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**A political-cultural approach to the biofuels market in
Brazil**

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1. Introduction: markets and social structures

The objective of this study is to review some of the most important institutional foundations for the expansion of biofuels in Brazil. The enviable technical and economic performance of Brazilian ethanol – praised, recently, even by Jean Ziegler, the United Nations Special Rapporteur on the Right to Food, who, in August 2007, had called for a moratorium on the expansion of biofuels¹ – cannot be understood if one does not take into account its historical roots. Sugar cane industrial products– the emblematic offspring of a making of Brazil based on the predatory exploration of natural resources, slave work, large plantations (*latifundia*) and export-driven monoculture– are today among the most dynamic of the country’s economy. Targeted by large-scale foreign investments and boosted by an accelerated process of technical innovation, Brazil’s sugar cane industry also displays governance modalities whereby the great social and environmental problems it brings about are starting to be openly and publicly discussed by their representatives.

The social and economic effects of the expansion of the Brazilian ethanol will be determined, on the one hand, by its competitiveness vis-à-vis other first-generation biofuels, and, on the other, by the time it will take to adopt energy alternatives that are less dependant on, and do not compete with, agricultural food products. Yet the future of fuel alcohol in Brazil – and, therefore, its socioenvironmental impacts – also stem from a number of social pressures that aim to reduce the sector’s negative environmental impacts and to ban the most degrading forms of labor upon which, still today, it is largely dependent.

The situation of biodiesel, in turn, is quite different. Though research studies into biodiesel had existed in Brazil since the 1970s, it was only in 2003 that the National Program for the Production and Use of Biodiesel (PNPB) was created. Currently, all of Brazil’s diesel already contains 2% of biodiesel., This ratio will increase to 3% in July 2008 and, in all likelihood, the 5% initially forecast for 2013 is expected to be brought forward to 2010. This is a very recent program, which, nonetheless, is prompting rapid increase in production. However, unlike alcohol, biodiesel is not a product whose technical and economic viability is widely accepted, and some critics are skeptical that biodiesel becomes established (Horta Nogueira, 2008, Barbosa, 2007, Buainaim, 2008). Nowhere in the world is the price of biodiesel lower than that of conventional diesel – despite the 12-plus years’ that Germany has spent promoting it. The Brazilian biodiesel market is still in its formative stages, with basic structures still lacking the stability that characterizes ethanol in Brazil: supply chain agents face too many options with regard

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¹ A great part of the literature critical of biofuels considers the Brazilian ethanol an exception, in an environment wherein, to use the expression by Doornbosch and Steenblik (2007), one often suspects that the cure can be worse than the disease. See also Ziegler, 2007.

to raw materials, technological pathways are varied, Federal Government intervention in markets is pronounced, and the supply of raw materials tends to be precarious rather than secure and reliable. Differently from ethanol, a sector in which Brazil exports technologies, a significant part of the industrial plant for biodiesel comes from American or European technology.. In spite of the explicit governmental intention that the Biodiesel Program may become a source of income generation for hundreds of thousands of family farmers(as it enables the use of their, so far, underutilized agricultural areas, thereby contributing to the diversification of rural landscapes and to income generation) the truth is that, in these first two years of its existence, the program has relied almost entirely on soybeans.

Why does soy make up such a significant share of the supply of raw material for Brazilian biodiesel? Are governmental policies aimed at broadening the supply of biodiesel, based on a contracts between industry and family farmers, in fact capable of stimulating diversification of supply into the less favored segments of family farming in the country's poorest regions? Does the PNPB have any chance of stimulating technological advances capable of raising productivity of the raw materials that compose the oil therefore reconciling economic and energy efficiency with the social objectives it aims to accomplish? With regard to biodiesel, the main hypothesis of this study is that it will be a decisive element in altering the organization of what Frank Ellis (1988) termed incomplete and imperfect markets, characteristic of the traditional products of the most impoverished segments of family farming.

Most of the international literature on bioenergy limits itself a discussion of the comparable efficiency and prospects of the different alternatives already available or in the pipeline, as well as their impact upon agriculture and agricultural prices more generally.. These comparisons are useful for policymakers considering efficient forms of energy use, food security and the environment. This study draws on this fundamental contribution, but seeks to approach the theme of biofuels in Brazil from the perspective of a **sociology of the organization of their markets**.

The text organizes the information on the biofuels' institutional foundations in Brazil, by building on the four basic characteristics that compose what Neil Fligstein (2001) terms the architecture of markets and the political-cultural approach to markets. No market stabilizes itself without clearly defining its participants' **property rights**, its **governance structure**, the **rules of exchange** that govern their relations, and the **conceptions of control** on which they act.

It is important to highlight that, in the Brazilian case, there are no consistent indications that increasing production of ethanol and biodiesel represents a serious threat to national food security². Inflationary stabilization, cash transfer programs (that reach today at least 11 million households and nearly 50 million people), the increase of the minimum wage, the expansion of credit to poor families, and the overall growth in employment all contribute to improving the purchasing power of the lowest income segments. Drawing on a comparison that has become popular among Brazilian economists, over the past years, for the 20% to 30% of the poorest, income in Brazil has grown at a pace similar

² A discussion on this issue can be found at http://g1.globo.com/Noticias/Economia_Negocios/0,,MUL418110-9356,00-OS+BIOCOMBUSTIVEIS+VAO+PRODUZIR+ESCASSEZ+DE+ALIMENTOS.html (extracted from internet april 25th 2008.

to that of China.³ The negative impacts stemming from soaring international prices on the consumption basket of the poorest are strongly attenuated by the overall context of income elevation in the poorest segments. At any rate, this increase in agricultural prices does not seem to be provoked by a reduced Brazilian supply, which –contrary to what happened with the US corn – suffered no restriction as a result of sugarcane expansion and the beginning of biodiesel production. The truth is that, since oil prices broke the thirty-dollar cap, agricultural raw material prices started to follow oil prices, even in those cases in which there is no direct utilization of the particular raw material in biofuel production. But there is no denying that, as shown by Nassar (2008), “energy agricultural commodities are more strongly pegged to oil prices and, more importantly, there is a causality relation between them”. Nevertheless, as we shall see in item 2.3 when examining the rules of exchange in the ethanol market, there is a crucial difference between ethanol and all other energy raw materials.

This study has three other parts in addition to the introduction. Part 2 seeks to outline the structures of the ethanol market. Part 3 is dedicated to biodiesel. The conclusions are presented in Part 4 of the text.

2. Ethanol

There is a vast literature⁴ directed at studying the competitiveness of the Brazilian ethanol, its positive energy balance—augmented by the use of bagasse and straw in the production of electric energy—, its capacity to contribute positively to the reduction of greenhouse effect, and the possibility that its expansion will neither compromise Brazilian environmental objectives nor the country’s food security.

Yet the undeniable competitiveness of Brazilian ethanol should be understood in light of the way its markets are organized, and of the structures and social forces underlying them. It is grounded, historically, on a tripod that the great classics of the country’s social sciences⁵ studied as the roots of the Brazilian civilization: the latifundia, slave labor and monocultural exports. Social relations corresponding to those which Max Weber characterized as patrimonialism are fundamental to sugar cane mills. The power of the landowners extended beyond the purely economic, into personalized forms of domination, fundamental to the political making of countries with a latifundia and slave tradition. Technological innovation, in this context, is seriously hampered not only because of the relatively easy access to cheap, low-skilled labor, but also because of rent-seeking behavior exhibited by proprietors in their relations with the State. Boundaries between the commercial enterprise and the family are not clearly laid down, while land tenure serves both as a business asset and a personal asset. The existence of vast territorial expanses prompted the main activities – coffee, in the second half of the nineteenth century, and especially cattle ranching – to expand upon depletion of the land’s natural resources in favor of new areas. The result, as Warren Dean’s superb

³ A recent calculation by an important private consulting firm (MB Associados) shows that, over the last five years, classes C, D and E had an addition of BRL 118 billion to their income, whereas the additional gain of classes A and B in this period was of BRL 75 billion. The calculation is based on the National Household Sample Survey, of the Brazilian Institute of Geography and Statistics (IBGE). An unprecedented phenomenon in Brazil: 67% of the country’s credit cards, in 2008, were in the hands of households of the so-called classes C, D and E (Neumann, 2008).

⁴ Macedo, org (2007), Fundação de Desenvolvimento da UNICAMP (2005), Moreira, Goldenberg et al (2003).

⁵ Freyre, Prado Jr., Furtado, Buarque de Holanda (1936)

study shows, was a reduction in the size of the Atlantic Forest, situated in the South and Southeast of Brazil, to about 7% of what it was originally (Dean, 1998).

Contrast between the roughly sketched traits described above and the present economic might of Brazil's ethanol could not be more obvious, as we shall see below. At the same time, in spite of profound transformations, three basic characteristics have followed the sector over time. Its agricultural productive base is composed of immense territorial expanses. Its expansion entails a threat not to the Amazon Region or the Atlantic Forest, but – at a scale whose magnitude is difficult to assess with accuracy – to the Cerrado, the Brazilian savannah. Brazilian ethanol still relies heavily on some degrading forms of labor, albeit at a declining rate.

Yet this does not mean that the most important source of alternative energy to oil for the Brazilian transportation industry today is marked by what Fernando Fajnzylber (1990) called **spurious competitiveness**. Productivity gains in agriculture and manufacturing, especially as of the mid 1970s with the Pro-Alcohol Program, are remarkable. When the program began, each hectare of sugarcane yielded 3,000 liters of ethanol. Today the figure is 7,000 liters (Jank, 2008).

The integration of ethanol production and industrial research enabled the country not only to reduce the levels of urban pollution through the addition of alcohol to gasoline, but also to become one of the pioneers in the manufacturing of flexible-fuel engines, fit to run on gasoline and on alcohol. According to the president of energy research company Empresa de Pesquisa Energética, Maurício Tolmasquim (<http://iptv.usp.br/overmedia/home.jsp#>), in 2003 a major motor vehicle assembling company provided the Ministry of Science and Technology with information that research on the *flex* vehicle was quite advanced. And, by 2006, as shown in Figure 1, the production of *flex* cars had surpassed 80% of production of all new Brazilian passenger vehicles. This integration between industrial innovation in engines and the advance of alcohol is important in understanding the context of ethanol in Brazil. What is amazing is the speed at which the technology was adopted.

FIGURE 1

SALES OF NEW VEHICLES

Cars + Light-Duty Commercial Vehicles

1,000 vehicles

| | Gasoline | Ethanol | Flex-Fuel | Total |
|--------------------------------|----------|---------|-----------|-------------|
| 2004 | 1,099 | 51 | 328 | 1,478 |
| 2005 | 750 | 30 | 780 | 1,559 |
| 2006 | 413 | 0 | 1,240 | 1,653 |
| 2007 | 434 | 0 | 1,302 | 1,735 |
| 2008 | 456 | 0 | 1,367 | 1,822 |
| 2009 | 478 | 0 | 1,435 | 1,913 |
| 2010 | 502 | 0 | 1,507 | 2,009 |
| Mean Annual Growth Rate | | | | 5.2% |

The worst environmental problems caused by sugar cane (slash-and-burn techniques to facilitate hand harvesting, whose impacts on neighboring small- and medium-sized municipalities are catastrophic) are being attenuated and should be ended by mechanization, which already accounts for nearly half of the production in the State of São Paulo, where two-thirds of the product's national supply is located.⁶ Though mechanization will bring about high levels of joblessness, it is worth pointing out that it has positive multiplying effects, for it requires skilled labor and an important services structure for industrial machines and equipment. If, on the one hand, the sugarcane plantation impoverishes agricultural landscapes through its continuous expansion, on the other, the current forms of industrialization and the agronomic breakthroughs with regard to enhanced productivity require a more skilled labor force (albeit in a smaller one) than those of other sectors. As will be seen below in item 2.4.3, mechanization will altogether eliminate precisely those activities less dependent on skilled labor. In the state of São Paulo alone, according to calculations by the Pastoral of the Migrant, in 2008 no fewer than 55,000 workers are to come from the Northeast and the Jequitinhonha Valley to work on sugar cane plantations, earning much higher wages that they would be able to in their regions of origin (Tomazela, 2008). Within a few years, this labor demand will be extinct. The effects of this extinction on poverty depend primarily on three factors: the demand for low-skilled labor – which, in the Brazilian Center-South, is increasingly smaller⁷–, improvement in the qualification of sugar cane workers (which the industry's business organizations have already announced, but which, of course, will be of a limited scope) and, foremost, the implementation of better opportunities for income-generation for migrants in their own regions of origin.

Brazil's increased production of ethanol rests on the dual nature of its historical construction. Its worst features –namely, degrading work and environmental devastation– are the object of an ever more explicit public contestation, which manifests itself in the very governance of its markets and the conceptions of control therein prevalent.⁸ The existence of round-tables involving sectoral actors and a broad spectrum of NGOs points towards this. The establishment of serious socioenvironmental certification is among the basic conditions for the accomplishment of one of the sector's goals: the transformation of Brazilian alcohol into an international commodity (Abramovay, 2008). As for the gigantic continuous territorial expanses on which the agricultural base of Brazil's ethanol production rests, there are several studies demonstrating the technical feasibility of integrating the sugar cane production with other activities (cattle farming, for example, Sparovek and Freitas, 2007), thus contributing to interrupt the monotony of the landscapes where ethanol prevails. Likewise, there are attempts to produce ethanol based on the product's supply by family farmers (Box I). Such initiatives, however, are of an experimental nature, and there are no indications that the actors are ready to replicate them at an appreciable scale. On the contrary, the prevailing trend is for sugar cane monoculture to even enter the

⁶ In 2006, only 30% of the area of the state of São Paulo was mechanized (Brito, 2008).

⁷ Even those sectors traditionally intensive on low educational level workers, as civil construction or security services for companies today, in Brazil, require minimum schooling of eight years and often of eleven years.

⁸ And much less in large-scale social movements as the ones that characterized sugar cane plantations in the Northeast and in São Paulo between the late 1970s and the mid 1980s. The strikes covered by the media in the second half of 2007 (http://www.sucre-ethique.org/article778.778?var_recherche=greve) do not, in the least, have the impact of those movements of some decades ago.

settlements, whose title deed holders lease their lands to the mills, renouncing any crop or cattle farming activity on their own plots.

Box I

Family Farming: a value, rather than an economic sector

Family farming is that in which the property, management and most of the work carried out in the productive unit lie with individuals who have with one another either blood or marriage ties. The term has been in use in the scientific literature, in Brazilian public policy-making and in the documents released by the social movement since the early 1990s. Family farming denotes not so much a clearly identified economic sector but, rather and above all, a value. The historical making of Brazil is rooted in the most radical forms of separation between laborers and their objective conditions of production: slavery and latifundium. Thus, terms as “small-scale production”, “low-income production” or even “subsistence production” are indicative of a socially important segment, yet one that is economically weak, ephemeral and lacking the conditions to compete with the initiatives undertaken in the big latifundia. This so-called precariousness was an important ideological justification for the agricultural policies that earmarked resources to those holders of the largest territorial expanses. The Brazilian redemocratization and the pressures originating from the National Program for the Strengthening of Family Farming (PRONAF), which appeared in 1996 under the Fernando Henrique Cardoso Government, alter this picture. Family farming is not just socially important, but – and it is in this sense that it represents a decisive value – it points to the economic viability of productive initiatives carried out within units within the working capacity of a household. It is on family farming that rests not only the production of traditional staples such as cassava, but also that of products that are highly integrated to international markets, such as chicken and pork.

Yet it is clear that family farming is socially differentiated. The great majority of family farmers cannot even produce that necessary for their survival and have their livelihood guaranteed by activities performed outside the establishment they live in or by public transfers of cash in the form of retirement or family allowance. One of the important objectives of the National Program for the Production and Use of Biodiesel (as will be seen in part 3 of this study) is to create conditions such that products typical of those poorer segments of family farming, as castor oil in the Northeast or *dendê* palm oil in the Amazon region, may be valued and, subsequently, come to represent a road in the struggle against poverty.

Sugar cane is the product over which big landowners have the greatest economic power in Brazil. This is not a technical inevitability –since, in India for instance, the product comes from household production units– but instead a historical outcome. Thus far, attempts to reduce the big landowners’ domination over sugar cane are extremely limited, piecemeal and localized.

Let us then examine how these constituent contradictions of the history of sugarcane and of current ethanol production in Brazil are expressed in the fundamental characteristics of its markets.

