De-polluting Doubts:

Territorial Impacts of the Expansion of Energy Monocultures in Brazil

A study by
Wendell Ficher Teixeira Assis and Marcos Cristiano Zucarelli

Coordinator
Lúcia Ortiz

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About the authors

Wendell Ficher Teixeira Assis, sociologist, completed his Masters in Sociology at the Federal University of Minas Gerais (UFMG). A researcher with the Group of Studies on Environmental Themes (GESTA/UFMG), he investigates environmental conflicts, environmental licensing processes, monocultures and the impacts of agrofuels production. (wwficher@yahoo.com.br)

Marcos Cristiano Zucarelli, sociologist, also completed his Masters in Sociology at the Federal University of Minas Gerais (UFMG). His work as a researcher with the Group of Studies on Environmental Themes (GESTA/UFMG), focusses on environmental conflicts, environmental licensing processes, compulsory resettlement due to infra-structure projects and conservation areas. (mczucarelli@gmail.com)

Lúcia Schild Ortiz is a geologist, and completed her Masters in Geosciences at the Federal University of Rio Grande do Sul (UFRGS). A former researcher at the Fundação Estadual de Proteção Ambiental – FEPAM-RS (State Environmental Protection Agency), she worked on projects relating to water and air contamination by coal mining and processing in power plants in the south of Brazil. Lúcia is currently the General Coordinator of Friends of the Earth Brazil and a member of the coordinating committee of the Energy Working Group of the Brazilian Forum of NGOs and Social Movements for the Environment and Development (FBOMS). (lucia@natbrasil.org.br)

About the study

The study **De-polluting Doubts: Territorial Impacts of the Expansion of Energy Monocultures in Brazil** was developed in the context of the project “International debates on Bioenergy: raising voices in South America and presenting bad and good practices and policies for biofuels production in Brazil”, carried out by Friends of the Earth Brazil, Vitae Civilis Institute and Ecoa – Ecologia & Ação, with the financial support of the C.S Mott Foundation.
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Introduction

I agree that ethanol is an alternative for the future, but not if it takes over everything and butchers our land. We speak out, but you know, our voice is weak. The ethanol plants come and destroy everything. I don't know how much more I can take, I'm scared of sliding into desperation (Farmer and agrarian reform settler, Nova Alvorada do Sul, State of Mato Grosso, sugar cane expansion region).

Agrofuels have been championed world-wide as a solution to climate changes caused by fossil fuel consumption, and to the threat of dwindling oil reserves. Within this context, a professed concern for the environment is used to justify using 'clean' energy, while at the same time allowing for the continuation of the voracious rate of environmental exploitation. Although this transition to agrofuels is cloaked in social acceptability through the use of environmental preservation discourse, a closer look reveals threats in the form of increased deforestation, pressure on ecosystems, competition with food crops and displacement of rural communities, etc. In light of this, it is necessary to re-evaluate current paradigms of consumption and question the faith in technical efficiency that has perpetuated the process of environmental degradation.

Within the framework of growing agrofuels use, Brazil presents itself as an important player, given its place as the largest exporter of ethanol world-wide, and is already emerging as a potential supplier of biodiesel to external markets. Given this context, this investigation aims to evaluate the territorial socio-environmental impacts of such expansion.

The task began in October 2006 and developed in two stages. The first involved text-based research to identify the priority areas for energy crop expansion. With this information, we began the second phase, involving field work in areas selected for expansion. This phase took place between 22/11/06 and 23/12/06, covering 8000km across regions in four Brazilian states: the Minas Gerais Triangle region and Forest Zone, Western São Paulo State, South and East regions of Mato Grosso do Sul, and North-western Rio Grande do Sul.

Fieldwork included structured and semi-structured interviews, which were not audio recorded; however, field notes were taken. The objective was to consider a variety of stakeholders, allowing us to construct a new picture of the expansion of sugar cane and oilseed plantations for agrofuel production. In this context, the following people were interviewed: representatives from rural workers unions, government bodies involved in rural technical assistance, indigenous groups, small and medium-scale farmers, representatives from the Pastoral Land Commission, sugar cane cutters, representatives from the Indianist Missionary Council (CIMI), biodiesel plant workers, local business people, plant owners, prostitutes, agrarian reform settlers, tenant farmers, politicians, and representatives from cooperatives, among others. In addition, ethnographic studies of the rural properties visited and of meetings and public hearings were undertaken using the participatory observer method (Malinowski, 1978)

Information collected during fieldwork paints a sad picture of the expansion of sugar cane and oilseed crops. Ethanol production based on sugar cane monocultures has resulted in innumerous social and environmental impacts including: provoking a re-organization of land, forcing people off the land, exacerbating conflicts over land, exploiting indigenous labour, and reducing food production, etc. Similarly, the Brazilian program for biodiesel production has not managed to comply with its objectives of social inclusion and income generation and is becoming an escape route soy monocultures. Thus, it is foreseeable in the near future that these models of agrofuel production, rooted in the cultivation of monocultures, will aggravate socio-environmental conflicts in Brazil.

This document is divided into two parts. The first maps the expansion of sugar cane crops and outlines their principal impacts. The second focuses on the regulations instituted by the Brazilian biodiesel program and discusses logistical problems and the difficulties of including family farmers.

1) Ethanol Production

1.1 - Coordinates of the Expansion of Sugar Cane in Brazil

The prospect of increased demand for ethanol, both in the domestic market (due to an increase in flex-fuel cars) and the international market (due to adherence to the requirements of the Kyoto Protocol)[1], has become the key argument for expanding sugar cane plantations. It is estimated that in order to meet future demands, Brazil will need to

[1]*During 2001 to 2005, Brazilian ethanol exports grew by 614.3%. This growth was most evident from 2004 onwards (IEA/SP, 2006).*

double current ethanol production and increase sugar cane production by 44% over the next seven years. This equates to an increase in sugar cane production of approximately 230 million tonnees (CGEE, 2005), representing an increase in the area planted to the order of 3.2 million hectares. The principal expansion zones selected by the sector are: the Minas Gerais Triangle, Western São Paulo State, Southern Goiás, Southeast Mato Grosso do Sul, and Maranhão. The following map displays the sugar and ethanol plants currently in operation in Brazil, as well as the concentration of new developments in the Central-West and Southeast:

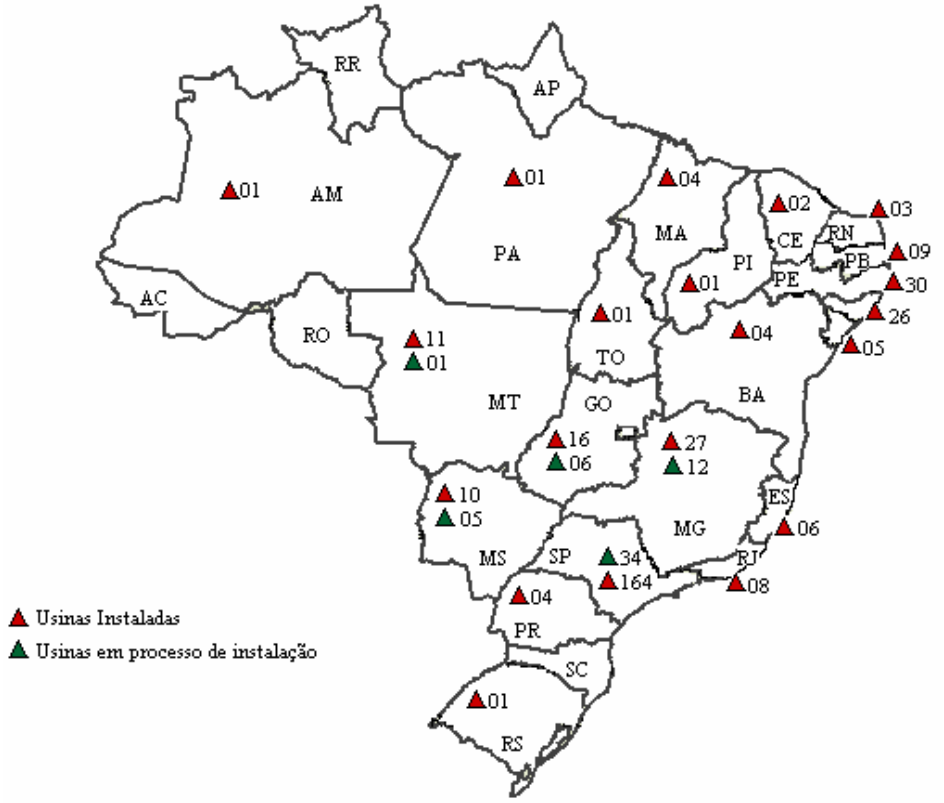


Figure I – Map of Sugar and Ethanol Plants in Brazil.

Region	Under construction	In operation
North	-	003
Northeast	-	084
Central-West	12	037
Southeast	46	205
South	-	005
TOTAL	**58**	**334**

It is evident from the map that there are no new plants planned for the Northeast, which was formerly the traditional center for sugar cane production. This is due to the demand for greater productivity and profitability and spells a shift in investments from Northeastern groups to the Central-Southern region of the country. As will be shown further on, the expansion of sugar cane plantations in the Southeast and Central-West has completely altered the land use dynamic, causing deforestation, decreasing the availability of foodstuffs, making small-scale farms unviable, and impeding the progress of the Brazilian land reform program.

1.2 - Impacts on Land Use and Food Production

The cultivation of monocultures over large stretches of land is identified by social movements and environmentalists as the cause of inequality in the countryside and a barrier to maintaining the traditional way of life in rural communities. Impacts on family farmers and changes in the agricultural production matrix were detected during fieldwork carried out in the Minas Gerais Triangle, Western São Paulo State and Southeast Mato Grosso do Sul.

The land market is an important factor in the expansion of monocultures and consequent pressure on small and medium scale rural properties. According to Guedes et al. (2006) the dynamic of this market is indicative of the strength of the agricultural industry and transformations in the production structure . It also assists in understanding the degree or permanency in the means of production across different social groups.

The expansion of sugar cane is aided by a land market characterized by minimal legal or social regulation, creating a positive effect on the cost of production while at the same time concentrating land ownership and making small-scale farming unviable. Because increased production in the sugar cane industry is tied to the expansion of plantations, there is a consequent reconfiguration in land use and puts pressure on the rural way of life.

