the family farmer is one who practices activities in rural areas, while meeting the following requirements: (i) does not hold in any capacity greater than 4 (four) fiscal modules area; (ii) uses mostly hand labor of its own family in the economic activities of establishment or undertaking; (iii) has predominantly originated household income linked to the property itself or economic development activities; and (iv) directs its establishment or undertaking within the family (Brasil, 2006).

Based on data from the last agricultural census (IBGE, 2010), Table 1 summarizes the distribution of establishments from family farms in five regions of Brazil.

Table 1. Establishments of family farming - Brazil

Category	Number of Establishments	Distribution %	Distribution of Establishments		
			Region	Absolute	%
Family Farming	4,367,902	84.4%	Northeast	2,187,295	50
			South	849,997	19
			Southeast	699,978	16
			North	413,101	10
			Midwest	217,531	5

Source: Own elaboration based on: (IBGE, 2010).

In Table 1 is observed that the family farm is 84.40% of total farms, in contrast to 15.60% being commercial agriculture. Half of these establishments are located in the Brazilian Northeast, making this region an early implementation focus of the PNPB in regards to the opening of a workstation and improving the income of farmers.

4. General Aspects of Biodiesel Market in Brazil

Biodiesel is a biofuel derived from biomass that can be used alone or mixed with diesel and other equipment without requiring that they change engines. In chemical terms, it is a mixture of alkyl esters of fatty acids can be produced from oils extracted from plant and animal fats or waste (Pintom et al., 2005; Ramos et al., 2011; NBB, 2014).

Brazil has a variety of oil with the possibility of extracting oils for biodiesel production on a large scale, ranging from traditional crops such as soybean (*Glycinemax.* L.), palm oil (*Elaeisguineensis*), castor (*Ricinuscommunis*), cotton (*Gossypiumhirsutum*), sunflower (*Helianthusannuus* L.) and peanut (*Arachishypogaea* L.), to alternative crops such as canola (*Brassicanapus* L. var. *oleifera*), jatropha (*Jatrophacurcas*) and babassu

(O*rbygniabarbosiana*). Besides the beef tallow and other animal fats and residual origin (Silva, 2008; Padula et al., 2012).

The roots of biodiesel in the world are linked to the invention of the engine with compression ignition, and produced by the German engineer Rudolf Christian Karl Diesel in the nineteenth century. Between 1930 and 1940, and during the Second World War, vegetable oils were used in engines with compression ignition (Altin et al., 2001; Karakosta et al., 2013).

Brazil, for political and economic reasons as well as technological issues, invested in the development of alcohol (ethanol) as an alternative to oil. The National (Pro - Alcohol) Ethanol Program was launched in 1975 with the purpose of production of anhydrous alcohol to be incorporated into gasoline.

In 1980, the National Program for Vegetable Oils for Energy Purposes (PRO - OIL) was launched whose goal was the replacement of 30% mineral diesel anchored in the production of oil. However, the program did not take off, and the government in the same period launched the National Renewable Energy Alternatives Program of Plant Origin (OVEG), which aimed to demonstrate the technical and economic feasibility of using vegetable oils in diesel cycle engine (NAE, 2005).

In 1984, the Brazilian government launched the program called Dendiesel. The program faced several difficulties with respect to its operation, even with the decline in oil prices during the 80s, biodiesel had not taken off, because the macroeconomic environment was driven mainly by tax issues with little government incentive to provide resources to an incipient project.

In 2002, the Ministry of Science and Technology (MCT), launched the Brazilian Biofuels Program (PROBIODIESEL) and was without a doubt the start of the regulatory framework of the Brazilian biodiesel. This program was a reflection of a complex work accomplished by the National Biofuels Network (GNI), with approximately thirty (30) organizations and large-sized institutions directly involved in the program. The main points of the program were: i) reduce the dependence of oil products; ii) the creation of new markets for other crops; iii) the increase in global demand for alternative fuels and; iv) the reduction of GHG emissions.

In 2005, through Law No. 11.097/2005, PNPB was born which became the official program for the purpose of investing heavily in the exploitation of their potential for the production of biodiesel. From the beginning of the program, there has been a consolidation of the biofuel market with an installed capacity of 7,504 m³/year in 2013 (Figure 1), placing it among the largest producers of biodiesel (MME, 2014a).

In January 2014, Brazil operated 58 commercial units, whose 45 units of SCS plants. These plants were idle for 61 % of its installed capacity potential in 2013 (Figure 1) (MME, 2014a).

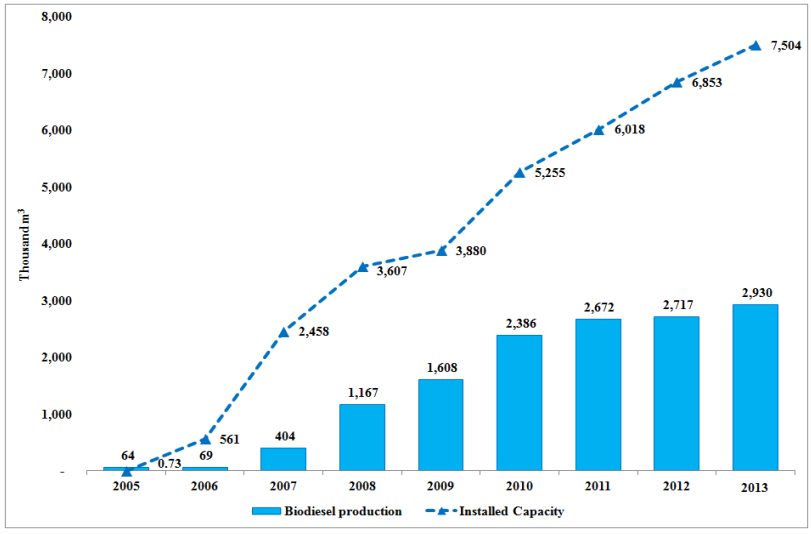


Figure 1. Installed capacity and production of biodiesel production in Brazil

Source: Own elaboration based on: (MME, 2014a).

It is observed that from 2005 to 2013 there was an increase in the production of biodiesel, because of regulations establishing the percentage of biodiesel blend with mineral diesel in Brazil. From 2005 to 2007, the authorized

percentage was 2%, which became mandatory for producers of biodiesel and holders of the Social Fuel Seal in 2008. Since then, three other increases in the percentages of mixtures were made: 3% in 2008 4% in 2009 and 5 % in 2010 (ANP, 2012).

The continuous increase in percentage mixing anticipated goal of mandatory B5 in three years (2013 to 2010), which demonstrates the rapid growth of the biodiesel market in Brazil following the launch of PNPB years. Only in the last three years, the average production was 2.7 billion liters/year.

With regard to raw materials used in the production of biodiesel, accumulated until November 2013 data showed that soybean oil led with 73.30 % followed by 20.50% with tallow, cotton and other materials 2.30% materials with 3.9% (MME, 2014a).