2.1. Property Rights: patrimonialism and concentration

An article published in a wide circulation national newspaper by Xico Graziano (2008), the incumbent Secretary of the Environment of the State of São Paulo and one of the most important leaders of Brazilian agribusiness,⁹ showing the advance of mechanization and, with it, the prospect of both the end of the sugar cane *queimadas* (slash-and-burn techniques) and the extenuating work associated with the harvesting process, concludes: “Sugarcane *queimadas* must, and will, end. The major defect of the sugar and alcohol economy, however, lies in the concentration of power. A few families dominate the wealth extracted. It would be good if fuel alcohol, which now gains the world, contributed to reduce social inequality. Green and fair ethanol.”

Graziano is not referring to the working conditions of the salaried but, rather, to the fact that land and capital concentration in the sugar cane agro-industry brings about alarming social consequences, even if the worst environmental and manual labor exploitation practices come to be suppressed. Let us examine the issue more closely.

Biofuels are among the most attractive sectors for new investments in the Brazilian economy. In May 2007, data provided by the Sugar Cane Agribusiness Union of São Paulo (UNICA) revealed that, in addition to the 325 sugar cane mills in operation in the country, 86 new projects were underway, involving no less than USD 17 billion, of which USD 14 billion was for setting up new units (and USD 3 billion for the expansion of already existing units). The sector’s horizon is one of increasing sugarcane production from 425.7 million tons in 2006/07 to 727.8 million tons in 2012/13, a 71-percent increase. Wilkinson and Herrera (2008) show that foreign capital¹⁰ can be divided between consortiums and funds with no operational tradition in the sector, and those who already work or intend to do so directly (Table 1).

⁹ Xico Graziano, a federal lawmaker, is very close to ex-president Fernando Henrique Cardoso, and was Secretary of Agriculture of the State of São Paulo.

¹⁰ Large Brazilian corporations coming from non-agricultural sectors also make important investments in biofuels, in the same process in which family farmers are removed from the direct management of the mills. One of Brazil’s largest corporations in the construction business, Odebrecht, has a budget for investments in the sector of no less than USD 5 billion. The capacity of Odebrecht’s company ETH Bioenergia, which was of 1.5 million tons in 2007, should surpass 20 million in 2011 (Scaramuzo, 2008b).

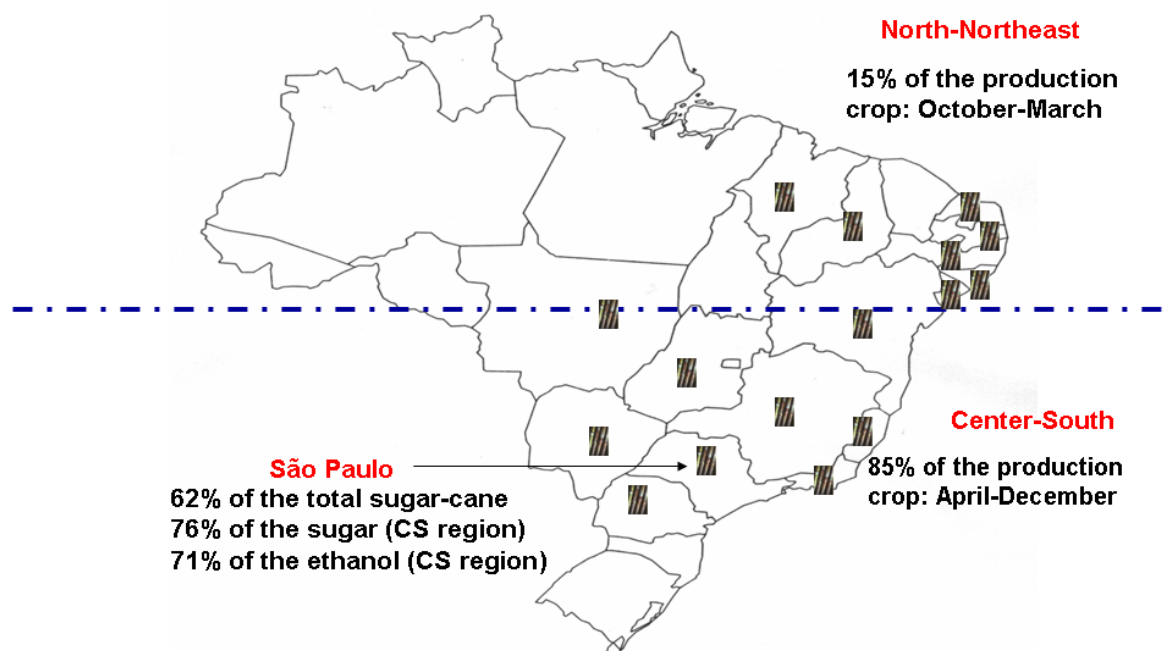
Table 1
Types of foreign capital investment in ethanol industry businesses

| TYPES OF FOREIGN CAPITAL | |
|--|--|
| <p>A – Consortiums between entrepreneurs and international investment funds interested in investing resources in a promising business, yet without direct involvement in the operation.</p> | <p>B – Companies already doing business in the sugar and alcohol industry abroad and trading companies that participate or are willing to participate more actively in the international trade of alcohol</p> |
| EXAMPLES | EXAMPLES |
| <p>George Soros (Hungarian mega investor): Partner of Aldecoagro, which acquired the Monte Alegre Mill, in Minas Gerais, in 2006, and is building a new mill in Mato Grosso do Sul. The company plans to invest BRL 1.6 billion to reach a processing capacity of 11 million tons of sugar cane by 2015.</p> <p>Vinod Khosla (Indian billionaire): partner of Brazil Renewable Energy Company (BRESCO), company launched in March by Henri Philippe Reichstul, a former PETROBRAS president.</p> <p>James Wolfensohn (Australian, former World Bank president): foreign partner of Brenco, which plans to invest USD 2 billion in the production of alcohol in Brazil.</p> <p>Kidd & Company: holds the control of the sugar cane mill of COOPERNAVI, and has a stake in company Infinity Bio-Energy together with other names such as American brokerage firm Merrill Lynch and international investment funds Stark and Och-Zitt Management.</p> <p>Infinity Bio-Energy: owner of four sugar cane mills in the country. In the first IPO it held abroad, in 2006, it raised USD 300 million, exclusively for investments in the Brazilian sugar and alcohol sector.</p> | <p>Tereos and Louis Dreyfus (French enterprise, first to arrive, in 2000): Louis Dreyfus has a controlling stake in sugar cane mills Luciânia, in Minas Gerais, Cresciumal and São Carlos, in São Paulo; in February 2007, he bought four mills from Pernambuco-based Tavares de Melo group, in addition to having started building a fifth unit in Mato Grosso do Sul. Tereos, in turn, holds a 6.3-percent stake in Cosan, plus 47.5% in Franco-Brasileira de Açúcar (FBA) and 100% in Açúcar Guarani.</p> <p>Cargill (American): BRL 10.9 billion in revenues in Brazil in 2006. In June 2006, the company acquired for an estimated BRL 75 million the controlling stake of Central Energética do Vale do Sapucaí (CEVASA), a mill located in Patrocínio Paulista, upstate São Paulo.</p> <p>Bunge (already operating as a sugar and alcohol exporter in Brazil): recently made bids in an effort to purchase Vale do Rosário mill, the third largest producer of sugar and alcohol in the country. In spite of the initial refusal by controlling stakeholders to sell the business, Bunge had not given up its intention of reaching a deal by June 2007.</p> <p>Pacific Ethanol: its partners are billionaire Bill Gates, German NordZucker SudZucker, which operates in the sugar industry in Europe, and Indian BHL, owner of mills in its country of origin, which hired consulting firm KPMG to coordinate its expansion in Brazil.</p> |
| <p>The demand is such that prices are already inflated. In the race not to remain out of this market, anyone willing to acquire a Brazilian sugar cane mill must be ready to pay, today, twice as much as the average price recorded in 2005, which was of USD 40 per milling ton capacity. Despite the price escalation, there are plenty of parties interested in opening their coffers.</p> | |

Source: Table copied from Wilkinson and Herrera (2008).

Sugar cane is not a crop of great spatial occupation. It has the important characteristic of being able to generate a huge amount of energy over a relatively small surface, when compared with, for example, the occupation by grains or, most importantly, by pasturelands. Preliminary data of the Crop and Cattle Farming Census of Brazil, done in the country in 2006, show that the 5.2 million crop and cattle farming establishments occupied an area of 355 million hectares, with crops corresponding to 77 million hectares. In 2006/07, sugar cane occupied 6.5 million hectares. The forecast is that, in 2020, it will occupy 14 million hectares, which would allow, productivity increases considered, increasing the production of ethanol from 18 to 65 billion liters a year. Two-thirds of this production capacity is located in the State of São Paulo and only 15% in the Northeast, as can be seen in Map 1.

BRAZIL: REGIONS AND SEASONALITY



One of the polemic themes with regard to the advance of biofuels lies in the impacts of such expansion over ecologically fragile biomes. The immediate threat is not against the Amazon region (whose climate and soil conditions are inadequate for the crop), but against the Cerrado, as we shall see further ahead in this study.¹¹ So much so—and this is the first relevant point from the perspective of property rights—that sugar cane is produced in gigantic territorial expanses, with unit after unit of some thousands of hectares.

¹¹The fear that the expansion of sugar cane over the Cerrado will have an indirect impact on the destruction of the Amazon region is not completely unfounded, though thus far there is no evidence minimally consolidated that this is already happening. The worrying advance over the pastureland in Amazonia, at least until now, cannot be directly linked to the expansion of ethanol, even if indirectly.

Differently from that which occurs with most cereal and oleaginous crops,¹² sugar cane is a highly perishable product that needs to be processed immediately after it is harvested. "This technical limitation compounded by the prevailing land tenure structure helps to account for the fact that two-thirds of the product comes from crop and cattle farming units owned by the mills themselves, while only one-third from independent suppliers. Actually, these producers' independence is, oftentimes, only formal: The mill leases their lands, incorporates them to their dominions and undertakes all productive operations, from sowing to harvesting. Contrary to what happens with the production of grains, and even with part of the cattle ranching industry (dairy, for instance), the space occupied by family farming in the sugar cane production is practically null. Unlike India, for instance, where sugar cane is grown in small establishments, the predominance of the latifundium in Brazil is almost absolute.

This prevalence of mill-owned areas in large land concentrations brings about three important consequences for the study of the property rights on which the expansion of ethanol is based.

- a) Big investments in agroenergy in Brazil weaken the patrimonial nature of the Brazilian agrarian capitalism to the benefit of a capital structure that tends to acquire the features prevailing in other economic sectors. Crop and cattle farming businesses go public, and the presence of foreign investments alters the physiognomy of a sector from which they were, until very recently, almost absent. For a long time now, the presence of foreign capital has been important in segments other than the crop and cattle farming production. But today, large companies and, increasingly, investment funds are beginning to participate in the capital of sugar and alcohol production mills. Fifteen percent of ethanol production is already under the control of foreign capital. Some 70% of the transactions (acquisitions of stakes in units or companies by private equity funds) made in the ethanol industry in Brazil in 2007 came from foreign groups and funds. The number of mergers, acquisitions and purchases of stakes in mills goes from 5 in 2003 to 9 in 2006, and to 25 in 2007, with an estimated 25 other similar processes to take place in 2008. American multinational Bunge, Spain's Abengoa, Asian Noble Group, and French Louis Dreyfus Commodities and Tereos all acquired mills. A French group linked to beetroot sugarbeet producing cooperatives also invested recently in Southern Brazil. International companies and funds process in Brazil's Center-South some 35 million tons, or 8.3% of the total harvested in the region in 2007/08 (Scaramuzzo, 2008a). It is impossible to understand these markets' social structure of functioning, their dynamism, their innovation capability, and their ties with creative processes for products derived from Brazilian and international research if one fails to take into account the internationalization that characterizes them. But even the Brazilian banking industry capital (particularly the Bank of Brazil) builds financial operations to participate in this entry movement of private equity funds in the sector (Zanata, 2008).

Not always do foreign investors have an interest in acquiring the lands of the mills in which they have invested. There are quite a few cases in which mill owners need, firstly, to sell the lands – a process that, sometimes, is done by

¹² With the exception of palm oil, which, just like sugar cane, does not tolerate a long distance between the harvest and the industrial crushing unit.

transferring them to family members— leaving the investor only with the industrial part of the operations. In these situations, however, the new proprietors rent the lands in contracts frequently lasting over twenty years. Yet the leasing contracts, as will be seen below, go well beyond the lands of the former mill owners and significantly affect the settlements themselves.

- b) The crop and cattle farming areas in which the mills operate have continued to concentrate over the last years. A mill's **average area** in São Paulo, which, in 1970, was of 8,000 hectares, reaches today 12,000 hectares. In the stratum of areas with 30,000 hectares-plus, the average is 38,000 hectares, with several occupying areas ranging between 40,000 and 50,000 hectares (Veiga Filho, 2007). For the higher-than-20,000 hectares stratum, the average for own-cultivated land is 31,000 hectares, in 2002/03, 9% higher than the 28,500, recorded in 1995/96. Meanwhile, the strata below 1,000 hectares see their average area drop from 476 to 376 hectares over the same period (Veiga Filho and Ramos, 2007). This concentration, in São Paulo, occurs not only through acquisitions, but also through the leasing of lands formerly worked by independent farmers. Many of the plots deemed as suppliers' lands are leased by the mills, which are in charge of all operations therein, from the preparation of the soil and sowing to the harvest (Veiga Filho, 2007). Well, this productive pattern is prevalent in the recently occupied areas, and everything seems to indicate that it presides over the expansion of the crop in the Cerrado region. The Statute of the Sugar-cane Crop, promulgated in 1941, sought to regulate relations between sector participants, defined what was a sugar cane "supplier", and determined that a suppliers' list be kept by the Sugar and Alcohol Institute (extinct today). Forty percent of the mills' sugar cane should come from autonomous suppliers. The Statute had as one of its objectives to regulate the access to the benefits of the use of the property of the soil, safeguarding the interests of farmers not owning mills. Today, there is not a single legal instrument or internal sectoral regulation limiting the size of the mills and their power – *de jure* or *de facto* – over the lands they control.

It cannot be said that direct control by the mills over such large land expanses (whether belonging to them or to suppliers) is the result simply of technical necessity. In Australia, for example, the sugar cane farming industry "organizes itself on the grounds of a complete and radical separation between the industrial and farming activities of sugar cane production" (Reydon and Guedes, 2001). True, the costs of production in that country are higher than are those in Brazil. Yet nothing indicates that the better performance of Brazilian producers can be explained by, for example, a reduction in the transaction costs involved in the mills' direct power over the land and its use, or as the result of economies of scale derived from the size of the land estates. Of course, the differences between Brazil and Australia in the way relations between sugar-cane farmers and businesses evolved reflect the long-term historical options of each of these societies: in the case of Australia, territorial occupation aimed at strengthening a family farming that affirmed its productive capabilities, unlike Brazil where, since the mid-19th century, the entire process of land occupation is undertaken in an effort to limit the farmer's direct access to land ownership.

- c) The history of the sugar cane crop is marked, in all regions where it is predominant, by disputes between landowners and workers over access to land.

The sugar cane mill supplied the workforce's needs, until the late 1960s, based, to a great extent, on the figure of the **dweller** (*morador*). In addition to working in the sugar cane plantation, the workers had their **dwelling** (*morada*) inside the mill or farm premises, where they grew their own food. As of the 1950s (and made easier, from 1964 on, by the political conditions of a dictatorial regime that had weakened trade unions), a new process began of massive expulsion of workers from their homes, and the construction of self-contained neighborhoods, in the suburbs of the medium-sized cities of sugar cane regions, of "*trabalhadores de ponta de rua* (end of street workers)". Access to housing and to food production areas –set forth by the Statute for the Sugar Cane Crop and enshrined in agreements between workers and proprietors– was eliminated, seriously aggravating the living conditions of those who relied on salaried work in the sugar cane business and, evidently, broadening the bases of land concentration which, increasingly, has come to characterize the sugar cane crop.