Interviews and statements gathered during fieldwork show that land leasing is the principal strategy used by the sugar cane/ethanol sector in order to expand their plantations. In the Minas Gerais Triangle region, plantations to supply ethanol plants already dominate large stretches of land in the

municipalities of Uberaba, Delta, Conceição das Alagoas, Frutal, Itapagipe, Iturama, Limeira do Oeste, Alexandrita and União de Minas. However, in Southeastern Mato Grosso do Sul, this incursion is at a more advanced stage. There has already been an alteration in the landscape; from cattle farms to sugar cane monocultures. In these regions, a view of the leasing situation can be ascertained through various statements, the following of which stood are particularly salient:

> *The plants arrived here and they bought up land, choosing the best lands and renting what they could. Now they fix the prices and control everything. That's the way it is, their economic power is very strong. (Interview with a representative from the Rural Business Cooperative of the Minas Gerais Triangle), Uberaba, Minas Gerais, 26/11/2006)*

> *The plant owners aren't interested in the land. All they want is to have sugar cane planted and produced, that's why they go for leasing and independent production (Interview with a representative from the Rural Workers Union, Rio Brilhante, Mato Grosso do Sul, 03/12/2006).*

> *We're getting squeezed out. There are some people who think differently, they have a connection with the land, and so they don't lease to sugar cane growers, but others can't take it and end up giving in. I'm being surrounded by sugar cane. (Interview with a small-scale farmer, Uberaba, Minas Gerais, 26/11/2006).*

> *When you rent to cane growers you suffer. You stay here, surrounded by cane or you move into town where everything's different. My dad, for example, he won't take the R$48,000 that the plant keeps offering, but people who have lived on the land their whole lives suffer when they see their land full of cane (Interview with a small-scale farmer, Cássia, Minas Gerais, 24/11/2006).*

> *I, for example, am 51 years old. If I lease to cane growers for 12 years, when it's up I'll be 63. And then I won't be able to take up farming again and I'll end up having to renew the contract (Interview with a medium-scale farmer, Uberaba, Minas Gerais, 26/11/2006).*

> *The distillery comes, rents land, and thinks it owns the place. But do you think that anyone will go back to the land after 8 to 10 years? You end up having to sell or renew the lease (Interview with a trader, Iturama, Minas Gerais, 29/11/2006).*

The leasing of land is the major means of increasing sugar cane plantations and involves a complex alteration in the types of agricultural production, job availability, migration to cities, food avalability, and the possibility of appropriating land for agrarian reform. This can be observed when traveling through rural and urban zones in regions chosen for expansion. In municipalities within the Minas Gerais Triangle, we confirmed changes in land use, including various locations in which pasture has given way to sugar cane. In other words, in the birthplace of the Minas Gerais cattle industry, sugar cane is advancing on the production of the milk, beef and leather. In the Minas Gerais Triangle/Alto Paranaíba, cattle numbers dropped by more than 448,000 head between 2003 and 2005 (IBGE PPM, 2006). Furthermore, although official statistics still do not show a reduction in milk production, interviews undertaken in cooperatives in the region report a fall in deliveries.

In Western São Paulo State the situation is similar, as sugar cane crops are advancing on cattle raising areas. In the rural zone of the municipalities of Andradina and Castilho, the landscape alternates between vast sugar cane crops and areas formerly used for pasture that are now being prepared for planting sugar cane. In this case, the substitution of pastoral land had a direct impact on cattle stocks, with a drop of more than 326,000 head between 2003 and 2005. Similarly, the number of milking cows fell by 12.3%, translating to a decrease of more than 34 million liters of milk in two years (IBGE PPM, 2006). Municipalities in the Minas Gerais Triangle and Western São Paulo State, which have a strong tradition in beef and milk production, have experienced a shift in cattle stocks due to the concentration of sugar cane plantations in the central-south of the country.

Information gathered during fieldwork identifies the Northern states as the new frontier for cattle grazing, as can be noted in the following description:

The traditional farmers from here in the Triangle region are leasing or selling their land to the sugar cane growers, and going to raise cattle up in Tocantins, Rondônia and Mato Grosso (Interview with veterinarian from the Iturama municipal council, Minas Gerais, 28/11/2006)

In the same vein, official statistics from 2002 to 2005 point to an increase of more than 11 million head of cattle in the northern region, primarily in the States of Pará, Rondônia, Amazonas and Tocantins, which have experienced increases of 48.1%; 41.2%; 33.7% and 14.3% respectively, while growth at a national level was 5.9% (IBGE PPM, 2006). Thus, it is evident that cattle raising is putting pressure on the Amazon and Cerrado biomes which are located in these states. In Southeast Mato Grosso do Sul, sugar cane expansion has occurred in areas dedicated to producing of soy, corn and cattle. On top of this, there are indications that farms previously considered unproductive (in terms of land reform) have been made productive by being rented out for sugar cane cultivation. This type of mechanism exacerbates tensions in the countryside, as is evident in the following statements:

Right here there's a farm that was going to be appropriated for land reform, to become a new settlement, but then leasing came along. That's one of the plant owner's strategies; they lease land from unproductive farms as a way of throwing a bucket of cold water on agrarian reform. It's scary, they're taking up all of the land in this region (Interview with a leader from the Pana Settlement, Nova Alvorada do Sul, Mato Grosso do Sul, 04/12/2006)

The cane conflict and agrarian reform here in the municipality of Rio Brilhante is extremely difficult. We can't take agrarian reform any further. Since the sugar cane arrived, the number of landless families camped on the side of the highway has only increased (Interview with a representative of the rural workers union - Rio Brilhante, Mato Grosso do Sul, 03/12/2006).

In Nova Alvorada do Sul there were 17 areas that were earmarked for agrarian reform. After leasing to sugar cane growers, they were then considered productive (Interview with a representative of the Pastoral Land Comission (CPT), Dourados, Mato Grosso do Sul, 01/12/2006).

Evidence such as this collected during fieldwork is supported by studies published by the CPT. In the State of Mato Grosso do Sul, for example, land disputes (actions resisting occupation, use and ownership of territory) increased by 87.5% between 2003 and 2005, jumping from 16 to 30 confrontations. Similarly, the number of rural real estate occupations grew by 100%, from 8 occupations in 2003 to 16 in 2005 (CPT, 2006). It is worth highlighting that 24 occupations occurred in 2004, 15 of them in municipalities where new cane fields are planned. Based on fieldwork and registered incidents, it is possible to conclude that the expansion of sugar cane in Southeast Mato Grosso do Sul could spell increased tension and conflicts over land ownership.

Another problem encountered during fieldwork relates to the expansion of sugar cane plantations in areas surrounding land reform settlements that are dedicated to family farming. In Iturama in the Minas Gerais Triangle, sugar cane plantations have completely surrounded the Água Vermelha settlement and residents affirm that proposals to lease or plant sugar cane are constant. Aside from this, they say that sugar plantations in the region have threatened fruit and vegetable crops and made them unviable, as they are forced to use a series of agrichemicals to combat plagues that migrate from the sugar cane plantations. Such cases are illustrated in the following statements:

When the people from the plant use poison to kill the growth that comes up in the cane crop, it spreads and kills all our pasture, when we didn't have much to begin with. We loose a lot come milking time. Then there's the insects that come from the plantations and attack our vegetable plots and fruit trees. Before, we didn't use poison, but now if we don't attack with force, no plants grow at all. (Interview with a small-scale farmer, Iturama, Minas Gerais, 28/11/2006).

In the past, we didn't even need to use poison on our crops, now not even poison can stop the plagues that come from the cane. There's bisourinho verde, bisouro vaquinha, *caterpillars,*

they eat up the all the vegetables (Interview with land reform settler, Iturama, Minas Gerais, 26/11/2006).

In Castilho and Andradina in Western São Paulo State, residents of the Nossa Senhora Aparecida Settlement have experienced the same situation, and question the problems caused by the advance of sugar cane plantations. Similarly, small-scale farmers from the Pana Settlement in Nova Alvorada do Sul, Minas Gerais, state that the sugar can expansion has threatened family-based food production, as the ethanol plants have offered settlers incentives for planting sugar cane. The regret and fear provoked in the region by the sugar cane expansion is expressed in the following account:

The arrival of cane is damaging. They want to get rid of everything. After the plants arrived the cane belt closed in around the settlement, and that compromises our future. It's scary, we're threatened here…soon you'll be able to travel 100, 200 kilometers in this region without seeing a single bean, corn or cassava plant. The land becomes degraded, and after the ethanol plants have used it up, only then the land can be bought for agrarian reform. This settlement right here used to be sugar cane land. It took a lot of sweat to get this piece of land productive again (Interview with a land reform settler, Nova Alvorada do Sul, Mato Grosso do Sul, 04/12/2006).

Another issue confirmed during fieldwork was that the increase in the number of sugar cane plantations in Southeast Mato Grosso do Sul has been identified by indigenous leaders as a threat to the indigenous land claims process. Studies highlight that there are more land claims in areas in which economic expansion has already taken place and consequently, the indigenous population is reduced and the size of land claimed is smaller (Oliveira Filho, 1998). Due to the fact that on one hand, politicians and business people see Mato Grosso do Sul as an agricultural expansion zone, while on the other hand a host of indigenous groups are making land claims, it is expected that there will be a prolonged struggle to establish indigenous reserves in the State. This view was expressed during interviews with indigenous leaders:

Our last land claim here in November, December last year was overturned. I think this was due to the arrival of sugar cane in the region. The way things are heading, conflict over land will increase (Interview with Guarani-Kaiowá indigenous leader, in Dourados, Mato Grosso do Sul, 02/12/2006).

Interviews carried out in the villages of Jaguapirú and Bororó in the Dourados region of Mato Grosso do Sul allowed us to identify the vision that indigenous leaders have for the area earmarked for a reserve don't allow for maintaining the group's way of life. Similarly, the Indians regard that having to work cutting cane is a result of measly land sizes, and that this contributes to distancing them from the culture of the village. Echoes of this unrest can be noted in the following statement:

I know that sugar cane work gets in the way of our main problem, which is the struggle for land. Relatives go off to work cutting cane and forget what life in the village is like […] When an Indian goes to work with cane he doesn't value the struggle, because he's not thinking about the land, the right to the land that is his. He only thinks about cane (Interview with Guarani-Kaiowá leader, in the village of Jaguapirú, Dourados region, Mato Grosso do Sul, 02/12/2006).

