Sustainability of ethanol from Brazil

in the context of demanded biofuels imports by The Netherlands

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Content

1_ Introduction

Brazil is internationally recognized as a leader in production and efficiency in the sugar and alcohol sector, but this leadership is not as developed in the social, environmental and governing capability of the sector.

Today the Brazilian sugar cane industry finds itself in a new cycle of expansion, with growth expectations never before predicted of sugar and ethanol production. To its principal inducer, the globalized market, it is summed up as a huge consolidated internal market powered by the new bi-fuel car engines commercialized successfully in the country. The globalized market is currently characterized by the increase in the price of petroleum and by commitments taken on by the developed countries to mitigate the effects of climate change, besides the reduction of agriculture subsidies for sugar. The response to this vast and growing demand points to the new incomes and job opportunities for the Brazilian economy as well as to the advance of monocultures and their social and environmental impact in the country.

Beginning with the involvement of various national and international actors, this context offers space for a transforming process to adopt better practices in the production of sugar cane ethanol along the entire chain. Doubtless, the use of this bio-fuel on a large scale is also an important contribution to the global effort to reduce greenhouse gas emissions because it offers a renewable alternative to petroleum.

Sustainability, however, is not only about mitigation of greenhouse gas emissions, technological advances or the legal enforcement over the production of bio-fuels. Sustainability means greater responsibility, austerity and equity of international standards of the consumption and use of energy, whose demand has also contributed to the specialization and homogenization of the use of land to supply raw material to the global market, which results in risking the sustainability of the populations and environment of the producer countries. The actors of this market, especially civil society at the international an national level, should then take advantage of this moment when the production and commercialization of bio-fuels is being discussed, to pressure for changes in the standards of production and consumption of energy.

This case study evaluates the bottlenecks and opportunities for advancement in sustainability of social, environmental and in the economic issues of the production of sugar cane ethanol in Brazil, considering the rapid growth of its production for internal consumption and exportation.

The case study about sugar cane ethanol from Brazil was carried out in the context of the project "*Dutch import of biomass - Producing countries' point of view on the sustainability of biomass exports*", funded by the Dutch Ministry of Housing, Spatial Planning and the Environment and undertaken by three Dutch NGOs, i.e. Both ENDS, Stichting Natuur en Milieu and COS Nederland, in co-operation with consultancy firm CREM B.V. and the following counterparts in biomass producing countries: Núcleo Amigos da Terra (NAT) and Vitae Civilis Institute [Brazil]; Biodiversity Foundation Kehati, in co-operation with Sawit Watch, Social Economic Institute (INRISE), Bogor Agricultural University and Media Indonesia Group-Daily Research and Development [Indonesia] and Ms Gwynne Foster [South Africa].

The most relevant sustainability aspects for the sugar cane ethanol industry, guided by the CREM sustainability frame work[1] were considered and analyzed in this study.

The study was based on the analysis of research data on the sector in Brazil and on the various visions of different actors – NGOs, industry, rural workers, the financial sector and government departments – concerning the most polemic or divergent aspects of sustainability in the sector, stated in interviews carried out with main stake holders in the state of Sao Paulo (according to the annex 2)

Finally, this paper presents some possible ways to include sustainability criteria in the negotiations of exporting ethanol, taking into account the minimization of its production social and environmental impacts in Brazil, as well as its necessary monitoring and guarantee of its application by the various interested actors and other possible strategies to be carried with this aim.

[1] See the complete report about sustainability of biomass imports from The Netherlands at www.crem.nl

2_ Characteristics of Brazilian sugar cane supply chain [2]

2.1_ A brief history

The introduction of the production of sugar cane ethanol in Brazil dates back to the beginning of the colonial period. In the middle of the 16th century Brazil became the major producer of sugar cane in the world by supplying Europe with this precious commodity, a cycle which lasted 150 years.

A new cycle began, as now, during a petroleum crisis, during the 1970s. The national program of alcohol (Pro-Álcool), which began on the 14th of November, 1975, was accompanied by the development, as much for the production of sugar cane and ethanol fuel, undergoing genetic improvements and utilizing adapted seeds, to the applied methods in the mills and distilleries, as for the automobile industry, which was had to adapt to a new national reality. After a little more than 10 years, between 1986 and 1989, more than 90% of the automobiles made in Brazil were fueled by hydrated alcohol. During this period, production reached 10.5 billion liters of hydrated alcohol and 1.3 billion liters of anhydrous alcohol per year.

On the other hand, the first cane cycle mentioned above left, as an inheritance, the advance of the agriculture frontier on natural areas, principally on the Atlantic Forest biome, which is presently only 7% its original size; the archaic agricultural methods still prevalent in the Northeast region which resulted in bad usage and contamination of waters and the consolidation of labor relations for temporary workers employed on manual sugar cane harvesting, which in many ways copied the injustices of the colonial period.

At the end of the ‘80s the crisis of governability and confidence of the sector began as a result of the lack of supply in the vast national market which had been created. From 1987 on there was a strong reaction of public funding to finance Pro-Álcool. At the same time the sugar market was raising its prices. This situation frustrated the expansion and renovation of the sugar cane plantations, and the producers began to use their natural resources intended for the production of alcohol, for the production of sugar, with export possibilities in mind. As a result, at the end of 1989 there was an alcohol shock which created long lines of cars waiting for alcohol in all the Brazilian cities, and the ironic situation of Brazil importing methanol to supply its vehicles as well as adding 5% of gasoline to carburant alcohol. During the ‘90s the Brazilian government ended the discounts of IPI (taxes for industrialized products) on alcohol-fueled cars. The government also ended the state measures for regulating the sector as well as regional quotas and the control of exportation and prices. The only market guarantee left standing for the sector today is the requirement of a mixture of 20-25% alcohol in gasoline.

2.2_ Current Potential

Today Brazil is still the major sugar cane producer in the world, followed by India, Thailand and Australia (UNICA, 2006). Brazil is responsible for 45% of

[2] The text characterizing the production chain of sugar cane was adapted from data based on a text by Lachefsky, K. And Teixiera, W (2006), written for the publication of the Energy Working Group “AGRONEGÓCIO E AGROENERGIA: Cumulative Impact and Territorial Expansion Tendencies of Monocultures for the Production of Bioenergy”, available at www.fboms.org.br/gtenergia

the world's fuel alcohol. The cane crop permitted a national production of alcohol of 14.5 billion liters in 2005 – of which more than 2 billion of liters were destined for exportation.

The area used for this plantation covers about 6.2 million hectares, figure that represents 1.7% of the area able to agriculture in the country or 18.3% of area currently occupied with annual crop production (IBGE, 2005).

Table 1. Main figures on land use for sugar cane production in Brazil

Land use	**(in hectar)**
Total Brazil area	851.404.680
Non agriculturable (roads, cities, legal Amazon etc)	497.793.441
Agriculturable area	353.611.239
Area with perennial agriculture	7.541.626
Area with annual agriculture (a)	34.252.829
Area occupied with sugar cane (2004) (b)	6.252.023
% Area with Sugar cane (b/a)	18,30%
Repose area (c)	8.310.029
Natural pasture area (d)	78.048.463
Artificial pasture area	99.652.009
Natural forest area	88.897.582
forestry area	5.396.016
Area non utilized (e)	16.360.085
Agriculture inapt areas	15.152.600
Possible expansion area for sugar cane [(c+d+e)/2]	51.359.289

Source: Censo Agropecuário IBGE 2006

The regions which have the greatest areas of plantations are in the subtropical zones of the Mid-south and in the Atlantic tropical areas of the Northeast of Brazil. Nevertheless, the traditional producer groups of the Northeast have re-directed their investments to the Mid-south. They have installed new processing units or incremented the plantation areas. Currently the mid-southern region is also responsible for 80% of the ethanol produced. The southeastern region, specifically the state of São Paulo, is responsible for a constant growth of the production and yields 89% of the volume of sugar cane, 89% of the alcohol and 90% of the sugar produced (IEL, 2006).

Among the main producer states we find Paraná, in the South, and Alagoas in the Northeast. Nevertheless, both of them have less expressive participation than those in the Southeast. Each of the later produces approximately 8.5% of the national total.

In the 2004/5 harvest more than 416.2 million tons of sugar cane were harvested – 55% for ethanol and 45% for sugar (UNICA, 2006). With this dual stature the sugar cane agro-industry is able to react rapidly to oscillations of international markets which are a competitive advantage over countries which produce only sugar. The production of sugar and alcohol is expanding and the estimate for the 2006/7 harvest is 469.8 million tons, which is an increase of 8.9% over last year. This occurs because of the increase of 5.4% of planted area and a gain of 3.4% of productivity in this period (CONAB, 2006).

The distribution of this total amount shows the following: 50.5% is for the manufacture of sugar, 39.6% is for alcohol and the remaining 9.6% is for

other objectives – cachaça, seeds, animal ration, brown sugar and others (CONAB, 2006).

2.3_ Future Potential

The expectations of the Brazilian government expressed in the National Policy of Agro-energy (2005) launched projections of growth of internal consumption of 1.5 billion liters a year. This represents a demand estimated to be about 25 billion liters for 2013 and a total offer of ethanol close to the 30 billion liter mark by 2015, aggregating to that number the predicted volume for exportation. The consolidation of expectations of the consumption and exportation of ethanol and sugar should represent an additional demand of 220 million tons of sugar cane and the incorporation of 3 million hectares of new areas.

The mid-western region has shown itself, in the latest harvests, to be the new area of expansion of the crop – mainly in the state of Goiás which had an increase of 81% of planted area in the harvests of 1999/2000 to 2003/4 and is already responsible for 6.6% of sugar cane production in Brazil (IEL,2006). The western part of Mato Grosso do Sul and the southeastern part of Minas Gerais, also in the Cerrado area, accompany this expansion tendency of new areas.

This way, pressure on the Cerrado can be detected, which represents the preponderant biome in this Brazilian region. This expansion tendency occurs because of the availability of manpower and the declivities of land which are suited for the mechanization of the production process.

Figure 1: Present areas of sugar cane production in Brazil (red)

More recently, there has also been a prediction concerning the sugar cane culture expansion, in the border region between the Cerrado and the Amazon forest, beginning with state government programs that aim to take advantage of the geographic conditions and infrastructure which are favorable to exportation.

Since the western region of São Paulo and its neighbor states (Mato Grosso do Sul, Goias and Minas Gerais) cover areas of the greatest production and expansion of sugar cane for exportation, the analysis of the impact and the aspects of sustainability issues of sugar cane ethanol industry in this work will focus on the data of these regions.

2.4_ Other relevant aspects

In reference to the harvests, the Brazilian climatic conditions permit two possibilities: in the Northeast the harvests are from October to March, while in the Southeast, the South and the Mid-west, from April to August, been Brazil able to produce sugar and alcohol all year long.

With one sugar cane seedling it is possible to achieve five subsequent harvests with a small but progressive loss of productivity. The variation in the results of the harvest depends on, besides natural conditions, comprehensive knowledge of the producers. In São Paulo a harvest can reach, on average, 85 tons per hectare and with independent suppliers, 68t/ha. In Minas Gerais the average is about 73t/ha and Alagoas, 63t/ha. In Pernambuco the average is about 51t/ha (0RPLANA 2006, IBGE 2002). Seventeen Brazilian states are producing sugar cane, but in only 8 of these states is the harvest superior to 6 million tons. The production of these 8 states is equal to more than 90% of the Brazilian total.

The production and processing of sugar cane are exclusively in the hands of the private sector. In Brazil the sugar cane sector has the smallest cost of production in the world for sugar and for alcohol and is appearing as a highly competitive country in the international market (GONÇALVES, 2005).

Planting occurs primarily on land surrounding 340 sugar mills and alcohol distilleries (MAPA, 2006). Besides this, there are approximately 60,000 independent suppliers[3] with properties smaller than 150 hectares each which contributing with 27% of the total national production.

The 13,110 suppliers from the state of São Paulo produces 67% of all the independent producers followed by the producers in Pernambuco who contribute 8.4% of the production and 3.3% of the national production. The volume delivered by the independent São Paulos producers Paulo is greater than the production of countries like Mexico, Australia, South Africa and Thailand, the main global sugar cane planters (ORPLANA, 2006).