If rights to housing represented a constraint to the territorial expansion of the sugar cane crop, the ever more important presence of sugar cane in agrarian reform **settlement areas** nowadays, in the State of São Paulo, can be seen as land reform in reverse, where many of those who were granted rights to access land begin making a living off the income they earn from its direct exploitation by the mills. Drawing on meticulous field work, Ramos (2006) shows that a settler leasing a 15-hectare plot, in the municipality of Promissão, in the State of São Paulo, earns an income of nearly BRL 500 per hectare, for a six-year contract, during which the farmer ceases any activity whatsoever on his own plot. Hardly any other farming activity would be able to yield such high gains. In addition to the land concentration and the monotony of the landscape caused by the sugar cane's overwhelming presence, it is no less problematic the fact that it transforms families settled by land reform, who paid nothing for the land, into leasers. This type of contract whereby the farmers cede part of their land for the cultivation of raw materials by certain industries (which take charge of every productive task, from preparing the soil to harvesting) is also frequent in the pulp and paper industry. Yet in the case of sugar cane, the crop occupies the whole extent of the plot, for that facilitates everyday tasks and the harvest. In the case of reforestation for cellulose, businesses encourage the maintenance of the farmers' activities inside their properties, which does not occur with sugar cane.

Yet, curiously, the National Program for the Production and Use of Biodiesel (Part 3 of this study) opened an amazing opportunity for farmers to be able to break away, at least partially, from the monotony of the sugar cane dominance and introduce other activities in resting areas of the big plantations, as may be seen in the case related in Box II.

BOX II

Through peanuts, farmers return to the heart of the sugar cane plantation

Based in Catanduva, in the State of São Paulo, Fertibom's main activity is the production and distribution of agrichemicals for the sugar cane industry, serving the whole region in a 100 km radius. As an agrichemical compounding company its products are made to each client's specifications, specially prepared for each tract within the same farm, which ensures a more efficient use of inputs in the sugar cane precision farming. Customized products, customer service and competitive prices are the company's trump card.

Three years ago, Fertibom, with an annual revenue of BRL 5 million (a small business for the Brazilian standards), taking advantage of installed capacity and equipment, set up a biodiesel plant with capacity for 6 million liters/year, upgraded now to 40 million, with the financial support of the Brazilian Development Bank (BNDES).

Because it is close to a cattle raising region (São Paulo State's northwest), the basic raw material for the production of biodiesel is beef tallow, which represents around 65% of the total biomass used, the remainder coming from oleaginous crops acquired from the Family Farming sector, peanut especially.

Family farmers partnering up with the company are originally from Catanduva or neighboring towns, and reside in rural areas on small ranches of up to two hectares, where they only grow vegetables and fruit, and raise pigs for their own consumption. They are quite prosperous. Traditionally they rented tracts of up to 40 hectares, where they grew peanuts, potatoes carrots, and beans for commercial purposes. The advance of the sugar cane monoculture in the last 15 years, however, has rendered their everyday practice of renting the lands more difficult, since landowners prefer to lease their lands to the mills. Many of them work today as contractors for the mills, that is, they are subcontracted to provide soil preparation or to recruit workers.

Taking advantage of a loyal customer portfolio of sugar-cane agrochemicals' purchasers and the trust earned, Fertibom proposed to the mills to allow those family farmers to grow, during the sugar-cane agricultural fallow period, peanuts to supply raw material for the production of biodiesel. By this arrangement, Fertibom would be the legal co-signer of the re-leasing of the lands (since the mill itself leases from local owners) to family farmers for a period of four months. The mill would hand over to the family farmers the land already ploughed and, at the end of the peanut harvest, between March and April, the farmers would return the land already prepared for seeding sugar cane to the mill, plus the equivalent to 8% of the peanut revenues in pay for the leasing. In case of a breach of contract, Fertibom would shoulder equivalent expenses.

For the farmers this entailed an excellent opportunity to resume growing peanuts, their specialty and a crop with high market value. Moreover, access to land that already been prepared by the mill made it unnecessary for them to get bank loans for this phase, the most costly, precisely at a moment when family farmers are hard-pressed for funds. To Fertibom it was the only way to buy oleaginous crops from the Family Farming sector in the region, without which it would not be able to produce biodiesel in compliance

with the requirements set by the social fuel seal (see part 3 of this work). To the mills, the advantage was the re-leasing, but especially the marketing of allowing access to family farmers while harmonizing the sugar cane activity with the production of food.

In the arrangement there is yet another peanut-based products' family business, called *GUED's*, which receives the grain from other medium-sized and large producers in the region. Family farmers sell their peanut crop to Fertibom, which takes the product to Gued's. There, the unshelled peanut is milled, and the two companies exchange peanuts broken in the process for whole peanuts (at a ratio of 4 kilos of broken peanuts for 1 kilo of whole peanuts). To Gued's, what is interesting is the whole peanut, for this high value-added product is designed for human consumption, whereas to Fertibom what matters is the oil, thus the broken peanut makes no difference. The oil extracted from the broken nuts stays with Fertibom, and the cake (the oil-less peanut mass) is used to make a typical Brazilian sweet, *paçoca*, and belongs to Gued's. The shell is used as fertilizer or for the generation of energy. The revenue made by each farmer, who cultivated some 59 hectares, was of BRL 218,000.

Fertibom sells the peanut oil to the same Gued's, as it is a noble oil, and buys the equivalent value in beef tallow in the region, increasing the quantity of raw materials for the production of biodiesel (one liter of peanut oil sold for the price of fifteen liters of tallow). In line with the PNPB, Biodiesel industrialists were allowed to use the oil acquired from family farmers in whatever way they preferred; therefore, the peanut-based arrangement, in spite of the company not using the peanuts in the production. This made possible, for instance, the production of castor oil, sold to the aeronautic industry, while buying the equivalent amount in soybean oil, increasing dramatically the amount of raw material.

Though sugar cane requires a 5-to-7 year fallow period, regionally there is a crop rotation, so that in the region there always is a 12 to 17% area of rested soil annually, ready for integration. Furthermore, contrary to what happens with other crops like soybean and corn, whose fallow is in the dry season, the sugar cane crop fallow occurs precisely in the rain season, the only time of the year when the seeding may dispense with artificial irrigation, which would make it economically unfeasible for Family Farming.

Catanduva is a very small municipality, with a total area of 29,200 hectares, 13,500 of which with sugar cane, which means an average of 2,025 hectares of rested land per year. It only has 1,246 hectares of native forest and 400 ha of peanuts (before the arrangement). This arrangement occupies 1,000 hectares with the re-leasing to 15 families. (Box prepared by Rafael Feltran Barbieri of the PROCAM at USP).

2.2. The governance of a strategic sector

It is not among the objectives of this study to review how sugar and alcohol prices are formed, or the relations between them and fossil fuels quotations. Of course, there are organized processes whereby actors seek to reduce the uncertainties derived from their exposure to market price variations, but their study is not essential to understanding the social effects of the expansion of ethanol in Brazil¹³.

Two dimensions of the governance of the ethanol market will be briefly reviewed. The first one is the liberalization of its markets. The second one refers to the rising weight that a significant number of stakeholders wield in the sector's fate. What is at stake here is the relation the private sector keeps with two forces that are essential to its own functioning: the State, on one hand, and organized civil society (in the form of the labor movement, NGOs and advocacy groups), on the other.

2.2.1. Liberalization: how far should Government intervention go?

The most important institutional aspect of the governance of Brazilian ethanol is in the transition from a system in which the State was omnipresent –in the setting of its basic rules, in the commercialization and in the subsidies awarded– to the present situation in which intervention by Government is much more limited. With the closure of the Sugar and Alcohol Institute, in 1990, the government gave up the direct monitoring of mill-supplier relations and the setting up of the rules for the sugar and alcohol markets. In the Pro-Alcohol first phase, from 1975 to the mid-1980s, the product was delivered to Petrobras, and the Public Treasury subsidized it so that it could be added to gasoline, and be sold at the pumps to be used with the new automobile makes then being manufactured. This intervention was decisive in that it enabled the sector to fulfill its learning curve and achieve the technical conquests that characterize it today. Bermann *et al* (2008:74) estimate that in the first two decades of implementation of the Pró-Álcool the investments made amounted to USD 11.7 billion, of which USD 7.4 billion came from the State, largely in the form of subsidized credits, many of which are still under “renegotiation” today. Plummeting fossil fuel prices (after the two shocks in the 1970s) made the program extremely costly – Brazilian State had to cover for the difference between a declining gasoline price and that of alcohol– and caused the production of Brazilian alcohol-powered cars to drop to a minimal level.

Today, Brazilian alcohol is a product that does not receive governmental subsidies for its production. Even rural production credit comes mainly from private sectors than from the Government. No doubt, there is strong integration with Petrobras, but high fossil fuel prices and ethanol's productivity gains no longer require Petrobras to subsidize the product to allow its consumption. The presence of the State in organizing the sector is achieved today, fundamentally, through financing programs offered by the National Bank for Economic and Social Development (BNDES) and through incentives to set up public goods favoring its expansion. This is the case for instance with the incorporation to the Growth Acceleration Program of the construction of an alcohol pipeline with 1,150 km connecting the states of Goiás and São Paulo. The proximity of the port of São Sebastião will enable export of 3.5 billion liters of alcohol exporting 3.5

¹³ The world's most important ethanol producer, COSAN, a Brazilian group, has just acquired the Brazilian branch of Exxon (Esso). Thereby, COSAN will be the first private group to be able to integrate ethanol production and fuel distribution, building on Exxon's large service stations' network.

billion liters of alcohol per year, starting in 2011. The alcohol pipeline will stimulate the construction of no fewer than 40 mills along its route, in the states of Goiás, Minas Gerais, São Paulo, Mato Grosso, Mato Grosso do Sul and Paraná (Porto, 2007).

Nonetheless, it is worth remarking that the reach and limits of governmental action in the growth of Brazilian ethanol are not clearly determined. Roberto Rodrigues, for instance –an important national leader and ex-minister of Agriculture in the Lula administration– calls for more governmental intervention and even the opening of a National Energy Department, with the mission of giving the sector the strategic treatment that today, in his view, it lacks. Nor is it irrelevant that Rodrigues presides (together with Jeb Bush, former Florida governor) over the Inter-American Ethanol Commission. Without such strategic coordination for the sector –which, according to him, only the government may deliver– it will be impossible to transform alcohol into an international commodity, one of the sector’s greatest aspirations, as we shall see further ahead when we examine the rules of exchange on which the Brazilian production hinges. According to Rodrigues, the oil industry will make every effort to obstruct the formation of a worldwide ethanol market, while the coordination of the interests that can oppose this obstruction is precarious.¹⁴ Furthermore, Rodrigues –with the authority of a former minister who has a huge constituency in the sector– points out an extraordinary drop in prices in 2007 (around 30%) due, in his opinion, to lack of planning, that is, the sector’s incapacity to regulate the quantity of alcohol the market needs, thereby exposing itself to oscillations whose consequences might be very serious. Additionally, in Brazil, there are no less than eleven ministries involved somehow in ethanol production, and the country lacks a research strategy that matches the importance of the sector. While the United States spends USD 2 billion a year on ethanol research, Brazil disburses less than 10% of that amount.¹⁵ His is a respected voice, and one that raises doubts as to the sector’s capacity to monitor its growth by itself.

2.2.2. The role of stakeholders

It is interesting to note the importance the negotiation between business and a diverse spectrum of actors have gained in different sectors of the Brazilian agriculture. What is remarkable is that this is a sector that is historically known for tense social relations and the rampant use of illegal and violent practices in the resolution of conflicts. In 2006, the Brazilian Association of the Vegetable Oil Industries and the National Association of Cereal Exporters decreed the **soybean moratorium** (Abramovay, 2006), whereby the companies agreed not to buy the product from areas that had been recently deforested. A problem that, in principle, corresponds to an externality, whose solution in theory would depend on the public sector, is openly assumed by the private sector. Pushing this orientation forward required that farms made available certain information that until then was strictly private. So much so that the measure provoked, at first, a furious reaction from the Mato Grosso State Federation of Agriculture and Cattle Raising (<http://www.alerta.inf.br/news/487.html>), as well as an editorial by newspaper O Estado de São Paulo, one of the most important in the national press, criticizing it. Such opposition is less surprising than the adherence to the moratorium of corporations like Cargill, ADM and Bunge and, particularly, of organizations like Greenpeace, The

¹⁴ Yet, one cannot ignore the very recent investments made by huge oil companies such as BP in Brazilian ethanol production. Shell and Total are also investing in and doing research on biofuels (Aragão, 2008).

¹⁵ Interview to newspaper *Folha de São Paulo*, 20 January 2008, p. B9.

Nature Conservancy, WWF Brasil, in addition to some rural workers' unions. These new negotiation modalities generally occur in very export-dependent sectors. This means that pressure on foreign buyers has considerable impacts on the sector's own organization, also illustrated by the connection between the soybean moratorium and McDonald's decision not to buy soy oil produced in devastated areas of the Amazon region.

Other segments of the crop and cattle and the timber extraction industries have also sought the support of nongovernmental organizations to negotiate modifications in their productive practices. The Sustainable Amazon Forum, for instance, gathered, in November of 2007, important Brazilian organizations as the Instituto Socioambiental, Projeto Saúde and Alegria, and Imazon, and social movements as the Rubber Tappers National Council (where Chico Mendes' emblematic figure arose), together with companies such as Vale do Rio Doce, Petrobras, Alcoa, Philips, ABN, Banco Itaú and Banco da Amazônia, to discuss forms of land use.

Faced with the shortcomings of a purely sectorial approach to environmental problems and the conclusion that, should there be restrictions to growing soybean, the producer would opt, for example, for corn to dodge the moratorium's restrictions, the municipality of Lucas do Rio Verde brokered a coalition between the public, the private and the associative sectors, and will be the first in the country to have all rural properties regulated with regard to compliance with the Forest Code. The ambition is to eliminate socioenvironmental liabilities, including its labor-related facet. The initiative has the support of private companies such as Sadia, Syngenta and Fiagril, local government bodies and the public attorney's office, and the (farmers') rural trade union, and is endorsed by The Nature Conservancy. It is important to underscore that Lucas do Rio Verde is today an important grain producer, while also the potential target (just like so many other municipalities in the Brazilian Center-West region) of the expansion of sugar cane.

There is a strong tradition of labor bargaining in the sugar and alcohol sector as a function of the previously mentioned social/strike movements of the late 1970s and, before that, of mobilizations that can be traced to the early 1960s. Ethanol's strategic importance certainly is at the root of the enlargement of the circle of actors interested in the sector, which range from research inside the universities¹⁶ and EMBRAPA to the very automotive industry, farmer-gathering organizations (ORPLANA) and, above all, the Sugar-Cane Industries' Union (ÚNICA), which brings industrialists together. Diversification of investors, as pointed out above, increases the number of the sector's stakeholders, which include, too, several government agencies and Petrobras itself. Still, it was only recently that a negotiation began involving organizations such as WWF, Conservation International, The Nature Conservancy, IMAFLORA and OXFAM.¹⁷ These stakeholders are bound to assume rising importance in the sector's organization for a decisive reason: the transformation of Brazilian ethanol into a commodity does not depend only on its price competitiveness and its positive energy balance. Ethanol may be considered –to use Neil Fligstein's terminology– a *challenger* in an international

¹⁶ In 1999, the sugar cane genome project started as part of a program of international repercussion coordinated by the São Paulo State Foundation for the Support of Research (FAPESP). Sugar cane is one of the few Brazilian farming products to which the contribution of private research –including the polemic realm of genetically modified organisms –is quite considerable.

¹⁷ OXFAM attended only the last meeting.

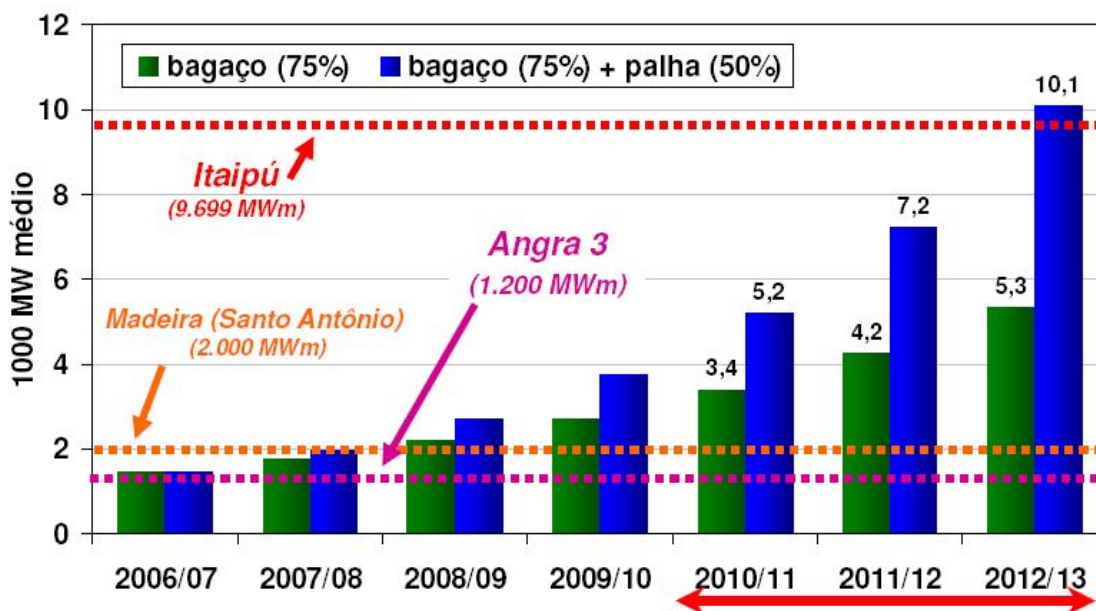
market whose *incumbents* will do everything possible to transform social and environmental rules into entry barriers. In this sense, just as it happens with soybean, meat, forestry, and pulp and paper, nongovernmental organizations and social movements will become interlocutors with a growing influence on the corporate organization of the Brazilian agribusiness.

