FOOD, ENERGY AND SOCIAL JUSTICE IN BRAZIL

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Introduction

In this paper we will focus particularly on the position of biofuels in Brazil but will situate this within the framework of Brazil's overall energy profile. To understand the issues involved in the biofuels debates as they affect Brazil it is also necessary to understand some of the special features of this country's agriculture and agroindustry. And thirdly, a discussion of biofuels in the Brazilian case needs to take into account its protagonist role in the global dynamic of the biofuel economy and polity.

Our opening section will deal briefly with the first two of these three contextualising issues. We will then present an overview of the two major components of Brazil's biofuels initiatives – ethanol from sugar-cane and biodiesel from a variety of raw material sources. Each of these will then be analyzed separately before exploring recent convergencies. In the following section we will take up the third contextualizing issue, that of Brazil's protagonist role in the promotion of global markets for biofuels. In the final section, we will discuss the future for biofuels in Brazil in the light of the dominant innovation trajectory focusing on the use of lignocellulose raw materials.

This paper will be particularly concerned with the implications of biofuels for food supplies and food prices. It will also explore the impact of biofuels on questions of social inclusion, local and regional development. In particular, it will highlight new forms of direct investment in land, a key feature of biofuels development both in Brazil and other resource rich developing countries.

With the current crisis a huge question mark hangs over the timetable and the scope of future investments in the sector. Recession and global slowdown are rapidly modifying relative prices between fossil and renewable fuels, and between food, fuel and feedstock further increasing uncertainty as to the rhythm and future directions of biofuels expansion.

Even prior to the current crisis the biofuels debate was suffering a sharp *volte-face.* Mimicking financial bubbles, the biofuel euphoria of the early years of this millennium which had led to ambitious adoption targets being set by the major industrialized and emerging economies has now been replaced by sustained critiques from NGOs, influential representatives of the techno-bureaucracy and global agrifood firms. As a result governments are currently reviewing their policies further exacerbating the uncertainties surrounding biofuels.

Brazil's Energy and Agroindustry Profile

Brazil is distinguished by the degree to which renewable sources participate in its use of energy, being responsible for almost a half of total consumption. The Table below compares Brazil's renewable/non-renewable mix with the global average. The breakdown of the different components of the energy matrix show that Brazil has an overall participation of renewable sources of some 44% as against 14% globally. Of these, biomass accounts for 30% compared with 11% globally. Sugarcane alone is responsible for some 15% of Brazil's total domestic energy supply.

Matriz Energética Mundial e do Brasil, em %

	Mundo 06/2003	Brasil 12/2005
Petróleo	34,9	39,7
Carvão	23,5	6,5
Gás Natural	21,1	8,7
Combustível Renovável e Resíduos	11,4	29,1
Energia Nuclear	6,8	1,5
Hidrelétrica	2,3	14,5

Fonte: Agencia Internacional de Petróleo e Ministério das Minas e Energia.
Elaboração: DIEESE.

At the same time, the total area dedicated to sugar cane production, some 7 million hectares in 2006, roughly divided equally between sugar and ethanol, represents a small proportion of Brazil's total cultivable area calculated as reaching 340 million hectares. Ethanol production accounts for 1% of this total or 5% of actually cultivated land estimated at 63 million hectares.

As from the '80s, Brazil's agricultural research system adapted soy and other crops to the semi-tropical latitudes of its vast savannah interior creating a new frontier of more than a hundred million hectares, which includes large tracts also of the Northeast and now reaches into the Amazon region. This new frontier has transformed Brazil into the world's leading agricultural commodity exporter. Soy at 22 million hectares and corn with 13 million hectares are currently responsible respectively for seven and four times the area dedicated to ethanol production. In addition, some 200 million hectares are classified as pasture land (MAPA, 2008) The implications of these figures will be discussed in greater detail below but they are sufficient to suggest both that the food energy equation may be negotiable in Brazil and that this represents an exceptional situation when compared with other countries in Latin America and especially so when compared with other continents.

Brazil's Biofuels Initiatives

Brazil has currently two very different initiatives in the area of biofuels – ethanol and biodiesel. Ethanol is based exclusively on sugarcane (although there were experiments with

cassava in the ‘70s) whereas biodiesel has developed a polyvalent strategy with regard to raw material inputs. In spite of this, as will become clear biodiesel currently depends almost exclusively on soy. Ethanol is produced on a large scale, both in terms of its agriculture (heavily monoculture, although intercropping is possible) and its processing plants and depends on extensive use of farm labor. Biodiesel has been directed at the family farm sector with a strategy of integrating the crop to be used for biodiesel within the traditional diversified farming systems. This has been particularly the strategy adopted in the Northeast where castor oil is the preferred crop. The ethanol market is currently deregulated with the exception of the compulsory mixture of ethanol in gasoline. Biodiesel, on the other hand, is the product of complex public market construction and regulation which has defined every aspect of its functioning (Abramovay & Magalhaes, 2007).

Nevertheless, as we will discuss in the concluding sections of this paper, in spite of these differences in conception and objectives important convergences are emerging which may lead to a more unified biofuels sector. Key players are now active in both areas. Petrobras, Brazil’s state petroleum company, would be a case in point, as would the global trader ADM. To the extent that soy has become the principal raw material for biodiesel, traditional agribusiness interests are displacing family farm participation. A more radical perspective for convergence has emerged as a result of the joint research between Crystalev, a leading Brazilian sugarcane processor and Amyris, the US biotechnology research company. Biodiesel, they claim, can now be produced directly from sugarcane. This development complements moves for the consolidation of integrated agrofuels production, evident in new investment plans, with sugarcane processing plants planned exclusively for the energy market. The growing importance of the production of bioelectricity through the burning of bagasse, sugarcane waste material, has reinforced this trend. In the following sections we will now present each initiative in some detail

Ethanol in Brazil

Ethanol production in Brazil has a long history going back to the ‘20s of the last century. It emerged as a major factor in Brazil’s energy strategy as from the ‘70s in the wake of the petroleum price hikes. The Pro-Alcohol Program was launched by the military government in 1975 with the aim of being able to substitute 20-25% of gasoline with anhydrous ethanol. The production of hydrous ethanol was then promoted for use in light vehicles specially adapted for alcohol. A highly regulated market was created to guarantee adoption of ethanol, involving price controls, compulsory supply at gas stations and a range of subsidies. By 1986 some 12 billion liters of ethanol were being produced and ethanol run cars represented some 90% of new car sales. Although the incorporation of new lands was the principal response to increased demand this period also saw important advances in research and engineering capacity involving seeds, agricultural practices, fermentation technology, equipment and machinery. Since the ‘70s overall productivity has increased by an average 4% per year lowering costs so that subsidies are no longer necessary. Brazilian ethanol is considered competitive with petroleum as US$30-35 a barrel (Proalcool, 2007).