According to Oliveira Filho (1998), the strategy used by the now defunct Indigenous Protection Service to diminish clashes between economic expansion fronts and indigenous groups seems to have been to establish reserves with restricted areas of land. This practice gave indigenous people some land rights, while at the same time freeing up the rest of the land to be used by the whites. The results of this policy can be seen in the indigenous reserves of Mato Grosso do Sul where the Guarani-Kaiowá live (Dourados, Caarapó, Porto Lindo and Amambaí) which feature the lowest ratio of land per inhabitant; less than one hectare per person, approximately 15,000 indians in little over 10,000 hectares (CIMI, 2005).

Through interviews undertaken in the field, we were able to identify a latent concern amongst indigenous leaders regarding the advance of sugar cane in areas surrounding reserves. In the villages of Jaguapirú and Bororó, sugar cane plantations have already surrounded indigenous land in almost

every direction, and leaders fear worsening conflicts, given that from the point of view of the Indians, the plantations area situated on ancestral territory that transcends the limits of the reserves. In relation to this, it is important to note that Mato Grosso do Sul is the state with the greatest number of conflicts stemming from violations of indigenous land rights: including 23 of the 26 cases registered in Brazil in 2003; 28 out of 41 in 2004; and 17 out of 32 registered up until July of 2005 (CIMI, 2005).

1.3 - Impacts of Job Creation and Work Conditions

The restructuring of the sugar-ethanol sector aims to develop a management apparatus capable of allowing the introduction of new technology, of rationalizing labor, and increasing labor productivity, thus creating new circumstances for workers and worsening their conditions (Scopinho, 2000). With the increased mechanization of sugar cane production, workers who had experienced unsafe work conditions have begun to worry about other problems such as increased unemployment and requirements for greater productivity in sugar cane harvesting. According to Veiga Filho et al. (1994), the modernization of agriculture is not limited to technical and economic transformations, but encompasses changes in social structures and industrial relations. In this regard, automation worsens the levels of exploitation and unemployment in the sugar cane industry, and is therefore a significant social problem.

These changes cause a reconfiguration of practices in the sugarcane industry, and unskilled labor extends to the following phases: growing seedlings, planting, ant control, equipment maintenance, operating machines, manual harvesting, and removing waste. Of these activities, the greatest demand for work is in manual harvesting, which accounts for over 60% of workers (Conçalves, 2005). In this phase, payment is based on a worker's productivity, whereby the fixed monthly wage can be increased according to improved cane cutting efficiency. For example, the average production by workers in the Ribeirão Preto region currently reaches 12 tonnes per day, whereas in the 1980s the rate was 6 tonnes per day (Alves, 2006). The constant pressure to increase productivity has caused enormous problems for workers, as is evident in the following statements taken during fieldwork:

> *Not even the axe is as cruel as the machete. You've gotta cut right at ground height, gotta grab the cane, and that's the hard part. With wood, you strike and cut, but not with cane. You've gotta hold it, strike, cut, and then haul it. That's our lot (Interview with cane-cutter and union leader, Rio Brilhante, Mato Grosso do Sul, 03/12/2006).*

> *I've done three harvests and I can't handle it any more. There's days when you get cramps, headaches, nose bleeds, and come nighttime you can't even sleep you hurt that much (Interview with migrant cane-cutter 'R' from the State of Alagoas. Uberaba, 27/11/2006).*

> *It's tough; we can barely take it. You sweat so much you're soaked through and your boots fill up with sweat. […] The pressure is so high, you don't want to fall behind, there are guys here that push themselves and cut 19 tonnes a day, but they nearly kill themselves doing it (Interview with migrant cane-cutter 'F' from the State of Maranhão, Uberaba, 27/11/2006).*

> *There are days when we're forced to cut cane when they're burning off. The cane fire comes along burning the stumps all around us and we have to work alongside it. It's so hot that you get blurry vision. It's hard to put up with this suffering (Interview with migrant cane-cutter 'J' from the State of Maranhão, Uberaba, 27/11/2006).*

> *Cutting seven rows really kills. We have to drag the cane more than twenty meters, there and back. At the end of the day I collapse in a heap (Interview with migrant cane-cutter 'Z' from the State of Maranhão, Uberaba, 27/11/2006).*

These serious problems, which include cases of deaths, are dealt with by some sugar cane companies in a criminal manner. Workers are discouraged from seeking medical assistance as they are told there will be penalties for seeking consultations unless in cases of illness that prevents the person from working. According to Scopinho (2000), this is a means of forcing workers to only seek medical assistance when they are at the limit of tolerating their condition. Therefore, deaths relating to overworking are indicative of an internal dichotomy within the sugar-ethanol industry, which on one hand uses the latest equipment, and on the other enslaves workers through performance-based pay and control

over absences and medical consultations. Statements from interviews conducted in the field verify this practice:

> *My head hurts a lot, my whole body's weak. So I go to the doctor, who takes my blood pressure and says there's nothing wrong with me. And then he asks: Did you come here for medicine or for a doctor's certificate? That's the kind of doctor this company provides (Interview with cane-cutter 'J', Uberaba, Minas Gerais, 06/12/2006).*

> *When I came here I did bone tests, did an X-Ray, did all of the tests. I got drenched in the rain over Carnaval, I was on top of the truck and we got saturated. The next day I woke up with a fever, inflamed throat, flu. I went there [to the doctor] and they wouldn't give me a doctor's certificate. I ask you: did I cause this illness? I even had to pay for the medicine (Interview with cane-cutter 'P', Uberaba, Minas Gerais, 06/12/2006).*

This regime which impels workers to work at the limits of their physical capacity is further worsened by the fact that the cutters don't have control over the quantity of cane cut. This makes calculating wages impossible, leaving workers at the mercy of a measurement made by the plant itself. Interviews in the field featured constant complaints that overseers who weigh the sugar cane are instructed by the plant to register quantities much lower than what is actually extracted. Furthermore, as payment is based on tonnes and not meters cut, there is a grey area regarding how much a worker should be paid, given that cutters are not informed about the proportion of tonnes to meters of sugar cane.

In the Minas Gerais Triangle and Western São Paulo State, there is a large presence of migrant workers from Northeastern Brazil, in particular from Maranhão, Alagoas and the region of Vale do Jequitinhonha in Minas Gerais. Migrant workers are employed by a third-party known in the sugar cane industry as a 'cat'. The role of 'cats' is to find workers in the Northeast and Jequitinhonha and recruit them on behalf of the plants. Reports received during fieldwork assert that in most cases, workers are enticed in their home towns with offers that aren't fulfilled by the plant owners when they arrive in the sugar cane plantation areas. Indicators of such practices can be noted in the following statements:

> *Back home in Monte Carmelo [Minas Gerais] it was the plant representative who came to pick us up. We came to Uberaba, did the tests, and got the all clear. We waited for work for nine days, without being paid a cent; they made promises and didn't fulfill them. I didn't come here to be a slave; I came here to work as a human being (Interview with migrant cane-cutter 'A', Uberaba, Minas Gerais, 06/12/2006).*

> *The cat gets paid per head that he puts to work for his boss [plant owners]. It's like a herd of sheep, come here and dump them. In the beginning they say that it's an improvement, but it's not at all (Interview with migrant cane-cutter 'C', Uberaba, 06/12/2006).*

> *A cat is the worst type of person imaginable. They own the busses; usually they're paid for productivity, so they only choose the men that produce the most. They earn a percentage of total production, so they make the cutters work harder, pushing them to the limit. [...] They take up everyone's worker's record books and give them to the plant, effectively taking the workers hostage (Interview with representative from the Rural Workers Union, Andradina, São Paulo, 29/11/2006)*

In Southeast Mato Grosso do Sul the sugar cane is cut by indigenous workers who leave the reserves to live in housing in the middle of the sugar fields, similar to migrants from the Vale do Jequitinhonha region in Mato Grosso do Sul. Whereas the Central-South is dominated by 'cats', in the sugar regions of Mato Grosso do Sul the role of intermediary in contracting indigenous workers is fulfilled by a member of the tribe, called a 'head hunter'. They recruit the strongest, youngest Indians and take them to the sugar cane regions. Sometimes those chosen are not yet of legal age, and are given fraudulent papers to deceive labor inspectors. In the eyes of indigenous leaders, this represents a significant problem, as the migration of young people destroys the culture of a village:

> *I tell you that it's the young ones who go to cut sugar cane. This destroys the village and our customs even further (Interview with Guarani-Kaiowá indigenous leader, Dourados, Mato Grosso do Sul, 02/12/2006).*

Sugar cane work takes us away from our culture, and then comes the alcohol, the drugs, those things which complicate family life. A relative goes there to work, and when they come back they've missed the planting season (Interview with Guarani-Kaiowá leader undertaken in the Village of Jaguapirú, Dourados region, Mato Grosso do Sul, 02/12/2006).

When they leave to work in the cane fields, indigenous workers receive food coupons in advance to sustain their families while they are away cutting cane. However, these can only be used in shops chosen by the 'head hunter', in which prices are inflated. Upon arrival at the plant housing, the system of food coupons is repeated, and causes the majority of indigenous cane cutters to become indebted. From information collected during field work, it is possible to confirm the existence of indigenous people working in degrading conditions, and having their work remunerated in alcohol, housing and food. The use of indigenous labor in sugar cane harvesting is seen by the leaders of the Jaguapirú and Bororó tribes as a consequence of the small quantity of indigenous land available from which to sustain their families. In addition, migration to the cane fields disrupts family bonds and renders food cultivation within the village unviable, leaving families dependent on buying rations. The following transcriptions illustrate this situation:

A people that doesn't produce anything is a people without creativity. It's a way of killing us, if you don't have banana, manioc, corn or fish you die. […] Then the illnesses come, labor exploitation. I say it again and again, they're killing our people at work and doing it with our own permission (Interview with Guarani-Kaiowá leader, Dourados, Mato Grosso do Sul, 02/12/2006).

I worked on the cane harvest for 15 years, and all I got were the illnesses and the pains in my body. Many relatives still go there, this harvest there were nearly a thousand. I'm scared that my sons will one day have to go cut cane (Interview with Guarani-Kaiowá leader in the Village of Jaguapirú, Dourados, Mato Grosso do Sul, 02/12/2006).