2.3. Rules of exchange: certification, geopolitics and society

From the national point of view, the rules of exchange that provide fluidity and stability to the sugar-cane byproducts market are clearly defined. Situations like the one in the mid-1980s, when alcohol-powered vehicle owners faced lines at the service stations to fill up their cars, are no longer on the horizon not just because of the increase in the production of alcohol, but also, and more importantly, because of the flexibility afforded by new car technologies. Two issues may, however, jeopardize such stability. The first one is being addressed in a seemingly satisfactory way: the use of sugar cane waste to generate electricity. It is an important part of the energy balance of the ethanol production in Brazil that, with mechanization and with the advance of industrial research in the field, sugar cane leaves – previously burnt to facilitate hand harvesting– are now increasingly being used not only in the mills furnaces, but also to export energy. Besides an extraordinary increase in sugar cane productivity, over the last thirty years, research made progress in relation to the achievement of greater productivity in the production of alcohol and to new applications for sugar cane and its byproducts. Electric energy production potential is shown in Figure 2 below.

Figure 2

Current production and sugar cane bagasse and straw potential to generate electric energy



The generation of electric energy derived from the use of sugar cane bagasse and straw in mechanized areas reaches now, in 2007/08, the level of a 2,000 MW hydroelectric plant, and has the potential to surpass, in the next five years, the total provided by Itaipú

hydroelectric power plant. Energy supply contracts are long-term ones, ranging from ten to fifteen years.

But there is a second strategic dimension in the organization of the rules of exchange wherein things are much less clear: the effort to transform alcohol into an international commodity. The current scenarios for the expansion of sugar cane (UNICAMP's Development Foundation, 2005, for example) are premised on the assumption that Brazilian ethanol will become one of the decisive components in the decarbonization of the transportation sector. The key argument underlying such scenarios lies in the economic and energy efficiency of the Brazilian sugar cane products.¹⁸ International markets, however, do not respond mechanically to rules of efficiency. They incorporate critical **strategic** and **social** dimensions for the functioning and stabilization of rules of exchange.¹⁹ It is interesting to make reference to a warning in the F&C Investments newsletter, based on the analysis of thirty companies, about the sector's highly uncertain future on account of political risks.²⁰ It is important to mention this two-folded dimension, even if briefly.

- a) As well shown by Caesar *et al* (2007), the situation of profound uncertainty that shrouds the energy market cannot only be attributed to oil price hikes. The truth is that the factors weighing on the investments' profitability –cost of raw materials, governmental rules, but, foremost, the entry speed of innovations that may replace advantageously that which today seems the epitome of efficiency–²¹ are unstable. This does not mean that companies and investors will keep on waiting for safer solutions. New technologies are developed as a function of the interaction between industrial demand and research, not only by *learning by*

¹⁸ The research by UNICAMP's Development Foundation conducts a thorough survey of the social effects of the expansion of ethanol based on an input-output matrix model. It is not necessary to get into the details contained in the study to be able to conclude that farm mechanization and the industrial production of ethanol integrated to the energy supply have positive multiplying effects on the labor market. Nevertheless, reaching the targets forecast in the study –with ethanol contributing 5% of the world's supply of liquid fuels– supposes geopolitical and institutional conditions that might not be attained before new technologies allow the transportation sector to be less dependent on fossil fuels and likewise on those fuels originating in agriculture. This is the thesis, for example, both of the latest book by Lester Brown (2008), and of Bell (2007).

¹⁹ Referring to the "Economic and political sociology of international economic agreements", Neil Fligstein (2005:185) remarks: "market actors need rules to guide their interactions and exchanges, and without these rules, they may fail in the realization of investments".

²⁰ http://www.fundnets.net/fn_filelibrary/file/co_gsi_reo_research_biofuels.pdf Fevereiro de 2008. Quite interesting is the argument in the F&C Investors newsletter that the sector is in jeopardy due to instability in the prices of raw materials, poor governmental policies and broad social contestation. F&C itself relates its effort to "catalyze a more sustainable biofuels industry that will be attractive to long-term investors". This entails engaging in carbon economy, labor standards and biodiversity, with basically four actors: new biodiesel producers with publicly-held companies, large oil companies with projects in the area of biodiesel, the Roundtable on Sustainable Biofuels and public policymaking. Yet it is also important to point out F&C's view of the timidity of such concertation efforts and the decisive role oil companies may play therein.

²¹ Bell (2007) shows the extraordinary array not only of alternative energy sources to oil (and to nuclear energy too), but also the actual possibility of reducing the quantity of energy the transportation sector requires today. Lester Brown's latest book (2007) also brings a very rich account on this matter, even though his approach to first-generation biofuels is of a superficiality that contrasts with the wealth of information regarding other technologies. Indian company Tara, controlled by group Bengal Enamel (manufacturer of home appliances) recently announced, in partnership with China's Aucma (manufacturer of refrigerators, freezers and electric golf carts) the manufacturing of Tiny, an automobile that is even cheaper than the famous Tata, and which is to run on a 220-volt rechargeable battery (*O Estado de São Paulo*, 20 March 2008, p. Ca1).

doing but, as pointed out by Charles Sabel, by *learning by interacting*. No matter how deficient US corn energy performance is,²² there are three important strategic reasons for the US to have opted for its strengthening. In the first place are the interests not only of farmers, but also of the companies that invest in gigantic ethanol production units in the USA. Among them are precisely those that dominate the Brazilian grains markets, which also invest in sugar-cane ethanol (ADM and Bunge, for example). When these interests converge with the dynamism that the new product brings to several mid-western US regions, we realize that subsidies to the product –irrational from the perspective of free trade and technological efficiency– find solid roots for their maintenance. The second reason is that companies focusing on the production of corn ethanol are the same as those that account for a significant share of the research that might lead to the appearance of second-generation fuels, particularly those based on the use of cellulose. The third reason to explain the American strategy –which has a decisive effect on what Brazil does– is that the US will not accept to become dependent on the import of a source of energy whose productive and technical virtues are excessively concentrated in one single country.

This explains the efforts made by the Brazilian government and by the entity representing ethanol industrialists (UNICA) to promote the expansion of the sugar cane crop, concentrated today in a small number of countries.

Yet this effort prompts an important question from the angle of the international dissemination of the Brazilian experience and the transformation of ethanol into an international commodity. Are the huge territorial expanses and the level of industrial concentration (wherein efficiency starts with the milling of one million tons per crop harvested in a continuous area of 30,000 hectares UNICAMP Development Foundation) the reason for the Brazilian competitiveness? If the answer is yes, this means that the production of alcohol will require not only the undeniable technical competencies mastered by the Brazilian corporate organization, but also social structures as concentrated as those that already existed in Brazil, which the sugar cane expansion came to reinforce. Should the answer be negative, then the point raised by Xico Graziano and the very social usefulness stemming from the concentration that follows the Brazilian ethanol can be seriously questioned in Brazil itself. In other words, Brazil's extraordinary technical breakthrough in the production of ethanol may find an obstacle to its dissemination precisely because of the land, wealth and power concentration that characterizes it. The viability of less concentrated models outside Brazil is a practical questioning of the social sense of the immense territorial expanses on which sugar cane is based. To place these immense expanses as an essential requisite for competitiveness entails, in practice, blocking the advance of ethanol to other countries and its transformation into a commodity. The theme is directly related to the second dimension of ethanol's rules of exchange.

²² This deficiency is often overestimated, as shows the important, yet unfortunately little divulged, work by Morris (2008), in which he criticizes articles published in *Science* in 2008 (Serchinger, 2008 and Fargione et al. 2008). See also the interesting review by Wang and Haq, in a letter published in *Science* on 7 February 2008.

- b) The second decisive aspect of the rules of exchange underlying the transformation of Brazilian ethanol into a commodity is certification. Lower prices will not suffice at all to guarantee the entrance of the Brazilian product in the international markets. A recent work by Bartolomeu (2008), carried out with the support of a corporate initiative called ARES (Responsible Agribusiness) shows that, thus far, there are no clear definitions as to what are sustainable practices in the sugar cane industry. Sector representatives tend to view certification requirements as tantamount to protectionism, yet, at the same time, they prepare themselves for the fact that, without it, expansion plans and the investments made recently may be seriously endangered. Given the European target of replacing 10% of the consumption of fossil fuels with biofuel, by 2020, in all likelihood certification standards will be adopted mirroring those of the FSC in the forest exploration area. The rural zoning being prepared by Brazil's Ministry of Agriculture will facilitate this certification. Yet should it require, as predicted, "protection of the forests and river basins, the maintenance of forest corridors, safeguarding biodiversity and socially responsible aspects", even the most modern segments of the sugar and alcohol business will find it difficult to attest to compliance with the rules. Bartolomeu's text (2008) reveals that some of these certification processes rely heavily on the active participation of several stakeholders in their definition.

A second important dimension with regard to the social outcomes of the expansion of sugar cane refers to the impacts on food production and its prices. As revealed by the studies of the Agricultural Economics Institute of São Paulo, the surface cultivated with sugar cane in São Paulo has been rising, since 1970, at a pace of some 500,000 hectares a year. As the state's so-called agricultural frontier was nearly entirely occupied during that period, we may say that this growth came from the substitution of crops. The detailed study by Gonçalves *et al* (2007) shows that the main activities replaced by sugar cane were low-productivity pastures and, to a lesser extent, peanut (which now once again gains space within the sugar cane plantations, as was seen in Box II), and rice.²³ Beans, corn, and poultry and eggs did not suffer any influence from the expansion of the sugar cane crop in the State of São Paulo.

The already cited study by Nassar (2008) is accurate in that it shows that the production of biofuels accompanies hikes in oil prices. From 2005 to the first months of 2008, prices of farming energy commodities have outweighed those of oil, with the exception of sugar. Based on the energy content of each product, Nassar converts each of them into oil-equivalents and compares their relative prices. In 2005, corn, in oil prices, was worth USD 0.49 per kilo, while oil corresponded to USD 0.42 per kilo. Today corn is worth USD 1.05 per kilo, and oil is at USD 0.73 per kilo. Price relations go from 1.15 to 1.44. For colza, the ratio goes from 2.3 to 2.8. Soya goes from 1.5 to 2.3. In the case of sugar, unlike other agricultural raw materials, it devalued in relation to oil.

In short, the rules of exchange that will allow Brazil to become a strategic player in forming the markets that will accompany the decarbonization of the transport sector will

²³ Dr. José Sidnei Gonçalves, of the Agricultural Economics Institute (interview to the author), stresses that both rice and peanuts were associated with pasture renovation areas. Additionally, in São Paulo varieties of these two products were cultivated, though consumption was declining.

not be the result of the competitiveness and energy efficiency of their production. They depend on negotiations that involve both scaling up production capacity in other countries, and submitting alcohol to certification processes whose costs may be considerable.

2.4. Conceptions of control

A market's organization, its firms' behaviors, what is accepted as legitimate in their practices, and accepted and rejected forms of competition and cooperation are historical and cultural products and not mechanical outcomes of objective economic conditions. New technologies or modalities of industrial organization entail projects, proposals that can only prevail through a process of negotiation internal to the firms, the sector, and increasingly, the society.

In the case of Brazilian sugar cane, the conceptions of control with respect to the resources on which it hinges involve three decisive themes for an analysis of the biofuels' socioenvironmental impacts. The first one is the transition of a segment that used to live, to a large extent, off state-owned resources and whose pace of technological progress was precarious, into a **dynamic sector** that not only uses, but also promotes research and, today, attracts a sizable share of private and public investments. The second dimension of the conceptions of control refers to the relation with the **environment**. Two themes are critical in this regard. The first of them refers to the conflict between continuous areas of large expanses and the requirements of the environmental legislation with regard to the very organization of the production units: even mills considered exemplary, characteristically do not keep the 20% of native woods that, in the Southeast region, is required from each farming establishment. Often they do not even respect the secondary forest areas necessary to maintain the watercourses that run inside the farms. The second environmental theme is the expansion of the mill areas toward Cerrado regions: contrary to a frequent view, it is erroneous to characterize the Cerrado biome as farmland waiting to be occupied productively and whose preservation is of low interest. The third dimension of the conceptions of control outlined addresses the sensitive theme of the **working conditions** of the sugar cane salaried workers and the consequences of mechanization.

2.4.1. From the pro-alcohol to the pro-sugar cane

Ignacy Sachs (2007) always criticized the Pro-Alcohol Program for not fully tapping into the agronomic potential of the product. Brazil should have set up a **pro-sugar cane** and not a pro-alcohol, says he. By different ways from those advocated by Sachs, the recent technical progress boosted impressive diversification in the use of the product. The route taken was not, fundamentally, that of using biomass as a source of animal feed and integrating crop and cattle. Bonomi *et al.* (2006) show that the sector's technical progress stems not only from gains in farming productivity²⁴ – these have been characteristic for some decades, at least in Brazil's Southeast region – but also from adopting the concept of biorefinery, which entails the full use of raw materials geared to a broad array of products. On one hand, energy products: “the hydrolysis of lignocellulosic material in the production of fermentable sugars (chemical and biological route) and the gasification of this material followed by the synthesis of liquid fuels (thermal route)” (Bonomi *et al.* 2006). However, other uses of alcohol require

²⁴ Which has been, in the last years, of 2.5% a year.

large investments. Belgian group Solvay is investing USD 500 mi to produce ethene (a PVC input) using ethanol in place of naphtha (Scaramuzzo, 2008 b). The National Bank for Economic and Social Development will fund the setting up of a factory of the Belgian group with BRL 153 million. The news is particularly interesting because of the fact that the Belgian group has already used alcohol in the past and abandoned this technological road when a petrochemical pole was established next to the capital of São Paulo. Now the group returns to this technology. Another example of the diversified applications of ethanol is a company in the State of Paraná that uses the CO₂ released in the production of alcohol to produce sodium bicarbonate and, whose owner, signed a contract with ABN AMRO Bank of London to sell carbon credits in the future (Barros, 27 August 2007).

Bermann *et al* (2008) build on Macedo's work (2007) to show that if, until 1990, technical progress was concentrated on crop farming and on the crushing processes (introduction of new varieties, use of wash water in ferti-irrigation, biological plague controls, enhancement of crushing and fermentation techniques, generation of electric energy for the mills themselves), since then the techniques used will involve not only the mechanization of the harvest and the optimization of the cutting process (with extremely perverse consequences over the already exhausting pace of work), but also the selling of electric energy surpluses to concessionaires, the mapping of the sugar cane genome and the advance of research in transgeny, as well as flex-fuel engines and new management methods.

2.4.2. Frailties of the great environmental trumps

It is not necessary to elaborate on some of the sugar cane's considerable environmental advantages with regard to the production of energy. It is hard to imagine what the city of São Paulo would be if, for example, its transportation system was entirely dependent on gasoline and diesel. Moreover, studies about the advantages of sugar cane in capturing carbon and its thus far unrivalled energy balance –at least when compared with commercially viable products– are widely known.

There are, however, two environmental problems about which the conceptions of control prevailing in the sector are not sufficiently clear.