The average regional production of biodiesel in 2013 showed the following distribution (Figure 2). Biodiesel production in Brazil is concentrated in the South, Southeast and Midwest where there are the highest production of soybeans and has the largest cattle herd of the country regions. The three together account for over 90% of all production of biodiesel and poorest regions (North and Northeast) has only 9.4% together (MME, 2014a):

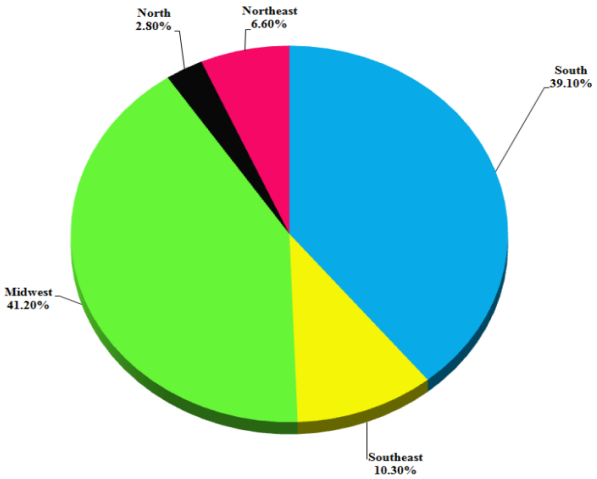


Figure 2. Regional average biodiesel production in Brazil in 2013

Source: Own elaboration based on: (MME, 2014a).

5. Results and Discussion

5.1 Social Fuel Seal

The Decree 5.297, of December 6, 2004 provided the definitions of “biodiesel”, “producer or importer of biodiesel” and the institution of SCS, an identification given to biodiesel producer which gives it the status of a promoter of social inclusion of family farmers by enabling them to participate in the national fuel market by providing raw materials for the production of biodiesel (Brasil, 2004).

Among the advantages of the SCS are: decreased rates of federal taxes and the Social Integration Program Training Program the Public Service (PIS/PASEP) as well as the Contribution to Social Security Financing (COFINS), varying according to the raw materials purchased and region; commercial financing and incentives; and ensuring participation in larger batches of auctions organized by the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), which joins biodiesel producers, refiners and distributors, who buy this biofuel blend it with diesel fuel oil.

In contrast, a biodiesel plant assumes the obligation to purchase a minimum percentage of raw material from family farmer in the year biodiesel production; sign in advance of purchase and sale contracts with family farmers or their cooperatives or associations; and ensure training and technical assistance to family farmers agreed. All these procedures are regulated by Ministry of Agrarian Development (MDA) through Normative Instruction (IN) or Ordinances (Abreu, 2013).

From 2005 to 2012, four guideline-instruments were launched for granting, maintaining and using the SCS instruments: the Normative Instruction (IN) No. 01/2005, No. 01/2009 and No. 01/2011 and Decree No. 60/2012, currently in force (MDA, 2005; MDA, 2009; MDA, 2011b; MDA, 2012).

The first legal instrument regulating the SCS, IN No. 01 /2005, which prevailed for four years in the phases of the blends B2 and B3. The second, IN No. 01/2009, began with the obligatory B4 in 2009 and ended in 2012 with the institution of B5.

The differential, IN No. 01/2009, was the change in percentage for the purchase of raw materials from family farmers towards the production of biodiesel (Table 2). For the Northeast, Southeast and South regions, the percentage is at least 30% of acquisitions (previously 50%). As for the North and Midwest, this value was 10% for the crop year 2009/2010. In the 2010/2011 season, rose to 15%.

In June 2011, the MDA issued a Normative Instruction No. 01, which retained the same mandatory percentage of procurement of raw materials for each region, however, regulates the requirements for obtaining and sustaining the SCS and the participation of cooperatives in agricultural activities linked to family farmers as suppliers of raw materials for the production of biodiesel.

Table 2. Minimum percentage required to purchase raw materials from family farmers by region

Regions	IN nº 01/2005	IN nº 01/2009 and IN nº 01/2011			Ordinance nº 60 /2012	
	Initial Proposal	Harvest 2009/2010	Harvest 2010/2011	Harvest 2011/2012	Harvest 2012/2013	Harvest 2013/2014
North	10%	10%	15%		15%	15%
Midwest	10%					
Northeast	50%		30%		30%	30%
Southeast	30%					
South	30%				35%	40%

Source: Own elaboration based on: (MDA, 2005; MDA, 2009; MDA, 2011b; MDA, 2012).

In September 2012, the government published the new and current Ordinance No. 60 of 06/09/2012, which was drawn up through consultation with those involved in the biodiesel production chain. This ordinance, the changes in the percentages for the acquisition of raw materials were restricted to the South, this to encourage the purchase of soybeans and canola produced in this region (MDA, 2013a).

The new percentage distribution impairs the Northeast and benefits, for example, the Midwest, holder of soybean production region and South that have a cooperative organization structure and well-organized.

Also with respect to minimum percentage of acquisition, it was found that the eight plants installed in the Northeast, only three (two in the State of Bahia and one in Ceará State) remain in operation, and reach the target of 30% of purchases of raw materials from family farms established for the region through cooperative contracts with the South region.

These plants also buy castor and palm from cooperatives and northeastern farmers in order to keep the SCS. Because they are not required to produce biodiesel oil with these, they are resold and the value obtained is directed to the purchase of soybeans.

It can be stated that, from an economic standpoint, the northeastern mills are correct, for the production of biodiesel from castor oil and palm oil could derail the deal, since these oil prices in the international market are more attractive.

Overall, it makes no difference to the Northeastern family farmer if the production of oilseeds is being designed for other markets. What really matters in this logic is the PNPB being able to generate employment and supplement the income of farmers in this region.

This perspective is based on the premise that much of the supply of oilseeds for biodiesel production would come from family farms, especially through the production of castor and palm oil in the Northeast (MDA, 2014). However, what we see is that most acquisitions of oil is from family farmer of the South and Midwest (MME, 2013a).

Vedana (2008) has questioned this. According to him it depends on the size and location of the plant and often the Social Fuel Seal is not recommended. The reason is due to the high cost in meeting the legal requirements for starting a program next to small family farmers in these poorer regions with the cultural and social characteristics

of farmers. The high cost of technical assistance to small farmers requires large-scale biodiesel production. This means that once again the government transfers the responsibility of public policies to the private sector (private companies), demonstrating that the government is moving away from its actions with regard to technical assistance, extension, distribution of seeds and utensils, the liberalization of finance, and many others.

The Institute of Applied Economic Research - IPEA (2012) conducted a review and upheld that the SCS has not complied with the guidelines and goals for which it was established, it observed a weak social integration with failures in the objectives and goals in the Northand semiarid Northeast, and on the other hand, almost no short-term alternative to soy, has generated low impact on regional development.

At this point, it is noteworthy to mention that soy maintained its superiority both in respect to raw materials used for biodiesel production, as in purchases from family farmers, providing somewhere around 95% of the total amount (MDA, 2011a). Then, the small share of other oil acquisitions in the matrix of family farming caused a model of regional participation within quite different from planned PNPB.

The North, Northeast and other Brazilian semiarid regions, that supposedly would focus on social inclusion, were hardly ready to produce sufficient raw materials for the production of biodiesel, making the goals of purchasing raw materials from family farmers in these regions unmet (Machado, 2012).