With the reversion in petroleum prices as from the middle ‘80s government commitment to the program waned and shifts in the relative attractiveness of sugar and ethanol prices led to crises in supply of the latter at the gas stations undermining confidence in the ethanol car market. By the end of the ‘90s ethanol car production represented only 1% of total car production and the sugarcane sector increased its exports of sugar from one to ten million tons. In this decade, Brazil was led to import ethanol to maintain the mixture in the gasoline.

This situation changed abruptly in the current decade with the renewed increase in petroleum prices, greater levels of private sector coordination in the sugarcane sector and the innovation of flex-fuel cars allowing the customer to make his/her choice not at the point of purchase but at the gas station depending on the evolution of relative prices. Flex fuel car purchases exploded as from 2003 and now account for over 70% of new car purchases. Sugarcane and ethanol production has expanded sharply since 2003 and is projected to reach 24.3 billion liters in 2008/9, an increase of 27% in relation to the current harvest. Sugarcane production is up 9% with ethanol being responsible for 75% of this increase. The domestic market will absorb some 20.4 billion liters with the remainder being exported to the slowly emerging global commodity ethanol market.

Such growth perspectives, combined with the pressures to respond to global warming and fulfill Kyoto commitments have unleashed an avalanche of investments, which are beginning to transform the profile of the sector. Estimates vary depending on timetable adopted and source. The Brazilian government’s Program for Accelerated Growth (PAC) calculates that some 77 new ethanol mills will come on line up to 2010 involving investments of R$17.4 billion. Other estimates with a longer perspective looking at the 2020s put the figure at around US$40 billion.

The sugarcane sector is still quite fragmented with some 350 mills, 230 dual purpose and over a 100 exclusively for ethanol. Although the majority of mills are individually owned the leading firms - Cosan, Crystalev, Nova America – all have numerous plants and are involved in processes of consolidation. The latest move in this direction has been the transformation of the Cooperative Coopersucar with 85 partners and 31 mills into a firm so that it can respond to the new competitive climate. Foreign investment has been traditionally low with global players preferring minority associations. This situation is rapidly changing with acquisitions and particularly green field investments dominating. At present some 40 firms control 50% of the sector’s production and it is expected that this will be reduced to some six to eight in ten years with foreign participation reaching 50% (Wilkinson & Herrera, 2008).

Perhaps the most striking feature of planned investments is the diversity of their sources. In the first place the leading players in the sector are themselves investing heavily, launching themselves on the stock exchange, and becoming involved in strategic investment related to the sector’s expected expansion. A remarkable case here would be Cosan, the sector´s leading firm, buying up Exxon’s gas station network. Another example would be Crystalev, the sector’s second leading firm, which in addition to developing a bioplastics operation with Dow Chemical is, as mentioned earlier, developing biodiesel from sugarcane in collaboration with Amyris. These incumbent leaders are, however, now faced with a more

aggressive stance by the global traders, Dreyfuss, Tereos, Cargill, Bunge and ADM soon to be joined by the Singapore group, Noble. Brazil's transnationals, particularly those involved in countries with potential for ethanol production – the construction company Odebrecht, and Petrobras - are now investing heavily in the sector. Votorantim, Brazil's leading cement and cellulose firm deserves special mention here since in addition to direct involvement in the sector it is, through its Biotechnology Investment Fund, the main promoter of cutting edge research and innovation related to sugarcane in such firms as Alellyx and Canavialis (Gazeta Mercantil, 2008)

Of special note, however, are the new actors entering the sector particularly in the form of global investment funds, often headed by Brazilian investors - BRENCO, Clean Energy Brazil, Adecoagro Infinite Bioenergy. Investors here include such diverse actors as Sun Microsystems, AOL, Merrill Lynch, Soros, Goldman Sachs. Such projects, ranging from hundreds of millions to various billions (US$), typically involve multiple green field investments on the new frontier with a view to becoming leading players in the sector. Governments, either directly or through their leading firms are also negotiating a stake as they commit themselves to partial fuel substitution. China, in addition to its minority participation in Cosan has ambitious projects in the State of Bahia. India is present through its leading firms, Bajaj Hindustan and Reliance Industries. Japan is negotiating a thousand kilometer ethanol pipeline with Petrobras to secure exports.

Brazil's Development Bank, the BNDES, has become a major financer and supporter of ethanol production. For the BNDES, the sugarcane complex assumes strategic importance in Brazilian development strategies since this is a sector where at the moment domestic competences dominate all aspects of the value chain from advanced genetic research to turnkey factories. As such it is thought to be a window of opportunity provided by natural resource competitiveness for assuming technological leadership in a globally dynamic sector.

Given their focus on green-field sites and also the nature of sugarcane production, which demands that processing occurs within twenty-four hours of harvesting, these investments mark a new phase in foreign direct investment (FDI) since they involve the purchase of land, which is now becoming identified as a strategic resource. While in the Brazilian case land for energy is the principal motive this is not exclusively the case and increasingly land is becoming the object of FDI also for food. This would seem to be part of a more general global tendency as capital rich but resource poor countries look to large-scale land investment to secure their food and energy supplies, a tendency identified in Africa, Asia and Central Europe.

These investment projects, however, were designed and negotiated before the current crisis, which now threatens a global slowdown reversing the pressure on commodities and modifying the relative prices between biofuels and petroleum. While investments in the Brazilian case are very much premised on the expansion of the domestic market, this too is beginning to suffer the effects of tighter credit, which will hit the light vehicle market.