When an Indian comes back from the harvest after six months, he buys something, and all his money is gone. When he's cutting there's no time to plant crops and no money to buy food. […] He comes back owing money and so goes back to cut cane to earn more and pay off the debt (Interview with Guarani-Kaiowá Chief in the village of Bororó, Dourados, Mato Grosso do Sul, 02/12/2006).[2]

The leasing of land in regions chosen as sugar cane expansion zones has caused job losses in traditional areas such as dairy, beef and crop farming. In most cases, former workers are not re-hired, and the agroindustry requires new professionals, creating an influx of seasonal workers and increasing unemployment in local communities. This in turn causes migration to the cities. These problems were confirmed during fieldwork, and are illustrated in the following statements:

I'm worried about the arrival of these ethanol plants. The people who work on the soy harvest and who raise cattle are all loosing their jobs. There are days when I sign over 30 break of contract forms because of land leasing. (Interview with Rural Workers Union, Dourados, Mato Grosso do Sul, 01/12/2006).

The people from around here don't cut cane because it's really cruel work. So people come from elsewhere to do this kind of work. In fact, it's mostly migrant workers who cut cane. In the end, it's the locals who are left without jobs (Interview with local trader, Iturama, Minas Gerais, 28/11/2006).

The people here form a chain. The milk I produce here goes to the community cooperative, creating jobs there. Then it goes to the city and creates other jobs there. That's without counting those farmers who use tractors to plough the land, and when they break down, that also creates jobs. If we lease our land to sugar cane producers and stop producing milk, everything down the chain stops, because the factory doesn't create these sorts of jobs (Interview with a small-scale

[2] *According to Oliveira Filho (1998), creating small indigenous reserves is an inefficient mechanism, as it dislocates tribes and favors the proletarization of indigenous people. This is evident in Mato Grosso do Sul, where 13 reserves of less than 31,000 ha were created. Cases such as these serve more as labor reserves than indigenous territories, as seeking temporary paid work in an attempt to sustain the community is becoming a characteristic of these areas.*

farmer in Uberaba, Mato Grosso do Sul, 26/11/2006).

The big farm used to hire many people here in the region, but after land leasing started, the jobs dried up. When the farmer leased his land, my dad and my uncle, who were employed by him, lost their jobs. […] We're not going to be able to survive on the land and we'll end up having to move to the city. There in Palestina [rural zone of Uberaba] four or five families have already moved to the city sine the farmers started to lease out their land to cane growers (Interview with representative of the Rural Workers Union, Uberaba, Mato Grosso do Sul, 27/11/2006).

Another result of increased numbers of migrant workers is the creation of housing in the middle of the sugarcane plantations. Fieldwork investigations revealed the instability and poor treatment that workers suffer within these installations. In the municipality of Rio Brilhante, Mato Grosso do Sul, housing in the middle of the plantation was described to us as being like 'Carandiru prison'[3] due to terrible hygiene, overcrowding, poor food, lack of privacy, imprisoning workers within the cane fields and far from towns. In the Minas Gerais Triangle region, in the municipality of Nova Ponte, reports were no better. The region stood out in terms of the high levels of cruelty, given the unanimity of complaints of beatings by security guards contracted by the plant to maintain control in such a harsh environment. Given this, we maintain that the use of this form of accommodation puts workers in a vulnerable situation, at a long distance from social protection networks such as unions, labor offices and social movements.

Plants with more modern management, generally those which intend to enter foreign markets, have begun to improve working conditions and have introduced special education, dietary and physical preparation programs for workers. In general, these companies are interested in avoiding losses due to strikes, illnesses and law suits, which can reduce production and harm the company's corporate image overseas. On the other hand, studies have demonstrated that the introduction of technological innovations have not improved the unhygienic and harsh conditions that cane cutters are subject to; nor have they reduced the number of cane fires, given that yields are up to 30% greater when the sugar cane is burnt (Alessi and Scopinho, 1994; Scopinho, 1999; Alves, 2006). It is notable that even though there have been technological improvements in the sector, the sugar cane agroindustry has given little or no attention to the social problems inherent in the production process. Accordingly, the technological development paradigm predominates this important Brazilian industry, translating into: industrial or agricultural progress, lower employment, poor working conditions, and disregard for Brazilian law.

1.4 - Impacts on Urban Infrastructure

The arrival of the sugar cane agribusiness in small and medium-sized municipalities has altered the entire urban dynamic, creating new demands on public services such as health, security, education, water, sewerage, and housing, etc. The influx of workers puts pressure on existing infrastructure and at the same time demands greater investments by municipal governments. Fieldwork confirmed that in the sugar cane municipalities visited, residents associate the plants with a decrease in the quality of public services, and increased criminal activity and prostitution:

The plant brings in workers during the harvest, and then robberies, murders and prostitution rise. Afterwards, those that come here and like it bring their families and it gets even worse (Interview with local trader, Iturama, Mato Grosso do Sul, 28/11/2006).

In Ipezal there are more men than anything else. Before it was just a sleepy town, now it's like a beehive. From the 1st to the 10th of the month you should see the number of women that head there. All of them prostitutes. This sugarcane doesn't bring development to a place, it's nothing more than a burden for us (Interview with land reform settler, Nova Alvorada do Sul, Mato Grosso do Sul, 04/12/2006).

Another problem you always hear about is that when the Northeasterners come, prostitution goes up. Come harvest time the women come and spread out over the streets (Interview with Sister 'T', religious leader, Rio Brilhante, Mato Grosso do Sul, 03/12/2006).

[3] *Carandiru was prison in São Paulo, infamous for overcrowding and poor conditions, and site of the Carandiru massacre in which 111 inmates were killed by police. The prison was decommissioned in 2002.*

> *I always come here at the end of the month when the guys [cane-cutters] get paid. Back where I come from there weren't any alternatives, so the only option was prostitution (Interview with prostitute, Iturama, Mato Grosso do Sul, 28/11/2006).*

Similarly, fieldwork confirmed the pressure on housing infrastructure and the consequent inundation of the periphery of towns. In the municipality of Uberaba, Mato Grosso do Sul, the number of residents in certain periphery areas has increased considerably due to the arrival of migrant cane-cutters who decide not to return to their home towns. Examples of this are the suburbs of Jardim Uberaba, Valim de Melo and Jardim Alvorada. The migration of workers to sugar cane cities, and the subsequent arrival of their families (as has occurred in Jardim Alvorada, where the majority of shacks are occupied by people from the state of Maranhão) places a great demand on basic services such as health, education, waste removal and security. Furthermore, as fewer workers are employed in the period between harvests, many of the workers who do not return to their home towns remain unemployed until the next harvest[4].

The harvest period was identified as the time of greatest pressure on municipal infrastructure. During these months, there is an increase in; the number of residents, hospital admissions, the amount of waste produced, and water usage, etc. These changes affect the entire urban dynamic and require a readjustment in the routine of residents who were previously accustomed to a quiet and tranquil community. Similarly, this forces the municipality to increase its investment capacity in order to address the issues created by the sugarcane industry. The impacts of this are illustrated in the following declaration by a municipal secretary:

> *During harvest time our infrastructure comes under great pressure. To give you an idea, the average amount of rubbish here in the municipality is 700g per day, per capita. At harvest time this jumps to 1200g. We've even had to expand our landfill (Interview with representative of the Agriculture and Environment Secretariat, Iturama, Mato Grosso do Sul, 08/11/2006).*

Damage to highways and rural roads is another problem associated with the sugar cane industry. The excessive loads carried by trucks that run between the fields and the plants reduce production costs, though at the same time ruin asphalt surfaces and roads that link rural communities. During fieldwork it was possible to confirm the heavy flows of large trucks on the roads leading to the plants as well as the dangerous conditions of roads surrounding cane fields. During interviews in the municipalities visited we noted a link between the transportation of sugarcane during the harvest and the degradation of local access roads.

1.5 - Environmental Impacts of Sugar Cane Production

Field-based research revealed that sugarcane production has caused many environmental problems, such as; destruction of native vegetation, soil and water contamination, atmospheric pollution due to sugar cane fires, and the destruction of biodiversity, among others. The most visible environmental problem is the fires, which occur in approximately 80% of the crops. This technique reduces cane straw by 80% to 90% while at the same time facilitating manual cutting, reducing transport costs and compensating for losses of up to 20% in the harvest. However, legal conservation reserves that are surrounded by cane fields, as well as native animals and the communities who live near the plantations have carried all of the socio-environmental burdens of this practice[1]. Evidence of this was collected during research and can be noted in the following statements:

> *The plant burns the cane during the night, or just before dawn, around 5am. It makes everything dirty. They burn in a circle, and the animals get stuck in the middle. They all die, the poor things. There used to be* capivara *around here, but then lots of them got burnt. These days you don't see any. You don't see red* araras *anymore. Sometimes you see some blue ones, but they're disappearing (Interview with land reform settler, Água Vermelha settlement, Iturama, Minas Gerais, 26/11/2006).*

> *The wild animals escape to the towns, all of them with burns.* Arara, maritaca, curicaca, siriema, lobo guará, cutia, capivara, *even* cervo

[4] *This situation was encountered in the municipalities of Nova Alvorada do Sul and Rio Brilhante in Southeastern Mato Grosso do Sul.*
[5] *It is important to note the negative effects of burning off on microorganisms present in the soil, as well as the threat to remaining areas of native vegetation. Furthermore fires in cane fields lead to greater water consumption, as is confirmed by data from the Department of Water and Sewerage of Ribeirão Preto, where water use increased by 50% during harvest time. This is because residents are forced to wash their backyards, pavements and clothes frequently due to the smoke (Mattos and Feretti Filho, 2000)*

do pantanal, *have shown up with burn marks on them (Interview with local NGO representative, Castilho, São Paulo, 29/11/2006).*

There's a conservation reserve right here in the middle of the cane fields, and each fire destroys a piece of land that should have been protected. You don't see a single bird in these cane regions, it's a poisonous, untouchable place (Interview with representative from the Rural Workers Union, Rio Brilhante, Mato Grosso do Sul, 01/12/2006).

In Nova Alvorada do Sul, Mato Grosso do Sul, the cane fields are less than 20 meters away from houses at the edge of town. According to the residents of these suburbs, the burning-off period represents serious problems in the form of ash, smoke, fire risk, increased respiratory illnesses, heat, and increased water consumption. These problems were also experienced by residents who live more than 30km from the plantations. Thus, we can confirm that aside from environmental problems, cane fires also create problems for residents in the municipalities surrounding the cane fields.