Thus, commercial production in North and Northeast is forced to make contracts with cooperatives in the South and Southeast of Brazil, demonstrating that PNPB produced a model that operates polemically outside the logical of what was planned, with widely divergent results not only on data but especially because of the inability in governance of the program.

5.2 Tax Model Disputes of Biodiesel in Brazil

To boost the participation of family farmers in the biodiesel market and the implementation of the SCS, the Brazilian government granted differentiated tax rates: PIS/COFINS and PASEP for each type of supplier of raw materials employed by the biodiesel producer, whereas lower incidence of taxes occurred in purchased inputs of family farming (Brasil, 2005a).

Within this context, a differentiation of the PIS/COFINS and PASEP for raw materials derived from established farmers in the poorest regions of Brazil (Table 3) was also established.

At first, castor and palm produced in the North, Northeast and semiarid regions have benefited from Decree No. 5.297/04 and No. 5.457/05 (Brasil, 2004; Brasil, 2005b). However, other oilseeds produced by family farmers as sunflower, peanut, cotton and jatropha have not benefited from these grants, applying to them the general rule of the program (case 1 of Table 3).

After three years with the Decree No. 6.458, of May 14, 2008 (Brasil, 2008), altered art. 4 of Decree No. 5.297, reducing to zero the PIS/COFINS and PASEP for all oilseeds grown by farmers under National Family Agriculture Program (PRONAF) in regions of Northeast, North and Semiarid.

In 2012, the government changed again taxation with Decree No. 7.768 of June 27, 2012 (Brasil, 2012), reducing by 16.84% the values of PIS/COFINS and PASEP, which was R$ 70.03 going to be R$ 58.24 per cubic meter of biodiesel, for purchases of raw materials originating from regions of the South, Southeast and Midwest (case 3 in Table 3) family farmers. This means, once more an incentive for these regions, given that they are the largest producers of raw materials and also biodiesel production, and consequently the Northeast, North and Semi-arid regions will be increasingly less attractive and less competitive.

With these new decrees the government tries to raise the “mix” of oil to produce biodiesel (Note 2) without making it clear what the best oilseed in many ways, given that soy is currently the best option in the short to medium term, although there is possibility of generating a high degree of instability in the biodiesel industry, for economic, strategic and environmental reasons, particularly for the poorest regions of Brazil.

What is being questioned regarding their applicability is the government’s attempt to reorder their guidelines of the regulatory framework of biodiesel. However, they are not included again in the processing of tax reductions other raw materials for the production of biodiesel , such as animal tallow and waste oils and fats (OGR), fixing their framing in general rule (case 1 of Table 3) , that is, the lowest tax incentive.

Table 3. Federal taxes on biodiesel as Decree No. 6458/2008 as amended by Decree No. 7,768 of June 27, 2012

Biodiesel		**Base**	**Base Reduction coefficient of PIS/PASEP and COFINS**			
			Case 1	**Case 2**	**Case 3**	**Case 4**
		Special Regime	Rule General	Castor, Palma N, NE, SA	PRONAF Family Farming	Family Farming N, NE, SA PRONAF
Reduction Coefficient	**0.000**	**0.000**	**0.6763**	**0.775**	**0.896**	**1.000**
	Rate (%)	Value R$/m^3	Value R$/m^3	Value R$/m^3	Value R$/m^3	Value R$/m^3
PIS/PASEP	6.15	120.14	38.90	**22.48**	**10.39**	0.00
COFINS	28.32	553.19	179.10	**103.51**	**47.85**	0.00
TOTAL	34.47	673.33	218.00	**125.99**	**58.24**	0.00

Source: (Brasil, 2004, Brasil, 2005a, Brasil, 2005b, Brasil, 2008, Brasil, 2012).

Notes: 1) Adapted according to Decrees 5.297/04, No. 5.457/05, No. 6.458/08 and amended by Decree No. 7,768 of June 27, 2012 (Note 3) (emphasis added); 2) Quote of the U.S. dollar: R$ 1.00 is equivalent to US$ 2.21 (on 14/05/2014, retrieved from http://www4.bcb.gov.br/pec/taxas/batch/taxas.asp?id=txdolar).

Cases 2-4 (Table 3) refer to the type of raw materials, and the framework regions of the farmer. Nowadays, biodiesel plants are virtually unable to stay in Case 4, as well as not having raw materials in the regions established in the decree, the three biodiesel plants installed in the Northeast are making purchase contracts with other Brazilian regions, between them the South, Southeast and Midwest.

The PNPB emphasizes the importance of participation of family farmers, social inclusion, with the possibility of improvement in the socioeconomic indicators. However, the North and Northeast region currently accounts for about 6% and 3% of the installed power plants and 6.6% and 2.8% of the total biodiesel production in the country (MME, 2014a). In this situation, it is important to note that the SCS has provided certain guidance to the interests of the agro industrial complex of other regions and other sectors of the vegetable oil industry and animal fat than the interests of family farmers, because the biodiesel market is almost vertical for the complex of soy and animal tallow (IPEA, 2012).

At present, the South region corresponds to 35% of installed power plants and 39.1% of all biodiesel production in Brazil (MME, 2014a). Therefore, to the South the applicability of the SCS needs to be re-thought, because farmers produce soybeans in this region for a few decades. This means that they were already included before PNPB therefore the SCS with or without these farmers would be producing anyway. What really happened was only a formalization of the purchase of the raw material (soybean) formalized contracts with the mill and farmer (or cooperative) as a mandatory instrument PNPB.

The regions of the Midwest and Southeast, correspond to 44% and 12% of the installed plants and 41.2% and 10.3% of the regional production of biodiesel, respectively (MME, 2014a). This shows that the SCS favored these regions, due to economic, agronomic, infrastructure scenario and an enabling regulatory framework for the implementation of the industrial plant in these regions.

5.3 Social Inclusion Seal Fuel Social in Brazil

The results of industrial PNPB have reached the required volume of biodiesel to diesel mix in recent years. In relation to the SCS data from both the social side as the distributive, the results are not encouraging. The quantity of contracted farmers effectively to provide raw materials was below the initial target set by the government, which was to include 200,000 families (Repórter Brasil, 2010).