- a) The first of them is in reference to the mandatory procedure, provided for in the Forest Code, that every farming establishment must preserve a forested area. In the country's Southeast region, this area is of 20%, and there are strong indications that this obligation is not being abided by.²⁵ The vegetation upon which streams and rivers inside the properties depend is often cut down. The São Paulo State Department of Agriculture estimates that the recovery of these areas could reach 1.7 million hectares, but there is no precise information on how much, of this total, corresponds to sugar cane crops. Sugar cane in the State of São Paulo surely has the largest biological control system in the world. The biological problems that arose during the expansion of the crop's mechanization

²⁵ The government of the State of São Paulo established, by means of a 2006 order, that compliance with the federal forest legislation (20% of reserve areas in each property) may be replaced by maintaining an area outside the property, provided it belong to the same ecosystem of the forest destroyed. Researchers of the São Paulo Agricultural Economics Institute (Gonçalves and Castanho Filho, 2006) consider unrealistic compliance with this legal provision and argue that it would require abandoning 3.7 million hectares of productive areas, with a loss of crop and cattle gross earnings estimated at BRL 5.6 billion.

have been solved. In the production of sugar, the Sugar Cane Technology Center (CTC) is patenting a sugar production process that eliminates the use of sulfur, a mineral used theretofore to whiten the product, originally of a dark color. Another significant recent innovation is the elimination of the washing of the sugar cane as it arrives at the mill, and its replacement with a dry-ventilation system. It is interesting that the very researcher involved in these innovations remarks that “we are a step ahead of potential questions by importing countries, which could create technical barriers to the Brazilian product” (Scaramuzzo, 2008c). In spite of these important environmental breakthroughs in the biological and engineering fields, the sector has tremendous difficulty in preserving the legal reserve and oftentimes the secondary forest area.

Yet how is it possible that in such long continuous surfaces large-scale phytosanitary problems do not arise? In the orange and cotton crops, for example, the appearance of these problems came to be one of the factors for the huge losses endured by the producers as a result of the growth of their plantations. Indications are that, in the case of sugar cane, the vast territorial expanses do not lead to serious agronomic problems due to the immense diversity in the varieties researched and planted. It is a form of landscape diversification in biological terms, maintaining however its monotony, important for the advance of mechanization. Certainly the balance in these vast expanses is precarious: in September 2007, the Sugar Cane Technology Center (CTC) detected an attack by a giant *broca* boring worm (*Telchin licus*), whose method of combat is still unknown and which has already started to cause losses in the plantations (Scaramuzzo, 2008d).

It is worth recalling that there, where the largest mills are concentrated, the harvest is increasingly mechanized (as we shall see below, in item 2.4.3), and that the sector’s representatives made an agreement with the government of the State of São Paulo to bring forward the deadline for the total extinction of the slash-and-burn fires or *queimadas*. In the expansion of these large-scale mills to the country’s Center-West, *queimadas* should not be a problem, since harvest mechanization is in line with the new units’ standards. Yet in the Northeast, *queimadas* still represent a very serious problem,. Although investing in mechanization is worth its price, there, where productivity is high, its cost is of a magnitude that beyond the majority of the northeastern producers.²⁶ Research studies of smaller machines— more adequate for areas with steep inclines – are still in development.

But the polemic theme, whose conceptions of control have not been stabilized and are a source of conflict, is that of the techniques necessary for an agronomically sustainable production. Sugar is Brazil’s most-exported organic farm product, and one of the main farms producing it meets every requirement set by the environmental legislation, with no use of agrichemicals and preserving its native woodlands, as well as the coverage of its rivers. This is a mill that cultivates an impressive 14,000 hectares of sugar cane (São Francisco Mill), and whose produce is certified (http://www.nativealimentos.com.br/cana_verde/colheita.php). Its productivity is 105 tons per hectare, 25% bigger than the already high average of the State of

²⁶ The machine, and the structure that comes with it, costs approximately BRL 2 million.

São Paulo. Crop management seeks to eliminate to the utmost the use of external inputs, and adopts crop rotation. The mill produces one million insects per day to stimulate the biological control of plagues. These practices have made it possible for the mill to relocate at least partially the workers engaged in the manual cutting of the sugar cane to biological control activities (Yoneia, 2008). It is worth noting that ÚNICA is getting specialized advice to enable it to reduce the impacts and environmental risks inherent to the continuous production in such huge expanses.

- b) The second poorly addressed environmental problem is related to the expansion of the sugar cane crop. It is indeed true that the Amazon region is not directly threatened, since its soil and climate conditions are hardly adequate for sugar cane, which needs a longer hydric stress period to fully develop its energy potential. Yet it is still unclear the effect that the purchase of land for the production of sugar cane has on soy and cattle farming. Nilo d'Avila, a researcher with ISPN, reports²⁷ the migration of herds in consequence of the sale of lands for the setting up of mills. There are municipalities in the Center-West of the country seeking legal means to limit the presence of sugar cane in their territories.

It is in the Cerrado region that the greatest environmental risk stemming from the expansion of sugar cane lies. The problem there, different to the Amazon region, is the weak social (domestic and international) pressure to protect the Cerrado biome. The Cerrado is construed as an agricultural frontier and not as a biome whose maintenance is in the interest of Brazil and of humanity. Actually, a very important part of the Brazilian Cerrado has already been deforested. Yet, when it is said that sugar cane will occupy degraded pasturelands, a good part of these areas belongs to the Cerrado ecosystems, whose use is poorly monitored if it exists at all. The setting in place of infrastructures such as the alcohol pipeline strengthens the economic actors' propensity to consider the Cerrado as an area to be occupied with productive activities.

2.4.3. Between degrading work and mechanization

The third component in relation to which the actors' conceptions of control are undergoing important and controversial changes is the labor market. The worst practices of the 1970s and 1980s –lack of formal labor contracts and recurrent use of child labor– were practically banned in the Southeast region and are declining in the rest of the country (Balsadi, 2007). Critical to these improvements were the struggles waged by the salaried workers and the establishment of a specific organization to represent them, the Rural Employees' Federation of the State of São Paulo, FERAESP. In 2004, in the sugar cane work, an impressive 93% of the workers residing in the municipal center had work contracts and enjoyed social security benefits. Revenues from salaried work grew: The percentage of workers who earned one-minimum wage-plus rose from 57.6% in 1992 to 69.6%. Child labor, which was at 14.7% in 1992, fell to 0.8% in 2004. It is worth remarking that workers living outside the municipalities' government center exhibit far worse social conditions: in 2004, only 40% of them had work contracts.

²⁷ Interview to the Author.

Despite these improvements, work in sugar-cane cutting is extenuating, entails long hours and generates such physical exertion that researcher Maria Aparecida de Moraes Silva (2005) concluded that the useful life of a sugar-cane cutter is shorter than that of a slave. The cutting is performed by young individuals who come from very poor and distant regions (Jequitinhonha Valley, in Minas Gerais, arid and semi-arid zones of the Northeast). Upon arriving, they are submitted to a productivity test that screens only the strongest and fittest, who will, on average, give 30 scythe blows per minute in working days that will extend for ten, sometimes twelve, hours. In 1969, a worker harvested 3 tons per day. These days, a performance of less than 10 or 12 tons a day will be deemed poor and, the job, therefore, threatened (Ramos, 2006). The harvest's pay, which was BRL 2.73 per ton in 1969, goes down to BRL 0.86 per ton in 2005 (Ramos, 2006, deflated data). The use of IT systems to control the pace of work, making it easier to manage individual production, also contributes to raise the amount of sugar cane harvested by each worker (Graziano, 1997).

Sugar cane's degrading work also extends to the regions it has expanded to. A news report, published in Brazil's most important business and economy newspaper (Valor Econômico) is eloquent: "In one of the visits to sugar cane plantations in [the municipality of] Naviraí, we spoke to a Northeastern cutter who had had his finger torn off by the *podão* (machete) that same day. The worker, who preferred not to identify himself, had been medicated, but went back to the plantation to wait for the bus that would take him home. He would remain there for another six hours. Pernambuco-state cutter Francisco Carlos da Silva, aged 34, says he has constant cramps in the stomach, yet he never stops. He reveals that he earns by volume cut, and that he cannot stop. His wage is BRL 700 per month – most of it saved for the family, who live in Trindade. The mills to the west of Mato Grosso do Sul State were the target of denunciations in the last months for unhealthy working conditions, poor lodgings and ill treatment of Indian and northeastern labor, according to the State Labor Attorney's Office". Denunciations of ill treatment of sugar cane workers are frequent, often involving large companies in the Center-West. Brenco, for example, which has investors as Bill Clinton, James Wolfensohn and Vinod Khosla and which is set to open ten ethanol mills in Brazil, was caught red-handed by a Ministry of Labor team employing 1,500 workers in degrading conditions, which might be characterized as slavery.²⁸

Mechanization will suppress these patterns of workforce use in ethanol production. Today almost half of São Paulo's harvest is mechanized. The environmental protocol that brought forward the deadline for the end of the *queimadas* and the prospect of using sugar cane straw to supply electric energy broadens the incentives to mechanization, which is expected to cover the whole of the state of São Paulo by 2014. Indications are that all new units to be installed in the Center-West of the country will also be mechanized. Mechanization, in São Paulo alone, should eliminate the jobs of at least 420,000 workers by 2014, when the *queimadas* will be banned in the state. Indeed, the figure that marked the social living conditions in the sugar cane industry throughout the country, the *volante* or *bóia-fria*,²⁹ is to disappear from sugar cane plantations in ten years' time. As of 2008, the sugar cane complex will lay off more people than it will be able to recruit for new tasks derived from the mechanization. A recent research study by Professor Pedro Ramos (in a story published by newspaper *O Estado de São Paulo*,

²⁸ <http://www.24horasnews.com.br/index.php?mat=247470> – Retrieved from the Internet on 26 March 2008. The company's web site does not deny or clarify the matter.

²⁹ Migrant workers, who got the nickname from the precariousness of their nourishment.

Gallo, 2008) shows that 171,000 jobs will be generated in this transition in the sugar cane industry. Yet, those are jobs requiring a much more skilled workforce than that which is leaving the fields. It is of critical importance to bear in mind that these are degrading jobs, as explains Professor Pedro Ramos: “cutting sugar cane makes no sense, it’s a waste of human effort”. And he rightly concludes: “these laid-off workers will need land and employment in their States of origin”.

3. Biodiesel

The National Program for the Production and Use of Biodiesel (PNPB) seeks to accomplish three, not necessarily compatible, objectives.

The first consists of diversifying the bases on which the decarbonization of the transport sector will be made possible. However efficient ethanol is, it would be imprudent to concentrate on it all governmental efforts to free the country from fossil fuel dependence. Even more so because biodiesel’s technological pathways may contain potential for innovation, whose opportunities in terms of wealth and income generation—particularly with Brazil’s endowment of land, water and sun— are unpredictable today.³⁰

But such diversification –the second objective– is to be met by the private sector, no matter how relevant Petrobras’ corporate actions might be. One of the important arguments of several foreign investors in the area lies exactly in the potential offered by diversification.³¹ Of course, this second objective poses a serious problem: those longer-existing, more mature production chains tend to dominate the market, while access for new actors is hard. Thus far, the PNPB has in soybean –and, to a lesser degree, beef tallow– the overwhelming majority of its raw material, with companies seeking to diversify facing significant problems.³² Therefore, one of the core challenges for the PNPB is to diversify corporate activity toward products other than soya. As many of those raw materials are not edible and can be exploited in lands of relatively low fertility, therein lies the hope that the program be advanced without compromising the country’s food security or threatening ecologically sensitive areas.

The program’s third objective focuses on making the expansion of biodiesel a strategic factor for strengthening family farming and, above all, its most fragile sectors. The PNPB is, from this standpoint, an outcome of policies that had their start in 1996, with the National Program for the Strengthening of Family Farming, and is created with the outright objective of aligning the struggle against the greenhouse effect and changes in the transport sector’s energy standards with better income distribution. The ambition is so much more important since, as was seen in item 3 of this work, ethanol’s energy and economic efficiency (as expressed by alcohol’s declining prices and its positive energy balance) has as its counterpart extraordinary concentration of land and productive resources.

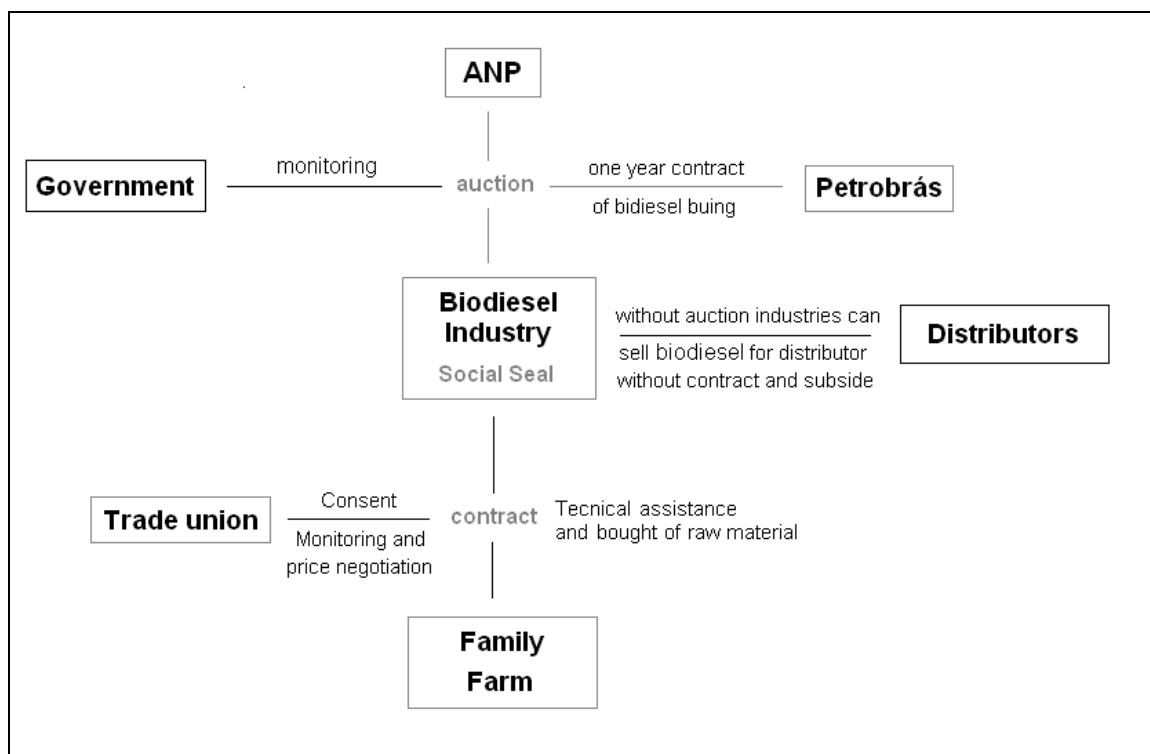
³⁰ Petrobras, for example, already has biodiesel production technologies based on the direct crushing of castor seeds, without the need to transform them into oil first. The Petrobras Research Center (CENPES) developed and patented H-Bio, a product that does not require sulfur, reduces emissions of pollutants and comes from farming raw materials.

³¹ Spanish group Promobarna is building 30 mini mills in Northern Minas Gerais, with a total investment of USD 200 million. The technology allows the same unit’s operation to rotate raw materials, which fosters diversification of the supply sources (Moreira, 2007).

³² Yet even traditional soya industry companies conduct research into other raw materials with the prospect of diversifying their productive base.

Created in 2003, through a negotiation involving government, rural workers' trade unionism and the private sector, the PNPB managed, in two years, to reach the target of incorporating 2% of biomass-derived product to fossil diesel. The main instruments for achieving this objective are summarized in Figure 3.

Figure 3. Agents engaged in the National Program for the Production of Biodiesel



Source: Abramovay and Magalhães, 2007.

The government guarantees the purchase of the product based on the legal provision that, as of 2008, the Brazilian diesel would contain 2% of the original biomass product. This ratio is to rise to 3% in July 2008, and it seems that the 5-percent target (to come into force in 2010) will be brought forward. Petrobras makes the mixture, under supervision of the National Council for Energy Policies. The acquisition of the product by Petrobras can be done in two ways. The first one is through the market. The other one is through auctions, whose participants must have been awarded a **social seal**. This seal, under the supervision of the Ministry for Agrarian Development, attests that the company signed contracts with family farmers who will take charge of supplying a variable, from region to region, quantity. In the Northeast, to obtain the social seal, 50% of the raw material processed by the industry has to come from family farming. In the Center-West, only 10 percent. The social seal clears the way for the company to get fiscal exemptions and obliges it, in turn, to provide farmers with technical assistance and a guarantee for the acquisition of the product at a pre-established price. The labor movement, in principle, monitors the contracts, and a protocol is in place between the National Confederation of Workers in Agriculture and one of the sector's main

companies, Brasil Ecodiesel.³³ As we shall see below, in item 3.2., auction rules were relaxed last year, and the social seal was not required in the auction that took place in 2008.