Brazilian Ethanol and Socio-Environmental Debates

In the same way that Brazil is a protagonist in the promotion of ethanol as a global commodity it has also become a key player in the global debates over the impacts of ethanol on access to food, on the environment and on issues relating to workers' rights. The sector is represented by UNICA, whose members account for some 60% of global sugarcane production (UNICA, 2005). This body, now headed by a leading academic proponent of modern agribusiness practices, has developed its own research competence and receives support from the agribusiness think-tank ICONE. The sector receives the support of the ex- Minister of Agriculture who chairs the committee for the transformation of ethanol into a global commodity. Key figures in the Brazilian academic community are vocal supporters of the ethanol program such as the well-known physicist, Goldemberg (2008).. The Brazilian President has also made the ethanol program the centerpiece of his international diplomacy efforts.

Their vigorous proactive defense of the ethanol program in international forums has clearly had a major influence on the evolution of the global debate. While as we noted earlier there has been a swing from euphoria to widespread criticism, the international debate increasingly separates out the Brazilian ethanol program as a special case not to be confused with the US corn-based energy program or the EU support for biodiesel. Successively, World Bank, OECD, and FAO (2008) studies have exempted Brazil's ethanol program from the central critiques on biofuels in terms of economic efficiency, contribution to greenhouse gases and impact on food prices. Important international NGOs have also either given their support to Brazil's program, as in the case of the WWF or drawn attention to its distinctive features as in the recent Oxfam report.

What are the principal arguments put forward in defense of Brazilian ethanol? In the first place it is argued that sugarcane occupies a very small percentage of arable land in Brazil and only half of this is currently dedicated to ethanol. Total arable land is estimated at 340 million hectares of which only 63 million are currently dedicated to crops (2006 harvest). Sugarcane for ethanol represents only 1% of total arable land and some 5% of land actually under crops. According to these calculations, some 77 million hectares are available for cultivation in addition to a large part of the land currently dedicated to pasture, some 200 million hectares.

Cattle farming is rapidly increasing its productivity and also adopting the practice of confinement, both of which point to a greater availability of land. EMBRAPA, the Brazilian agricultural research institute, is currently promoting a mixed crop and cattle farming system for the savannah region which it is argued would drastically reduce land use and increase sustainability.

In the light of these figures and tendencies, it is argued that Brazil could easily multiply its ethanol production without encroaching on sensitive ecosystems. Further more, unlike cattle farming sugarcane production is only viable close to sugar mills making it easily identifiable and easily controllable. A mapping of the existing and projected sugar mill investments, based on those included within the Government's PAC program would seem to confirm that they are situated far both from the Amazon and the Pantanal, Brazil's huge wetland region.

It is similarly argued that the increase in sugarcane production has been accompanied by an increase in both food crops and cattle production, transforming Brazil into the number one overall exporter of the different components of the animal protein complex. Sugarcane therefore, on this view, could not have been at the expense of overall food production and could not be judged responsible for increases in global food prices.

Many State Governments in the Northeastern region have vigorous programs for the promotion of ethanol production. These include the States of Bahia, Tocantins, Maranhão, Piaui, involving cooperation and investment from China, Japan, the US and Germany. In Pará, Roraima and Acre in the Northern, Amazon region, there are currently very few mills but the region's governors, including the State of Amazonas, defend the production of sugarcane on what are known as "degraded lands" – lands which have long been logged, transformed into pasture land and are now idle. In the Amazon region, it is argued, such lands amount to 90 million hectares. In addition, research programs are underway to develop sugarcane varieties adapted to these regions. There is similar pressure to allow mills to be established in the Pantanal region and here too distinctions are made between different types of land in the region, which are currently under debate between the Ministry of Agriculture and the Ministry of the Environment.

While most of the attention has been focused on the encroachment of investments into new sensitive regions there is increasing concern with regard to the effects of sugarcane expansion in the State of São Paulo, which has long been the center of production and is responsible for some 60% of the national harvest. The State has 19 million hectares of agricultural land of which 9 million is pastureland. On the basis of projects approved or in the process of approval São Paulo will have over 6 million hectares of sugarcane by 2010 or more than 60% of the land planted to crops in the State. It is generally argued that sugarcane is advancing on degraded pastureland but studies show that basic crops such as beans and rice associated with small-scale production have declined. Increases in land prices and the semi-permanent character of sugarcane tend to make its expansion irreversible in relation to basic food crops. Milk production has also experienced a sharp decline. On the other hand some food crops – wheat, corn, soy – have shown increases, and others (oranges) although displaced have relocated (Montragio Pires de Camargo, 2008). The picture is unclear because Brazil is in the process of a strong re-regionalization of its agriculture and agroindustry.

Perhaps the greatest concern in São Paulo has been with the social and environment implications of sugarcane expansion. This has led to a new zoning policy published in September 2008, which includes environmental criteria – biodiversity, availability of water, quality of the air, areas of preservation (Valor economico, 2008). Critics argue, however, that these measures will be innocuous since they do not apply to mills whose projects have already been approved. Producer Associations (Ocesp, the São Paulo Cooperative Association) are also opposed to the measures since they argue that zoning policies should be limited to recommendations. In addition, none of these measures confront the issue of monocultural production and its impact on biodiversity and ecosystems (Cardos da Silva, 2007)

The concern with social and environmental measures is evident in the State legislation on the adoption of mechanization for sugarcane harvesting, and the voluntary anticipation of the timetable for adoption by the major producer association UNICA. This has been motivated by the global context in which the sugarcane sector is now situated both from the perspective of investment and conditions of access to export markets. Given its magnitude, its transient nature, and the inhospitable working conditions repeatedly exposed by civil society organizations, manual harvesting is now being substituted by mechanization. Each harvester is said to replace 100 cane-cutters.

This also has important environmental implications since manual harvesting requires prior burning of the sugarcane and serious pollution to the surrounding towns. Almost all new plants, particularly those in the new savannah regions include provision for 100% mechanization. In the State of São Paulo the timetable for mechanization on levels lands, 2017, has been brought forward and it is estimated that 70% of the harvest will be mechanized by 2010. Retraining schemes are being planned, but these will only cover a small proportion of the half million temporary workers in the sugarcane sector.