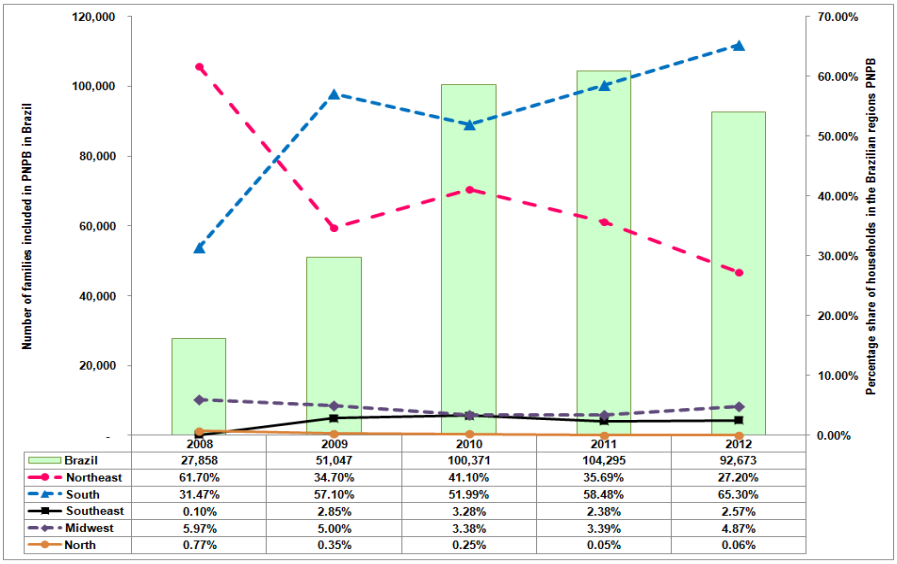
That is because in the early PNPB, family farmers have struggled to integrate into the biodiesel production chain, due to targeting of public policies for the integration of these farmers. Many of them, especially those in the North and Northeast regions, had never been invited to participate in an agribusiness production chain with regulation by law. In other words, it is the first time in the history of the agricultural economy of Brazil that an agent of the production chain must take part of the negotiation, the family farmer. The insertion took place in a gradual manner and with support from the Federal Government through regulatory instruments such as SCS and easier access to credit lines PRONAF (MDA, 2011a).

The major bottlenecks this program encountered were the size of farms and the multifaceted nature of the product mix produced by these farmers. Their livelihood has become a limiting factor for entry on the supply chain, which a priori requires large tracts of land and use of sophisticated technologies to ensure scale and production efficiency. Some data presented below corroborate this position.

Between the years 2005-2010, the number of family farming establishments reached 100,371 or 50% of the target set by the federal government in the first five years of the PNPB. In 2011, there was an increase of 3.91% in the number of establishments, reaching 104,295, but a fall of 11.15% in 2012 meant that the number of establishments benefited 7.67 % for 92,673 stores (MDA, 2011a; MDA, 2013b).

As the distribution of family farmers contracted to supply raw materials for the Brazilian region, it was observed that at the beginning of PNPB 97.87% of these were located in the Northeast, but this percentage has been falling consistently reaching 61.70% in 2008 (beginning of the mandatory B2) and 27.30% in 2012. Already the South region showed strong growth and has consolidated the national leadership of farmers entered into PNPB to leave 0% to 31.47% and 65.30 % in same period observed (MDA, 2011a; MME, 2013b).

It is worth mentioning that in the North the program is a total failure of farmer inclusion. Figure 3 shows the evolution of the number of establishments in the family farming region of Brazil. The fragility of the SCS has been confirmed with this diagnosis and data.



	2008	2009	2010	2011	2012
Brazil	27,858	51,047	100,371	104,295	92,673
Northeast	61.70%	34.70%	41.10%	35.69%	27.20%
South	31.47%	57.10%	51.99%	58.48%	65.30%
Southeast	0.10%	2.85%	3.28%	2.38%	2.57%
Midwest	5.97%	5.00%	3.38%	3.39%	4.87%
North	0.77%	0.35%	0.25%	0.05%	0.06%

Figure 3. Evolution of the number of establishments in the participating family farms PNPB by Region, 2005-2012

Source: Own elaboration based on: (MDA, 2011a; MDA, 2013b; MME, 2013b).

Thus, this data demonstrates that despite various federal decrees modifying tax rates for the production of biodiesel in an attempt to reorder the participation of farmers, there is proof that the regions should increase the participation of family farmers who have not worked with the PNPB - expected effects.

Below, we find the main results of family farming in PNPB regarding cooperatives, procurement of raw materials and gross income per family is analyzed, based on the report prepared by (MDA, 2011a) entitled "National Program for Production and Use of Biodiesel: social inclusion and territorial development" and the latest results released by the MME and MDA between April and August 2013.

5.4 Cooperative Purchases of Raw Materials and Income of Farmers in PNPB

Cooperatives play an important role in overcoming the economic, agricultural, technological and infrastructure bottlenecks, and qualify, train and give necessary conditions for farmers to participate effectively PNPB. However, the capacity of the organization in the form of cooperatives is still a great challenge among farmers, especially in the Northeast.

So PNPB sought to increase the various institutional arrangements through cooperatives in order to achieve better and better results with the purpose of obtaining a number of advantages in terms of production scale, lower

costs, improved logistics, access to various inputs, technologies and investments. Imposed on cooperatives, small farmers, a priori, would reduce the risks inherent in the activities and increase their bargaining power in transactions with biodiesel plants (MDA, 2013b).

Moreover, access to government programs like the National School Feeding Program (PNAE), Food Acquisition Program (PAA) and Technical Assistance and Rural Extension would be facilitated.

The number of cooperatives of family farming in Brazil contracted under PNPB has increased in the period from the beginning of the program. In 2006 there were only four cooperatives in 2008 rose to 20 (twenty) and in 2012 this number accounted for 74 (seventy-four) units (MDA, 2013b; MME, 2013b).

It can be stated that the participation of agricultural cooperatives in dialogue with the biodiesel plants is not harmful to PNPB, on the contrary, it proves to be very important. A clear example is the marketing of raw materials for biodiesel plants through cooperatives, representing R$ 1,680.34 billion or 80 % of the whole amount purchased in 2012 against 70%, 68% and 31% in the years 2010, 2009 and 2008, respectively (MDA, 2013b; MME, 2013b).

It was observed that in 2012, 52 cooperatives were located in the Southern region, given that this region has a tradition of cooperatives linked to family farming. It is no coincidence that 85 % of the volume of raw materials from family farmers sold to producers of biodiesel are marketed through cooperatives (MDA, 2013b; MME, 2013b).

With PNPB incentives, the Northeast region, with little tradition in cooperatives, excelled on the national scene until 2010 with the creation of 10 cooperatives to assist in the creation of lean production systems for growing oilseeds; diffusion of technology and inputs; improvement in technical assistance and ; marketing of the crop (MDA, 2013b; MME, 2013b).

However, in 2012 only 6 projects were still in the program, representing a reduction of about 40%, which could increasingly undermine the bargaining power of farmers in that region (Figure 4).