Its two years of operation do not allow a judgment of whether the program is meeting its objectives. The Pro-Alcohol, in its inception, was much more dependent on public resources than the PNPB is today, while the former's capacity to meet the market demand proved to be quite precarious, when –less than ten years before its launch– the costs represented by the gap between ethanol and oil prices, which the Brazilian State had to foot, made it economically unfeasible. This comparison is cited with enormous frequency to show that there is a technological and social learning curve that has every chance of allowing the PNPB to establish itself.

Yet the information available on the two years of the Program's functioning does allow us to raise at least three problems on whose solution the future of the PNPB depends.

The first of them refers to family farming. To date, only its more prosperous segments have managed to integrate themselves to the biodiesel production chain: More than 90% of the raw material from which the oil is made comes from soya and the remainder, almost entirely from animal tallow. True, a significant share of the soybean comes from household production units. In the State of Rio Grande do Sul, for example, more than 50% of its supply comes from establishments that do not employ salaried work. However, soya producers are within the wealthier family farming segments, that is, those that not only have more land, but especially those with access to more dynamic and competitive markets. In the Center-West, for example, soya family farmers that join the program own properties often exceeding 200 hectares. Products corresponding to the family farming's lower-income segments (castor seed and *dendê* palm oil, for example) hold so far a minute share. The recent work by Ferreira (2008) in the State of Goiás shows that the acquisitions by companies from land reform settled farmers producing castor bean were insignificant given the importance of the supply of soybean by the more consolidated family farming segments.

The second problem arose in 2007, with a considerable rise in raw material prices, especially those of an agricultural origin, in a process that some have already christened agflation. The PNPB was planned when agricultural prices were depressed and, from this angle, it could work as a means to stabilize prices and guarantee income to farmers. The rise of international prices –and the impacts of this rise on grain quotations as a consequence of growing corn to produce ethanol in the United States– change the scenario for two reasons. Firstly, because it makes it more difficult to incorporate biodiesel to the fossil fuel, given the potential impacts on the final consumer's pocket.³⁴ Moreover, higher raw material prices increase opportunities for trading farm products and pushes up the opportunity cost for the production of biodiesel. As yet, the

³³ Abramovay and Magalhães (2007) reviewed in detail the basic mechanisms of the PNPB functioning, herein briefly summarized. Also, see the book recently launched by FASE on the theme (Brazilian Network for the Integration of the Peoples –Rebrip, 2008). The book's core thesis –that the theme studied here should be called agrifuels and not biofuels, since the latter expression comes from Greek, meaning life, and agrifuels are not produced respecting life– is not convincing (Leroy, 2008). Even if it is not sustainable, farming is, of all economic activities, the one most dependent on living processes and the main feature of this decarbonization path for the power grid (unlike aeolian and photovoltaic energy) is to support itself on the use of living processes, even if considered distant from sustainable processes.

³⁴ These direct effects on the Brazilian consumers' pocket, as will be seen, tend to be negligible.

mechanisms are still unclear whereby actors will seek consensus to stabilize their relations, without allowing these price swings to be destructive to the functioning of the market. Even more so because, as well demonstrated by Nassar (2008), agricultural price hikes are strongly influenced by factors that are well beyond the reach of local markets.

The third problem is that the enthusiasm itself of the private sector with the program seems to have dampened, relatively to the moment it was launched, due to the contrast between investments made, the commitments pledged and difficulties in delivering the product in face of more advantageous opportunities for its commercialization, out of the biodiesel production. The bottom line is that this is about a conflict between the use of agricultural products for energy and other purposes (food, for example, but in the case of castor bean, for cosmetics or the ricin-based chemical industry). But it is also about the difficulties of organizing a sector –or a social field, to use Pierre Bourdieu’s language–, in that rules of behavior socially accepted as valid in competitive disputes are not clearly established.

The application of the four basic categories based on which Neil Fligstein addresses markets from a political-cultural perspective, is, in the case of biodiesel, much less clear than in the case of ethanol. This is about a start-up sector that has not clearly established its **property rights** (Who can produce biodiesel and who benefits from its trade?), its **governance structure** (How much should the sector invest to avoid becoming a victim of its own idle capacity? How can we make sure that firms are fulfilling their contracts with the farmers? Is it valid to commit oneself to deliver castor oil and deliver soybean oil? What is the role of Petrobras?), its **rules of exchange** (Who are the farmers who supply raw material? Can vegetable oils be used to make biodiesel in an apparently strong bullish market?), and its **conceptions of control** (Which technologies are employed and what are the odds for the autonomous organization of family farming in this market?).

Condemning the program based on the fact that, today, it relies on raw materials whose immediate economic viability is low and whose energy balance is worse than that of ethanol, means renouncing the diversification of alternatives to oil, and focusing exclusively on alcohol. Yet the fact that biodiesel might represent a strategic road for Brazil does not mean that the current frame and the incentives created by the PNPB do not have flaws. This is what we will see next.

3.1. The political construction of property rights

Property rights are not only important from a juridical-formal perspective, but also for their capacity to define who claims the gains of a certain economic activity. Such definition is always political, especially in a market in which the presence of the State is critical, not only because it defines laws and procedures, but also because it is the direct regulatory body and exercises –through Petrobras– a corporate productive activity.

There are four fundamental actors contesting for the gains –and occasionally for the distribution of losses– stemming from the production of biodiesel: Farmers (employers and family farmers), the biodiesel producing companies, Petrobras, and the State itself (as regards tax collection). Four interesting themes can be raised.

a) The family farmers taking part in the Program are formally defined as such through a PRONAF declaration, the Declaration of Aptitude (DAP), issued by the rural workers' trade union or rural extension offices. This is a mechanism used by the PRONAF to keep those social segments that do not belong to the family farming sector from benefiting from the incentives set in place by policies designed to strengthen it. To obtain the social seal, companies must establish contracts with individual farmers (directly or via cooperatives) who hold a DAP. This means that trade unions and rural extension –present in 90% of the Brazilian municipalities– have, in principle, an important power in the definition of the rights of farmers to participate in the Program. Each contract between the industry and the farmer is signed by the president of a given municipality's trade union.

b) In contrast to what happens in other agribusiness activities –including alcohol– the production of biodiesel by farmers, for their own use or local commercialization, although possible, is subject to a heavy set of legal requirements that practically rule it out. Even with regard to initiatives by family farming cooperatives and self-consumption for its members, strict compliance with the rules is required. By legal standards, the production (and not only the commercialization of biodiesel) presupposes the existence of a company formally established with a minimum capital of BRL 500000. This requirement can be waived in special cases. There is the need to obtain an authorization from ANP, the National Oil Agency, and a special registration with the Internal Revenue Office, together with environmental licenses, permits to start operations and the approval by the fire brigade of the fire prevention project. Commercialization of biodiesel for self-consumption by the cooperatives' members requires a special authorization from the ANP, whereas the commercialization to third parties can only be done by companies, though not to end consumers. Even so, this requires an ANP authorization. Another relevant aspect, when assessing the potential for producing biodiesel in small scale, is that quality control expenses involving laboratory analyses are relatively high and are under the entire responsibility of the biodiesel industry. This means that exercising property rights in the production of biodiesel is hardly accessible to rural workers' organizations and their cooperatives and, even less, to independent producers, even if their volumes are high enough to allow them to take part in the market or to guarantee their own supply.

c) As Petrobras has the monopoly over the acquisition of diesel, this gives it extraordinary power. Part of the BRL 38-million loss that Brasil Ecodiesel, one of the most important firms in the industry, posted in 2006 was attributed, by a company official, to a bottleneck in Petrobras' capacity to retrieve the fuel (Bouças, 2007). Even though the situation since then has normalized,³⁵ this means that the right to enjoy the benefits derived from the production of biodiesel is contingent upon relations with Petrobras. The role of Petrobras in this market is much more important than in the case of ethanol. And it is important to remember that Petrobras, besides having a decisive function in regulating the market, also acts as a biodiesel producing company and is building three mills in the cities of Candeias (Bahia), Montes Claros (Minas Gerais) and Quixadá (Ceará), with an annual production, each of them, of 57 million liters, for a total investment of BRL 227 million. More important was the news that the company is to soon install in the Northeast a mill with a capacity for producing over 800 million liters, tapping into the already mentioned technology whereby biodiesel is directly

³⁵ As of the current year, other distributing companies can also retrieve biodiesel to make the mixture, although, the authorization for and control of the operation is with the National Oil Agency.

extracted from the bean, without first being transformed into oil. Should indeed this initiative prove successful (Petrobras did not deny the news), it considerably undermines one of the Program's basic principles that was to anchor the agricultural and industrial production fundamentally on the private sector.

d) The corporate structure of Brazilian biodiesel is still unstable. Despite the apparent diversity of companies, actually one of them has a huge control over a market where the Program's social benefits are most expected, the Northeast. Brasil Ecodiesel is not a traditional company in the oil-crushing field. It comes from the electric energy industry and arose as a challenger (in the sense employed by Fligstein), by innovating its corporate practices, floating its capital on the stock exchange, implementing its own technical assistance program, and even organizing a settlement, Santa Clara Farm, in Piauí. This company is not a member of the sector's most important industrial association. At the same time it is the one with which the National Confederation of Rural Workers signed a cooperation agreement. It is important, for the future of the Program, to keep track of how the establishment and development of companies capable of tapping the economic advantages of biodiesel is done, in other words, of making their property rights worth.

3.2. Governance: auctions, investments and social participation

It is around the competition and cooperation relations established between the main actors of a market –based on formal and informal parameters that are historical outcomes particular to each society– that the modalities of market governance are established. There are three polemic themes in the way the biodiesel market governance is organizing itself.

3.2.1. Auctions: reach and shortcomings of a stabilization mechanism

The main problem with the auctions, as carried out in their first year of functioning, is that market prices far exceeded what the companies and Petrobras had agreed. The 800 million liters auctioned eventually translated into the delivery of only 400 million liters. Table 2 refers to the period up to July 2007, which is why it shows a production volume of 212 million liters. Nonetheless, what calls one's attention is that only one company –Granol– matches closely the volume produced and the volume auctioned. Brasil Ecodiesel, for example, which undertook to deliver more than half the volume acquired in the 2007 auctions, was way below fulfilling its commitment. Granol, in turn, delivered the entire production it had committed itself to do. This created a feeling of inequality and uneasiness that considerably compromised corporate cooperation in the sector and the very confidence of the private sector in the Program.

At the time of delivery, ANP set the auction's opening price at BRL 1.92 per liter (July 2006). In September 2007, according to an industrialist from the sector (Bouças and Bueno, 2007), the product was to be sold at BRL 2.20–2.30. Well, at that time conventional diesel was selling for BRL 1.80. The very existence of the auctions was brought into question by the sector's industrialists, since they induced them either to fail to fulfill the contracts they had signed or to trade the product at a lower price than that paid by the market. The internal unity of the business community – which threatens the confidence of this decisive sector for the PNPB– was seriously undermined by differences in the conduct of those companies that fulfilled and those that failed the commitments made at the auction.

TABLE 2

Volumes of biodiesel traded and produced up to July 2007



Source: Bouças and Bueno, 2007.

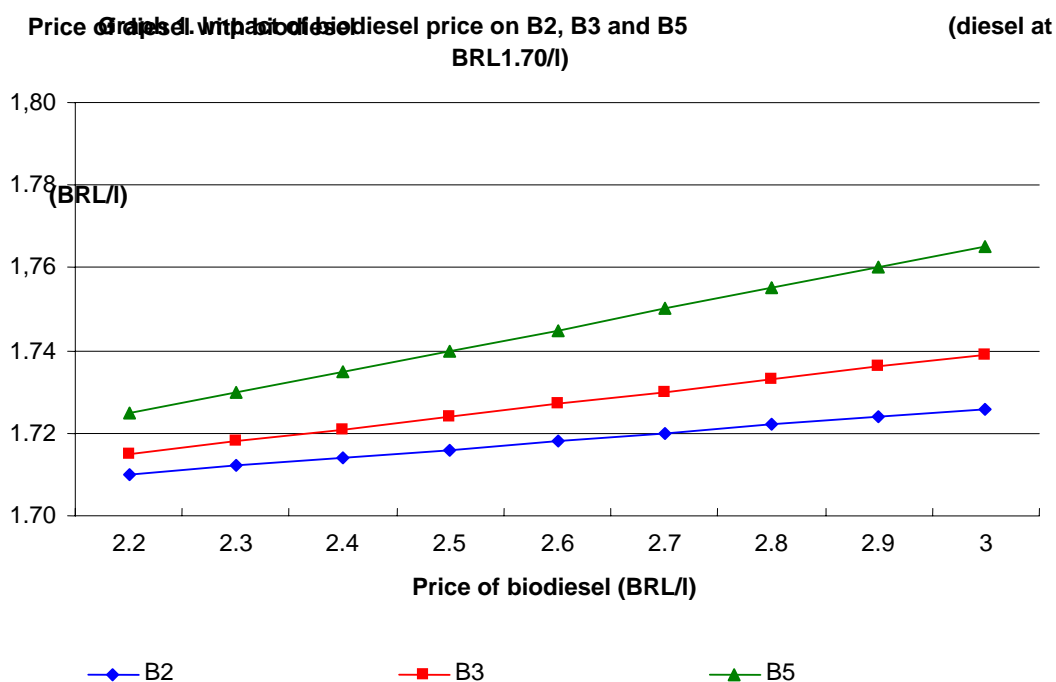
It is worth highlighting that, at that time, the non-delivery of the product auctioned did not entail any legal penalty. Today, this has changed: delivery became mandatory and the penalties, in case contracts are not fulfilled, are severe. The average price obtained at the auction held on 10-11 April 2008 rose to BRL 2.69 per liter, nearing the current market situation and boosting the odds that the product will indeed be delivered for the production of biodiesel. More than that, during the first auction the price was 25% below the ceiling established by the government. Such a big difference signaled the likelihood of predatory competition between participants and, therefore, contract failures. Now, despite the large number of participants, prices were negotiated at only 4% below that established by the Government. Delivery terms for the product fell from six to three months, which reduces the chance of a big difference between the strike price and the market price at the time the product is delivered.

Yet it is noteworthy that of the 330 million liters that the companies pledged to deliver by the terms of the auction, only 16% should come from the Northeast. The North region has only 0.6% of the total. The country's most prosperous regions and where the incidence of rural poverty is smaller contribute more than 80% of the biodiesel production that is auctioned, which serves to show the enormous difficulty encountered in stimulating the organization of the markets in which the lowest-income segments of family farming are.

The impact of such a considerable price raise on what the consumer will pay for the biodiesel is insignificant, as can be seen by Graph 1. The graph shows the weight of the biodiesel price increase on conventional diesel, as the proportion of the product from the

biomass admixed to the fossil-based product rises. The effects of the mixture amount to two decimal places: a proportion lower than that of the discounts that gas station owners offer to their clients and, therefore, even if it reaches 5%, it will not be felt by the consumer. It is worth pointing out that biodiesel does not receive any direct governmental subsidies except for a fiscal relief of a very low rate. The incorporation of biodiesel to diesel is paid for by the consumer and, from what Graph 1 shows, its impact is very limited.³⁶

Neither can we neglect the fact the Brazilian diesel is among the cheapest in the world because of an option made for road transportation by the Juscelino Kubitschek administration's Targets Plan (1955/1959), which stimulated road cargo transit to the detriment of the railways. Brazilian diesel is particularly disastrous, from an environmental point of view, and the State of São Paulo, together with the Federal Attorney's Office, filed a tort claim against the National Oil Agency and Petrobras, demanding the observance of standards that should immediately modify the composition of the diesel, so that it has, among other modifications, a lower level of sulfur. Compliance with this standard should raise the cost of diesel somewhat, which may bring it closer to the diesel derived from farm products. What is important is that the low price of the Brazilian diesel conceals a serious negative externality that contributes to the very poor quality of the air in Brazilian metropolises. It is critical, when discussing the economic feasibility of biodiesel, that this factor be taken into consideration.



Despite its imperfections – among them the time lag between the signing of the contract at the auction and the sale of the product–, the auction seems to be an interesting mechanism to ensure both the supply to Petrobras and a stable market horizon for the

³⁶ Apparently, such considerations were not taken into account in the criticisms that one of the most important Brazilian experts on the theme, Professor Horta Nogueira (2008), made to the PNPB in a recent article.

companies. The price increases that marked 2007 will not perpetuate themselves, and it is likely that the entrance of new producers in the market may lead –as is happening with ethanol– to a price reduction. In principle, the auctions represent a healthy effort by the State toward aiding to stabilize a market that is still in formation.