It has been verified that there is a transition of the extensive logic to the intensification with a consequent increase in productivity (glucose/ha), the reduction of jobs and the increase of differentiated production (ALVES, 2002). Although these producers call themselves independent, studies reveal a degree of integration and dependence in relation to the mills and distilleries – there is no difference in crops and the production exclusively supplies the agro-industrial complex (GUEDES et al, 2006; ALVES, 1992).

The sugar/alcohol sector directly employs approximately one million people, of which 511,000 work in agricultural production, mainly cutting sugar cane. Almost 80% of the Brazilian harvest is manual (UNICA, 2006). Mechanization depends on the topography since the harvesting machines can only be used on declivities of no more than 12 degrees. As shown previously, there has been an increase in crop planting in regions which are machine-friendly and this has triggered different social problems[4]. In the mountainous regions of Pernambuco, almost all the cutting is done manually, while the amount of mechinazation in São Paulo has reached around 30% with the potential of increasing (TEIXEIRA, 2002).

[3] See item 3.1 criticism concerning the use of the word “suppliers”

[4] Later in the text we will discuss implications arising from the process of mechanization of sugar cane production.

3_ Sustainability issues

3.1_ Social issues

Use of land

Monocultures, rural populations and access to land

The cultivation of monocultures on great extensions of land have been pointed out by social movements and environmentalists as being motivation for inequalities in the countryside, as well as being a barrier to the social reproduction of rural populations. The absence of an efficient judicial classification concerning the Brazilian land ownership structure, capable of regulating the uses and determining the limits of properties, associated to the possibilities of cheap available manpower has contributed to the expansion of monoculture areas. In relation to this, impact on the maintenance of family agriculture and changes in the standard of agricultural production can be verified. A confirmation of this can be seen in regions of São Paulo state which specialized in the production of sugar cane (GUEDES *et al*, 2006).

"The agricultural model based on monoculture for exportation is contrary to proposed policies which guarantee food sovereignty and agrarian reform. The current expansion of this crop in agricultural frontier areas causes conflict among indigenous peoples and small farmers."
Rede Social and CPT "The OMC and the destructive effects of the sugar cane industry in Brazil", 2006

It is interesting to note that, although in the sugar cane industry there is a high concentration of rural properties as well as the participation of owners of small and medium sized properties – approximately 60,000 independent suppliers owning property no larger than an average of 150 hectares each and which contribute 27% to the total production. However, these owners do not live off the land. Thus it is important to differentiate between the size of the property and the activity of family farming, which is not characteristic of the sugar cane agroindustry.

"The private or individual land owner has tax advantages for production... The great majority of these suppliers are not suppliers, but rather, land gigolos – they are not rural producers and they don't work the land. There are suppliers who are dentists, doctors..."
Elio Neves – President of FERAESP, Araraquara, interviewed 07/25/2006.

As the present tendency of increased production in the sugar cane agro-industry is intimately related to the expansion of the crop in new areas, a reconfiguration of geographic space and pressure upon the customs and activities of rural life is triggered. The following table presents data on the increase of production and planted and harvested areas.

Table 2: Production of sugar cane planted and harvested in hectares – Brazil 2000/2005

Sugar cane	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Production (ton)	326.121.011	344.281.802	363.721.019	389.849.400	416.256.260	416.560.113
Planted Area	4.879.841	5.022.490	5.206.656	5.377.216	5.571.395	5.623.442
Harvested Area	4.804.511	4.957.897	5.100.405	5.371.020	5.634.500	5.687.137

Source: IBGE and MAPA

Competition with food production

From the analysis of this table one can notice that in the 5 year interval of planted and harvested areas there was an increase of 15.23% and 18.37% respectively[5]. This growth is mainly concentrated in the mid-southern region and it is already possible to verify the reduction of other crops and a reconfiguration of rural space. Estimates of agricultural production for the state of São Paulo in the harvest of 2005/06 point to the reduction of tomato crops, peanuts "*das agues"* and oranges all of which are being substituted by sugar (IEA/SP, 2006). By the same token, research on the coffee harvest indicates a reduction perspective of planted area by 2.63% in Minas Gerais; 4.15% in Espírito Santo and 7.66% in São Paulo, all as a result of significant grown of the sugar cane production in the Southeast region (CONAB, 2006). This data shows that, contrary to what is affirmed by the sugar cane agro-industry, the amplification of sugar can crops directly influences and imposes restrictions upon the production of food crops.

"Sugar cane is not going to new areas. Logistically, it is not possible for the areas to expand. What has happened is only a conversion, not very significant, of pastureland to cane, since cattle-raising has become more intense."
Laura Tetti, Consultant of ÚNICA[7] , iterviewed in São Paulo, 07/25/2006.

"We have monitored the expansion of sugar cane and seen which activities have been substituted. Basically they are cattle-raising areas. And where do the cattle go? We have observed that cattle-raising area has been reducing in size, while head of cattle per hectare has been increasing. This means that cattle-raising has been intensifying, going from 1.1 to 1.2 head of cattle per hectare. Translated this means that there is no pressure on the production of food nor the migration of economic activities to other areas."
Suani Teixeira, Vice Secretary of the Secretariat of the Environment of the state of São Paulo, interviewed 07/26/2006.

"Sugar cane would rob traditional grain crop areas in São Paulo. In the red earth of the southeastern region of the State, where crops like beans predominated, the sugar cane production has been advancing and transforming the local scenery. [...]
Data from the Institute of Agriculture Economy (IEA), linked to the Secretariat of Agriculture of the State, show that the region has 7 thousand hectares in new areas with sugar cane, totaling 20.8 thousand hectares this year. In Taquarituba, 2 thousand hectares of sugar cane were planted this year [...]
In Avaré, sugar cane occupies 7.4 thousand hectares, planted to supply the demand of mills in Lençóis Paulista and Barra Bonita. José Andrade, secretary of Agriculture of the municipality, affirms that there are 64 thousand hectares of pastureland that can be used.
"The problem is that if one were to plant all the crops needed here, the total would be 125.6 thousand hectares. That's equal to all the farmable area in the municipality. That way there will be no room for grains."
José Clóvis Casarim is one of the grain producers who began to plant sugar cane in the region. He used to plant 250 hectares of soy and corn per year in Taquarituba and now cultivates 200 hectares of sugar cane to supply the Farias Group. The 140 producers of the Cooperativa Regional Agrícola of Taquarituba (Coreata), for example, saw their production of soy, corn and wheat fall from 1M sacks in 2004/5 to 600 thousand in 2005/06. Next harvest it probably will not reach 600 thousand, says Valentim Righetto, president of the cooperative.
According to Righetto, sugar cane should occupy 50% of the area which is currently used for grains. The only reason the expansion will not be greater is because a good part of the crops are irrigated and the cost of removing the central pivots and substituting grain harvesting machines for sugar cane tractors is high. [...]

[5] Estimates by CONAB - Companhia Nacional de Abastecimento indicate an even greater increase of planted area in the 2006/07 harvest. The area cultivated with cane should reach 6.2M hectares, which represents an increase of 5.4% or almost 500,000 new hectares.

[7] The industries associated to UNICA – União da Agroindústria Canavieria do Estado de São Paulo, represent 75% of the national sugar cane production.

"The monoculture can increase the profits from agriculture in the municipality, but reduce agricultural activity and not stimulate regional development.", evaluates José Antonio Quaggio, researcher from the Centro de Solos e Recursos Agroambientais do Instituto Agronômico (IAC), linked to the State Secretariat of Agriculture."
Cane advances in the southeastern part of São Paulo - Valor Online 08/30/2006

Vulnerable Populations and respect for traditions

With respect to the traditions and impact on vulnerable populations, one notes that the indigenous issue is particularly sensitive in relation to sugar/ethanol activity in Mato Grosso do Sul. In 2004 the Marçal de Souza Center for the Defense of Human Rights produced a report showing that some mills in Mato Grosso do Sul employed indigenous manpower who had to work in precarious and inhuman conditions (Biodiversidad 2006).

"It is said that 32 alcohol and sugar mills will be constructed here in Mato Grosso do Sul in the next few years. [...] Today there might be around 20 thousand Indians for this work. A few thousand are already working in the cane fields, in a regime characterized by human rights institutions as semi-enslaving and by anthropologists and other academics as highly damaging at the base of the social organization of these peoples, especially family-wise. Despite some small improvements in labor relations (collective contracts, for example), what one perceives is that the regime of absence of the workers from their villages for two and even three months at a time generates consequences ranging from hunger, to which the women and children are submitted, because they stay back in the villages, to the introduction of countless illnesses and the rise of addictive habits such as alcohol, drugs, among others.[...]
Faced with the criticisms of what represents prolonged distancing of the Indians from their villages, they now come up with the story that they are seeking to build the mills near indigenous areas to make it easier for the workers to go home at the end of the day or week...in other words, the villages will definitely become the mills' dormitories. [...]."
Egon Heck – Centro Indigenista Missionário- CIMI Regional Mato Grosso do Sul,16/08/2006.

A symbolic issue of the cane sector in Brazil is the high rate of employment of migrant manpower. According to data from IEA (SP), in 2005, of the 242,859 migrant workers in the state of São Paulo, 40.8% were not residents. The high incidence of migrant and temporary workers, most of whom came from Bahia, Piauí, Minas Gerais and Maranhão states to work in the cane harvest in the Central-southern region cause significant impact on local culture as well as on the power of negotiating on the part of the local organized workers.

The option to use migrant worker manpower, feasible because of the unemployment rates in the countryside areas of origin, where monocultures are advancing and where there is extensive cattle-raising, also represents a strategy of the sector, considering that hiring is done without legal labor registration or by illegal contract mediators called "gatos". Sheltered in houses within the cane field areas, far from families and without access to local networks of protection (unions, land and migrant pastoral agencies and others) the workers are at the mercy of their employers. The pressure exerted by worker unions, principally from the mid-'80s, forced the introduction of social services which elevated the costs of manpower from 102% to 160%. The growing number of conflicts in the area of labor court, initiated by the non-observance of workers' rights, motivated companies to outsource services through the "gatos" mentioned above, illegal cooperatives, among others.

Consequently, the workers lost their rights to paid holidays, 13th salary, paid rest and the prerogative to sue their employers (CARNEIRO, 2000). As a result, space was created for the action of false cooperatives ("Coopergatos", "Gatooperativas") and the possibility of precarious and illegal employment (CUT/CONTAG 1999, p.101).

Since the end of the '90s, the Ministry of Agriculture has recommended the creation of "condominiums", where small cane suppliers can organize themselves and choose a representative in charge of the administration of the workers and the legal representation of all the members (CARNEIRO, 2000). It was hoped that a greater formalization of worker relations would result. However, for FETAEMG – Federação dos Trabalhadores da Agricultura do Estado de Minas Gerais (2002) this new arrangement made the action of the unions more difficult, mainly because some industries in the sector are transferring the production areas to independent suppliers who are organized in condominiums.

For this reason the collective representation of workers via their unions has been severely damaged, considering that this new reality forces the fragmentation of the category (cane cutters), splitting it into condominiums. Approximately 65% of all rural workers of the sugar-alcohol sector are not organized into unions. The result is a growing tendency of informal and precarious employment. Unpaid and slave-reminiscent work is still common in regions lacking occupational alternatives. In this atmosphere hired workers end up contributing to precariousness because, forced to reach their production targets in the cane fields, they involve their wives and children as additional workforce with no guarantees or labor rights.

"Migrant workers are not unionized, they do not pay unions, they agree with 5:1(five days of work for each rest day) because they do not have families with whom they can spend their weekends, they do not organize themselves to negotiate with their companies, they dismember the unions, cut more cane because they come to make more fast money and go home."
Aparecido Bispo – SerAndradina, seminár Açúcar Ético, São Paulo, 31/05/2006.

"The flow of migrant workers affects local tradition. People from the west of São Paulo have even lost their accent and complain that nowadays on the local rádios one can only hear forró (typical rhythm from the Northeast)"
Daniel Bertolli Gonçalves – LES-ESALQ/USP, seminar Açúcar Ético, São Paulo, 05/31/2006 .