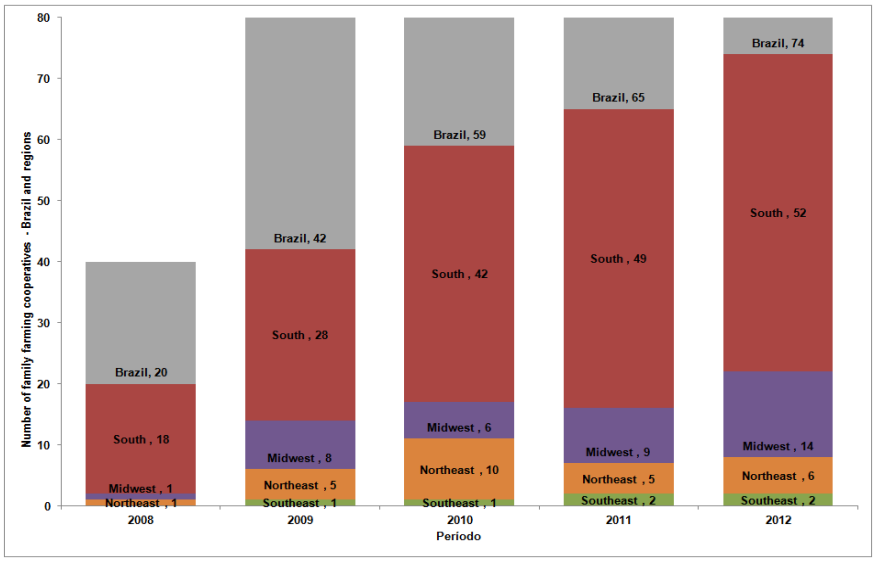


Figure 4. Number of family farming cooperatives in PNPB in 2008-2012

Source: Own elaboration based on: (MDA, 2011a; MDA, 2013b; MME, 2013b).

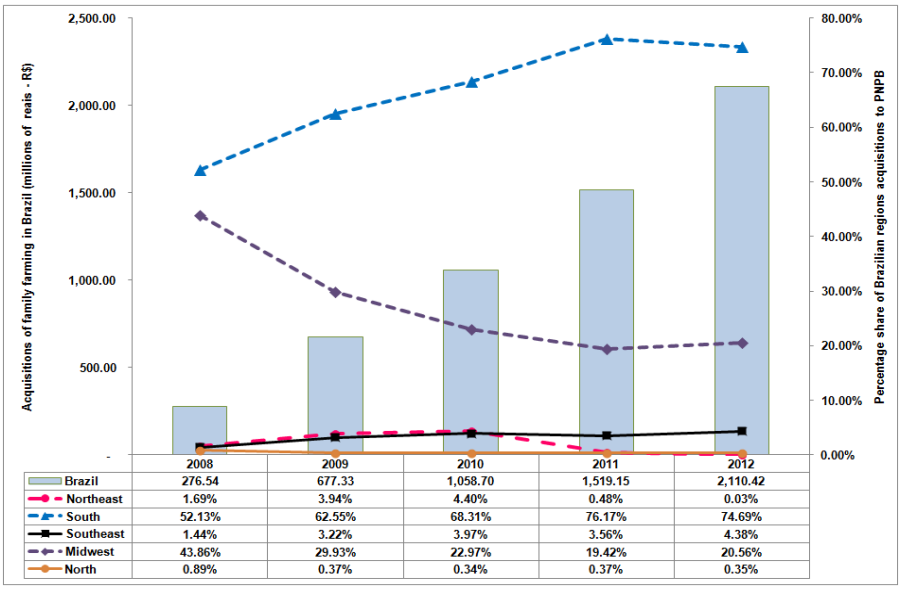
The figures are not equitable among other Brazilian regions and, secondly, to generate the increase in the percentage of purchase of raw materials from the South, which has the largest number of cooperatives, tends to weaken the opportunity for diversification of other raw materials for PNPB. This scenario is being modifying since the time when the government decreases the rates of federal taxes (Decree No. 7,768 of June 27, 2012) and driving more and more increasing agents in the South and Midwest.

When comparing the number of farmers in the Northeast with the number of cooperatives Brazilian regions, it is concluded that the Northeast needs more power cooperatives to equitably distribute the production in the various areas of the region by presenting a series of bottlenecks, such as: i) lack of tradition of family farming with the

cooperative; ii) lack of public policies (federal, state and municipal) to live with drought; iii) lack of technical training; iv) low education; v) lack of an entrepreneurial culture.

With respect to purchases of raw materials originating from family farming enterprises possessing the Social Fuel Seal, a rather uneven performance among Brazilian regions is presented.

In 2012 the company acquired the family farm, in every country, R$ 2,110.42 billion (Figure 5). Of this total, R$ 2,010.52 billion were purchased in the South and Midwest, thus the two regions snapped up 95.25% of the total resource available.



	2008	2009	2010	2011	2012
Brazil	276.54	677.33	1,058.70	1,519.15	2,110.42
Northeast	1.69%	3.94%	4.40%	0.48%	0.03%
South	52.13%	62.55%	68.31%	76.17%	74.69%
Southeast	1.44%	3.22%	3.97%	3.56%	4.38%
Midwest	43.86%	29.93%	22.97%	19.42%	20.56%
North	0.89%	0.37%	0.34%	0.37%	0.35%

Figure 5. Procurement (millions of reais) family farm from 2008 to 2012 in Brazil

Source: Own elaboration based on: (MDA, 2011a; MDA, 2013b; MME, 2013b).

Note: 1) Quote of the U.S. dollar: R$ 1.00 is equivalent to US$ 2.21 (on 14/05/2013, Retrieved from http://www4.bcb.gov.br/pec/taxas/batch/taxas.asp?id=txdolar).

In contrast, the Northern region had a negligible growth between 2010 and 2012 and the Northeast was the one with the worst scenario since the beginning of the program (Figure 6) with only 0.03% or equivalent to only R$ 540.00 acquisitions/year (equivalent to US$ 244/year), demonstrating that despite the amendment of Decree No. 6,458, of May 14, 2008 which reduced to zero the PIS / PASEP and COFINS, the North and Northeast regions have failed, clearly demonstrating the fragility of the SCS that aimed to increase production in these poorer regions and reduce regional disparities . On the other hand, there are the South and Midwest regions continually increasing their stakes in the biodiesel market, as shown in Figure 6.

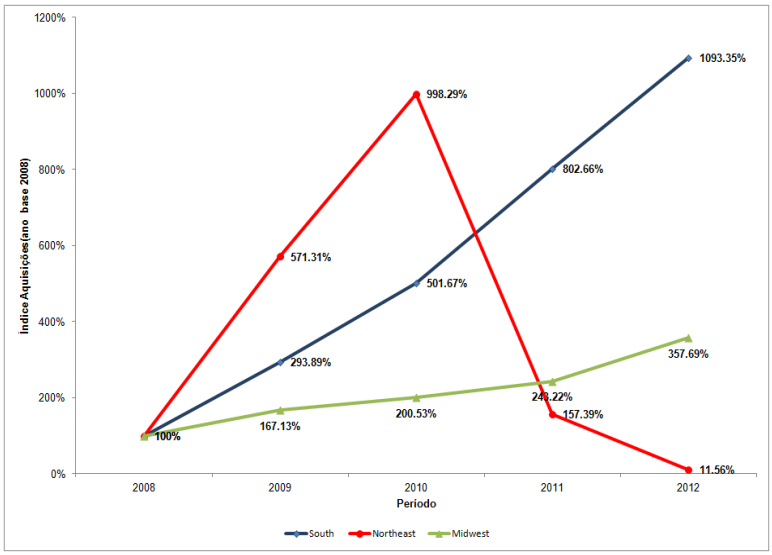


Figure 6. Comparative Index of the evolution of the volumes of purchases of raw materials of the South, Northeast and Midwest regions (base year 2008)

Source: Own elaboration based on: (MDA, 2013b).