Illegal deforestation in new plantation areas was another problem encountered during fieldwork. According to the majority of interviewees, land leasing has provoked an increase in deforestation, as fragments of forest on leased properties are felled in order to homogenize sugar cane plantations. In various municipalities, information collected points to illegal deforestation and the destruction of riverbank vegetation:

*The factory arrives and destroys everything. By day, the a*roeira *trees, the b*uritizeiro *trees, those pieces of forest are all there. Then they start preparing the land. By night, it's all felled and buried (Interview with a small-scale farmer in Uberaba, Mato Grosso do Sul, 26/11/2006).*

They knocked down all the trees that were in the middle of the fields. The groups of trees that were around here, they destroyed them all. During the day they prepare the soil and at night they knock down the trees (Interview with land reform settler, Nova Alvorada do Sul, Mato Grosso do Sul, 04/12/2006).

Many things have changed here; the roads changed, the forests are gone, there aren't any more fences. At nightfall, they [plant workers] are still preparing the soil, and by daybreak there aren't any trees left, they bury them all. Those long aroeira *trunks, they dig a big hole, 3 to 5 meters deep and bury them all. Makes you sad. The trunks which are too big get put on a truck and disappear. If it were a small-scale farmer doing this, the police would fine them on the spot, but with the big operators, nobody sees anything (Interview with local trader, Rio Brilhante, Mato Grosso do Sul, 03/12/2006).*

As can be seen in these excerpts, in new plantation zones, soil preparation is followed by the felling of trees, which are buried in order to impede inspections by environmental bodies. Another item on the list of environmental impacts is the intense use of agrochemicals, which in conjunction with illegal deforestation of riverside vegetation have contaminated rivers and streams. From transcripts of interviews conducted in the field, it can be noted that rural residents attribute these problems, as well as increased water scarcity, to the arrival of sugar cane plantations:

The planes that pass over spraying poison contaminate everything; water, corn, and other crops. These days there are a lot of people dying of cancer. In the past, farmers lived to be over 90. […] Our springs are disappearing and the fish are dying because of the poison that gets sprayed on the cane and runs into the streams (Interview with small-scale farmer 'B', Uberaba, Minas Gerais, 26/11/2006).

When they [the plants] irrigate the cane, the stream over there nearly dries up. We can't even get water for our stock to drink (Interview with land reform settler, Água Vermelha Settlement, Iturama, Minas Gerais, 26/11/2006).

I've been living here for 30 years. We used to walk everywhere. We were raised beside those streams. Then the cane arrived and destroyed everything, the streams are all dry. There aren't even any fish anymore (Interview with resident

from the rural zone of Itapura, São Paulo, 29/11/2006).

From interviews in the field and other sources cited in this text, it is clear that the current model of production used by the sugar cane industry does not meet the minimum standards of environmental and/or social sustainability. Therefore it is unacceptable that the production of this form of energy be touted as 'clean', given that it causes the innumerous socio-environmental problems previously mentioned. In this respect, it is important to keep in mind the complexity of the processes involved in generating this form of energy and not just its reduced level of environmental pollution, especially in light of the serious problems involved in the production process, such as; monoculture cultivation, displacement of rural communities, pressure on food production, alteration to the rural landscape, destruction of native vegetation, soil, river and spring pollution, atmospheric pollution, respiratory illnesses, and deaths from overworking, etc.

2) Biodiesel Production

2.1 - Legalization and Introduction into the Energy Matrix

Biodiesel is a liquid fuel derived from renewable biomass, and is produced from various raw materials, or feedstocks, such as: vegetable oils extracted from the seeds and grains of soy, sunflower, castor bean, *pinhão manso* (Jatrophas curca), palm, cotton, and *babassu* (Orbignya oleifera), among others; animal fat; and waste oils. A diverse range of technologies are used to produce this fuel; however, research has identified transesterification as the principal method of production. Transesterification involves an alkaline chemical reaction in which vegetable oils or animal fat react with an alcohol (ethanol or methanol). The principal product of this reaction is biodiesel (fatty acids ester). Glycerin is also produced as a bi-product and has many uses in the chemical industry[6]. Biodiesel production generates a series of other co-products, such as meal and cake which are used as soil fertilizers and animal feed.

Law No. 11.097/2005 introduced biodiesel into the Brazilian energy matrix, and delegated the responsibility for regulating production, importation, exportation, storage, stocking, distribution, reselling, commercialization and inspection, to the National Petroleum Natural Gas and Biofuels Agency (ANP). Moreover, the law mandated the compulsory addition of biodiesel to conventional diesel, at a minimum proportion of 2% (a mixture known as B2) and 5% (B5), to take effect from January 2008 and 2013 respectively. Within the same legal structure, Decree No. 5.297/2004 (later altered by Decree No. 5.457/05) created the 'Social Fuel Label' certification and set levels of financial incentives, including complete tax exemptions, as an incentive for social inclusion and the use of family agriculture in the production chain. In the North and Northeast regions, rebates of up to 100% are granted if the oilseed used is palm or castor bean grown by family farmers, which drops to 31% in the case of intensive farming. Other regions receive a rebate of 68% for any oilseed grown by family farmers. This Decree also established that for a biodiesel producer to obtain the 'Social Fuel Label' it is necessary to prove that a minimum percentage of feedstock comes from family farming, create rules for price fixing, establish and provide services such as technical assistance to farmers. Only producers who have been accredited with the 'Social Fuel Label' or who are in the process of accreditation can participate in the public auctions to buy biodiesel organized by the ANP[7].

Four public auctions have already taken place and the bid volume has reached 840 million liters per year of pure biodiesel (known as B100). This product is to be delivered by biodiesel suppliers (or their contractors) to one of the following authorized distributors; Shell Brasil, Texaco Brasil Ltda, Ale Distribuidora, and BR-Petrobrás (Federal Government, 2006). Biodiesel can only be commercialized by these distributors, who in turn mix the product with petroleum diesel to create B2.

The companies which bought at auction the rights to supply pure biodiesel own commercial plants that are already operating, or are in construction in various Brazilian states. Each state, theoretically, has its own feedstock specifications: palm in Pará; castor bean in Tocantins, Maranhão, Piauí, Ceará, and Bahia; soy in Mato Grosso, Goais, Minas Gerais, São Paulo, and Rio de Janeiro; and sunflower in Rio Grande do Sul.

[6] *Crude glycerin from biodiesel production can only be used in the chemical industry after certain impurities have been removed. Studies are being undertaken into developing a means of using this glycerin in the form in which it is produced. A major concern is that there are no predictions regarding the effect of intensive commercial biodiesel production on the supply and demand chain of the glycerin market. Therefore, it is not possible to evaluate issues that will arise from excessive glycerin production.*

[7] *For information regarding the rules of the auctions set by the ANP, see CNPE Resolution No. 3, of September 23, 2005.*

2.2 - Production Targets and Pressure on Ecosystems

The total demand for diesel in Brazil is 40 billion liters per year, 94% of which is produced internally, and 6% of which is imported, corresponding to 2.4 billions of liters annually. To use the B2 mixture, approximately 840 million liters per year of B100 will be needed (the amount that was auctioned at the last ANP public auction). To make the B5 mixture which will be mandatory from 2013, it is estimated that this volume will reach 2.6 billions of liters of B100 per year (MAPA et al., 2005). Therefore, the National Biodiesel Production and Consumption Program (PNPB) anticipates that the production of B5 will mean autonomy in meeting Brazil's diesel demands. However, although biodiesel arose as a gradual substitute for petroleum diesel, and has a guaranteed market for the next eight years, the cultivation of multiple oilseed crops and the logistical infrastructure for distributing feedstock are still rudimentary. This situation was described in an interview with the owner of a biodiesel plant in Cássia, Mato Grosso do Sul:

> *What happens is that some companies take part in the auction without having any production capacity. The procedures are flawed; they should at least consider the logistics of distributing the product. If this is done, it would be possible to offer biodiesel in the region according to the demand. The way it is now, you buy feedstock in one place, make the biodiesel in another, and deliver it to yet another (Interview on 23/11/2006)*

The 'Agro-energy Policy Directives 2006-2013' (MAPA et al., 2005) demonstrate that the biodiesel market depends, in the current phase, on mixed production infrastructure, composed of experiments based on small-scale pilot plants and medium-scale units with greater levels of automation. Nevertheless, information gathered during fieldwork indicates that many of the companies who were granted authorization from ANP to begin biodiesel production are still in the process of constructing their plants. Thus, it is evident that the infrastructure to meet the quotas auctioned by the ANP is still insufficient, which may prejudice the Program's targets.

Another issue relating to the lack of infrastructure to fulfill the PNPB is the distribution of biodiesel. ANP Resolution No. 42/2004 mandates that production units cannot sell directly to consumers, given that the mixing of pure biodiesel with petroleum diesel is restricted to liquid fuel distributors and refineries authorized by the ANP. In accordance with Order No. 483/2005, the transportation of B100 to mixing centers is subject to an agreement between suppliers and buyers. What was found during fieldwork was that this implies transportation over large distances and consequently increased energy expenditure, given that distributors are situated a long way away from biodiesel plants.