Working Conditions

Workload, wages, health and job safety

After a reconfiguration of the activities of the agro-industry, employment of manpower started to include the following phases: seedling production, planting, ant elimination, conservation of highways and hauling machines, machine operation, manual harvesting and field cleaning.

Of all these activities the one that requires most manpower is manual harvesting. It is responsible for more than 60% of the workforce. (GONÇALVES, 2005). The manner of payment used in this phase is the regime of worker productivity, where the monthly fixed salary may be incremented by cutting more sugar cane.

As an example, the average production of workers in the region of Ribeirão Preto currently reaches 12 tons/day, while during the 1980s it was 6 tons/day. Despite the productivity requirement having doubled in 20 years, the base salary for cane cutters has been reduced to practically half (ALVES, 2006).

From 2.5 minimum salaries, today a cane cutter earns an average of 620 reais (1.8 minimum salaries). This value is not one of the lowest for hired workers in the countryside, but the temporary condition of the job positions (maximum 8 months) forces the monthly income to be re-allocated over the other months of the year which are not harvest months. The constant pressure

to increase productivity in the fields has provoked enormous health problems for the worker, as demonstrated by reports presented by GONÇALVES (2005):

"I already cut myself when it was raining and continued cutting. Then the handle of my machete got really slippery. We want to continue working so as not to lose the day, then it slips."

"You want to work a lot, you almost kill yourself, you want to pass your point, you see that your body is not going to be able to stand it...[...] your body cannot stand the cramps. The job begins to be rather agonizing. There comes a time when you weaken a little, slow down, look around, it seems your head gets crazy. That strong sun that trembles like this, that heat and dust."

"In the fields we have this cramping problem, because it is forced labor, the sun is really hot, you drink a lot of water, eat very little, sometimes you get weak, you get crampls, your fingers curl up, cramps attack your legs...[...] I always get cramps, when we get to the city we go to the hospital, take serum to get better."
In: **GONÇALVES (2005)**

In reply to these serious health problems, including death cases[9], sugar cane agro-industry companies have informed their workers about how to identify those that use health services and do not suffer impeditive work sicknesses. To Scopinho (2000), this is a way to inhibit the demand for medical assistance and a way to force the worker to seek health services only when the worker can tolerate the illnesses no longer.

Thus, death resulting from excess work indicates an internal dichotomy of the sugar-alcohol industry which on one hand employs the most modern production equipment available while on the other hand enslaves the workers by performance systems and controls governing absences and medical appointments.

Gender

The participation of women in cane cutting activities has visibly diminished, mainly due to the production levels requirements and the physical effort in the sugar cane fields. Besides this, the Sindicato dos Trabalhadores Rurais de Andradina (SerAndradina), as well as the Rede Social and the CPT (2006) have registered cases where women have been required to present proof that their fallopian tubes have been rendered useless – infertile – so as to discriminate the female condition in relation to harvest work and consequently avoid pregnancy rights payments by the employers.

Child and slave labor

In 1993, 25% of the cane cutters in Pernambuco were between 7 and 17 years old. Of this amount 42.2% received no salary and 89.7% were not legally registered. Besides this, children were being integrated into the workforce by their own parents, as a way to increase levels of production and reach the high quotas of production defined for each paid worker in the cutting profession (ARAÚJO, 1999).

Meanwhile, in recent years inspections on working conditions in the sector were intensified. The Brazilian government signed recommendations nº 182, 138 and 146 from the OIT – International Work Organization which prohibited the most precarious forms of child labor and defines the minimum

[9] Pastoral do Migrante affirms that during the harvests 2004/5 and 2005/6 14 workers died in the sugar cane cur work due to excess of work load. They were young workers between 24 and 50 years coming from northern of Minas Gerais, Bahia, Poiauí and Maranhão states.

age of 18 for insertion into arduous activities. Indeed, a decline in child labor has been observed in the last decade.

"In Andradina, in the northeastern region of São Paulo, almost on the border of Mato Grosso do Sul, there are less inspections. Between harvest seasons there are children cutting sugar cane to produce seeds for new crops".
Aparecido Bispo – SerAndradina, seminário Açúcar Ético, São Paulo, 05 /31/2006.

On the other hand, the sector continues to register cases of slave labor, not only in the Northeast, where the oldest mills in the country are located, but also in the modern areas of production in the state of São Paulo. Once more we can clearly see the dichotomy of the Brazilian cane industry. Recently an operation of the Labour Ministry found 430 cane cutters working in precarious conditions in the Bauru, São Paulo state. A few days before, inspectors had freed 249 workers in slave-like conditions in Campos de Julho, Mato Grosso[10]

Burning, mechanization and unemployment

Companies with modern management, especially those which intend to participate in the international market, began to pay more attention to working conditions and introduced special programs for education, nutrition and physical preparation for their workers. Generally speaking, they are also concerned about avoiding damages caused by strikes, sicknesses and lawsuits which could provoke reductions in production and affect the image of the company abroad.

Studies show that the introduction of technological innovations - particularly the introduction of mechanized harvesting – do not guarantee the ban of burnings in the cane fields, the reason being that the yield of harvesting machines, particularly the old ones, is 30% greater with burnt cane (ALESSI & SCOPINHO 1994; SCOPINHO, 1999; ALVES, 2006).

The precarious conditions of manual cane cutting as well as the threats to the environment and human health resulting from pre-burnings, have propelled the debate in favor of the adoption of the practice of mechanized cane-cutting within a process of sector modernization.

With the expansion of mechanization processes the workers who experienced precarious working conditions began to worry about another problem: unemployment. For Veiga Filho et al (1994), the modernization of agriculture is not limited to the advance of technical-economical transformations, but includes transformations in the social structure and labor relations. In this sense, mechanization displaces human jobs in the sugar cane agro-industry and can start another social problem.

The first wave of mechanization in the cultivation of sugar cane occurred during the establishment of the PRO-ÁLCOOL program in the 70s and 80s, when cane loading became mechanized. Starting with this modification, the work of 16 workers, per each truckload involved in the logistic of transportation field/mill, was eliminated. Concerning recent mechanization, Ustulin et al (2001) affirm that a modern cane harvesting machine can substitute up to 100 laborers cutting sugar cane. Also, in an estimate made by Guilhoto (2002), there is a suggestion that mechanization is possible in approximately 50% of the northeastern areas and in 80% of the rest. Configured In this scenario is a reduction of between 52% and 64% of all the job positions generated by the production of cane.

[10] Correio Brasiliense Newspaper in 26/8/2006

Table 3: Employment in the Production of Sugar Cane: Brazil and Macro-regions

After the mechanization of the harvest *	Region	Manpower employed/1997	Manpower released
198	North	2 043	1 844
76 322	Northeast	225 911	149 589
11 036	Midwest	35 746	24 709
95 320	Southeast	194 669	99 350
11 487	South	52 282	40 795
194 363	Total	510 651	316 288

Source: GUILHOTO *et al*. 2002, p. 5.

The threat of unemployment is one of the strategies which lead to the acceptance of precarious working conditions. The atmosphere of insecurity generated by the employer, in relation to keeping one's job, is frequently used to force the worker to accept the non-regulamentation of his work hours, the lack or inadequate IPE (Individual Protection Equipment), poor quality and insufficient meals, unsafe and accident-prone transportation, among other irregularities. Besides all of the above, many workers suffer from illnesses provoked by monotonous and arduous activities, intoxications (agro-chemicals) and the exposition to particulate material and dust, which drastically reduces life expectancy rates (FETAEMG, 2002).

It is obvious that, even considering the advances of regulations in the sector, the sugar cane agro-industry has dedicated little attention to the social problems involved with the workers employed in the harvesting, which lives perspective employment reduction, precarious labor posts and disrespects of Brazilian legislation (GUEDES et al, 2006).

Training and living conditions

Even with the advance of mechanization processes, the task which most employs people in the sugar cane sector is still cane cutting. It is basically a difficult, repetitive activity which reduces working years by 10. A cane cutter daily delivers an average of 6 to 10 thousand machete blows and walks 4,000 meters among the rows of planted sugar cane.

Generally, the individual protection equipment (IPEs) and the rigid rules for cutting and stacking cane are dictated by the companies themselves and are monitored by the factor in the field.

The so-called "city-dormitories" grow in the region of the cane fields. These units are where the migrant workers live in hives, huts or pension houses which, despite their precarious situation, are more expensive (along with the food served) than the average prices paid by the population in general (Rede Social e CPT 2006). It is worthwhile noting that the majority of the “hunters” of migrant workers are also responsible for loans, from the payments of "excursions" (transportation from the regions of origin to the cane fields) as well as for the acquirement of groceries. This creates a cycle of indebtedness and over exploitation of the laborers.

3.2_ Environmental issues

The use of Land

Degraded Areas x areas rich in biodiversity

The expansion of sugar cane cultivation in Brazil in the last three decades of the 20th century occurred basically in areas used for extensive cattle-raising and annual agriculture plantations in a process that applied little pressure on the displacement of these to new agricultural limits. The new impetus of growth of emerging production in the first years of the 21st century and the search for new productive areas in São Paulo and vicinity and also in Maranhão could however, provoke the direct occupation of new natural areas and the displacement of part of the cattle ranges and agriculture production to agricultural frontier regions, with the consequent destruction of habitat and the relevant impact on biodiversity.

Landscape typical of an area of sugar cane monocultural production iin São Paulo state. In the case of this picture, it is possible to notice the native vegetation preserved along the water courses.

In the São Paulo state region, responsible for around 70% of the Brazilian production of ethanol, the expansion of the production of sugar cane triggered by the Pró-álcool program beginning in the middle of the 70s of the last century occurred mainly in areas which were used for cattle-raising and annual agricultural cultivation, not having employed clear cuts followed by burning and for the most part, not advancing on wooded areas and natural fields.

Land use change

Quartaroli (2005) analyzed the use of the soil in the northeastern region of São Paulo state which was caused by the expansion of sugar cane production between 1988 and 2003. In the region consisting of 125 municipalities and 51,725 km^2 in 1988 sugar cane plantations occupied 10,857 km^2, equivalent to 21% of the analyzed area. This occupation increased to 22,935 km^2 (44% of the analyzed area) in 2003. The proportion of lands used for agriculture-pasture-forestry activities remained stable in that period so that the expansion of sugar cane happened by way of the substitution of areas which had already been occupied for many years mainly by annual crops which yielded, during this period 5.96 km^2 to sugar cane, pastureland that gave up 4,748 km^2 and fruit crops which gave up 1,577 km^2 of its area to sugar cane. Quartaroli also observed that of the planted area of sugar cane in 1988, 9,897 km^2 (91% of the total) remained with the same crop in 2003, so that the total area of expansion of sugar cane between 1988 and 2003 was 13,038 km2 (25.5% of the total analyzed area).

Quartoroli's study of 2005 shows to what point the monoculture of sugar cane occupation had arrived – the traditional municipal producers of the northeastern region of São Paulo in the Araraquara, Boticabal, and Ribeirão Preto arch in 2003 had 60 % to 90 % of their areas covered by sugar cane.

Municipalities located to the north of the Jaboticabal, Pontal, and Ribeirão Preto arch, which in 1988 had a small expression of sugar cane crops, in 2003 had 70%, or more, of their areas occupied by the crop, as in the cases of Batatais, Morro Agudo, Jaborandi, Nuporanga, Terra Roxa and São Joaquim da Barra.

More recently it has been observed that there is a tendency of expansion of the production of sugar cane in regions never before occupied by this crop, where possibly, in the future, it will advance into natural areas, like the Pantanal matogrossense and Maranhão.

In 2005 the governor of Mato Grosso do Sul proposed a project in the Legislative Assembly which would change State Law 328/82. This law prohibits the installation of alcohol mills in the Bacia do Alto Paraquai. At the time the secretary of Production and Tourism of the state justified the project saying that the alcohol distilleries would be the only solution to economically develop the municipalities of the Pantanal neighborhood. The project was strongly protested by social movements and environmental organizations which worked together in the campaign called "No Alcohol Mills in Pantanal! ".The campaign, marked by the tragic episode of the suicide burning of environmentalist Francisco Anselmo de Barros, was victorious and the Legislative Assembly of the state discontinued the project (ECOA, 2005).