For this situation it is clear that the SCS had distorted their purpose as they are not reaching farmers in the North and Northeast regions by simply reflect in the figures.

With respect to revenue earned by farmers from selling raw materials, despite efforts to enter these farmers PNPB, the same have been facing problems related to the production of oil in the Northeast since 2009, becoming a reflection of disappointment PNPB this region. The average annual income of a family of farmers was a failure in 2011 and 2012, corresponding respectively to 1.37% and 0.09% of the national average income, estimated at R$ 22,770.00. Figure 7 provides a comparison between the average national income and its corresponding percentage in the five Brazilian regions (MDA, 2013b; MME, 2013b).

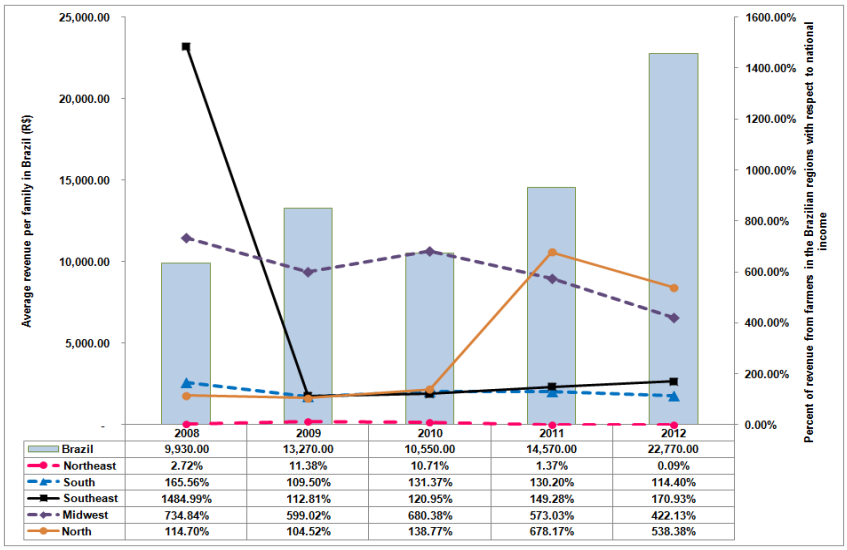


Figure 7. Average revenue per family in Brazil - PNPB (R$/household/year)

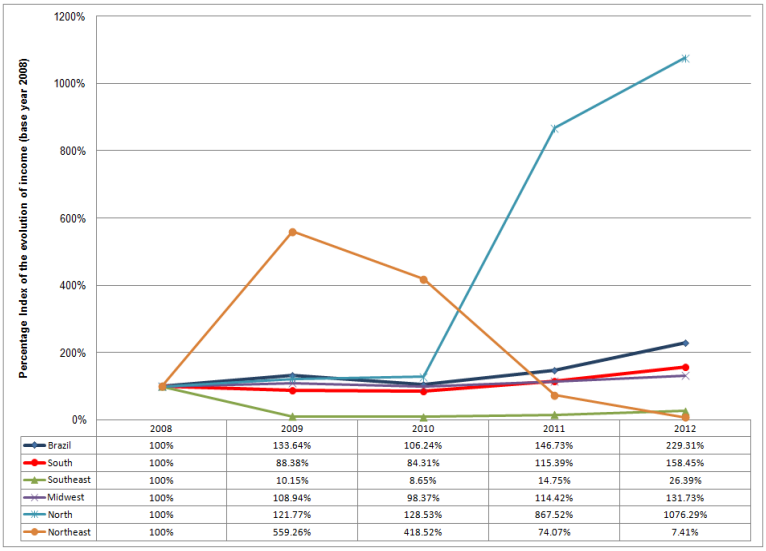
Source: Own elaboration based on: (MDA, 2011a; MDA, 2013b; MME, 2013b).

The gross income per family in family agriculture, expressed in R$/year, demonstrates once again that the Northeast suffers from the results of PNPB and has the lowest annual revenue from all regions. In 2012 the gross household income was R$ 20.00 per year. This means a little more than one dollar per month , far below the

World Bank uses to express the people who are in extreme poverty line (U.S. $ 1 per day per person) and the poverty line (U.S. $ 2 per person per day) (Loureiro, 2009).

It is worth noting that more than 40% farmers are inserted in the Northeast region, which proves that these farmers are not being benefited with PNPB. Since the program began billing for family farmers has always been very small, but in 2012 reached the lowest level, as shown in Figure 8.

On the other hand, the Northern region had the best leverage with respect to other regions. The positive result in the North is reflective of the amount of biodiesel produced by the inserted amount of family farmers, i.e. the northern region have only 60 farmers in PNPB in 2012.



	2008	2009	2010	2011	2012
Brazil	100%	133.64%	106.24%	146.73%	229.31%
South	100%	88.38%	84.31%	115.39%	158.45%
Southeast	100%	10.15%	8.65%	14.75%	26.39%
Midwest	100%	108.94%	98.37%	114.42%	131.73%
North	100%	121.77%	128.53%	867.52%	1076.29%
Northeast	100%	559.26%	418.52%	74.07%	7.41%

Figure 8. Evolution of income index (base year 2008)

Source: Own elaboration based on: (MDA, 2011a; MDA, 2013b; MME, 2013b).

In evaluating the MDA (2013b) the North, despite the small number of participating families, has received incentives for family inclusion through the creation of Sustainable Palm Oil Program, which created a new dynamic for social inclusion and relationships with industry. Currently, there are about 60 families planting palm (palm oil) for oil and more than R$ 40 million is for through the National Family Agriculture Program (PRONAF) for funding. The design of the palm (palm oil) is the government's response and the biodiesel production chain to encourage the North to develop (MDA, 2013b).

6. Conclusions

The facts and data presented question many aspects of sustainability of PNPB because, from the beginning, the program sought to reconcile economic, environmental and especially social issues. This search led to the actors involved in the production chain could institutionalize the program, influenced by his standards, by politics, supply, by organizations of institutions, among others. In any case, they were all taken to comply with legal legislation regarding program goals in percentage terms, but the data of the benefits of PNPB with respect to the desires of farmers are fairly questioned, in particular the values of oilseed production, the acquisition of raw materials, the number of cooperatives and productivity in the North and Northeast regions.

Based on the above, the research showed the following results: the changes of the law of SCS to promote production did not provide positive results for the North and Northeast: i) the acquisitions of family farming by companies who performed the SCS had a rather uneven performance among Brazilian regions; ii) the gross income per family in the Northeast during the study periods were very low; iii) despite increases in the number of cooperatives decreased units in the Northeast region.

Politically, the goal of the SCS was to make possible the production of oil, increase income and active participation of the poor farmers as crucial to the success or failure of PNPB factor. However, this study concludes that despite various modifications in the rate of federal taxes SCS to foster PNPB in the poorest regions, the results favored the more developed regions and yet the farmers in the most deprived areas not

heavily attended, so do not was successful.