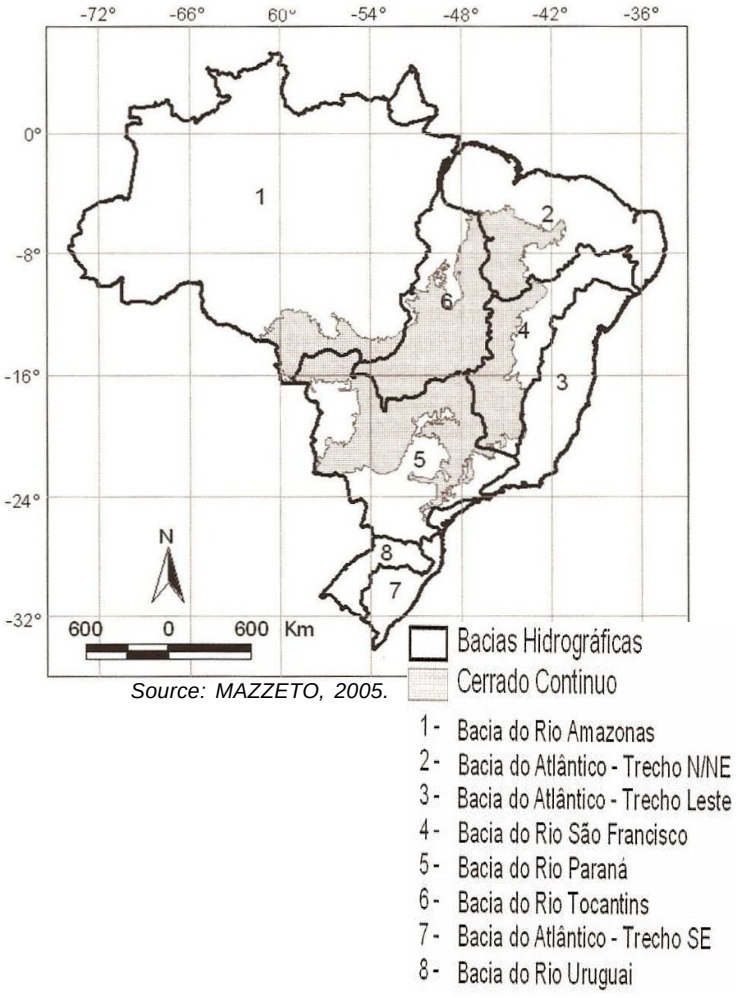
It is also important to consider the storage capacity of biodiesel producers. Fieldwork revealed that sufficient storage and transportation infrastructure is still not in place. In the case of Soyminas, the first biodiesel plant constructed in Brazil, in the municipality of Cássia, Minas Gerais, storage capacity is only 200,000 liters. This plant which is authorized by the ANP to produce 40,000 liters per day, would have to transport its product at six-day intervals. However, the distributor responsible for collection has delayed much longer that anticipated, taking up to five months to collect the biodiesel produced (Interview with biodiesel plant owner, Cássia, Minas Gerais, 23/11/2006). The lack of transportation logistics causes constant production hold ups, and as a result makes it impossible to provide the quantity of biodiesel granted at the ANP auction (12 million liters), given that in order to do so, the plant would need to operated 300 days per year and have its stock transported regularly.

The fact that such problems have not been resolved jeopardizes the Ministry of Agriculture and Food Stocks (MAPA)'s prediction that Brazil will produce approximately 50 billion liters of biodiesel for the internal market by 2035. The majority of this is to be produced through transesterification (80%), and the remainder through thermal cracking (20%)[8]. In order to achieve this production target, and deliver it country-wide, the Government will require new investments and a complete re-evaluation of the biodiesel production chain, from seed acquisition and diversity, through soil preparation, agrochemicals, agricultural additives, planting and harvesting, to manufacture, storage, transportation, mixing and distribution to the end consumer. The bi-products from biodiesel production are also to be ta-

[8] *This latest production technique involves a process which breaks apart molecules under high temperatures, forming a mixture of chemical compounds with properties very similar to those of petroleum diesel. The advantage of biodiesel produced by this method is that it can supply communities which are isolated from large industrial centers, due to ease of operating equipment and minimal need for raw materials proportional to demand, making them self-sufficient in terms of diesel oil (MDA, 2005)*

ken into account.

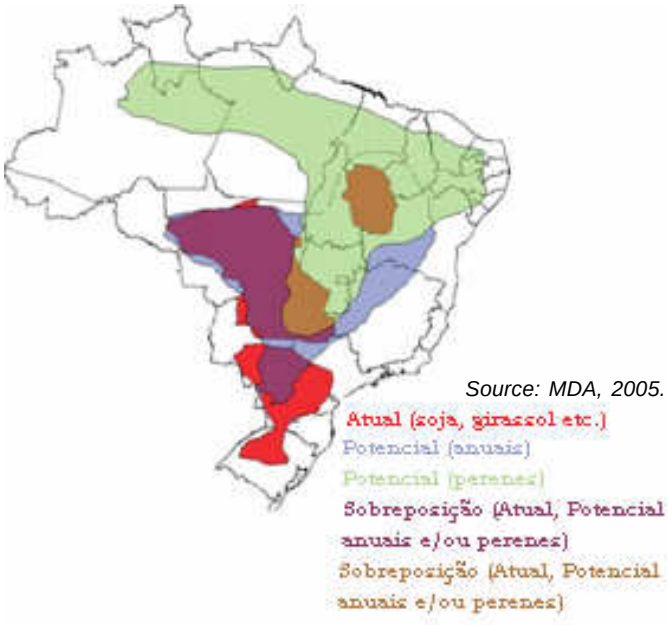
The situation worsens when one analyzes the calculation made by the government to meet national and international demand. It is predicted that by the end of 2035, 900 large-scale plants with production capacity of over 100 million liters of biodiesel per year will be needed. To achieve this, production should adopt the 'increased energy density premise' which requires improvement in production techniques, increased productivity, and greater oil count in oilseed feedstock (from 500kg/hectare to 5 tonne/hectare). To meet the demand for feedstock, almost 20 million hectares of new oilseed plantations will be needed (MDA, 2005). Given this, official studies stipulate that the use of new areas is possible in particular within the Cerrado biome, which 'possesses' approximately 90 million hectares 'free' for the expansion of crops used to produce biofuels (MDA, 2005; NAE, 2004). These expansion regions were chosen for their extensive areas of flat land which assists mechanized production; however, what was not taken into account is the ecological importance of the chapada ecosystems which are predominant within the Cerrado. Composed of deep, permeable soils, this ecosystem is integral to the water cycle of the biome and to distributing water that supplies the entire São Francisco and Araguaia/Tocantins river basins, in addition to parts of the Paraná, North-northeast Atlantic, and East Atlantic basins, and some of the tributaries of the Amazon River (Mazzetto, 2005).



Source: MAZZETO, 2005.

Figure II - Areas of Cerrado

The following figures demonstrate the overlap between Cerrado regions, agroenergy crops and catchment areas. From this is possible to see the direct influence of agroenergy crops on the hydrographic cycles of the principal Brazilian catchment areas. Furthermore, as there are areas in the Southern states of Mato Grosso, Mato Grosso do Sul and Minas Gerais which are characterized both as soy growing zones and potential areas for agroenergy expansion, it is feared there will be even greater impacts on the Amazon, Paraná, Tocantins, São Francisco and Uruguai river basins[9]. In the other direction, it is possible to envisage expansion in some regions of Goiás, Tocantins, Maranhão, Piauí and Bahia, which still contain Cerrado preservation areas, fundamental to the Tocantins, São Fransisco and Atlantic river basins. If current projections of the occupation of the Cerrado for cattle raising are confirmed, there could be a negative effect on water quality and quantity in the Brazilian watersheds.



Source: MDA, 2005.

Figure III - Expansion of Energy Agriculture

[9] *It was found during fieldwork that farmers in Mato Grosso do Sul and the Minas Gerais Triangle region are gradually substituting their soy crops for sugar cane.*

Aside from jeopardizing the role of the chapada in the water cycle, the occupation of these areas of Cerrado which are considered to have great agrofuel production potential in terms of agrofuel production, also threatens the biodiversity of this biome. This is the context that has given rise to the conflict between; agribusiness, ecosystem conservation, and the preservation of the way of life of people living on the land, including ethnic minorities and indigenous people who for generations have coexisted with the natural environment of the Cerrado.

2.3 - The Soy Monopoly in Biodiesel Production and the Risks of Substitution of Food Crops

The principal objective of the National Biodiesel Program is to promote the involvement of family farmers through diversifying their crops and taking advantage of the specific climate and soil conditions in each region in the country. However, in practice, this has not been the case.

As can be noted in the map below, development is concentrated in the Central-South region of the country, which has implications for the transportation of both feedstock and biodiesel. This concentration also prevents crop diversity, with respect to the specific natural attributes of each region. It is evident that the stronger financial incentives in the North and Northeast have not attracted investors, given that only 6 of the 23 plants authorized by the ANP were installed in these regions. Thus, the possibility of using soy (the price of which is dropping on the international market) has proved to be more advantageous. This has contributed to the formation of large scale market based on soy.

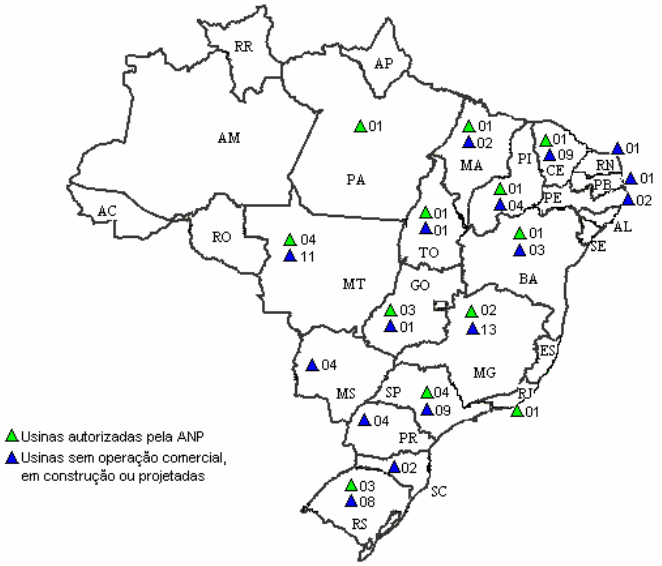


Figure IV – Map of Biodiesel Plants in Brazil

Region	Planned and/or construction	Authorized by ANP
North	01	02
Northeast	22	04
Central-West	16	07
Southeast	22	07
South	14	03
TOTAL	**75**	**23**

Source: ANP, MDA, SIAM, company websites *and regional newspapers.*

The ANP auctioned off twenty three licenses to produce biodiesel under the "Social Fuel Label" by the end of 2007. Of these, twelve use soy as their only feedstock and eight others use soy mixed with other oilseed crops. This makes a total of twenty projects dedicated to producing biodiesel from soy, representing almost 87% of the units authorized by the ANP[1]. Even the plants planned for the Northeast region which were going to use other oilseeds have now switched to soy. For example, Brasil Ecodiesel currently operates with the following feedstock ratios: 97.2% soy; 2.1% castor bean; and 0.7% cottonseed (Folha de São Paulo, 2006).

The consolidation of soy as the principal feedstock for biodiesel implies using a model of production based on monocultures, concentration of land ownership, forcing small-scale producers of the land and the destruction of native forests amongst other socio-environmental impacts. These facts contradict the objectives of the National Biodiesel Program, which aims to guarantee income and the viability of staying on the land for family farmers. Furthermore, growing multiple oilseeds would not only facilitate including family agriculture in the PNPB, but would also reduce the dependence on a single feedstock that is subject to market forces and weather phenomenon.