In July, 2006 the governor of Maranhão launched a program for the production of bio-fuel to motivate the production of ethanol in the state and the generation of 120 thousand jobs. The program is based on a study by Escola Luiz de Queiroz of the Universidade of São Paulo and shows a production potential of 45 million tons of sugar cane per harvest, with a plantation of 1.2 million hectares. One of the scenarios of the study foresees half the production of sugar cane being used to produce ethanol and calculates a potential production of 2 billion liters of ethanol, equivalent to 13% of the current Brazilian production. According to a study, among the greatest advantages of the region for the production of ethanol are the localization of Itaqui port, and its access to international markets, and the great availability of agricultural areas capable of large scale sugar cane production with access to the railway infrastructure already in existence (Government of Maranhão 2006).

According to the vision of alcohol and sugar producers, there is a huge potential of expansion of the production of sugar cane over areas which are already being used for cattle raising and less profitable crops in Brazil. Eduardo Pereira de Carvalho, president of ÚNICA - Union of the Sugar Cane Agro-industry of São Paulo - association of producers responsible for a large part of the Brazilian production, affims that Brazil occupies about 5 million hectares with a cane production in the northeastern and central-southern regions, producing 270 million tons of cane, and that the technology available permits production in the Cerrado region and makes 70 million hectares of land available and in condition to produce sugar cane.

This vision, however, is polemic. Pereira (2006) shows that the accelerated expansion of the sector turned on a warning signal in government environmental departments which are now requiring serious studies concerning impact on the environment and taking more than two years to grant environmental licenses to new distilleries. The principal concern of environmental departments is the creation of plantations, principally in the state of São Paulo where 40 new license requests were registered by August, 2006.

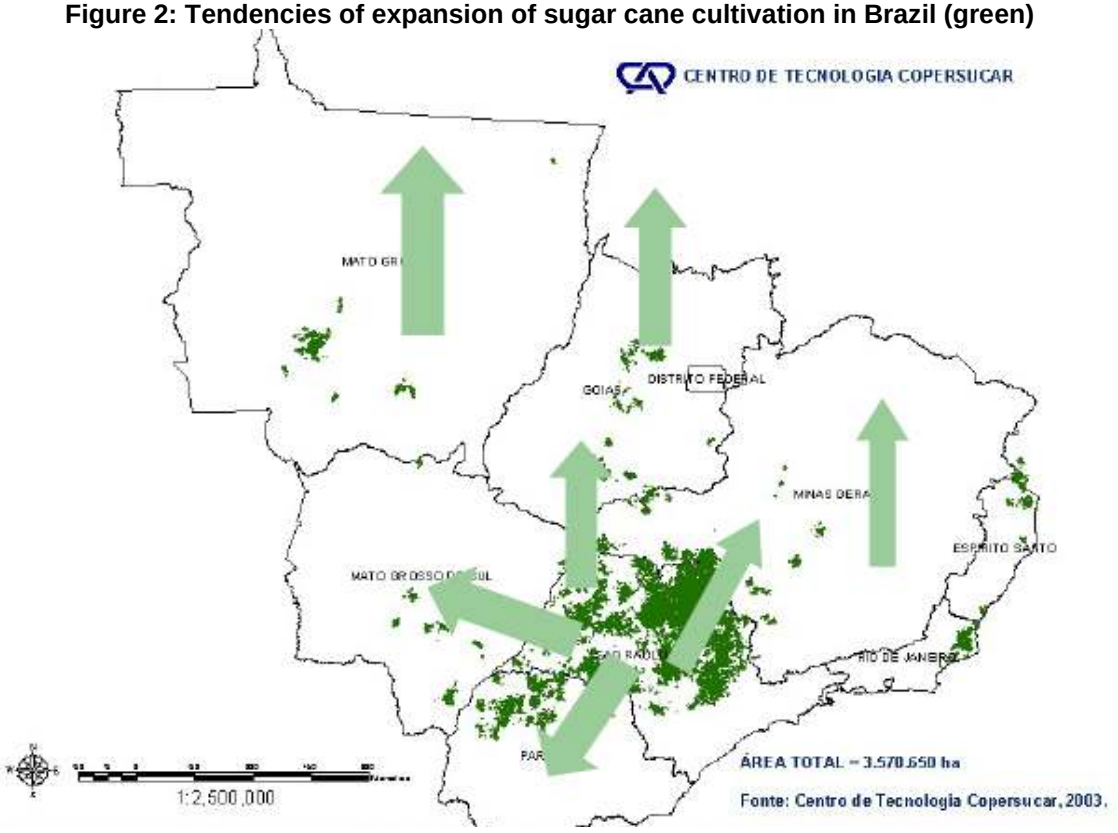
According to Pereira (2006) the secretary of the environment of São Paulo, Professor José Goldemberg, points out the expansion of the sector must be treated carefully to not cause greater impact on the environment.

Government technicians linked to the expansion of agriculture are also concerned about the effects of uncontrolled expansion of sugar cane crops.

José Antonio Quaggio, researcher of the Centro de Solos e Recursos Agroambientais of the Instituto Agronômico (IAC), linked to the State Secretariat of Agriculture, affirmed to newspaper Valor Econômico that "the monoculture could raise the agricultural revenue of the municipality but at the same time reduce agriculture activity without creating regional development" (Bouças 2006).

The vision of the producers is more contested by the environmentalist community which is concerned about one more vector of expansion of the monoculture in the Cerrado and also by the Indian organizations.The opposition of the environmentalists is recognized by the producers according to what was affirmed in the text of the seminar called "The opportunities and risks of Growth (Sugar and alcohol) " - "some environmentalist NGOs have adopted a more aggressive line of action, pitching themselves against alcohol and sugar mill construction projects and against the energy infrastructure, like in Mato Grosso do Sul. The environmentalist action highly inhibits investments and should also intensify in the Cerrado area where the sugar cane is migrating to with great technological potential, even with varieties of good productive potential and good adaptability". The concern of the environmentalist community is based on the forecast, made by the producers themselves, of the advance of the production of sugar cane, as illustrated in the map produced by the Centro de Tecnologia da Coopersucar shown below. The map shows the current spatial distribution of sugar cane cultivation in the central-southern region and the tendencies of expansion, illustrated by the green arrows. One can see that the producers expect a strong expansion toward the Cerrado area, a biome which is highly threatened, which could extend to the borders of the Amazon rainforest (Kitayama 2006).

Figure 2: Tendencies of expansion of sugar cane cultivation in Brazil (green)

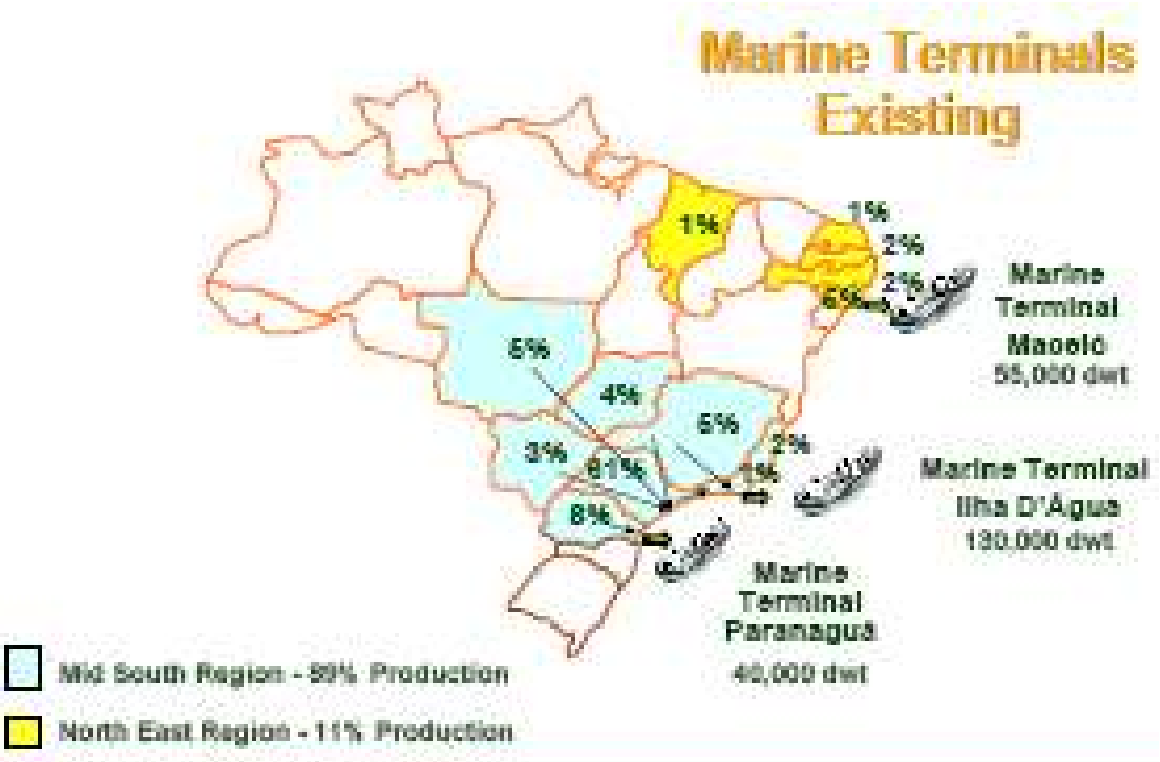


Infra-structure

As the expectation in the global market has grown, investments in the infrastructure in the central parts of the country and in the ports which already exist are accompanying this tendency. The focus on the external market has led companies to enlarge and diversify their assortment of products, as well as invest in quality control systems, technology and research. It is possible to observe changes in the organization of the sugar & ethanol enterprises, such as the increasing amount of mergers and the growing participation of capital from abroad. From 1997 to 2001, 24 mergers were registered, which includes the purchase of seven Brazilian firms by investors (PASIN & NEVES, 2002). Beginning with the consolidation of the bio-energy market, these processes will probably intensify.

Just as an example, the figure below represents the expansion plans of the infrastructure of Petrobrás which should support the expansion of ethanol production in the states of São Paulo, Goiás and Mato Grosso do Sul for exportation. They are basically alcohol-pipes, whose impact from construction tends to be localized, but the implementation of the logistic matrix tends to accelerate the pressure to occupy lands which are located in natural land in the Cerrado.

Figure 3: logistic matrix planned by Petrobrás to expand ethanol production for exportation



Source: Petrobrás 2004

Biodiversity

The historical process of the introduction of sugar cane and other crop production in Brazil during the XVI to the XVII centuries was disastrous for the biodiversity of the Atlantic Forest, a biome which has been reduced to less than 7% its original size, by the action of this crop, coffee and also by cattle-raising and lumber trade.

As discussed before, however, the expansion of the production of sugar cane motivated by Pró-álcool in the 70s and 80s of the past century occurred on lands which had formerly been used for extensive cattle raising and some less profitable crops in a process which had relatively little negative impact on the biodiversity, which was already quite dilapidated in these regions. As a matter of fact, according to some authors, the substitution of pastureland and annual crops by sugar cane had a beneficial influence on the biodiversity.

In the recent expansion process inspired by Brazil's entrance into the bio-fuel motor business and by international interest in the fuel, the situation looks similar to the last decades of the last century. Nevertheless, to continue this accelerated process, new regions may be incorporated by sugar cane, in the cerrado of Mato Grosso do Sul, Goiás and Minas Gerais, which could increase the pressure on the biodiversity which is already quite affected. From the environmental point of view, the perspective of the ethanol production in Maranhão is also troubling because the state has part of its territory covered by the Amazon rainforest.

The advance on the south of the great region of the cerrado and on the lands of Maranhão could have a negative impact on the biodiversity because the current practice of monoculture of sugar cane with wide use of chemical fertilizers and agro-toxics is quite aggressive.

A polemic issue in the regions of consolidated production of sugar cane is related to the 20% of the biodiversity reserve which Brazilian legislation obliges each piece of agricultural land to have. On one hand society expects this legislation to be enforced. On the other, the producers allege that if installations are made on lands which don't have this legal reservation and that to reconstitute it would not make sense, ecologically speaking. Some producer associations even propose mechanisms of compensation by which they would contribute financially to the establishment of conservation areas of biodiversity and would thus be freed from the obligation of reconstituting legal reservation areas within their properties.