The working conditions of cane-cutters have been a major focus of conflicts within the sector and a major focus also of adverse attention from civil society organizations and the media. In recent years, these combined pressures would seem to have led to improved conditions particularly within the more organized segments of the industry. Studies show a decline in infant labor, decreased informality, real wage increases, increased benefits and better schooling (Balsadi, 2007). Nevertheless, on the key issue of workload this has not been the case since the same system of payment by meter harvested prevails even though agricultural productivity has vastly increased over the last thirty years. It is estimated that cane-cutters must now cut 10-12 tons a day as against 3 tons in the 1970s and only young workers can resist the increased workload (Mendes, 2007).

In the areas of new investment, such as Mato Grosso do Sul there have been many denunciations of inhuman working conditions both in the case of migrant labor from the Brazilian Northeast and local indigenous workers. The high profile, BRENCO investment-company was charged by the Public Prosecutor in 2008 after inspections of its plants identified unsafe working conditions, degrading living conditions and use of informal recruiting systems. 140 contracts were rescinded and BRENCO has committed itself to improving conditions in the plant and to providing public services for the neighboring municipalities who are suffering from the influx of workers (Camargo, 2008).

Certification

Even though domestic growth will dominate the ethanol market in the medium term, Brazil's strategic goal is the creation of a global ethanol commodity market. This involves, as we shall see the promotion of ethanol production in other developing countries. It also involves the negotiation of agreed standards. The initial focus here was on technical criteria but in the light of growing critiques of biofuel production the discussion on standards has expanded to include environmental and social criteria. Inmetro, the National Institute for Metrology, Norms and Industrial Quality is in charge of the program and pilot projects are now being tested on a regional sample of sugar-mills (INMETRO, 2007). In addition to

physico-chemical criteria relating to the quality of the sugarcane, respect for labor legislation and levels of greenhouse gas emissions are also included. It is hoped that certification will provide the passport to global market access. Private certification schemes are also being developed, such as that of the Swedish Biofuels & Chemicals, which uses Brazilian sugarcane and is Sweden's leading supplier of ethanol for heavy vehicles. A particularly unusual example is the socio-environmental certification scheme established between independent small-scale sugarcane suppliers and the Usina Della Coletta sugarmill in São Paulo State (O Estado de São Paulo, 2008). In addition to seeing certification as providing a privileged basis for access to export markets this sugar-mill has committed itself to sharing any premium price eventually received. Small-scale independent sugar-cane suppliers make up some 25-30% of the total harvest and the plan is to extend the certification scheme to other producers in this category.

The Creation of a Global Ethanol Market

It is clear to Brazilian biofuels interests that the creation of a global commodity market requires more than standards and qualification systems. It requires above all that a good number of other countries also become producers allaying fears that one or two players may control the market. Brazil, however, as we have argued is a special case and if it can be shown that the conflict between ethanol and food production is not a central issue in Brazil this by no means indicates that the Brazilian model can be exported. A study by the FAO/ECLA (2007) has argued that there is land available for viable biofuels programs in various Latin America countries. It is similarly claimed that many African countries also would be able to support biofuels programs (Matthews, 2008). Both these options have become the object of foreign direct investment strategies by Brazilian firms and transnational based in Brazil. In the case of Latin America, it is above all the advantages provided by the Caribbean Free Trade Agreement (CAFTA) and the Caribbean Basin Initiative, which provide a loophole through which Brazil can export ethanol to the US avoiding the import tax of US$0,54 per gallon imposed against Brazilian ethanol. Jamaica, El Salvador and the Dominican Republic have all become the object of investments, which may involve little more than dehydrating ethanol exported from Brazil. Brazil has historic links in the lusophone, African countries and has become an important investor in the context of postwar reconstruction. The advantage here is access to the European market within the framework of the Everything but Arms (EBA) agreement. Rather than creating a global market these investment strategies are an expression of the transnationalization of the Brazilian biofuels complex. The danger is that Brazil in furthering its global interests will provoke the environmental and food supply conflicts in these countries, which it claims to be resolving in the very different conditions of Brazilian ethanol production (Seedling, 2007).

Second Generation Biofuels

While ethanol from sugarcane shows itself to be technically and economically superior to all other crops currently in use, it is widely thought that this advantage will be undermined

once second-generation ligno-cellulose technology becomes commercially viable. Indeed, in part the criticisms of the US biofuels corn-based ethanol are often thought to be partially deflected once the goal of a transition to non-food raw materials by 2015 is taken into account. We have already mentioned that the sugar-cane sector is seen to be of strategic importance for Brazil in terms of wider development objectives since in addition to strong traditional comparative advantages Brazil has established solid competences in all phases of the production chain. In particular, a strong national research network (RIDESA – Inter University Network for the Development of the Sugar-Alcohol Sector) has ensured a steady supply of new, adapted crop varieties and improved agricultural practices for the expanding sugar-cane sector. Brazil's biotechnology competence was confirmed with its contribution to genome research, (which has included sugar-cane), and leading researchers from this network have since been developing advanced genetic research directed to the sugar-cane sector through the start-ups financed by Votorantim's investment fund. While initiatives in other countries, however, explore the potential of new non-food crops (grasses, waste products, woods), Brazil is advancing in research designed to exploit the potential of the whole sugar-cane plant including the bagasse and the straw. It is probable, at this stage, therefore, that the centrality of the sugar-cane complex will be confirmed in the context of second -generation biofuels. In such a situation we are likely to see a further expansion of sugar-cane investments. With the São Paulo State already at saturation point these investments will increasingly be directed to regions where the attractiveness of income and employment opportunities often prove to be stronger than social and environmental concerns.

The Brazilian National Biodiesel Programme (PNPB)

Historically, during petroleum shortages, vegetable oils and their sub products have been proposed in Brazil as alternatives to diesel fuel. With the oil shock of the seventies a new opportunity for the use of non-conventional fuels was opened up. In 1975, the Brazilian government created the "Vegetal Oil Production Plan for Energy Uses" (PRÓ-ÓLEO) and in 1980, the Brazilian researcher, Expedito Parente filed the world's first biodiesel patent. The PRÓ-ÓLEO plan was not successful but external dependence on imported diesel fuel and the petroleum price explosion have once again put alternatives to diesel fuel on the agenda, with biodiesel being the leading option for a large petroleum diesel substitution program.