Even though the oil content of soy comprises 18% of the grain, much less that peanut (50%), castor bean (47%), palm (45%) and sunflower (45%), *pinhão manso* (Jatrophas curca) (37%) and oilseed raddish (36%), its use in biodiesel production is seen by Brazilian governments and business people as a strategic mechanism for regulating prices in internal and external markets. The idea is to replicate what is currently done with sugar cane; that is, use one raw material grown by large-scale producers to produce a diverse range of products, enabling greater profits depending on market demands. Evidence of this can be found in President Luís Inácio Lula da Silva's presentation during the inauguration of works in Mato Grosso:

[10] *These calculations were made by the authors based on data regarding the feedstock used by biodiesel plants, which is available on the ANP and MDA websites, as well as the websites of the plants themselves.*

> *[...] for soy producers this will be an extraordinary break, because the price of soy is controlled by the international market; sometimes it rises, sometimes it falls. When we begin using soy in diesel, what will happen? When the international price is low, we'll produce more biodiesel, and when the international price is good, we'll sell for a better price and guarantee a regulated market, like we currently regulate ethanol and sugar (President of Brazil, 2006)*

Thus, the dominance of soy in biodiesel production could amplify existing impacts and compromise the social objectives that were initially foreseen in the PNPB. In 2005, 23 million hectares were planted with soy (IBGE, 2005) and under current circumstances this is the only crop with a scale of production capable of meeting the demands of biodiesel plants. With an estimated production of 53 billion tonnes per year, soy corresponds to 90% of all oilseeds produced in the country. The government's expectation is for soy to comprise 60% of biodiesel feedstock (MDA, 2005). However, the large soy producers hope to maintain this figure at 90% of the market. A great concern that goes beyond market worries about agrofuel sales and consumption, is the continual advance of this monoculture on the Amazon and Cerrado biomes, as well as its impact on family agriculture and food crops[11].

In this new race to produce agrofuels, monocultures pose a significant threat to food production. The expansion of both soy and sugar cane has caused a series of uncertainties regarding food availability, given the possibility of substituting crops. As an indicator of the competition between oilseeds and food crops, we confirmed during fieldwork the use of combined crops as a means of reducing pressure on food production. Small-scale farmers interviewed in Northeastern Rio Grande do Sul and Southeastern of Minas Gerais described to us experimentations with planting sunflowers between rows of corn, as well as using this technique to grow castor bean with black beans, soy with corn, peanut with sunflower, or multi-cropping. In conjunction, we also received reports regarding the possibility of producing honey from sunflower, oilseed radish and canola plantations. It was reported that by combining 15 hectares of sunflower with three bee hives, it is possible to cover the costs of the harvest with honey sales alone (Interview with COOPERBIO technician, Palmeira das Missões, Rio Grande do Sul, 16/12/2006). Another possibility identified to reduce the pressure on food crops is to plant summer and winter crops, using crop rotation. Aside from reducing competition with food crops that were substituted with oilseeds, this technique compensates for lost areas of food crops, as it improves the productivity per hectare in the next harvest. In Cássia, Minas Gerais, oilseed radish was planted as a secondary crop, and the experience proved highly successful in terms of naturally balancing the soil, soil protection, and increased corn production in the following harvest (Interview with small-scale farmer, Cássia, Minas Gerais, 24/11/2006). Even though these examples demonstrate the possibility of diversified crops that marry food and energy production, the dominance of biodiesel manufacture based on soy monocultures makes sustainable, decentralized alternatives that include family agriculture simply unviable.

2.4 - Family Farming and Biodisel Production

During the study, we noted that the inclusion of small-scale farmers in the National Biodiesel Program is still incipient. Moreover, there are indications that the control and inspection mechanisms of the 'Social Fuel Label' are not capable of preventing family farmers from being used as a mere façade in order to obtain financial incentives. Farmers interviewed in the Cássia region of Mato Grosso do Sul confirm that the biodiesel plant was involved in 'buying documents' that certify the product as coming from a family producer, when in fact they bought feedstock from monocultures located in the Central-West of the country. In this respect, the following statements are particularly pertinent:

> *I was going to sign a contract with the plant to deliver my oilseed raddish, but when I read the contract, it was dated from 2003 and went until 2007, so I didn't sign. How can I sign something in the past? It was 2006, and on the contract it was 2003. When I asked at the municipal council they told me it was a typo (Interview with small-scale farmer 'A', Cássia, Minas Gerais, 24/11/2006).*

> *I don't just sell to the plant on paper only, but it's happening here in this region (Interview*

[11] *For information regarding the impact of soy plantations of the Cerrado and Amazon, see: Mazzetto, 2005; de Queiroz 2004; Fearnside, 2002; Galinkin, 2002; among others.*

with small-scale farmer, Cássia, Mato Grosso do Sul, 24/11/2006).

[…] What's happening here in this region is that small-scale farmers are used to justify the social label, but the plant isn't interested in what kind of conditions the oilseeds are grown in (Interview with EMATER officer, Cássia, Minas Gerais, 23/11/2006).

Interviews revealed also the frustration amongst small-scale producers who invested in oilseed radish:

I planted radish in the first year, but I don't think this crop's going to get anywhere because it ends up competing with other crops which yield more (Interview with small-scale farmer 'Z', Cássia, Minas Gerais, 23/11/2006).

The costs of planting and harvesting oilseed radish were not compensated by the yields. This shut out small-scale farmers, who here in the region plant other crops. […] In some cases they didn't even harvest the radish because the cost of the process wasn't worth it. The crop was offered to the plant, and even though they didn't incur the other costs, didn't harvest the crop (Interview with EMATER officer, Cássia, Minas Gerais, 23/11/2006).

In the beginning [2005], people were excited about the plant. Sixty farmers in the region planted approximately 500 hectares. This time [2006], with the second crop, six planted, but only two delivered their harvest (Interview with EMATER Director in Cássia, Minas Gerais, 23/11/2006).

These problems occurred precisely due to a lack of subsidies offered to family farmers. Initially, the biodiesel plants, in partnership with the municipal council, offered machinery to prepare soil and plant, leaving the harvest to the farmers. However, in the second harvest, all incentives were withdrawn (Interview with the President of the Rural Workers Union of Cássia, Minas Gerais, 23/11/2006). Because harvesting oilseed radish is only viable using machinery, small-scale farmers had great difficulty in harvesting their crops. Statements mentioned problems with gates and access roads that impeded the access of harvesters, as well as financial difficulties relating to paying for machinery and seed loss during the harvest. These logistical difficulties, coupled with low financial return on the oilseed radish meant that 97% of the farmers registered with the project did not continue with the crop the next year. It was found that growing oilseed radish in the Cássia region of Minas Gerais, contrary to the aims of the PNPB, favoured large and medium-scale properties which have greater investment capacity and use the crop primarily to enrich the soil:

The manner in which biodiesel was introduced in the region will only benefit medium and large-scale producers, because the crop is more suitable for agribusiness. It's actually uneconomical for small-scale farmers, but it could work in terms of improving soil quality (Interview with EMATER technician, Cássia, Minas Gerais, 24/11/2006).

The lack of interest amongst family farmers, caused by a lack of incentives and technical assistance coupled with the low production by medium and large-scale properties dedicated to growing oilseed radish lead to a reduction in the availability of this feedstock in the region. As can be noted in the following transcript, this situation has led plants to acquire different feedstock from further a field; principally soy from large properties in the Minas Gerais Triangle, Paraná, Mato Grosso and Paraguay:

Planting and obtaining feedstock aren't of concern to the operation of my plant. My production costs allow me to get feedstock from as far away as Paraguay. […]Buying feedstock depends on the offer. You buy it from anywhere, and you buy whatever's being offered (Interview with biodiesel plant owner, Cássia, Minas Gerais, 23/11/2006).

This highlights the lack of planning regarding the logistics of providing biodiesel feedstock. Currently, oilseed crops are planted in one area, biodiesel is manufactured in another, mixing is done in yet another location, and finally the product is taken to consumers. The impression given in interviews undertaken in the field is of a shift away from what was the principal focus of the biodiesel program: to provide social inclusion and income generation in the countryside.

For the time being, family farmers are frustrated about their real involvement in the biodiesel project. In relation to this, it is worth highlighting the comment by another small-scale producer in Cássia, who in the hope of increasing profits, planted four hectares with oilseed radish: “Everything starts off small, but ends up in the hands of the big players” (Interview, 24/11/2005). It is clear that family farming has not been included in even the initial stages of the Program, in other words, in the production of feedstock. Therefore, large-scale soy producers are taking over a market that is promoted as a *locus* of social inclusion for small-scale farmers.

Conclusion

The agrofuel market has been stimulated by various governmental policies aimed at mitigating climate change, while at the same time it is seen by Brazilian governmental bodies and agribusiness as a significant chance to fuel national economic growth. The analysis of the sugar cane sector and biodiesel production confirms that the discourse of the supposed greater threat presented by climate change is used to justify the expansion of monocultures at the expense of deforestation, exploitation of indigenous labor, concentration of land ownership, disregard of labor laws, pressure on biomes, and substitution of food crops. Field work enabled us to observe *in loco* the social and environmental problems stemming from the increasing expansion of this market. Therefore, we can ascertain that governmental plans regarding agrofuel production are still bound to monoculture plantations. Hence, sugar cane and soy have dominated the supply chains of so-called ‘green fuels’.

Given the recent announcements by the European Union and the United States of plans to substitute fossil fuels for agrofuels, with an aim to meeting greenhouse gas reduction targets, one can anticipate increased conflicts in new energy crop expansion zones. In particular, greater pressure can be expected on areas inhabited by indigenous groups, riverbank dwellers, extractivists, family farmers, ethnic minorities, and other more vulnerable groups. Aside from overt social conflict, there are significant environmental issues involved, such as; deforestation, contamination and depletion of waterways, damage to ecosystems, and threats to flora and fauna species. Given this situation, this study has endeavoured to demonstrate the consequences of these socio-environmental impacts.

References:

ALVES, F.J.C. *Porque Morrem os Cortadores de Cana?* In. Pastoral do Migrante. Guariba: Diocese de Jaboticabal. Available at <www.pastoraldomigrante.org.br>. Accessed on June 14, 2006.

_____. *Diagnóstico e Propostas de Políticas Públicas para o Complexo Agroindustrial Canavieiro na Macro Região de Ribeirão Preto*. In. MORAES, M.A.F.D.; SHIKIDA, P.F.A. Agroindústria Canavieira no Brasil. São Paulo: Atlas, 2002.

ALMEIDA, Guilherme Eidt Gonçalves de. *Fumo: servidão moderna e violação de direitos humanos*. Curitiba/PR: Terra de Direitos, 2005.