Genetically Modified Organisms

The genetic manipulation of sugar cane is not new and has guaranteed resistance to plagues with the substitution of the species adapted in cycles of 10 to 15 years. This is the time which is necessary to permit entrance of new varieties into the market. The usage of GMOs could reduce these deadlines and their use and objective of the sector which already counts on research authorizations for the use of GMO sugar cane – which is being analyzed by the National Technical Comission on Biosafety -CTNbio.

Soil degradation

Agriculture production of sugar cane and the industrial production of ethanol in distilleries have impacts on the soil related to the reduction of water availability due the superficial capture of water and the induction of erosive processes. Besides this, it presents risks of contamination of the soil and water resources because of the use of fertilizers and agricultural defensives and the inadequate disposition of vinasse.

Around 200 kilos of NPK are used per hectare of sugar cane. This number varies, however, depending of the necessities of the soil and its distance in relation to the distillery. In areas near the distilleries the use of ferti-irrigation with vinasse reduces the need of chemical fertilizers. The quantity of chemical fertilizers used in the production of sugar cane tends to decline with the technological advancement because this item can even reach 35% of the production cost (EMBRAPA, 2006).

It is important to mention that the most advanced techniques of agricultural management of sugar cane production tends to reduce erosion when compared to the usage of pastures or the production of grains that were previously existent on these same lands. Endres (2006) shows that the sugar cane culture protects the soil more than pastures and annual crops because it presents intense sprouting in its initial phase of growth and an intense growth of the principal stem which supply a more homogenous and dense vegetable coverage.

Besides this, because it is a graminia cultive subterrene, its root system offers reposition of organic material to the soil, restructuring it and activating the

live part of the environment (micro-organisms and micro-fauna), improving the conditions of the retention of water and its percolation by the profile of the soil.

Emissions to Water

In the cycle of the industrial production of ethanol, beginning with the cane itself, the principal effluent liquids that may sometimes be launched into water bodies are (CETESB, 2002): 1) vinasse, which is residue of the distillation of cane syrup, fermented to extract ethanol, which has high DBO and DQO; 2.) water from the cleaning of the vats which are the recipients of the fermentation with a composition similar to vinasse, but more diluted (around 20% of the consistency of vinasse); 3) the waters used for the cleaning of the cane before it is ground which has considerably high rates of sucrose, principally in the case of burn sugar cane and mineral vegetable material (adhered earth and rubble); 4) waters derived from barometric condensers and evaporators which have sugars carried by tiny drops; 5) water from the removal of chemicals (with soda or a solution of chloride acid) of encrustations whose composition varies a lot but presents greater quantities of phosphates, silica, sulfates, carbonates and oxalates.

Of these, the most important volume to negatively affect the environment is vinasse because of its high rates of DBO and DQO and the volume produced, around 11 to 14 liters per liter of ethanol. Uchimura (2005) shows the average physical-chemical characteristics of vinasse generated in a distillery installed in Alagoas:

PH	3.73
Total Solids (g/L)	25.2
Volatile solids (g/L)	19.3
DQO (mg/L)	31,350
DBO (mg/L)	17,070
Nitrogen (mg/L)	412
Phosphorus (mg/L)	109
Sulfate (mg/L)	897
Potassium (mg/L)	1,473

By the volume and the potential impact it can be seen that an adequate management of these effluents is fundamental to not strongly pollute the flow of water in the vicinity of ethanol plants. Fortunately, these effluents can – and are increaseling been – used as fertilizers in the sugar cane fields.

Emissions into the atmosphere

The burning
of sugar cane fields
before manual harvesting

In agriculture: traditionally, in Brazil the manual harvesting of sugar cane occurs after the burning of the fields. According to Ometto et. al (2005) the impact on health and environment caused by emissions from the burnings in the south-eastern region of Brazil is strongly negative. This area has the greatest concentration of sugar cane plantations in the country. According to the authors the burnings of the fields has serious effects on the environment and the health of populations nearby, among other reasons, because:

- emit ethene into the atmosphere, as well as other hydro-carbons which are precursors to the formation of the ozone in the troposphere, which is the main component of smog and is responsible for increases in the frequency of respiratory problems;
- emit into the atmosphere acids and chemical compounds that can be converted into acids which, once they are deposited in the water and the soils, increase the acidity. This acidification produces consequences such as the reduction of forest areas, the death of fish, the corrosion of metals and the disintegration of the covering of metallic surfaces and mineral materials used in construction.
- emit toxic compounds into the atmosphere which can hurt fauna and the human population by way of breathing the air with high concentrations of pollution. Besides the emissions related above, the burning of sugar cane emits into the atmosphere quantities of particulate material, including particles smaller than 2.5 microns (Fine Particulate Material or $PM_{2.5}$), capable of reaching the lungs.

Arbex (2004) working with information obtained from the theses of the Laboratório de Poluição Atmosférica Experiental (LPAE) of the Departamento de Patologia da Faculdade de Medicina of the Universidade de São Paulo shows that in the city of Piracicaba, located in the center of a great area of cane production in Sao Paulo state, the burnings of the sugar cane fields and the re-suspension of material eroded from the soil are responsible for 80% of the $PM_{2.5}$ and that with an increase of 10.2 hg/m^3, there is a 21.4% increase in hospital admittances of children and teenagers with respiratory diseases.

In that city, when they compared the non-burning periods of sugar cane straw to the burning ones, the negative effect of burning fields on health was 3.5 times greater, which shows the impact that burning cane fields has on health.

In the industrial process the distilleries are also sources of atmospheric emissions, although in a relatively reduced manner. Burning sugar cane bagasse in vats to produce heat or the co-generation of heat and electricity emit Particulate Material, which should be controlled by filters and Nitrogen Oxides (NO_x), precursor of tropospheric Ozone, which may be controlled by the maintenance and adequate regulation of the vats, or in the most critical cases, by filters for gas cleansing (Coelho, 2005).

Residue

According to CETESB (2005) the principal residue generated by ethanol distilleries are:

- bagasse from grinding the cane to extract the juice composed basically of cellulose with a rate of humidity between 40 to 60%,
- the pie of mud filtering generated in the clarification process, with soluble and insoluble residue rich in phosphates,
- the ends of the cane that come from cutting the cane for grinding, practically all of which is used for animal food.

Bagasse is produced in great quantities: one ton of cane produces around 140 kg of bagasse of which 90% is used in the production of energy, (thermal and electric), conforming to what will be talked about in the topic “energy”. The pie that is generated from filtering the mud of the clarification process is used for conditioning soil in the production of animal ration. So the ethanol production industry, quite advanced in the recycling area, can easily minimize and re-cycle its residue.

Energy

In the production of ethanol in Brazil fossil fuels (diesel) are only used to power farm machines and trucks. The heat and electricity necessary for the industrial processes are all renewable, obtained through the burning of cane bagasse.

However, the different plants installed take advantage of this renewable fuel with varying rates of efficiency. It is common to see older mills burning the bagasse with low efficiency, to become free of the residue as fast as possible, while in more modern plants the bagasse is burned in high pressure boilers, components of co-generation systems, able to supply all the energy necessary for the plant and also generate excesses of electricity to deliver to the national integrated network.

Energy balance

The table below shows the energy balance of ethanol production in Brazil organized by Macedo (2004). In the table, energy input represents the consumption of diesel in transportation and equivalent fossil energy present in the chemical fertilizers used and the fossil energy contained in the infrastructure and equipment. The output represents the equivalent energy present in the ethanol produced and in the cane bagasse used to generate electricity and heat for the process and commercial excess. The result is strongly positive and can explain why there is much national and international interest concerning the fuel: while the industry of petroleum spends practically one unit of energy for every unit of energy produced, for sugar cane ethanol one can obtain around ten units of energy for each unit of fossil energy used.

Table 4 : Total energy consumed in the agricultural and industrial phases for the production of ethanol in Brazil

	Input and Output (kcal / tons of sugar cane)	
	Input of energy	Output of energy
Agricultural phase	45861	
Industrial phase	9510	
Ethanol		490100
Bagasse		75600
Total	53371	565700
Outcome/Income	10,2	

This result has clear implications for the balance of carbon in the production of sugar cane ethanol. Macedo (2004) calculates the total emissions of greenhouse gases for the production of cane ethanol in Brazil to be 0.248 kg CO_{2equiv} per liter of ethanol – see table below. To understand the significance of this number, it is necessary to compare it with the emissions of the production and consumption of gasoline within the fuel life cycle. As one liter of ethanol

substitutes 0.8 liters of gasoline and the total emissions of greenhouse gases by burning 1 liter of gasoline emits 2.74 kg CO_{2equiv}, the reduction of greenhouse emissions by the substitution of gasoline for ethanol produced by sugar cane in Brazil is 2.43 kg CO_{2equiv}/liter of ethanol utilized.

Table 5: Emissions and CO_{2equiv}

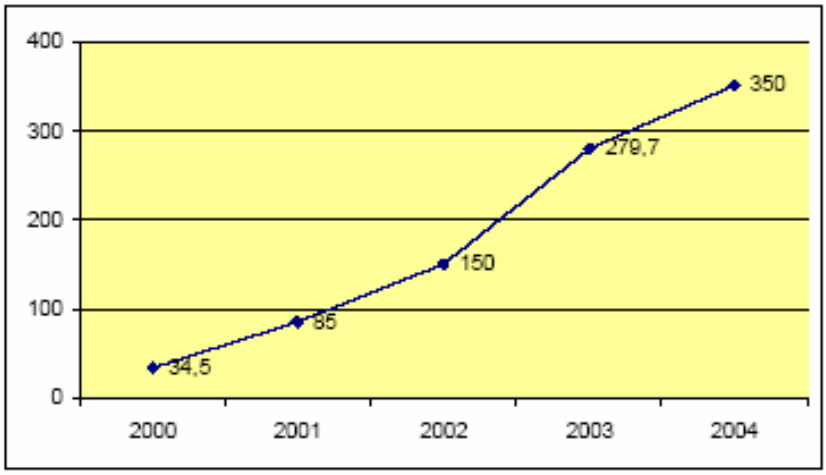
	Emissions	kg CO_{2equiv}/m^3 alcohol
CO_2	4.7 kg CO_2/t cana	201
CH_4	0.9 kg $CH_4/(m^3$ álcool)	10
N_2O	1.7 kg N_2O/(ha.ano)	37
TOTAL		248

In reference to the implications and the transportation and the end use of the biomass in the result to the carbon balance, with special attention to the flow of importation of Brazilian ethanol, it is important to note that the rate of the usage of fossil energy for the output of renewable energy can fall from 10:1 to 6:1 when an analysis of the life cycle considers, besides its production, Brazil, the transportation and consumption in Europe (EKOS Brasil, 2006).

The use of sugar cane straw in the production of energy

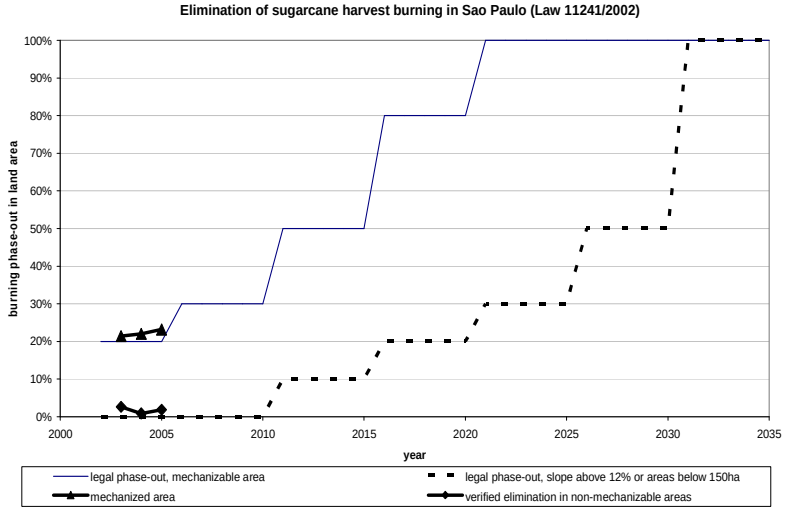
In production there is also the potential of improving the energy balance by way of optimizing the use of bagasse and cane straw to generate energy. Bagasse produced by the Brazilian sugar mills is equivalent to 11 million tons of fuel oil and it tends to be an important source of renewable fuel for the production of electricity in Brazil. Besides this, if the cane straw which today is left in the field, or burned before the harvest, were used, it would mean 3.2 million tons of oil. After the enforcement of the Kyoto's targets and its Clear Development Mechanism and with the recent tendencies to invest in new distilleries, bagasse burning with high efficiency in co-generation systems is becoming a predominant tendency.