The Brazilian biodiesel programme was officially launched in December 2004, with the specific aim of using this opportunity to promote social inclusion. Whether intentional or not, this also served to deflect criticism from the ethanol program based exclusively on the large sugar mills. A national 2% mandatory blending of diesel was imposed as of January 2008 to be increased to 5% by 2013 (Law nº 11,097, 2005). In July 2008, this share was already raised to 3%. According to the Program the preferred feedstock would vary according to region – palm oil in the North, castor oil in the Northeast, soy and other oil crops in the remaining regions. Tax exemptions are offered to biodiesel producers who

contract with family farmers for their feedstock. The Agrarian Development Ministry (MDA) offers a Social Fuel Certificate to those firms who comply with this requirement enabling them to participate in the biodiesel auctions, which are currently the pre-condition for access to this market. Targets for family farm participation were established for each region – 50% in the North, 35 % in the Northeast, 30% in the South and 15% in the Center-West. The biodiesel company should offer technical assistance to the farmers and guarantee that it will buy their production. State governments, for their part, have provided support for the involvement of family farmers into the program.

Brazil's biodiesel production is small when compared to the European Union (EU), which is responsible for 66% of world production, some 6.5 billion litres per year from 214 plants. The US produces 1.5 billion litres from 171 plants[1]. By 2012, the UE market is scheduled to increase to 15 or 16 billion litres, with a further 58 plants being constructed, while the US by the same year plans to increase to 8 billion litres with a further 62 plants[2]. In Brazil, 61 plants have the National Petroleum Authority's (ANP) permission to operate and have a combined capacity of 3 billion litres per year. 69% of the plants have only 21% of the total production capacity (each with 20 to 50 thousand litres), while 23% of the plants have 64% of production capacity (with 100 to 200 thousand litres each). A further 47 plants are under construction or planned, with an additional production capacity of 2.17 billion litres (BiodieselBr, oct 08). According to the World Information on Alcohol and Biofuels of the F.O. Licht, Brazil may produce as much as 9.5 billion litres by 2012. Since by this time statutory biodiesel demand would only be around 2.5 billion litres (B3) these figures suggest an ambitious export target. For the moment, however, national production has only a small export potential and the focus is on supplying domestic biodiesel demand[3].

While initially the Social Certificate was restricted to the family farm production of palm and castor oil – the law now contemplates all raw material coming from family farming. Nevertheless, officially data, published for the first time by the government (the Ministry of the Mines and Energy – MME) in September 2008, have shown that the reality does not fit expectations. Castor oil has not been used by any industry since January 2008 and palm oil participated with less than 1% during the six first months of the year. In spite of all the Program's explicit goals and practical efforts soy and animal fats dominate biodiesel production in Brazil (table 1).

Table 1 – Primary feedstock employed in the Brazilian biodiesel production.

Primary feedstock	Jan. 08	Feb. 08	Mar. 08	Apr. 08	May 08	Jun. 08
Soy oil	70,20%	64,89%	53,07%	53,78%	55,17%	57,39%
Animal fats	18,27%	17,78%	19,88%	14,82%	18,38%	6,80%
Cotton oil	0,26%	0,87%	5,34%	0,37%	0,01%	0,06%

[1] http://www.ebb-eu.org/EBBpressreleases/EBB%20Brochure%20FINAL%2025.07.08.pdf + http://www.biodieselbr.com/noticias/bio/esmagadoras-enfrentam-dilema-biodiesel.htm
[2] http://economia.uol.com.br/cotacoes/ultnot/2008/08/26/ult29u62992.jhtm
[3] http://economia.uol.com.br/cotacoes/ultnot/2008/08/26/ult29u62992.jhtm

Palm oil	0,23%	0,39%	0,34%	0,10%	0,62%	0,01%
Castor oil	0,18%	0,00%	0,00%	0,00%	0,00%	0,00%
Other fat materials	10,86%	16,03%	21,31%	30,88%	25,79%	35,65%
Pig fats	0,00%	0,04%	0,06%	0,06%	0,04%	0,05%
Recycled cooking oil	0,00%	0,00%	0,00%	0,00%	0,00%	0,03%
Cattle oil	0,00%	0,00%	0,00%	0,00%	0,00%	0,01%

* The percentages are relative to the processed volumes for biodiesel production.

** According to the MME, the "other fat materials" have been employed by the plants of Biocapital, Granol and Bioverde, with Granol responsible for almost 90% of the total. This product may be a mix of oils, among which from soy and cotton. Consequently, the percentage of the soy oil participation in the biodiesel composition is considerably higher.

Source: Biodieselbr, September 2008 – MME's data elaborated from the *Superintendência de Refino e Processamento e Gás Natural* (SRP)'s information, based on the SIMP.

http://www.biodieselbr.com/noticias/bio/mme-divulga-informacoes-materias-primas-biodiesel-03-09-08.htm

In addition to this failure to promote typical family farming products, the goals of social inclusion have also fallen short of the Program's targets. According to the national coordinator of the biodiesel programme, the incorporation of family farmers into the programme has ground to a halt making it difficult to attain the initial goal of 200 thousand of families. "The most important objective now" he said, "is to consolidate the existing 100 thousand participants, which means around 250 thousand people considering 2.5 persons per family", (FOLHA DE S.PAULO, news 16-08-08). A study by the Agrofuels Monitoring Centre of the NGO Reporter Brasil, published in September 2008, however, states that only 36.7 thousand families are currently working in the biodiesel value chain (REPORTER BRASIL, news 23-09-09).

In the Centre-West region, research has further suggested that it is the more consolidated family farmer producing soybeans rather than the small farmer producing castor oil who is benefiting from the programme (FERREIRA, 2008). About a third of soy is produced in properties of 50 ha or under mostly in the south and it may be the case that this strata participates in the supply of soy oil in Mato Grosso do Sul, the principal producer State in the Center-West. The soy lobby in the biodiesel market, however, is clearly based on the large-scale producers and if soy comes to confirm itself as the preferential raw material for biodiesel, it will be the large farmer and the dominant agribusiness channels, which will certainly take over the program.