ANP – AGÊNCIA NACIONAL DE PETRÓLEO, GÁS NATURAL E BIOCOMBUSTÍVEIS. *Capacidade Autorizada de Plantas de Produção de Biodiesel*. Brasília: ANP. Available at: <http://www.anp.gov.br> . Accessed on October 15, 2006.

ANP – AGÊNCIA NACIONAL DE PETRÓLEO, GÁS NATURAL E BIOCOMBUSTÍVEIS. *Relação de Usinas de Álcool Cadastradas*. Brasília: ANP.
Available at: <http://www.anp.gov.br>. Accessed on October 15, 2006.

BRASIL. Congresso Nacional. Lei n. 11.097 de 13 de janeiro de 2005. Poder Executivo, Brasília, DF, January 14, 2005.

BRASIL. Congresso Nacional. Lei n. 5.297 de 06 de dezembro de 2004. Poder Executivo, Brasília, DF, December 7, 2004.

BRASIL. Congresso Nacional. Lei n. 5.457 de 06 de junho de 2005. Poder Executivo, Brasília, DF, June 7, 2005.

BRASIL. Congresso Nacional. Portaria MME n. 483 de 03 de outubro de 2005. Poder Executivo, Brasília, DF, October 4, 2005.

BRASIL. Congresso Nacional. Resolução ANP n. 42 de 24 de novembro de 2004. Poder Executivo, Brasília, DF, December 9, 2004.

BRASIL. Congresso Nacional. Resolução CNPE n. 03 de 23 de setembro de 2005. Poder Executivo, Brasília, DF, September 4, 2005.

CGEE – CENTRO DE GESTÃO E ESTUDOS ESTRATÉGICOS. *Prospecção Tecnológica: Avaliação da Expansão de Etanol no Brasil*. Brasília: CGEE, 2004. Available at: <www.cgee.org.br/prospeccao/doc >. Accessed on June 25, 2006.

CONSELHO INDIGENISTA MISSIONÁRIO. *Violência contra os Povos Indígenas no Brasil*. Brasília, 2005. Available at <www.cimi.org.br>. Accessed on November 18, 2006

COMISSÃO PASTORAL DA TERRA. *Conflitos no Campo Brasil*. Goiânia: CPT, 2006. Available at <www.cptnac.com.br> Accessed on November 17, 2006

COOPERBIO - Cooperativa Mista de Produção, Industrialização e Comercialização de Biocombustíveis do Brasil Ltda. *Biodiesel e Biocombustíveis*. Palmeira das Missões/RS: Pontocom Gráfica e Editora Ltda., 2006.

DE QUEIROZ, Fábio Albergaria. *Impactos do Comércio Internacional de Soja sobre a Biodiversidade do Cerrado*. Indaiatuba/SP: II Encontro da ANPPAS, 2004. Available at: <http://www.anppas.org.br/encontro_anual/encontro2/GT/GT05/fabio_queiroz.pdf> Accessed on January 16, 2007.

FEARNSIDE, Philip M. “Serviços ambientais como estratégia pra o desenvolvimento sustentável na Amazônia rural”. In: CAVALCANTI, Clóvis (org.). *Meio ambiente, desenvolvimento*

sustentável e políticas públicas. 4ªed., São Paulo: Cortez: Recife: Fundação Joaquim Nabuco, 2002, p.314-344.

FOLHA DE SÃO PAULO. *Cooperativa-modelo agoniza no Nordeste*. Dinheiro. São Paulo/SP: 19 nov. 2006. Available at <http://www1.folha.uol.com.br/fsp/dinheiro/fi1911200602.htm> . Accessed on January 13, 2007.

GALINKIN, Maurício. *Expansão da Soja no Cerrado: Uso de instrumentos econômicos paradefesa da biodiversidade*. Brasília-DF: Fundação CEBRAC, 2002. Available at: <http://www.ifas.org.br/download/candeia5/txtoFA_SojaBiodivV.doc>. Accessed on January 16, 2007.

GONÇALVES, Daniel Bertoli. *Mar de Canal, Deserto Verde? Dilemas do Desenvolvimento Sustentável na Produção Canavieira Paulista*. Tese (Doutorado Engenharia de Produção). São Carlos: UFSCAR/CCET, 2005.

GOVERNO FEDERAL. "Distribuidoras de Biodiesel". In: *PNPB - Programa Nacional deProdução e Uso de Biodiesel*. Available at: <http://www.biodiesel.gov.br>, Accessed on January 05, 2007.

GUEDES, Sebastião Neto Ribeiro et al. *Mercado de Terra e de Trabalho na (Re)Estruturação da Categoria Social dos Fornecedores de Cana de Ribeirão Preto*. In. AGRIC/SP. São Paulo, v53, nº 1, 2006. 9. 107-122.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. *Produção Agrícola Municipal: Culturas Temporárias e Permanentes*. IBGE, 2005. Available at <www.ibge.gov.br>. Accessed on January 04, 2007.

_____. *Produção Pecuária Municipal*. IBGE, 2005. Available at <www.ibge.gov.br> . Accessed on January 08, 2007.

MALINOWSKI, Bronislaw. "A região e os habitantes do distrito do Kula". In. *Os Argonautas do Pacífico Ocidental: um relato do empreendimento e da aventura dos nativos nos arquipélagos da Nova Guiné*. São Paulo: Abril Cultural, 1978, p.17-34.

MAPA – MINISTÉRIO DA AGRICULTURA, PECUÁRIA E ABASTECIMENTO. *Destilarias e Usinas Cadastradas*. MAPA, 2006. Available at <www.agricultura.gov.br >. Accessed on November 14, 2006.

MAPA - MINISTÉRIO DA AGRICULTURA, PECUÁRIA E ABASTECIMENTO et al. *Diretrizes de Política de Agroenergia 2006-2013*. Brasília/DF: MDA, October 2005.

MATTOS, Katty Maria da Costa & FERRETTI FILHO, Neuclair João. *Desenvolvimento econômico versus desenvolvimento sustentável*. In: ENCONTRO DE ENERGIA NO MEIO RURAL, 3., 2000, Campinas. Available at <www.proceedings.scielo.br/scielo.ph> Accessed on November 21, 2006.

MAZZETTO, Carlos Eduardo. "Lugar-hábitat e lugar-mercadoria: territorialidades em tensão no domínio dos cerrados". In: ZHOURI, Andréa; LASCHEFSKI, Klemens & PEREIRA, Doralice Barros (Orgs). *A Insustentável Leveza da Política Ambiental - desenvolvimento e conflitos socioambientais*. Belo Horizonte, Autêntica, 2005, p. 217-244.

MDA - MINISTÉRIO DA AGRICULTURA, PECUÁRIA E ABASTECIMENTO. *Plano Nacional de Agroenergia 2006-2011*. Brasília/DF: Embrapa Informação Tecnológica, 2005.

NAE - NÚCLEO DE ASSUNTOS ESTRATÉGICOS DA PRESIDÊNCIA DA REPÚBLICA. *Biocombustíveis*. Brasília/DF: Núcleo de Assuntos Estratégicos da Presidência da República, Secretaria de Comunicação de Governo e Gestão Estratégica, Cadernos NAE, nº2, 2004.

OLIVEIRA FILHO, João Pacheco de. *Indigenismo e Territorialização: poderes, rotinas e saberes coloniais no Brasil contemporâneo*. Rio de Janeiro: Contra Capa, 1998.

PRESIDÊNCIA DA REPÚBLICA. Discurso realizado durante visita e entrega de trecho da BR364, entre Sapezal e Comodoro, Mato Grosso, 21 de novembro de 2006. Brasília: Secretaria de Imprensa e Porta-Voz, 2006. Available at: <http://www.info.planalto.gov.br> Accessed on January 15, 2007.

SCOPINHO, Rosemeire Aparecida. *Qualidade Total, Saúde e Trabalho: Uma Análise em Empresas Sucroalcooleiras Paulistas*. RAC v 04 nº 01, 2000. p 93-112. 18 jun. 2006.

SCOPINHO, Rosemeire Aparecida, EID, Farid, VIAN, Carlos Eduardo de Freitas et al. *Novas Tecnologias e Saúde do Trabalhador: A mecanização do Corte da Cana-de-Açúcar*. Cad. Saúde Pública. jan./mar. 1999, vol.15, no.1, p.147-162. Available at <www.scielo.br>. Accessed on June 21, 2006.

SIAM - SISTEMA INTEGRADO DE INFORMAÇÃO AMBIENTAL. *Usinas de*
Biodiesel em processo de licenciamento. Belo Horizonte/MG: SEMAD. Available at: <http://www.siam.mg.gov.br> . Accessed on October 17, 2006.

VEIGA FILHO, Alceu de Arruda et al. *Análise da Mecanização do Corte da Cana-de-Açúcar no Estado de São Paulo*. Informações Econômicas/SP. V 24, nº 10, 1994. Available at: <www.iea.sp.gov.br>. Accessed on July 03, 2006.

Photographs

Castilho, São Paulo State, November 29, 2006: The advance of sugar cane on areas earmarked for agrarian reform.

Dourados, Mato Grosso do Sul, December 02, 2006: Home of the Chief of the Bororó village (Guarani-Kaiowá).

Dourados, Mato Grosso do Sul, December 02, 2006: Jaguapirú village (Guarani-Kaiowá). Indigenous land surrounded by soy and sugar cane plantations.

Highway MG 255, Minas Gerais Triangle, December 04, 2006: The excessive weight of trucks loaded with sugar cane has damaged the road surface.

The periphery of Nova Alvorada do Sul, Mato Grosso do Sul, December 03, 2006: Aside from the increase in the number of residents in the peripheries of towns, many live close to the cane fields and are thus more vulnerable to problems associated with cane fires at harvest time.

Itapagipe, Minas Gerais (near the Caeté Ethanol Plant), November 27, 2006: Conservation reserves surrounded by cane fields.

Rural zone of Uberaba, Minas Gerais, Nov. 26, 2006: The advance of sugar cane on cattle farming areas. In the background the sugar cane crop is well established. In the mid-ground are new crops and land being prepared for planting. In the foreground; cattle and pasture.

Highway BR-463, Ponta Porã, Mato Grosso do Sul: Billboard announces the installation of a new sugar and ethanol plant. Note the pasture in the background.

Highway SP-595, Ouroeste, São Paulo: Billboard announces the installation of another sugar and ethanol plant and promises jobs and energy. Note the pasture in the background

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