Figure 4 : Co-generation in the alcohol/sugar sector: evolution of commercialized excess (in MW)



Utilizing sugar cane straw fundamentally depends on the mechanization of the harvest, which has been growing slower than expected, and has very modest goals of expansion for the next few years, according to what one can see in the graph below, which portrays the targets of mechanization of sugar cane harvesting in the state of São Paulo established by law no. 11241 of 2002.

Figure 5: Legal objectives to eliminate pre-harvest cane burning in São Paulo state



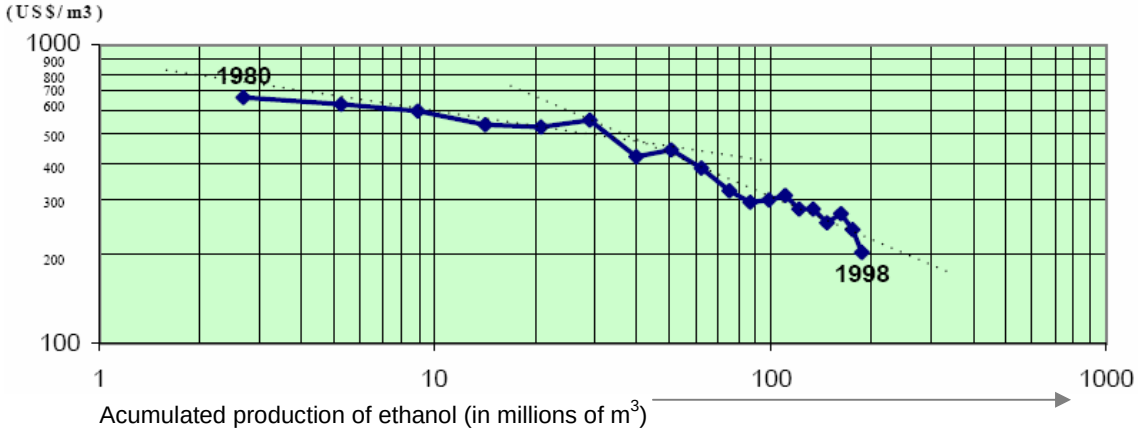
3.3_ Economic issues

According to the magazine Negócios (2006) the Brazilian sucroalcooleiro sector circulates R$ 40 billion annually, equal to 2.35% of the GDP and collects R$ 12 billion in taxes and other tributes. Currently it is able to produce 24 million tons of sugar and 14 billion liters of ethanol, of which 14.3 million tons of sugar and 2.5 billion liters of alcohol are exported.

Cost of the production of ethanol and innovation technology

The cost of producing ethanol has been falling in real terms, in the last decades, principally motivated by government actions of Pro-Álcool: a mandatory addition of 20% to 25% of ethanol in the volume of the gasoline - a variation depending on the condition of the market; the reduction of tributes on fuel (gasoline is taxed around 30 American cents a liter and ethanol, 17 American cents); the reduction of the tax on industrialized products (IPI) for cars which are fueled by ethanol; the opening of subsidized lines of credit to the sugar & ethanol sector. These actions added to the technological advancement in direction of eco-efficiency resulted in a reduction of costs per volume produced. Goldenberg (2004) shows that the amplification of the Brazilian rate of ethanol production and the improvement of the eco-efficiency of the same were responsible for reducing the cost of production from more than 600 dollars/m^3 in 1980 to around 200/m^3 in 1988, as can be seen in the figure below.

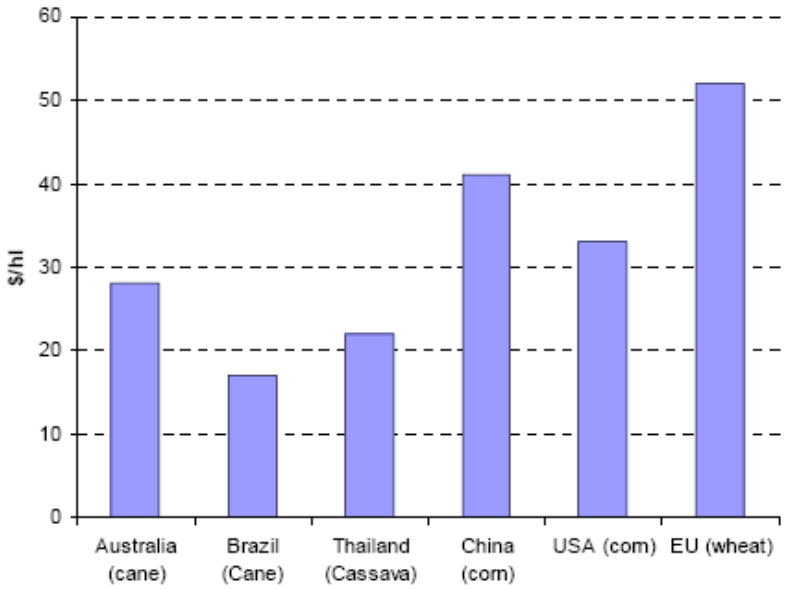
Figure 6: Curve of technological learning of the production of ethanol in Brazil



This increase in productivity resulted in competitiveness for ethanol produced in Brazil, as shown in the figure 7.

During the period of great production growth of sugar cane, motivated by Pró-álcool, from 1980 to 1985 when production grew from 140 million to 240 million tons annually, the principal technological advances occurred via the Program of sugar cane improvement of Copersucar and Planalsucar. This began to show results in the beginning of the 80s and placed emphasis on agricultural and industrial productivity. Around 1985 technological tools of management were also introduced. Since 1975 technological advances corresponded to 33% of the increase of productivity, 8% of the increase of sugar and 14% of the increase in the conversion of sugar cane to sugar and alcohol.

Figure 7 : Cost comparison for ethanol production in selected countries



Source: Chemical Marker Reporter 2005

In the second period of growth which occurred between 1993 and 1997, motivated by the increase of exportation, important technological factors became important again, for example the reduction in the price of production achieved in the previous period, and the increase in the quality of raw sugar, unrefined, resulting from the synergy between the productions of sugar and ethanol.

According to Embrapa (2003), the greatest challenge is maintaining a competitive position. For this the sector collects a series of actions and research which go in the following directions:

A) genetic improvement of the cane:

- increase in the varieties adequate for the various regions and production settings;
- genetic transformations of sugar cane: with the final part of the genetic mapping done by FAPESP and Copersucar, and the beginning of around 40 projects of functional analysis the area is, according to UNICA, promising. However, it is still necessary to formalize coordination, use the aid of FAPESP and others, solve legal problems (rights)
- development of technologies for large scale production of healthy seedlings (bio-factories, reduction of costs in the chain)

B) Innovations in the field of agronomy and agricultural engineering to produce sugar cane

- precision agriculture technologies
- new irrigation systems
- new sugar cane harvesting technologies without burning
- pedoclimatic zoning and harvest forecasting
- efficient use of ferti-irrigation with vinasse
- improvements in the machines and agricultural instruments to reduce loss
- improvements in the integration of software systems for planning and technological management

C) industrial processing

- automation of systems; sensor development, equipment and intelligent operational controls;
- analytic methodology: greater use of NIR spectroscope for on-line use in the factory
- fermentation: components, systems and controls for more robust fermentation in reference to fluctuation in the quality of raw material;
- use of new separation techniques and concentration in the sugar and ethanol factories (membranes and ionic change);
- development of new products made from sucrose (plastics, solvents, amino acids);
- development of technologies to recuperate straw at low cost (<US$1/GJ) and technologies for the production of additional energy in the mills;
- the increase of the scale of the co-generation of electrical energy and heat;
- hydrolysis for the production of ethanol;
- new technologies to reduce internal consumption of energy;
- extraction systems; refinement of processes which dry-clean the cane and hydrodynamic extraction.

Financial Aspects

The recent cycle of expansion of the production of ethanol, different from Pró-Álcool, is not a movement commanded by the government. The race to enlarge units and construct new mills is inspired by decisions from the private sector, with the conviction that ethanol will have an ever-growing role as a fuel,

in Brazil and abroad, financed by the Banco Nacional de Desenvolvimento Econômico e Social (BNDES) – more than R$ 7B between 2004 and 2006 – and by the Banco do Brasil.

Statistics state that in 2006 there are 89 projects for new mills in the works with predicted investments totaling US$9 billion.

Prices

In Brazil the prices of fuel ethanol have been liberated since the de-regulation in this sector which occurred in 1997. During the entire first semester of 2006 the price of ethanol oscillated upward, triggering a reduction in internal consumption. Meanwhile, its relation to the volumes allocated for exportation in this period, as well as future estimates, are still quite uncertain because they involve a complexity of factors.

In February 2006, there was a lack of sugar cane in the São Paulo mills, causing the price to go up 7%, which made the government temporarily determine to reduce the mixture of anhydrous ethanol in the gasoline from 25% to 20%. The goal was to reduce the national demand by 100 miilion liters a month and the inflationary pressure on the prices of the fuel.

Among the reasons explained were the time period between harvesting, the unfavorable climatic conditions in some states and the increase in consumption motivated by the new flex cars, but never a direct relationship, at least known to the public, with the influence of the exportations on the internal market. Even so, UNICA admitted that the harvest, which yielded 337 million tons of cane, was only 2% less than the projections of the sector. Of the total, 50% was destined to the production of ethanol, 85% to internal consumption and 15% for exportation.

For anhydrous ethanol to be competitive with gasoline (due the different calorific value), its price in the gas stations must be at least inferior to 65% of the price of gasoline. In May 2006 the national average price per liter of ethanol was R$ 1.813 per liter, making the consumption of gasoline a better deal.

Guarantees

The mandatory addition of 20% to 25% anhydrous ethanol to gasoline in the country, the incentive to the growth of the automobile fleet with bi-fuel technology, as well as agreements and expectations of bi-lateral negotiations to ship sugar and ethanol abroad, give guarantees of profit to the investors of the sector. Add these to the state fiscal exemption measures for the installation of new mills, announced on the States of São Paulo, Mato Grosso do Sul and Maranhão.

On the other hand, for the national consumer there are no price nor supply guarantees. The sector proposes a policy of stock to be regulated by the furnishers themselves but maintained by public money. The volumes estimated for the formation of this stock would be around 3.5 billion liters, sufficient to supply the demand for three months.

Land Use

The land market represents an important component in the expansion of monocultures and exercises pressure on small and medium sized rural property. Its dynamism and flexibility shown by an index of an annual

transaction of lands achieves a 5% rate in Brazil, one of the highest in the world and one of its characteristics is a high land ownership concentration[12].

For Guedes et al (2006) the dynamics of this market is an indicator of the vigor of the agricultural and cattle raising activities and of the transformations in the productive structure and helps in the understanding of the relationship change/permanency of the modes of production of different social groups.

Thus the expansion of the sugar cane monoculture is made easier by a land market with very little legal or social structure which attracts positive reactions in the production costs of the sector, while at the same time concentrating properties and making family subsistence farming infeasible.

According to the Rede Social and CPT (2006), there was a recent growth in the participation of foreign enterprises acquiring land and an increase in the concentration of lands and economic power of some groups. The pace of mergers and acquisitions accelerated from 2000 to 2004, when 20 mills were negotiated, most in the state of São Paulo, a fact which was accompanied by a tendency to close small mills. In the Northeast this tendency has been appearing for a longer period: in the last 20 years the number of mills decreased from 43 to 22, without altering the plantation areas and thus creating a higher land ownership concentration.

In the central-southern region, among the principal foreign groups are the French groups Louis Dreyfus and Beghin-Say.