For a general consideration, it is not the number of families included in the program who will claim that the PNPB will be a success, but the location of this inclusion, quality of services and the resources used to promote this chain. To solve the various bottlenecks of the program they will need to review the foundations of the program and verify that the PNPB really is available for family farms or in the service of intensive agriculture.

Acknowledgements

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References

Abreu, Y. V. (2013). *Mudanças na Legislação que Regulamenta o Selo Combustível Social e sua Vinculação com os Leilões de Biodiesel em 2011 e 2012 no Brasil*. Retrieved January 12, 2014, from http://www.eumed.net/libros-gratis/2012b/1224/selo-combustivel-social-vinculazao-leiloes-biodiesel.html

Alonso-Pippo, W., Luengo, C. A., Alberteris, L. A. M., Del Pino, G. G., & Duvoisin, Jr. S. (2013). Practical implementation of liquid biofuels: The transferability of the Brazilian experiences. *Energy Policy, 60*, 70-80. http://dx.doi.org/10.1016/j.enpol.2013.04.038

Altin, R., Çetinkaya, S., & Yücesu, H. S. (2001). The potencial of using vegetal oil fuels as ful for diesel engines. *Energy Conversion and Management, 42*, 529-550. http://dx.doi.org/10.1016/S0196-8904(00)00080-7

ANP-Agêcia Nacional de Petróleo, & Gas Natural e Biocombustíveis. (2014). *Dados Estatísticos Mensais*. Retrieved April 2, 2014, from http://www.anp.gov.br

ANP-Agência Nacional de Petróleo, & Gas Natural e Biocombustíveis. (2012). *Boletim Anual de Preços: Preços do petróleo, gás natural e combustíveis nos mercados nacional e internacional*. Retrieved January 24, 2014, from http://www.anp.gov.br/?dw=59757

Arent, D., Sábio, A., & Gelman, R. (2011). The status and prospects of renewable energy for combating global warming. *Energy Economics, 33*, 584-593. http://dx.doi.org/10.1016/j.eneco.2010.11.003

Bergmann, J. C., Tupinambá, D. D., Costa, O., Almeida, J. R. M., Barreto, C. C., & Quirino, B. F. (2013). Biodiesel production in Brazil and alternative biomass feedstocks. *Renewable and Sustainable Energy Reviews, 21*, 411-420. http://dx.doi.org/10.1016/j.rser.2012.12.058

Brasil. Casa Civil. (2004). *Decreto nº. 5.297. 2004*.

Brasil. Casa Civil. (2005a). *Lei nº. 11.097 de 13 de janeiro de 2005*.

Brasil. Casa Civil. (2005b). *Decreto nº. 5.457/2005*.

Brasil. Casa Civil. (2006). *Lei nº 11.326 de 24 de julho de 2006*.

Brasil. Casa Civil. (2008). *Decreto nº. 6.458/2008*.

Brasil. Casa Civil. (2012). *Decreto nº. 7.768/20012*.

Buainain, A. M. (2007). Tecnologia de gestão e agricultura familiar. *Agricultura familiar e inovação tecnológica no Brasil: características, desafios e obstáculos* (pp. 129-159). Buainain, A. M (coord.). Campinas: Unicamp.

César, A. S., & Batalha, M. O. (2013). Brazilian biodiesel: The case of the palm's social projects. *Energy Policy, 56*, 165-174. http://dx.doi.org/10.1016/j.enpol.2012.12.014

César. A. S., & Batalha, M. O. (2010). Biodiesel production from castor oil in Brazil: A difficult reality. *Energy Policy, 38*, 4031-4039. http://dx.doi.org/10.1016/j.enpol.2010.03.027

EPE-Empresa de Pesquisa Energética. (2013). *Balanço Energético Nacional 2013*. Retrieved April 10, 2014, from https://ben.epe.gov.br/downloads/Relatorio_Final_BEN_2013.pdf

FGV-Fundação Getúlio Vargas. (2010). *O Biodiesel e sua contribuição ao desenvolvimento brasileiro*. Rio de Janeiro: FGV. Retrieved March 24, 2014, from http://www.alice.cnptia.embrapa.br/handle/doc/872451

Gil, A. C. (2009). *Métodos e técnicas de pesquisa social*. São Paulo: Atlas.

I - R$ 22.48 (twenty-two dollars and forty-eight cents) and R$ 103.51 (one hundred and three reais and fifty-one cents), respectively, per cubic meter of biodiesel made from castor beans or fruit , seed or nut palm grown in the

north and northeast and semiarid.

IBGE-Instituto Brasileiro de Geografia e Estatística. (2010). *Censo Agropecuário 2010*. Retrieved April 24, 2014, from http://www. eia.doe.gov

IEA-Internation Energy Agency. (2013). *World Energy Outlook 2013*. OECD/IEA. Retrieved April 24, 2014, from http://www worldenergyoutlook.org

II - R$ 10.39 (ten dollars and thirty nine cents) and R$ 47.85 (forty-seven reais and eighty-five cents), respectively, per cubic meter of biodiesel made from raw materials acquired from family farmer framed in PRONAF.

IPEA-Instituto de Pesquisa Econômica Aplicada. (2012). *Biodiesel no Brasil: desafios das políticas públicas para a dinamização da produção*. Comunicados do IPEA, 137, Presidência da República: Brasília.

Karakosta, C., Pappas, C., Marinakis, V., & Psarras, J. (2013). Renewable energy and nuclear power towards sustainable development: Characteristics and prospects. *Renewable and Sustainable Energy Reviews, 22*, 187-197. http://dx.doi.org/10.1016/j.rser.2013.01.035

Lakatos, E. M., & Marconi, M. (1991). *Fundamentos da Metodologia Científica* (3rd ed.). São Paulo: Atlas.

Loureiro, A. O. F., & Suliano, D. C. (2009). *As Principais Linhas de Pobreza utilizadas no Brasil*. Instituto de Pesquisa e Estratégia Econômica do Ceará: IPECE. Nota Técnica, 38. Retrieved April 4, 2014, from http://www.ipece.ce.gov.br/publicacoes/notas_tecnicas/NT_38.pdf

Machado, A. G. (2012). As ações e estratégias do governo para o Selo Social. *Conference Agribio 2012: Agricultura Familiar no Biodiesel*. São Paulo: Palestra.

Marchetti, J. (2012). A summary of the available technologies for biodiesel production based on a comparison of different feedstock's properties. *Process Safety and Environmental Protection, 90*, 157-163. http://dx.doi.org/10.1016/j.psep.2011.06.010

Marconi, M. de A., & Lakatos, E. M. (2008). *Técnicas de pesquisa: planejamento e execução de pesquisas, amostragens e técnicas de pesquisa, elaboração, análise e interpretação de dados*. São Paulo: Atlas.

MDA. Ministério do Desenvolvimento Agrário (2013a). Participação da Agricultura Familiar no Brasil. *Conference Global BioenergyPartnership – GBEP*. Retrieved January 14, 2014, from http://www.globalbioenergy.org/events1/gbep-events-2013/working-group-on-capacity-building-meetings-2013/en/

MDA. Ministério do Desenvolvimento Agrário. (2014). *Programa Nacional de Uso e Produção de Biodiesel.* Retrieved April 4, 2014, from http://portal.mda.gov.br/portal/saf/programas/biodiesel

MDA-Ministério do Desenvolvimento Agrário. (2005). *Instrução Normativa nº 01, de 5 de julho de 2005*.