3.2.2. Investment control

The second problematic aspect of the Brazilian biodiesel governance is that industrial investments seem to considerably exceed the immediate demand for the product. Today, Brazil is nearing an installed annual capacity of 3 billion liters for an initial demand forecast for 2008 of 840 million liters. With the adoption of the 3-percent ratio in July, the demand will rise to 1.3 billion liters, still far from the installed capacity. The result is that, in February 2008, of the 51 biodiesel plants authorized to operate in the country, 30 were not operating or had a sporadic production. One of the largest industrial producers of farming equipment, Dedini, confirms that the initial enthusiasm with the program did not translate into a firm demand for new industrial facilities. The company now is much more focused on the export of equipment than on the initially promising³⁷ domestic market (Cruz and Scaramuzzo, 2008). Actually, this industrial dimension is adequate for a 5% mixture of biomass-derived product in diesel, forecast for 2010.³⁸ What remains to be seen is whether competition for the raw materials for other purposes will allow biodiesel to be economically viable. It seems –and there are statements by industry officials in this regard– that one of the plans of the private sector is to supply the European market. Of course, for that to happen, companies will have to submit themselves to the same type of requirement for socioenvironmental certification currently being announced for ethanol. Yet, among Brazilian biodiesel producers, the debate and measures in that regard seem much less mature than in relation to ethanol. It would be very important, thus, that the social seal be upgraded into a socioenvironmental seal that would include tracking and public disclosure of the impacts of the production of this fuel on the environment. At any rate, whether for domestic consumption or for the foreign market, there is an immediate gap between raw material volumes for delivery and the installed industrial capacity. Such a gap is a strong indicator of the interest of the private sector in stimulating an increase in supply, but this could be seriously affected should the opportunity cost of the raw material for biodiesel rise too much. This point will be discussed below, in 4.3.

3.2.3. Social participation

The PNPB contains in its provisions the establishment of Stewardship Working Groups, whose aim it is to animate local productive arrangements with regard to biodiesel and to control the implementation of clauses with which the companies agreed to comply, especially in respect of their relations with family farmers. Taking part in these groups are family farming organizations, the government, industry representatives, members of technical assistance and rural extension offices, and, on very rare occasions, financial institutions. Some international cooperation organizations are collaborating with these groups and are closely following the program's implementation: this is the case of GTZ,

³⁷ The text by Olivério (2005), a corporate director, written in 2004, does not shy away from comparing the chances of biodiesel with those of alcohol, stating that the incorporation of 20% of the product to the diesel would prompt a demand of 12.4 billion liters (in face of the 840 million liters required by the current standard of 2%). Such a target would add to the program an impact and dimension similar to that of the pro-alcohol, and could be attained by 2020.

³⁸ It is worth insisting that the 5-percent target was forecast for 2013 and is to be brought forward to 2010.

for example, in the Northeast. These are very recent initiatives, whose relevance to and effects on the organization of the market or fulfillment of the contracts with regard to the commitments negotiated by the companies and family farmers are still unknown. It would be important to set in place a procedure similar to that of a social watch, through which the steering group would disclose its remarks, suggestions, criticisms, as well as the program's achievements. The risk faced by a structure like the Stewardship Working Groups is that, once it is phased in, it will tend to lose its external character with regard to what the actors do, since it becomes part of the commitments they establish.

Therefore, two questions emerge regarding social participation in the PNPB: the first one consists of knowing the reason why, in a program in which the relation between family farming and industry is monitored by the labor movement and the Government (through the contracts the social seal enables), local steering groups are necessary. Why not assign the program's monitoring task to an evaluation system with clearly defined parameters and carried forward by actors who are not directly involved in it, with the commitment to publicly disclose processes and results? However, if the stewardship groups are indeed necessary, it is fundamental then that they adopt practices that prevent their routinization, by means of a working agenda that challenges local actors with goals that go beyond those they would achieve with their everyday actions, and by publishing in a broad and accessible way the results of what they do.

3.3. Rules of exchange: family farming, food and energy

No market stabilizes itself if their participants do not reach an agreement on with whom and under what conditions they can transact. Perhaps therein lies the biggest difference between a purely "economic" view and the political-cultural approach to markets: Social structures impose a coercive dimension on actors that objectively limits the scope of their choices and makes them select those with which they establish relations (Dobin, 2004). In this sense, two themes are fundamental when it comes to studying the socio-environmental impacts of biodiesel. The first - refers to the family farmers responsible for part of the supply of raw materials. It is extremely difficult to incorporate - farmers living in a social environment characterized by highly imperfect and incomplete markets into the PNPB. Indications are that, in these markets, the PNPB has disrupted the structure of traditional trading modalities, but has not stabilized its alternatives yet. The second important theme, in the study of rules of exchange, is about the different alternative uses for the program's raw materials.

3.3.1. Family farming's diverse markets

The term family farming indicates a productive form in which there is unity between worker and the conditions of production. In a country with a latifundium tradition, it is not trivial that an important part of the farming supply should rest on the initiative of a worker and his family. However, that does not mean that family farming is homogeneous at all. A number of studies in Brazil and Latin America show that, within this social segment composed of units that do not resort on a permanent basis to salaried work, internal differentiation can be enormous. In the Brazilian case, most of the so-called family farming - especially in the Northeast - cannot produce a subsistence level of output, and survives on the basis of off-farm labour. Such restrictions are explained not only by exiguity of the lands family farmers possess and by often-adverse climate conditions, but also by the social environment in which they live. Brazil is not the only place where the most impoverished segments of the population of the countryside

establish relations with highly imperfect and incomplete markets (Ellis, 1988). Often, they fund themselves through merchants who provide the few inputs they need in exchange for a right over their crops. The possibilities of improving productive capacities, in this environment, are very reduced and dependent on State intervention. The PRONAF contributed in an important way to improve the income of these farmers, yet did not manage to alter this social environment.

Thus, it comes as no surprise that the participation of family farming's lowest-income segments in the PNPB, in the first two years of the Program's existence, is quite below what had initially been forecast. More than that: the way the markets in which these family farmers participate were organized is still rather volatile. Differently from, for example, the more stable characteristics of markets like soybean or those where there is contract-binding integration between producers, the entrance of new commercial actors in the commercialization of castor tends to undermine the structures of the existing circuits without the immediate establishment of mechanisms designed to guarantee the fulfillment of new commitments and contracts.

In 2007, according to Ministry of Agrarian Development (MDA) preliminary data, some 30,000 farmers effectively participated in the Program. The number is **much smaller than initially forecast by the government's plans**. It is also **lower than the number of contracts signed between farmers and industry**. In 2007, 68,500 contracts were signed, 13,000 of which in Brazil's Southern region. The forecast for late 2008 was 255,000 contracts signed throughout the country, 85,000 of which in the Northeast, 18,000 in the Southeast, 27,000 in the Southern region (Abramovay and Magalhães, 2007). The numbers show a big gap between the targets and the goals actually achieved.

Moreover, those preliminary data equally show **the overwhelming weight of soya** in the composition of Brazil's biodiesel raw materials in 2007. The share of castor seed and *dendê* palm was insignificant. As shown by Abramovay and Magalhães (2007), the forecast, based on the contracts that had been signed, was that castor would correspond to 61% of the total and soya to 29%, as can be seen in Table 4, as released by the Ministry of Agrarian Development in 2007.

The weight of soybean in the composition of PNPB raw materials base conceals, however, an important change in the formation of the local markets for the other raw materials. The PNPB contributed to boost castor crops and also to increase the price of the product. At the same time, as with so many other farm raw materials, international castor oil prices rose dramatically, much above the price negotiated at the auctions. The company that most invested in castor, Brasil Ecodiesel, in face of the new scenario, opted for selling castor oil into the international market where prices were higher, delivering to the distributors the soybean oil it bought on the market. At the same time, the entrance of a buyer the size of Brasil Ecodiesel and the prospective entrance of Petrobras destabilized the conventional market for castor and its traditional protagonists did everything they could not to lose their suppliers by transferring to them—something they habitually did not do, given the imperfections of this market—the price hike, brought about both by the international context and the entrance of new buyers.

Table 3

| Regions | Cultivated area (ha) | | | | |
|--------------|----------------------|----------------------|------------|-----------|-----------|
| | Soybean | <i>Dendê</i> palm | Castor | Peanut | Sunflower |
| South | 94% | | 4% | | 1% |
| North | | 100% | | | |
| Northeast | | 5% | 88% | | 2% |
| Center-West | 39% | | 46% | | 15% |
| Southeast | | | | 100% | |
| Total | 29% | 4% | 61% | 0% | 3% |

Source: MDA/Social Fuel Seal, 2007.

Box 3 shows the attempt by Brasil Ecodiesel to build stable relations with castor suppliers, organized in cooperatives and under the strong influence of the labor movement, and, simultaneously, the capacity of traditional actors to destabilize the new bonds, transferring to the farmers the price increases, which did not used to make part of the customary commercialization methods of these traditional actors. Of course, the immediate effect of this transfer of high prices to the producers was beneficial to them. Yet, now arises a dispute over rules of exchange between forms of commercialization that purport to impose stability on the market in terms of prices capable of reflecting Brazilian and international swings, on the one hand, and the actors that have always dominated this market and are accountable for its low dynamism thus far, on the other.

It is worth recalling that castor oil is used in the ricin-based chemical industry, and that the few companies operating in this field never hesitated to resort to import of the product, given the difficulties encountered by local farmers to supply the product. One of these companies even came to try a contractual-integration project encouraging the production and the poly-cultivation of beans and castor, but unsuccessful, therefore persisting with the imports and leaving the local production in the hands of the so-called *atravessadores*, middlemen.

Although there are in the State of Bahia 141,000 hectares of castor bean plantations, the industrial utilization of the product has been, so far, meager, which explains why soybean has so much importance in the production of biodiesel, including in the Brazilian Northeast region. Napoleão Beltrão, a researcher with Embrapa speaking to newspaper *Valor Econômico* (Salgado, 2008), explains that the castor chain lacks a structure and is little dynamic: “it is common”, he says, “for a farmer to keep the castor at home and, when he needs to buy something, he takes it to the store to exchange it for products”.

BOX III

Castor seed: difficulties in constructing a new market

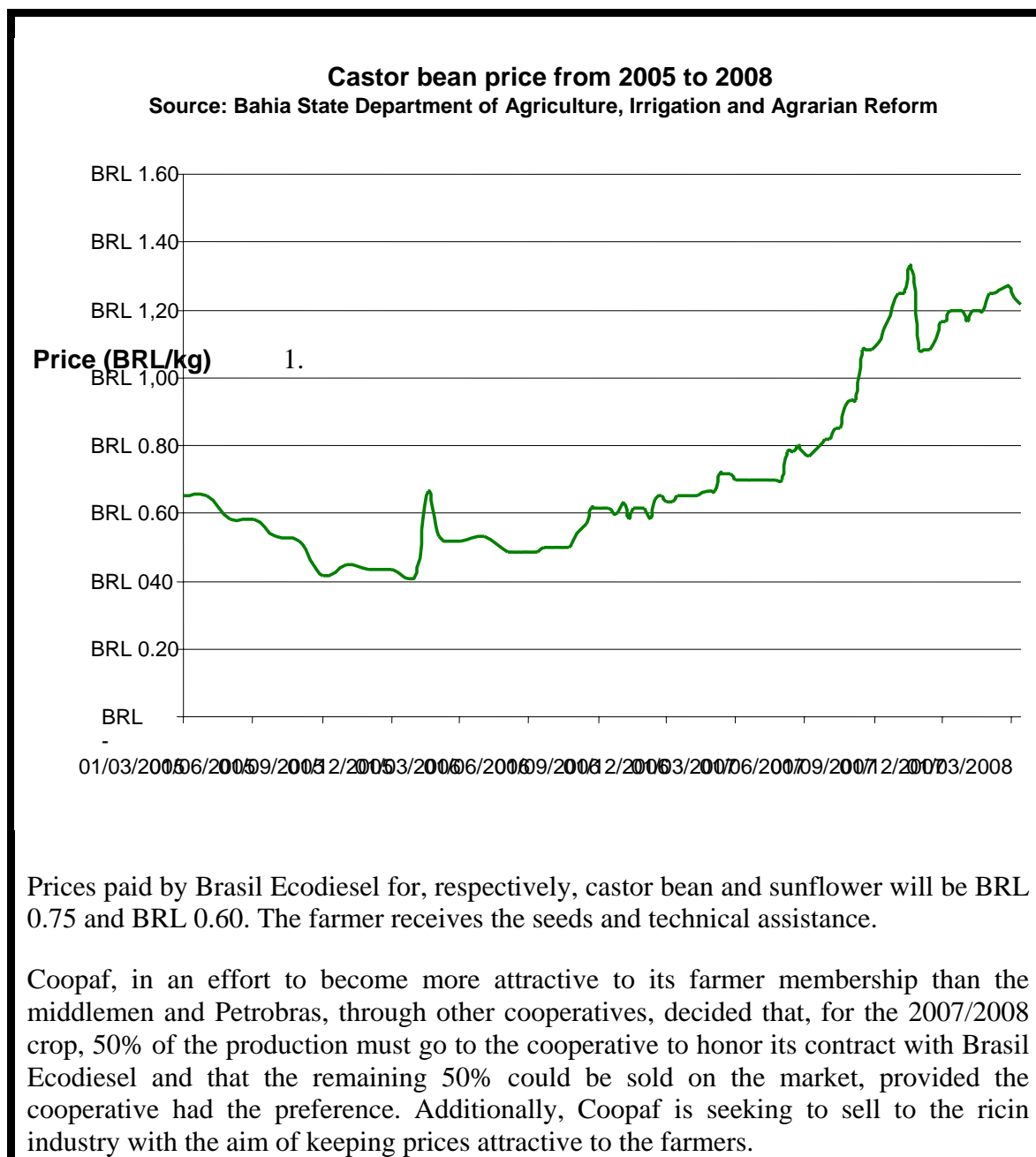
Created in 2006, Coopaf is a family farming cooperative bolstered by the biodiesel program and stimulated by the labor movement of the State of Bahia. It operates in the production and selling of castor, and in 2006 started growing sunflower. It has 5,000 associated members, and another 3,000 applying for membership. The cooperative quickly broadened its productive base upon the signing, in 2006, of a contract with Brasil Ecodiesel for the supply of castor. By the contract, the cooperative undertook to organize the production, source raw materials and give technical assistance to the farmers. Coopaf hired 13 technical staff to meet this demand. The cooperative also signed a contract with Comanche, a company awarded the Social Fuel Seal in 2007. In the past, local farmers used to grow castor together with cowpea, and resumed the activity, stimulated by the cooperative, with the arrival of biodiesel.

Coopaf picks up the raw material at the farmer's property, waits until it has amassed a stock of 8 tons and, thereafter, makes the sale. The farmer has an incentive of BRL 1.80 per bag if he himself does the shelling of the castor seeds. In case that is not done, Coopaf weighs the unshelled castor, and discounts 50% from the payment. In some cases, Coopaf's shelling machine goes to the property to carry out this operation. The farmer, with a technician's orientation, does the drying of the castor in the sun.

In 2006, pushed by the contract signed with Brasil Ecodiesel, 4,000 hectares were cultivated, involving some 2,200 farmers. The price negotiated was BRL 0.66/kg, when the ricin chemical industry paid from BRL 0.42 to BRL 0.48 per kilo.

In 2007, Coopaf stimulated family farmers to grow oleaginous plants hoping to trade no less than 15,000 tons. However, middlemen supplying the ricin-processing industry, outsmarted Coopaf and bought the production directly from the family farmers associated to the cooperative for much higher prices than those it paid. The price agreed with Brasil Ecodiesel was BRL 0.75/kg, while the middlemen came to offer BRL 1.15/kg. In 2007, Coopaf sold to Brasil Ecodiesel some 6,500 tons of castor bean and 600 tons of sunflower, against an expected production of 15,000 tons of oleaginous plants.

For this crop, Coopaf has signed a contract with Petrobras and is looking forward to renew its contract with Brasil Ecodiesel, whose terms and conditions have already been settled. The price paid by Petrobras for the castor bean will be the average price on the Irecê market over the last 36 months. Based on the price quotes provided by the Bahia State Department of Agriculture, Irrigation and Agrarian Reform (SEAGRI), from March 2005 to March 2008, the average price for castor bean should be BRL 0.78/kg.