Energy

According to the Minister of Mines and Energy Silas Rondeau (2006), from 1970 to 2006, the use of ethanol as a substitute for gasoline economized 1.9 billion equivalent barrels of petroleum for Brazil and avoided 615 million tons of carbon dioxide from being emitted into the atmosphere. Currently ethanol avoids the consumption of around 200 thousand barrels of oil per day.

The energy contribution of the sector, however, is not restricted to the substitution of gasoline. The burning in co-generation boilers could become a very important source of electricity for the country. The program to stimulate alternative sources of electric energy – PROINFA of the federal government, expects it to add 1.100 MW generated by this source in the next 2 years, which is significant but very below the possibilities of this source. The union of agro-industry of sugar cane (UNICA), calculates that 4,500 MW could be added to this national grid within the next 3 years, equal to 6.7% of the present capacity installed in the country and double the additional annual potential necessary according to the Ministry of Mines and Energy. However, the potential is even greater, according to Onorio Kitayama, of UNICA, who estimates this to be approximately 12,000 MW. The creation of adequate conditions in the Brazilian market of electricity for the incorporation in a high scale of this electricity source is one of the most important actions available to delay, postpone or even avoid great dams predicted for the Amazon, as those on the Madeira and Xingu rivers.

[12] Brazil has one of the highest levels of land concentration in the world, with only 1.7% of real estate occupying 43.8% of the total area registered by the Instituto Nacional de Colonização e Reforma Agrária (INCRA)

3.4_ Political issues / social control

Governance

The IBM Business Consulting Services in 2004 did research with the principal leaders of the sugar & ethanol sector (Gennaro 2004) to evaluate the strategic orientation of the main players to discover the strategic priorities of the companies and the market tendencies and evaluate the levels of maturity of the companies and their lines of organization management. According to the research, 80% of the interviewed companies believed that all the excess production of sugar should be directed to the international market. This would avoid price falls in the future. Almost unanimously the leaders agreed that car's bi-fuel engines technology is a watershed for the sector, significantly increasing the consumption and 74% don't believe in the advent of a source of energy which would threaten the position of ethanol on the national market, even with the growth of natural vehicular gas. In the long term, the research discovered that there is enormous potential in the establishment of ethanol as an international commodity, but, as uncertainties are still great, most people bet on results in a period of 10 years. Technology as a differential is important for 53% of those interviewed.

Concerning agricultural property, 86% of those interviewed did not present plans for expansion for their planted areas and they agree with the tendency of the market to operate with outsourced sugar cane. Despite this, they consider the possession of land a strategic issue.

The market is open for the entrance of new players and consequently mergers and acquisitions. The economic context created by an oligopoly with comparative advantages in relation to the rest of the world makes this market become attractive to external competitors by way of purchases and partnerships, as most agree.

Less than 53% consider themselves unprepared for subjects related to succession and the relationship of stockholders with the organization. 90% have no formal structure of governance to deal with subjects related to the role of agents, stockholder agreements and succession. Despite this scenario, a good part of those interviewed believe in the professionalism of their administration with a consequent disconnection of the family structure of key positions.

Considering the strong tendency toward consolidation, mergers and acquisitions, the sector pays little attention to an active administration of alliances and partnerships.

Most recognized they do not possess any tool to support an administration based on value and risk. More clearly, there is great concern about both subjects but the sector finds itself, in general, unprepared to deal with them in a structured way.

The study showed that, within the turbulent scenario the sector finds itself, there is a concern that the enterprises must structure themselves to survive. The tendency observed is the need for professionalizing, administration and technology, not only as differences, but as basic elements of survival.

One aspect which is relevant to the issue of international administration of the sector is the placement of non-tributary barriers – the socio-environmental kind. Some market workers displayed worry about the practically certain inclusion of these barriers in the agenda of commercial negotiations for international commercialization of Brazilian ethanol on the part of the USA and the European Union.

To illustrate this certainty, Costa (2006) comments on a meeting sponsored by the IFC and WWF which was held on the 23rd and 24th of June, 2006 at the London headquarters of the Tate and Lyle company, one of the major players in the world commercialization of sugar, to identify the principal environmental and social impacts of the production of sugar cane, as well as talk about the 'best practices available' to face them, which the author classified as an euphemism for the imposition of non-tributary barriers. According to Costa (2006) the model of this meeting to "implant socio-environmentalist clauses in the sugar & ethanol sector" is from the Better Management Practices, "the same that has been applied, at various levels, to five other commodities groups: cotton, palm oil, salmon, shrimp and soy".

Participation and Communication

The Brazilian sugar & ethanol sector is within a society that has few institutional mechanisms of participation and social control, excluding the participation in environmental councils of little political relevance. Thus, society counts only upon indirect mechanisms of participation to take decisions concerning the sector: labor unions, municipal environmental councils (when they exist) and state environmental councils. Besides this, few companies of the sector hold stock in the stock exchange so that minority stockholders taking part in cooperative decisions are also not very relevant.

The phases which generally contemplate aspects of participation and communication in environmental licensing are restricted to the processes of installing new industrial units because the march of the agricultural frontier and the changes of the uses of the soil alone are not ruled in Brazil by these processes, as we will see in the next few pages.

4_ Opportunities (& risks) for improving sustainability performance in the supply chain

The opportunities for the sustainability of the production of ethanol in Brazil are divided below into two groups, priority and feasible actions in short and long term periods and complementary actions which, despite being feasible, demand greater investments in research on alterations, even more in depth than the current production practices.

Comments on the risks related to these actions are intermingled below when in existence. In these cases compensatory actions are also described.

4.1_ Priority actions to improve the sustainability of ethanol production

Mechanization of the harvest and the end of crop burning

This action is accepted and recommended by almost all the stakeholders but actually it is delayed by force of producers due to the increase in costs in relation to the manual harvest. From a social point of view, however, the total mechanization of the harvest would certainly dispense a great contingent of unqualified manpower (around a half of million jobs in the manual harvesting), requiring action on the part of the three government levels and also on the part of the producers to train and relocate part of these workers. Rural workers, social movements some university researchers and the Catholic Church believe the mechanization should be compensating with the enlargement and acceleration of the agrarian reform to settle at least part of these workers.

Licensing of new sugar mills and distilleries opposed to registration of legal reservations and areas of permanent preservation.

In traditional regions of sugar cane production the legal areas of reservation are practically non-existent and the areas of permanent preservation are quite below what is legally required so that the mills and distilleries that are already installed in these regions have an environmental debt which should be steadily regularized.

In São Paulo state the Secretariat of Environment is developing a process of discussion with the producers to create an agreement for this passive which has been strongly resisted by the producers which argue the biodiversity will be never rebuild. Consequently part of the producers argues for an economical compensation system in which they would pay for other land owners to conserve more than the legal area required. In the northeastern region of the country the resistance is even more adamant.

It is important to note that the disrespect of these obligations established by the Forest Code is not homogenous in all of São Paulo's municipalities. Recent research by the NGO S.O.S. Mata Atlântica discovered municipalities where less than 5% of the producing properties had legally registered reservations and other municipalities where more than 90% of the properties did.

Considering the history of disrespect of the Brazilian Forest Code, the state environmental authorities should implant processes of licensing of new mills and distilleries which require the presentation of registration of legal

reservations and APPs of the properties involved in sugar cane production for this business. This idea is currently under development by the federal environmental agency IBAMA jointly with some state environment agents.

Licensing of new mills and distilleries vs. the installation of co-generation vats

The BNDES lines of financing the installation of new mills and distilleries already incorporate the requirements of high pressure vats to generate heat and electricity.

Even so, the employment of this equipment should be required in the licensing processes.

Closure of water-processing circuits

Mills and distilleries are great consumers of processed water but a significant part of the plants installed in the Southeast already show it is feasible and profitable to close the circuit and reduce water consumption by more than 90%.

IBAMA and state environment agencies are in process to incorporate this requirement in licensing process.

Optimization of ferti-irrigation

The use of raw vinasse, preferably after treatment in bio-digestors strongly reduces the need for chemical fertilizers for sugar cane agricultural production as demonstrated by an important part of the installed mills and distilleries.

Still, in some ethanol plants the vinasse is unevenly dispersed in productive fields. Those closest to the mill receive excessive amounts of vinasse and those farthest receive close to nothing. This practice, caused mainly by the cost of transportation, can lead to the contamination of subterranean waters surrounding the plants. This must be avoided. For this reason the equipment and usage processes of vinasse should also be subject to scrutiny at the time of licensing and actions which optimize the use of vinasse and consequently minimize its risk and the use of agro-chemicals should be applied. This procedure is foresee by environmental laws ruling industries and should be applied to the ethanol and sugar mills as well.

Formalization of labor relations

All the workers, without exception, in agricultural production as well as in the industrial production of ethanol, should be legally employed and have their rights respected as established by the Consolidation of Labor Laws (CLT), besides having their right to associate and protest respected; it is also fundamentally important that the transportation of rural workers be done in safe vehicles. This is a matter of law enforcement only.

Application to systems which promote corporate social responsibility

A group of industries in São Paulo, members of ÚNICA, and Ethos Institute adhered to a program of self-monitoring of its indicators of social responsibility. Ethos was created 8 years ago in Brazil with the objective of offering tools for the self-evaluation of enterprises in concerning the

implementation of administration tools for social responsibility which can be enhanced by the companies, based on the principal of voluntary initiative.

4.2_ Complementary actions to improve sustainability of ethanol production

Reduction of application of agro-chemical in soil management

The best practices of precision agriculture must be used to improve productivity and reduce the application of agro-chemicals to the maximum. This is very dependent of investments in knowledge. The controlled and efficient use of vinhasse as a fertilizer is a first step to reduce the use of agro-chemicals.

Use of cane straw to generate electricity

The harvesting and usage of sugar cane straw vats improves the energy balance of ethanol production even more, as well as its competitiveness by enlarging economic gains by sailings of exceeding production of electricity to the grid. Improvements in the equipment and harvesting processes should be implemented to make the most of its energy potential. The measure is dependent of investments in new harvesting machines and techniques.

Development of mechanisms of territorial management vs. mono-cultural dominance

In Brazil, the land occupation planning is a municipal responsibility. Not all municipalities have this instrument available and even those who developed it neglected to set down guidelines against monocultures. The Brazilian society and its representation do not have mechanisms which impede the takeover of whole municipalities and sometimes groups of them, by agricultural monocultures.

Brazilian municipalities have until October of 2006 to approve their direction plans and some are applying restrictive measures to monocultures. Nevertheless, it is expected that most of these will not do it at this opportunity. It will be necessary to construct a revision process of direction plans to ensure mechanisms of territorial administration which impede the monopolization of single crops taking over entire municipalities.

Implementation of integrated production systems, incentives to diversify production and the formation of cooperatives to produce ethanol in micro-distilleries

All three levels of government must work to:

a) include family farming in ethanol production by stimulating integrated and diversified production of small properties and
b) promote the organization of these families in producer cooperatives of ethanol and micro-distilleries

Organic production of sugar cane

Today there are examples of the viability of organic sugar production but they are destined to specific niches of the market which accept a premium for organic production. The viability of the organic production of ethanol however, has not been studied. Thus, it is an action of sustainability which demands further research and demonstration projects.

Substitution of fossil diesel and bio-fuel in tractors and busses for transportation of rural workers

At the peak of Pró-Álcool some firms which produced heavy transport equipment manufactured vehicles powered by ethanol, but the experience was short-lived. In the current expansion cycle of ethanol and with the concomitance of the bio-diesel used in tractors, harvesters, trucks and rural worker busses could be substituted by bio-fuels to improve the carbon balance in ethanol production even more.

4.3_ Instruments to implement actions for sustainability

Inspection of application of environmental and labor laws

This is a simple demand for labor law enforcement and should be carried out by state environmental departments and by the Labor Ministry, accompanied by organized civil society.

Terms of conduct adjustment to solve environmental debt represented by the lack of legal reservation areas and permanent preservation areas

To be elaborated with the State Public Ministry, state environmental departments (OEMAs), producers and organized civil society with approval of state environmental councils. The issue is currently under discussion by IBAMA and some state environment agencies.

Terms of conduct adjustment to solve environmental debt created by soils and subterranean waters contaminated by inadequate disposition of vinasse

To be drawn up among MPE, OEMAs, producers and organized civil society in case by case basis. This instrument is quite common in Brazil but the identification of the cases is not pro-actively researched by the environmental authorities; the stakeholder interested in clean ethanol production should demand environmental diagnosis from the distillers and mills.