The explosion of demand for soy has since the '80s promoted land concentration and threatened the position of family farming. In a comparison between the census of 1985

and 1996, an Embrapa study concluded that the number of properties producing soy had decreased by 42% (more than the national average of 16.3%), and the number of persons working in soy production had declined by 44% (Reporter Brasil, 2008). Besides soy, other crops targeted for biodiesel production are also dislodging family farmers who sell their lands to medium and large-scale industries. This is particularly the case in the State of Pará (North of Brazil) where big plantation investments such as that of Biopalma are underway (Reporter Brasil 2008).

Box 1 – Biodiesel from castor oil.

An ANP (Resolution ANP 42 of 2004 in 07 de 2008) has ruled out the use of castor oil as a 100% substitute for diesel. According to this decision, various characteristics such as viscosity and density do not comply with specifications. This reverses an earlier ruling (ANP 07) which contained specifications compatible with the properties of castor oil. The conversion of castor oil into biodiesel is more complicated than in the case of conventional oils: it is more difficult to separate the glycerine and the alcohol at the end of the process increasing costs. (SUAREZ, 23-09-08). On the other hand, "the addition of castor oil to biodiesel improves the quality of the final product" according to Amadeu Neto of the Agronomic Institute of São Paulo (IAC) (BIODIESELBR, 08-08-08). Report Equit-BA.
The majority of biodiesel producers reject castor oil, which is defended by the Government. In a survey conducted at the Brazilian Agribusiness Congress (ABAG) not one firm declared that it was using castor oil. "It may be a good option in the future but at the moment this is not the case. It is the Government which is insisting on its use," Marcello Briton, marketing director of Agro Palma.

http://si.knowtec.com/scripts-si/MostraNoticia?&idnoticia=9155&idcontato=599&origem=fiqueatento&nomeCliente=ETHANOL&data=2008-08-13
Castor oil produced by family farmers has not been excluded from the market but its low productivity and small scale has been a deterrent to industry http://si.knowtec.com/scripts-si/MostraNoticia?&idnoticia=9155&idcontato=599&origem=fiqueatento&nomeCliente=ETHANOL&data=2008-08-13

Biodiesel plants in Brazil:

The largest biodiesel companies and those that have closed the biggest deals in the auctions are the leading soybean agribusiness firms. This is the case of Agrenco, Granol, ADM (box 2), Caramuru (one of the biggest soybeans industries with national capital), and Oleoplan (a traditional industrial soy group). The leaders in the biodiesel market, ADM and Granol were responsible for 15% and 13%, respectively, of national production from soybeans during 2008. It is expected that soybeans will account for 90% of national

biodiesel production[4]. According to Reuters, soy oil also dominates the global biodiesel market with 58% of world production[5].

Table 2 – The 10 Largest Biodiesel Plants in Brazil – Authorized Production Capacity, Social Fuel Certificate, Raw Material Employed, and Production during 2008.

Company	State/Region	Authorized Capacity (million L/year)	Seal	Raw material announced by the company	Production in 2008* (million L)
Brasil Ecodiesel	CE/NE, BA/NE, MA/ NE, TO/N, RS/S	108 each	Yes	> 90% soy (rest: sunflower and castor oil).	108
Granol	RS/S, GO/CW, SP/SE	123, 122 and 90	Yes	100% soy.	127
Biocapital	SP/SE	247	Yes	50% soy, 50% animal fats (bought oils)	39
Agrenco	MT/CW	198	Yes	50% soy, 20% animal fats, 15% sunflower, 15% cotton.	2
Oleoplan	RS/S	198	Yes	Soy, sunflower, castor oil.	46
ADM	MT/CW	169.5	Yes	100% soy.	99
Fiagril	MT/CW	123	Yes	70% vegetable oil (soy, cotton, sunflower), 30% animal fats (bought).	43
Caramuru	GO/CW	112.5	Yes	100% soy (extracted by the company).	69
BSBios	RS/S	103.5	Yes	90% soy, 10% sunflower.	48
Comanche	BA/NE	100.5	Yes	Soy, sunflower, cotton, jatropha, animal fats, recycled cooking oil.	9
Brazil	-	-	-	-	**662**

[4] http://si.knowtec.com/scripts-si/MostraNoticia?&idnoticia=9155&idcontato=599&origem=fiqueatento&nomeCliente=ETHANOL&data=2008-08-13

[5] http://economia.uol.com.br/cotacoes/ultnot/2008/08/26/ult29u62992.jhtm

Notes: SP: São Paulo; MT: Mato Grosso; RS: Rio Grande do Sul; GO: Goiás; CE: Ceará; BA: Bahia; TO: Tocantins; MA: Maranhão; N: North; NE: Northeast; CW: Center-west; SE: Southeast; S: South. * Until August 2008.

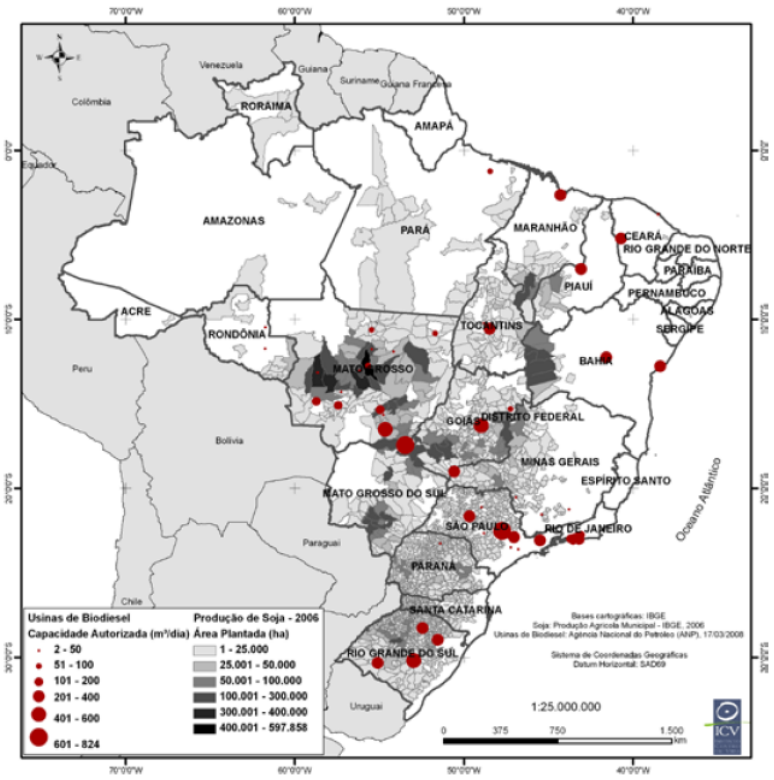
Source: ANP, BiodieselBr, MDA/SAF, O ESTADO DE S.PAULO News 05-08-08[6].