Unlike what occurs in the soya market –dominated by large corporations with stable trading schemes and in which the farmers’ embeddedness is unlikely to cause any surprise³⁹–the rules of exchange for the castor bean market are not clearly established. The arrival of actors of the importance of the private companies and Petrobras will contribute toward more unpredictable bonds between market participants. The challenge lies in building new market relations in which the transmission of price increases to the farmers is not done by the actors that, until now, have had a predatory behavior in the market, but within a frame of stable relations with the private companies and Petrobras.

³⁹ Most soya producers have not benefited from the price boom over the last months because they had already closed their sales contracts with the industry. There is no news, however, of any breach of contract as regards product delivery by the farmers.

A reflection of the immaturity of the bonds between the main actors of the castor bean market, bank credit for the sector is derisory, unlike what happens with soya, whose credit is granted to farmers without any difficulty.

3.3.2. Energy-food-raw material interface

The biodiesel market will not be able to consolidate itself in Brazil if the industries are prevented from arbitraging with the different types of oil they purchase, given the opportunity cost entailed by the delivery of the product to the distributors. Biodiesel feedstocks are not exclusively cultivated for energy purposes. In the case of soya, for example, its oil is merely the less valuable of its products, its main use (corresponding to 82% of the grain) being animal feed. All of the Brazilian farming research of the last years has focused on reducing the level of oil in soybeans, increasing their protein content. This means that, for each unit of oil consumed in the production of biodiesel, the industry is producing, at least, five and a half times more feed, contributing to increase the supply of food. In the oil extraction and refining processes, a by-product or residue, **the scum**, is formed, which has always been hard to market or treat for disposal. This residue is used in the production of biodiesel, which considerably increases its profitability and reduces costs associated with its disposal. Soybean complex generates a considerable amount of scum. Other sub-products are frequently used in the production of biodiesel. Company Big Frango has just invested BRL 500 million in a chicken slaughterhouse with the capacity to process 500,000 chickens and produce 600,000 liters of biodiesel from animal tallow (Cruz, 2008). The utilization itself of sugar cane fallow areas, as described in Box II in the production of peanut (in this case for human consumption) expresses well what Ignacy Sachs (2007) has been calling the food-energy interface, and reduces competition between the two activities. In the case of *dendê* palm oil, the Federal University of Rio de Janeiro developed an esterification technology that allows Agropalma to produce Brazil's cheapest biodiesel complementary (not competitive with) to the *dendê*'s food function, with the advantage that the sub-product of the oil extracted, which until then was discharged in the environment, polluting natural resources, is now used productively.

We may draw three conclusions with regard to the impacts of the production of biodiesel on food security.

- a) Nobody produces soya with the immediate and strict purpose of extracting oil from the product. In the soybean energy and economic balance, one must consider that its oil corresponds to less than 18% of its composition, with the remainder used to make feed.⁴⁰
- b) The diversification that is expected in the supply of raw materials for the production of biodiesel does not represent a threat to the current farming production, since it is based on products like castor bean (which is not edible) and sunflower and canola, whose weight on the population's consumption basket is insignificant.
- c) The biodiesel program has the virtue of instilling dynamism into markets that until recently were little valued. One of the problems, for instance, mentioned in the

⁴⁰ The negative environmental effects of ever-expanding soybean areas are an issue of serious concern in Brazil. But this expansion can't be attributed to the demand coming from biodiesel production. The recent document from the Centro de Monitoramento de Agrocombustíveis (2008) does not stress, unfortunately, that biodiesel is not the fundamental vector of soybean expansion in Brazil.

beginning of the program, is in reference with the huge volume of glycerin, which, it was feared, would have no commercial application. The increased production gave rise to new business opportunities, and today Brazil exports glycerin to China, for instance. Glycerin can be used to produce polymers and biodegradable plastic products. This potential use can also be achieved with castor bean, from which polystyrene and polyurethane can be manufactured, replacing petroleum as their raw material. When we put together these examples and the one previously mentioned regarding Solvay, it is possible to see that the use of oil by the chemical industry is being done, apparently, more intensively than was the case with ethanol, around which only recently an alcohol-chemical industry has developed.

There is no indication, therefore, that an increase in the supply of biodiesel in Brazil is a threat to food security both because of the fact that it is made from sub-products (as in the case of soya and *dendê* palm) and because of its growth prospects based on non-food products like castor bean.

3.4. Conceptions of control

In such a recent market, one is to expect a profusion of conceptions of control with regarding the way productive resources are to be organized and the actors' understandings regarding its growth. Even the technical standards on which the industry organizes itself are not consolidated: part of the sector employs technologies that come from an Italian company associated with Dedini (Brazil's largest manufacturer of equipment for the alcohol industry and responsible for the first plant to integrate the production of ethanol and biodiesel). Brasil Ecodiesel and Petrobras, in turn, use technology from both an American company and a Brazilian company.

We have seen so far that the main modalities of organization of the rules of exchange in this market, as well as its governance system, are unstable. There are three important themes with regard to the conceptions of control in place in the biodiesel markets, which will be cited herein synthetically.

3.4.1. The many alternatives for the production of oil

The biodiesel market does not seem to have revealed all of its potential, in that, thus far, it is based on a plant of a low energy yield. It is indeed true, as we have seen, that the soybean oil energy balance has to be conducted taking into account not only the oil, but also its production of feed and other by-products used by industry. Still, everything seems to indicate that *dendê* palm oil is much more promising and possesses potential comparable to ethanol. On the other hand, jatropha in India is beginning to take shape as a commercial crop and is the object, in Brazil, of research and experiments by several companies involved in the PNPB and by Petrobras. Research studies on these products have not yet allowed their technological pathways to be defined. It is also worth mentioning the corporate interest in the production of biodiesel from industrial cooking oils—and even from home kitchen oils—, adequately collected. An Austrian company and a Spanish company are starting to invest in these markets and are conducting research with *babaçu* palm, jacaranda and jatropha. It is impossible to know now whether any one product will be dominating the sector's raw materials or whether—as is more likely—the trend will be to affirm regional endowments. Companies themselves seem to be betting on this last outcome, yet the way firms will cooperate, the partners they will rely

on to operate in stable markets and the understandings of the actors with regard to their future, all that is in the process of being structured.

3.4.2. Environment off the agenda

The importance of soya at the present stage of the PNPB exposes the Program to an important additional shortcoming—in addition to the ones already cited in item 3 of this work. Soya is a significant actor in the deforestation process that is taking place in the Amazon region (Vera-Diaz *et al.*, 2007). Mechanized areas inside the Amazon region are growing at an alarming rate. True, as seen in item 3, the oil is just a sub-product of soya. Yet should Brazilian companies have any ambition to enter any foreign markets, the environmental conditions in which their products were made will be taken into account in the likely certification processes they will have to comply with. In this sense, it is important to remark that the Social Seal does not contain any environmental criteria. It only indicates that the raw material the product was made from came from family farming, but not the conditions in which that raw material was produced.

3.4.3. Reach and limits of collective production

If in the sugar cane production the few examples of direct control by farmers of the industrial production are insignificant, in the case of biodiesel it is still not possible to know the fate of these fledgling productive forms. An important leader of the Landless Workers' Movement (MST), in São Paulo, José Rainha⁴¹, is encouraging settlers to grow jatropha on an agro-industrial facility that would be controlled and managed by the settlers themselves, as part of an agreement with Petrobras, the Ministry for Agrarian Development and public funding agencies. The settlers would associate with private companies. It does not seem irrelevant that two foreign entrepreneurs, João Cardoso, president of Torryana Biodiesel, of Portugal, and Palmiro Soriano, president of a producers' association of Spain, participated during the announcement of the initiative. Inside the Landless Workers' Movement, the position in relation to the theme brings together two somewhat opposite views. On the one hand, CONTAG is the great political guarantor of the negotiation that led to the social seal: The trade unions in the municipalities – and CONTAG at the national level—give support and (at least in theory) control the contractual integration between companies and farmers. Therefore, it bets on the strengthening of the bond between farmers and private companies. Simultaneously, on the other hand, it sustains the idea that it is possible and necessary that industrial units belong and be directly managed by the workers. As for the Federation of Workers in Family Farming (FETRAF), CONTAG's rival in representation of family farming, it repudiates the path adopted by the PNPB and advocates that the Program should support, exclusively, industrial units owned and managed by the rural workers.

5. Conclusions

Ethanol and biodiesel are studied herein from the perspective of the social forces that give rise to the most important institutions responsible for the functioning of their markets. These markets are totally immersed in social life, and can be accounted for by dynamics that Neil Fligstein calls political-cultural. Understanding the technical foundations and the economic performance of each of them entails not only unveiling

⁴¹He is not supported by the MST National Board, yet is someone with a considerable public audience and undeniable influence on the settlements in the State of São Paulo.

their objective attributes and their technical and economic bases, but also the way individuals and social groups organize themselves to take advantage of the opportunities they offer. This work's main conclusions may be thus summarized.

1. The advance of biofuels in Brazil is backed by an important set of technological and organizational techniques which are altering the very physiognomy of the sector's corporate structure (especially in the case of ethanol), with the attraction of international funds and big national investors from outside the agro-industry. No other agro-industrial sector today has more investment attraction capacity than biofuels.
2. There is a contrast between changes in the sector's corporate structure and the limited progress made by research in the field. State-driven activities (via EMBRAPA and FAPESP, for example) and private activities (by means of the Sugar Cane Technological Center –CTC– or by the units supported by the Votorantim conglomerate) have not impeded specialists from identifying a slack of resources and of coordination of the efforts necessary to enable higher productivity levels. The US Department of Energy (DOE), for instance, is investing USD 1 billion in the construction of experimental refineries designed to transform vegetable matter into alcohol. In Brazil, only now is something similar happening with the announcement of the Bioethanol Science and Technology Center, which is to receive BRL 50 million in the next five years (Escobar, 2008). The Brazilian investment in cellulosic ethanol, so far, is meager, which entails the risk that the country might very quickly lose the technological edge it holds today in the ethanol area. As for biodiesel, despite the breakthrough represented by the patenting of H-Bio and by new techniques for the production of castor oil by Petrobras, as well as the agronomic research carried out by EMBRAPA and experiments by private companies with jatropha, nothing indicates there is a coordination between these efforts capable of rapidly raising agricultural productivity in the production of raw material and, most importantly, allowing diversification of its sources. Brazil, in short, faces the challenge of consolidating and increasing its competitive advantages in ethanol– and creating them, in the case of biodiesel–while simultaneously continuing to develop research into second- and third-generation fuels, and into new sources of energy which, in a future whose distance it is impossible to predict, will reduce the use of agro-industrial products as the basis for the decarbonization of transport.
3. The future of the biodiesel markets depends on two basic factors. On the one hand, on their own innovation capacity, as compared with the speed of the implementation of alternative energies based on a use of agriculture that does not compete with food purposes or non-agricultural products. On the other, the evolution of the biofuels markets is strongly determined by social pressures, which oblige the sector to disclose in an ever more substantiated manner the technical and social foundations on which it supports its expansion.
4. The proposals for a moratorium on biofuels do not take into account that, in the Brazilian case, they are based on productivity gains and the increasingly more intensive use of sub-products that open the way for a utilization capable of not compromising the integrity of the biomes in which they are embedded or the country's food security. Of course, biofuels–like any other technological change

in the contemporary world—bring risks. Yet, stopping activities in this area is definitely not the best way to build the institutions needed to face these risks. Social participation in the assessment and management of the decisions corresponding to such risks is more productive than a stoppage ensuing from a “moratorium”.

5. The expansion of sugar cane is marked by a two-sided social nature. On the one hand, the technological innovations driving the expansion of ethanol have boosted high-skill job opportunities at an appreciable level, with positive multiplying effects on many regions. On the other, Brazil’s historical land concentration legacy has been deepened and the sector is based on gigantic expanses of continuous areas that express an extraordinary concentration of wealth and power. Likewise, the crop’s rising mechanization—a positive element in that it not only reflects technical evolution, but also social pressure to end the *queimadas* and ban the degrading work practiced until these days in the harvesting—will lay off tens of thousands of laborers who—despite the training programs set in place by the private sector—will not be reabsorbed by the industry. It is with policies designed to economically develop their home regions that the social plight of these workers will be addressed. It is worth stressing the scarcity of social proposals and public debates regarding the appalling concentration of land and wealth in the Brazilian ethanol production.
6. Despite the immense technical progress in combating plague, in ferti-irrigation, which taps by-products of the crop itself, and the diversification of crop varieties, sugar cane plantations do not habitually respect environmental laws, even in the most developed states of the country. The sector itself is split with regard to the theme. To some, the problem can be solved by establishing reforestation areas outside the properties to offset the continuous use of the land. To others, on the contrary, respect for the environmental legislation broadens the crop’s agronomic sustainability and enables—by means of corridors communicating preserved areas—the recuperation of wild life on sugar-cane exploited surfaces.
7. The most serious environmental problem caused by the expansion of sugar cane is in the Cerrado. Public controls over the integrity of this biome are precarious and, albeit occupying a proportionally small area, sugar cane is a threatening presence already. There are no clear signs that a zoning process will be able to set adequate limits to this expansion, since the monitoring of fires derived from slash-and-burn techniques and of new facilities in the Cerrado do not have, by far, the accuracy of the records available for the Amazon region.
8. The tracking and subsequent certification of Brazilian biofuels are not simply disguised forms of protectionism with the purpose of limiting these products’ exporting potential. For alcohol to become an internationally acknowledged commodity, two obstacles will have to be overcome. The first one is that other countries, besides Brazil, should become more relevant in the supply of alcohol. This is a challenge that is not quite trivial, for it supposes corporate organization and, mostly, social structures from which other emerging markets are very far. If the competitive expansion of ethanol production is to be premised on the concentration of land such as exists in Brazil, the energy and economic advantages of the product will be eclipsed by its negative social effects. The

second challenge is whether the production of ethanol—and of biodiesel, of course—will prove to be grounded on non-predatory forms of space occupation and non-degrading modalities of work. The certification process is an important road, in the case of ethanol, to bridge the gap between economic and energy efficiency and the appalling social conditions—and, to a certain extent, environmental—on which it is based, and which are (it is important to acknowledge) in rapid transformation. Social participation in these certification processes is an element that enriches the biofuels market, by making it more transparent, reducing its negative effects, and increasing the investors' own security (Abramovay, 2008).

9. Improving the quality of diesel is a basic environmental demand for life in the large Brazilian cities, and biodiesel represents one of the ways to achieve this. The Government's decision of adding a biomass-derived product to diesel and the formulation of the National Program for the Production and Use of Biodiesel (PNPB) have stimulated the setting-up of new factories, the making of new investments and the beginning of a contractual integration between companies and family farmers whose results are still, as expected, very weak. The PNPB's main virtue lies in the Government's decision—followed, as it seems, by the private sector—of diversifying the raw material sources from which biodiesel is produced today.
10. Its two first years of existence show that the market so far has benefited the highest-income family-farming segments and is based on the product with the longest tradition, which is soya. The main problem stemming from this concentration is not so much on soy's supposedly negative energy balance: its oil is until now a very little valued by-product of a sector that basically targets the feed market and, therefore, the food market. Yet of course one of the basic objectives of the program is to reduce the participation of soya, in favor of products characteristic of the less wealthy segments of family farming and which might come from relatively degraded areas (castor bean, *dendê* palm and jatropha, for instance).
11. The arrival of actors of the stature of the new private companies operating in the sector and of Petrobras, at first, disrupts the structures on which the markets for products more typical of low-income farmers function, such as castor bean. A concerted effort by these business sectors in granting credit may reverse the present environment wherein contracts are not fulfilled and the castor bean market stabilization seems distant. It is important that farmers may receive—in these more organized markets—the benefits that the price appreciation of castor bean in Brazil and abroad has the potential to bring.
12. Despite the importance of the participation of the private sector, there are still few companies integrated to the PNPB, especially in the Northeast. This scant business foundation limits competitive possibilities and increases the odds for opportunistic conducts.
13. Actions of an associative character aiming at making the farmers the main actors in the management of industrial units are important and may represent a promising road not only among farmers, but also in poor urban areas, by using kitchen and industrial oil. These actions have to take into account, however, the

economic viability of such initiatives, as well as the transaction costs entailed. Their social interest cannot justify a situation of permanent dependence in relation to public funds, unless they want to conceal purported institutional innovation under the opaque cloak of the patrimonialist and clientelistic use of state funding.

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