The construction and implementation of mechanisms for environmental licensing of new mills and distilleries

To be constructed by IBAMA, OEMAs, producers, unions and organized civil society.

Legislation and programs to abandon the use of fire and manual cane cutting with training, worker relocation and agrarian reform

To be constructed by the National Congress and state legislative assemblies with the participation of the Ministries of the Environment and Agrarian Development, OEMAs, confederations of workers and organized civil society.

Actions to improve eco-efficiency

To be researched and developed by EMRAPA, research institutes of universities and the sector itself and by producer companies.

4.4_ The role of international stakeholders

Commitment to the reduction of the consumption of energy in countries of origin

Although the bio-fuels have an important role to fulfill in the mitigation of climatic changes and in the security of the supply of energy in the next decade, it is a fact that without a significant reduction in the standards of consumption in general and specifically in the consumption of energy, global society will not attain sustainability.

Thus, the first commitment of international stakeholders in the bio-fuel market must be to reduce the level of domestic energy consumption.

Criteria for the sustainability of bio-fuel production cannot be used as commercial barriers and unequal commercial mechanisms when dealing with emerging countries

Although the adoption of adequate criteria of sustainability for the production of bio-fuels can be a fair demand on the part of importers and an opportunity to obtain gains in sustainability for the society of emerging countries, these cannot be used as a tool to perpetuate global inequalities and above all they cannot greenwash interests of super-exploitation of workers and natural resources of emerging nations.

Avoid the commoditizing of the ethanol market

The negotiation and trade of biofuels in specific contracts can progressively incorporate the actions listed above as priorities to promote the sustainability of the production of this bio-fuel.

4.5_ The path to incorporate opportunities for sustainability in a practical way

In a short term the way for international stakeholders of the ethanol market to contribute to the implementation of identified actions of sustainability is the use of their purchasing power in direct deals with traders and producers of contract clauses which establish the progressive implementation of sustainability criteria. However, this way presents difficulties in monitoring which will be discussed in the following item, which defines the next long term step: the development of an international certificate of production system that could, for example, follow the steps of the Forest Stewardship Council for forest products.

An international label for ethanol and other bio-fuels, or an independent verification system of the agriculture production itself (once biofuel feedstcks can also be used for food or other markets) with criteria agreed upon by governments and organized civil societies of producer and importer countries and producer companies would demand the necessary conditions for independent and legally responsible third parties to verify, monitor and certify the production according to criteria defined, and would clear the way for international commercialization with social and environmental responsibility of the bio-fuel.

Once the strategy mentioned above is a defensive one, aiming the reduction or mitigation of the impacts of the expansion of production of biofuels in large scale, another, parallel, positive agenda should be pushed by

international and national stakeholders. This positive agenda could have the target to incentive the implementation of good practices and better projects of biofuels production in terms of decentralization, diversification, social control and management, for instance, identifying, subsidizing and or promoting projects that fit the sustainability criteria presented by the Energy Working Group of the Brazilian Forum of NGOs and Socials Movements (FBOMS)[13] and other groups like Biodiesel working group of CUT that aims the promotion of the inclusion of familiar agriculture in the biofuels productive chains.

[13] The publication “Sustainability criteria and indicator for bioenergy”, can be found at www.fboms.org.br/gtenergia and on the references in this study (Moret et al 2006)

5_ Monitoring of sustainability level of imported biomass

5.1_ How to monitor the level of sustainability

There are diverse challenges for monitoring aspects related to the sustainability of ethanol production in Brazil, beginning with the monitoring of the dynamic land market and the geographical expansion of the cane crop, which can already be witnessed in Brazil.

There are contradictory data among the productive sector, municipal and state governments and labor unions concerning the substitution of rural activities by sugar cane. This is an aspect to be monitored in real time during the coming years through methods other than official consolidated statistics that are somewhat outdated.

Similarly, referring to the advance of the agricultural frontier on natural areas, in Brazil there is a systematic absence of information divulged concerning the annual rates of deforestation of Brazilian biomes, excluding the case of the Amazon rainforest. Thus, the information and monitoring of this aspect should count on the specific efforts of governments and NGOs from now on.

In respect to monitoring the possible advancement of social issues which are more sensitive for the Brazilian sugar & ethanol sector – the levels of formalization and conditions of work – there is also the difficulty in the interpretation of data available. For ÚNICA, representing the productive sector, the levels of formalization of work of its associated industries go from 95% to 100%, even for rural workers. However, the numbers are not so easily measured for suppliers and land-leasers. These outsource the cultivation services and cane cutting, in general using migrant non-formalized manpower.

By the same token it is important to remember the regional inequalities, even those in regions like the Central-south, as touching the practices of companies and laborers, in the sense of not generalizing the sector as one based on the information that is generally diffused by the more articulated sector: the industries of São Paulo (Paixão, 1999).

As to the monitoring of agreements, contracts or other forms of negotiating regarding the compliance of agreed criteria of sustainability to the purchase of volumes of ethanol for export, here are the opinions of some Brazilian stakeholders:

> *"Brazil negotiates almost 15 billion liters of ethanol annually, 0% in the form of contracts. Contracts don't exist even to guarantee the internal market. Its possible to aggregate value and social and environmental criteria. Having a clear and open contract of purchase we can place all the criteria and social and environmental guarantees we feel necessary."*
> **Laura Tetti, Consultant of ~UNICA[14], interviewed in São Paulo, 07/25/2006**

> *"What guarantees? There has to be other channels of negotiations. The unions are interested but they want to participate in the negotiations from day 1. The more actors participating in this process, the more guarantees one will have that the process will last."***Elio Neves, President of Feraesp, interviewed in Araraquara 07/26/2006**

[14] Industries associated to ÚNICA – União da Agroindusria Canaviera do Estado de São Paulo, represent 75% of the national production of sugar cane

For Ethos Institute, self monitoring of management performance regarding corporate responsibility is not any guarantee but a process which supplies the instruments for the enterprises to understand their conditions better and the possibilities of usage of the administrative tools, which can be applied voluntarily. Sector responsibility indicators which should result from the process of evaluation and joint monitoring between Ethos and ÚNICA could be discussed and also be applied by various sectors of the society as a monitoring device on a further step of this starting process.

For environmentalist NGOs it is necessary that there be a greater strengthening of local groups, especially in places of expansion of cane areas, as well as the development of skills so that the theme of bio-fuels is placed on the agenda of these organizations to enlarge its power of monitoring activities of the sector. Even so, the daily monitoring of the execution of commitments related to sustainability criteria to be negotiated and established will always depend on the involvement of laborers and their organizations, like unions and the Social Observatory, linked to CUT.

5.2_ Possible paths and the role of international actors to guarantee sustainability of imported biomass

The formalization of middle term purchasing contracts (e.g. 4 years or more) between enterprises/governments who buy ethanol and Brazilian producers seems, in short term, to be an accessible instrument capable of incorporating criteria and more sustainable standards of production, above all in reference to the basic aspects of the accomplishment of labor and environmental legislation from optimization of technologies of production and the adoption of transparency and management practices.

Once again, in this case also, a guarantee of the accomplishment of minimal agreements is dependent upon the interest and capability of monitoring on the part of the local actors. This depends greatly, as said before, on the involvement and commitment of these actors during the whole process, from the negotiation of criteria and standards to be upheld to the verification of its execution over time. In this sense, the role of the international actors would guarantee the support of the strengthening of skills and the participation of local partners in the definition of criteria to be incorporated in the contracts.

It is also necessary for governments, companies and society in general form industrialized countries to become familiar with local realities and the bottlenecks concerning sustainability of a provision of the growing demand for energy resources, advocating the adoption of goals and consumer standards less dependent on and destructive of territories and the populations of developing countries.

As for national actors, it is hoped they will make use of international discussions and attention regarding these negotiations, and possibly the best examples of the incorporation of criteria and commitments to be adopted on bio-fuel exportation contracts, to apply pressure to reduce the inequalities in the sector and throughout the country.

This means making use of the international process to seek a transformation of production standards concerning aspects where implementing social and environmental improvements are possible, while at the same time considering the limitations and incompatible aspects of the agro-exporter model based on the expansion of monocultures and the inefficient flow of energy in relation to socio-environmental sustainability.

Both national and international stake holders should take into account this is a defensive strategy which, in the Brazilian ethanol case, has potential to

reduce social and environmental impacts of the current productive practices, improving them significantly. But parallel strategies to promote the possibilities for implementation of a more positive agenda, based on the support for the replication of bioenergy productive models integrated on a vision for local development that can be consider sustainable should be a next step to be taken based on the international cooperation process promoted by the context of this work and the international agenda on the theme of bioenergy..

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Abbreviations

CIMI Indigenist Missionary Center (Centro Indigenista Missionário)

CONTAG – Confederação Nacional dos Trabalhadores da Agricultura

CPT - Pastoral Land Commission (Comissão Pastoral da Terra)

CTNBIO - National Technical Commission of Bio-safety (Comissão Técnica Nacional de Biossegurança)

CUT - Central Workers Center (Central Única dos Trabalhadores)

DBO – Bio-chemical Demand for Oxygen (Demanda Bioquímica de Oxigênio)

EPI – Individual Protection Equipment (Equipamento de Proteção Individual)

ESALQ – Luiz Queiroz Superior School of Agriculture (Escola Superior de Agricultura Luiz Queiroz)

FERAESP – Federation of Hired Rural Workers of São Paulo state (Federação dos Empregados Rurais Assalariados do Estado de São Paulo)

FETAEMG - Federation of Agricultural Workers of Minas Gerais state (Federação dos Trabalhadores na Agricultura do Estado de Minas Gerais)

IAC - Instituto Agronômico da Secretaria de Agricultura do Estado de São Paulo

IBAMA _ Instituto Brasileiro de Meio Ambiente e recursos renováveis

IEA - Agricultural Economics Institute (Instituto de Economia Agrícola)

IPI – Tax on Industrialized Products (Imposto sobre Produtos Industrializados)

LPAE - Laboratório de Poluição Atmosférica Experimental do Departamento de Patologia da Faculdade de Medicina da Universidade de São Paulo

MW – Megawatts

NPK – Antonym for fertilizers based on Nitrogen, Phosphorous and Potassium

OEMAs – State Environmental Agencies (Organinismos Estaudais de Meio Ambiente)

OIT – International Organization of Work (Oganização Internacional do Trabalho)

OMC / WTO – World Trade Organization (Organização Mundial do Comércio)

ONGs / NGOs – Non-governmental Organizations (Organizações Não – Governamentais)

PIB / GDP - General Domestic Product (Produto Interno Bruto)

PRO-ALCOOL – National Program of Alcohol Fuel (Programa nacional do Álcool Combustível)

ÚNICA – Union of Sugar Cane Agro-industry of São Paulo (União da Agroindústria Canavieira de São Paulo)

ANNEX 1 – List of stakeholders interviews carried out for this study

The following interviews were carried out during 2 opportunities the author had to meet with different brazilian stakeholders in São Paulo:

30-31 may 2006 – during the Açucar Etico Seminar:
- **UFSCAR** – University of São Carlos (www.ufscar.br), with Francisco Alves
- **SerAndradina** – Trade Union of Hired Rural Workers (Sindicato dos Empregados Rurais de Andradina), with Aparecido Bispo

24-27/07/2006 – during the project trip :
– **ÚNICA** : Union of Sugar Cane Industries of the State of São Paulo (União da Industrias Canavieira de São Paulo - www.unica.com.br), with Laura Tetti
- **ABN AMRO Bank** (www.bancoreal.com.br), with Silvia Schicarino
– **FERAESP** : Federation of Hired Rural Workers of São Paulo state (Federação dos Empregados Rurais Assalariados do Estado de São Paulo – www.feraesp.org.br), in Araraquara, with Elio Neves
- Deputy Environment Secretary of São Paulo State and Director of CENBIO (**Reference Center for Biomass** – São Paulo University - USP – www.cenbio.org.br), with Suani Coelho Teixeira
- **Ethos** Insitute for Social Responsibility (www.ethos.org.br) with Mauricio Mirras

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