Biofuels and Soy

Brazil has successfully distinguished itself from the "bad ethanol" made from key food crops such as corn in the US or wheat in China and the EU. With the failure of other alternatives, however, it now finds itself for biodiesel relying on soy, the central feedstock of the animal protein market and as edible oil a strategic food resource especially for poor urban families in developing countries. In a similar manner to US discourses, the argument is that for the moment soy is the only option although with time other inputs will become viable. New investments in industrial plant, however, although in principle able to use a variety of raw materials are concentrated in the soy producing areas, as the map below makes clear. In addition, the production of biodiesel involves the use of ethanol which favours regions also producing sugar-cane.

Soy is primarily a protein source and its oil content is low – one unit of oil producing four units of animal feed. Projections of future trends have to take into account a complex series of variables. In principle, Brazil could accommodate the extra demand by exporting meal rather than grains, in which case it would not have to increase the area under cultivation. On the other hand, as in the case of sugarcane, the argument in the Brazilian case would be that land is no problem. ABIOVE, the soy bean business association projects that Brazil will be producing 105 million tons of soy by 2020 as against 60 million tons in 2008. Another option would be to divert exports of edible oil for the production of domestic biodiesel. This may contribute to an increase in world prices of edible oils creating obstacles to access to a key food ingredient especially for poor urban families in developing countries. High prices, however, make biodiesel production unviable and therefore the likely response would be to re-continue edible oil exports. As for the export market, much depends on European strategies, which may favour the import of grains, crude or refined oil, each with different implications for the exporting country. In addition, in this market Brazil has to compete with a highly competitive Argentina. Nevertheless installed and planned capacity which far exceeds domestic market demands in the near future suggest that exports for the biodiesel market have become an integral part of the soy complex's strategies. These investment include the world's largest biodiesel plant in the Southern State of Paraná which should come on stream in 2010 capable of processing 600.000 tons per year.

[6] http://www.biodieselbr.com/noticias/em-foco/r1-usina-biodiesel-substitui-mamona-oleo-soja-05-08-08.htm

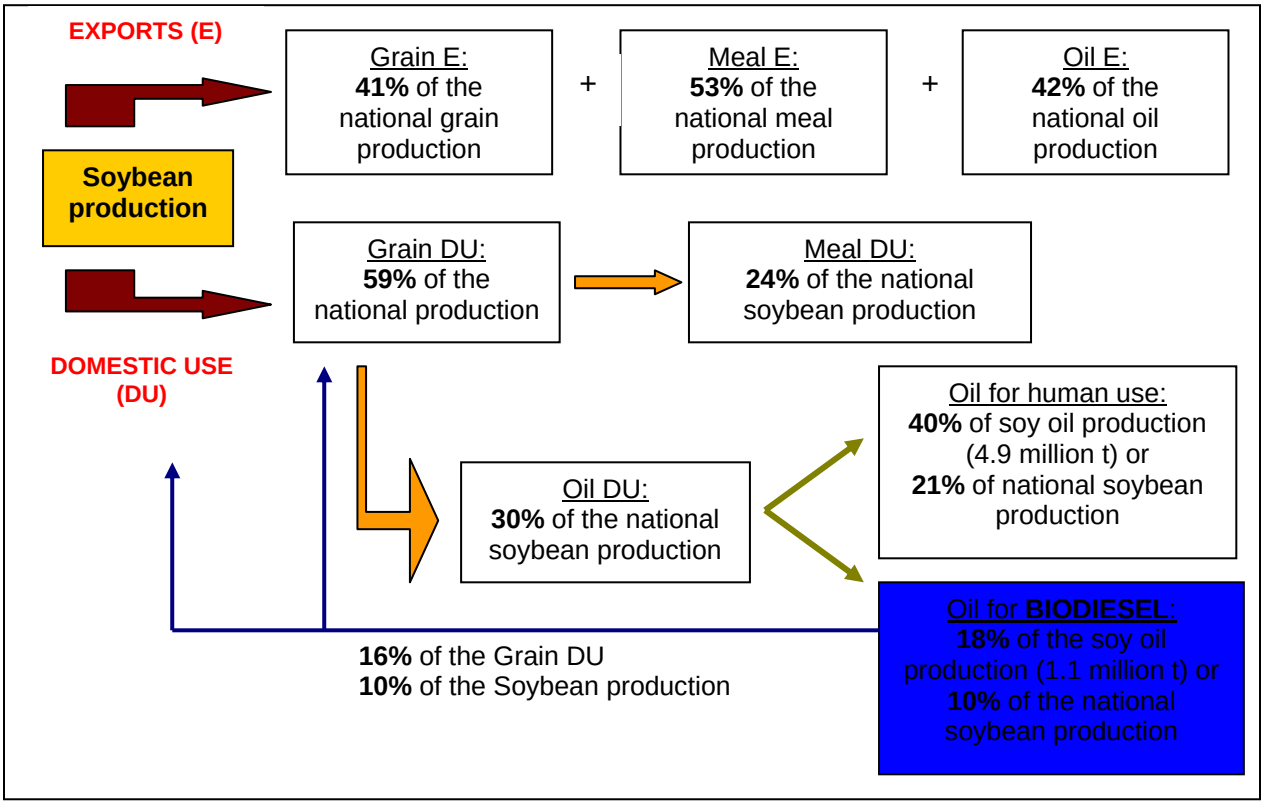


Source: Repórter Brasil, 2008.