MDA-Ministério do Desenvolvimento Agrário. (2009). *Instrução Normativa nº 01/2009*.

MDA-Ministério do Desenvolvimento Agrário. (2011a). *Programa Nacional de Produção e Uso de Biodiesel - Inclusão Social e Desenvolvimento Territorial*. Brasília, DF: MDA. Retrieved March 24, 2014, from http://portal.mda.gov.br

MDA-Ministério do Desenvolvimento Agrário. (2011b). *Instrução Normativa nº 01, de 20 de junho de 2011*.

MDA-Ministério do Desenvolvimento Agrário. (2012). *Portaria nº 60 de 06/09/2012*.

MDA-Ministério do Desenvolvimento Agrário. (2013b). Selo Combustível Social: balanço e próximos passos. *Conference Agribio 2013: Agricultura Familiar no Biodiesel*. São Paulo: Palestra. Retrieved January 20, 2014, from http://www.biodieselbr.com/agribio/palestras

MME. Ministério de Minas e Energia. (2013a). *Boletim mensal dos combustíveis Renováveis*. Brasília, SPG, n. 67, ago. 2013. Retrieved February 24, 2014, from http://www.mme.gov.br/spg/menu/publicacoes.html

MME-Ministério de Minas e Energia. (2013b). *Visão Geral do Programa de Biodiesel*. Apresentação na 16ª Reunião Ordinária da Câmara Setorial da Cadeia Produtiva de Oleaginosas e Biodiesel, abril de 2013. Retrieved January 17, 2014, from http://www.agricultura.gov.br/arq_editor/file/camaras_setoriais/Oleaginosas_e_biodiesel/16RO/App_MME_Biodeisel.pdf

MME-Ministério de Minas e Energia. (2014a). *Boletim mensal dos combustíveis Renováveis*, Brasília, SPG, 74. Retrieved April 10, 2014, from http://www.mme.gov.br/spg/menu/publicacoes.html

NAE-Núcleo de Assuntos Estratégicos da Presidência da República. (2005). Biocombustíveis. *Cadernos NAE* 2,

26-30, 2005. Retrieved April 4, 2014, from http://www.nae.gov.br/cadernos_nae/ 02biocombustiveis.pdf

NBB-National Biodiesel Board. (2014). *Biodiesel Basics*. Retrieved January 24, 2014, from http://www.biodiesel.org/what-is-biodiesel/biodiesel-basics

Nogueira, L. A. H., & Capaz, R. S. (2013). Biofuels in Brazil: Evolution, achievements and perspectives on food security. *Global Food Security, 2*,117-125. http://dx.doi.org/10.1016/j.gfs.2013.04.001

Note 1. The nomenclature in the mixture of biodiesel with mineral diesel is known as Bx, where the letter B means Blend (mixture) and the letter x represents the percentage of biodiesel was blended with mineral diesel.

Note 2. See case 3 in Decree 6458 and its amendments

Note 3. Art. 4 - The coefficients of differentiated reduction of PIS/COFINS and PASEP provided for in § 1 of Art. 5 of Law No. 11,116, 2005, shall be as follows:

Notes

Padula, A. D., Santos, M. S., Ferreira, L., & Borenstein, D. (2012). The emergence of the biodiesel industry in Brazil: Current figures and future prospects. *Energy Policy, 44*, 395-405. http://dx.doi.org/10.1016/j.enpol.2012.02.003

Pinto, A. C., Guarieiro, L. L. N., Rezende, M. J, C., Ribeiro, N. M., Torres, E. A., Lopes, W, A., ... Andrade, J. B. (2005). Biodiesel: an overview. *Journal of the Brazilian Chemical Societ, 16*, 1313-1330. http://dx.doi.org/10.1590/S0103-50532005000800003

Quintella, C. M., Teixiera, L. S. G., Korn, M. G.A., Costa Neto, P. R., Torres, E. A., Castro, M, P., & Jesus, C. A. C. (2009). Cadeia do biodiesel da bancada à indústria: uma visão geral com prospecção de tarefas e oportunidades para P&D&I. *Química Nova, 32*, 793-808. http://dx.doi.org/10.1590/S0100-40422009000300022

Ramos, L. P., Silva, F. R., Mangrich, A, S., & Cordeiro, C. S. (2011). Tecnologias de Produção de Biodiesel. *Revista Virtual de Química, 3*, 385-405. http://dx.doi.org/10.5935/1984-6835.20110043

Rathmann, R., Szklo, A., & Schaeffer, R. (2012). Targets and results of the Brazilian Biodiesel Incentive Program – Has it reached the Promised Land? *Applied Energy, 97*, 91-100. http://dx.doi.org/10.1016/j.apenergy.2011.11.021

Repórter Brasil. (2010). *A agricultura familiar e o programa nacional de biodiesel - retrato do presente, perspectivas de futuro*. Retrieved January 15, 2014, from http://www.reporterbrasil.org.br/documentos/AgriculturaFamiliar_Biodiesel2010.pdf

Silva, M. S. (2008). *Biodiesel no Estado da Bahia: potencialidades, entraves e ações indutoras*. Dissertação (Mestrado). Departamento de Engenharia, Universidade Salvador – UNIFACS, Salvador.

Souza S. P., & Seabra, J. E. A. (2013). Environmental benefits of the integrated production of ethanol and biodiesel. *Applied Energy, 102*, 5-12. http://dx.doi.org/10.1016/j.apenergy.2012.09.016

Távora, F. L. (2012). *Biodiesel e Proposta de um Novo Marco Regulatório: Obstáculos e Desafios*. Núcleo de Estudos e Pesquisas do Senado Federal: Brasília. Textos para discussão nº 116.

Timilsina, G. R., & Shrestha, A. (2011). How much hope should we have for biofuels? *Energy, 36*, 2055-2069. http://dx.doi.org/10.1016/j.energy.2010.08.023

Torres, E. A., Collantes, H. D. C., Alves, C. T., Santos, D. C., & Camelier, L. A. A. (2006). Biodiesel: o combustível para o novo século. *Bahia Análise e Dados, 16*, 89-95.

Vaccaro, G. L. R., Pohlmann, C., Lima, A. C., Santos, M. S., Souza, C. B., & Azevedo, D. (2010). Prospective scenarios for the biodiesel chain of a Brazilian state. *Renewable and Sustainable Energy Reviews, 14*, 1263-1272. http://dx.doi.org/10.1016/j.rser.2009.12.008

Vedana, U. (2008). Produzir é que importa. *Biodieselbr, 1*, 25-30.

Watanabe, K., Bijman, J., & Slingerland, M. (2012). Institutional arrangements in the emerging biodiesel industry: Case studies from Minas Gerais, Brazil. *Energy Policy, 40*, 381-389. http://dx.doi.org/10.1016/j.enpol.2011.10.023