The advance of the soy frontier in Brazil has attracted much attention from the international media and from a wide range of opinion formers. For some years now the share of the North and the Northeastern region in total soy production has been increasing with figures for 2005 indicating that this has now reached 8%. All of this production has occurred over the last 15 years. The Greenpeace campaign against Cargill's grain terminal in Santarém brought the world's attention to the presence of soy production in the Amazon. This has led to a moratorium agreed between leading traders and international NGOs on the marketing of soy produced on land in the Amazon region deforested since 2006. This moratorium, due to end in 2008 has now been renewed and production from the region carries a certificate testifying to its environmental credentials. As State governors in the Amazon region have argued in the case of sugarcane, many defend the production of soy on the degraded lands in this region, which have long been logged calculated as being in the order of 90 million hectares. Such lands are not included in the moratorium. EMBRAPA is promoting an Integrated Production System for this region which would combine crops and cattle raising.

With all these caveats we present below a description of the current profile of the soy complex in Brazil:

Figure – Distribution of the Brazilian soybean production.



Source: authors' elaboration considering 20% of oil in the grain (MAPA, 2007), a soy oil density of 920 kg/m^3 (BRANDÃO *et al.*, 2006) and Abiove's crop data of 2007/08.

On the basis of this profile the following Table projects the demand for biodiesel depending on different suppositions as to levels of blending, increasing diesel demand, likely productivity increases and ABIOVE's estimates for increases in production. If we add to this the declared strategy of contesting export markets and the investments already being put in place with this in mind it is clear that the biodiesel market implies a radical shift in the direction of the soy complex in Brazil whose implications are as yet unclear. Agribusiness analysis has argued that the soy complex needs an alternative to the vegetable oils markets and that Brazil has a chronic surplus (Zilio, 2005). In this view biodiesel become a key strategy for the dynamic of the sector as a whole and points to a sustained increase in production with a continuation of all the tensions which have accompanied its advance on the basis of large-scale monoculture up from the savannah regions of the Center-West into the Amazon.

Table 3 – Soy area and volume demands depending on the Bx.

	2008	2013	2014	2018	2020
Annual increase of the energy demand[1]	4.1%	4.1%	4.1%	4.1%	4.1%
Diesel demand[2] (million L)	40.453	47.087	50.948	59.304	64.167
X% of biodiesel in the diesel[3] (Bx)	**3% (B3)**	**5% (B5)**	**6% (B6)**	**8% (B8)**	**10% (B10)**
Biodiesel annual demand (million L)	1.214	2.354	3.057	4.744	6.417
Soy oil demand[4] (million L) – 90%	1.214	2.354	3.057	4.744	6.417
Soybean volume[5] (1,000 t) – biodiesel	6.568	12.741	16.543	25.675	34.725
National soybean production[6] (1,000 t)	60.017	75.012	82.509	97.503	105.000
Soybean area[7] (1,000 ha) – biodiesel	2,332	4,340	5,547	8,401	11,251
National soybean area[8] (1,000 ha)	21.313	25.549	27.666	31.902	34.020
% of the soybean national production or area	**11%**	**17%**	**20%**	**26%**	**33%**

Source: Authors' calculations

1- EPE (2007), calculates the annual increase in diesel demand as 4.1%. 2- Demand for 2008 is that of ANP until August. Annual demand is calculated considering monthly average demand over the year. For the following years, the demand is calculated considering the values for 2008 and the annual increase of energy demand. 3- According to Law nº 11,097/2005, biodiesel had to represent 2% of diesel sales as from January 2008, and 5% from January 2013. In July 2008, however, the mandatory blend was established at 3%. For 2020, the European blend of 10% is adopted. 4- The efficiency of the transesterification process is about 90% (ALMEIDA *et al.*, 2006). The soy oil represents 90% of the biodiesel feedstock. 5- The efficiency of oil extraction is about 85% (NETO *et al.*, 2006). 6- Conab's data is used for 2008 and Abiove's data for 2020. For the intervening years, the values are based on these two data. 7- Based on the results of soybeans volume and soy productivities calculated from 6 and 8. 8- Conab's data for 2008 and Abiove's additional area rate (46%) for 2020 extrapolated from CONAB data for 2005 (note 11).

Conclusions

Biofuels are now a key component of Brazil's agroindustry economy and their consolidation poses fundamental questions with regard to the environment and models of economic and social development. The advantages of scale have been largely accepted in the case of ethanol and the focus of critique has been the environment and working

conditions. A number of initiatives have emerged integrating sugar-cane ethanol into family farming systems with a view to local and regional consumption (Ramis, 2006) and the potential for a new decentralized agroenergy/food system has been forcefully defended (Sachs, 2007). Nevertheless, these have made little headway either in practice or in discourse. While localized conflicts over food displacement have been identified it is argued that Brazil's exceptional availability of land and water in favorable climatic conditions permits the continued growth of both fuels and food. Exports have accompanied ethanol expansion and domestically food politics are seen primarily in terms of income and access.

Biodiesel promotion, on other hand, was initially designed as a regional development strategy whose priority was social inclusion. Local raw materials were to be used and priority given to the family farm sector as supplier and where possible as primary processor. Despite its innovative design and the commitment of considerable human and material resources, the structural weaknesses of the family farming sector have led it to be marginalized from the program. Biodiesel has come to depend almost exclusively on soy and is increasingly integrated into the strategies of agribusiness. Given the complex inter-dependencies between the soybean, meals and vegetable oils markets the long-term impact on food markets is as yet unclear. The last years however suggest that the volatility of supplies and prices will be exacerbated pointing to the need for different policy instruments than have prevailed over the recent period.

Biodiesel developed as the antithesis of ethanol in almost all respects. The more recent tendency, however, has been towards convergence. Petrobras, the State petroleum company, in addition to its investments in processing and refining in biodiesel, controls distribution. It is also a major investor in ethanol and has now set up a separate company responsible for its biofuels activities. Leading traders such as ADM are investing in both sectors. The use of ethanol for the production of biodiesel also favors convergence. The future, however, may see a more radical integration of biodiesel into a sugar-cane dominated biofuels sector if the research pointing to the possibility of producing biodiesel directly from sugar-cane proves economically feasible. Until such a time, biodiesel is likely to be increasingly integrated into the soy complex, although this is often claimed to be provisional depending on the development of alternative non-food feedstocks. While the current crisis will dampen demand in the coming period, medium and long term demographic tendencies point to the continued shift to an animal protein diet in developing countries which is likely to maintain demand for soy. In this context, we will see a persistent advance of large-scale soy production in Brazil with all the attendant social and environmental tensions.

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