
SOCIAL AND ENVIRONMENTAL IMPACTS OF THE SUGARCANE INDUSTRY

Lara Bartocci Liboni

Professor

Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto
Universidade de São Paulo, Brazil

Luciana Oranges Cezarino

Doctorate in Business Administration

Faculdade de Economia, Administração e Contabilidade de São Paulo
Universidade de São Paulo, Brazil

ABSTRACT

Currently, the concern about the environmental degradation and the conditions of life of our planet has increased. An alarm literally sounded relating the environmental problems and the uncertainties of the future. An energy revolution is necessary in face of the climate changes. Nature offers numerous possibilities of energy production and Brazil is in a great position in this scenario. It is the greatest producer, consumer and exporter of ethanol. Analyzing the Brazilian sugarcane industry, it is easy to recognize its historical and economic importance. More than ever, this industry has shown environmental solutions with changes in the energy matrix using ethanol as renewable fuel. It is essential to have the industry development in balance with social and environmental values. Thus, the first step to expand this sector would be to identify the social and environmental impacts of the sugarcane industry. Public policies are also acting on the sector and have a prominent role in the scenario.

Key-words: Sugarcane industry. Social impacts. Environmental impacts. Public policies.

RESUMO

Atualmente a preocupação com a degradação ambiental e com as condições de vida de nosso planeta têm aumentado. Literalmente um alarme soou relacionando os problemas do ambiente e as incertezas do futuro. Uma revolução energética é necessária perante à mudança de clima. A natureza oferece muitas possibilidades de produção de energia, e neste cenário o Brasil se apresenta em ótima posição. É o maior produtor, consumidor e exportador de etanol. Analisando a indústria de cana-de-açúcar brasileira, é fácil reconhecer sua importância histórica e seu peso econômico. Mais que nunca esta indústria tem apresentado soluções ambientais com mudanças na matriz energética usando etanol como combustível renovável. É fundamental que o desenvolvimento da indústria esteja em equilíbrio com os valores sociais e ambientais. Para isso, o primeiro passo para a expansão deste setor deve ser a identificação dos impactos sociais e ambientais da indústria da cana-de-açúcar. Políticas públicas também aparecem como atuantes no setor e têm um papel significativo no cenário.

Palavras-chave: Indústria da Cana-de-Açúcar. Impactos Sociais. Impactos Ambientais. Políticas-públicas

1 INTRODUCTION

The productive sector of organized societies worldwide has been overtaken by the intensity of regulatory pressures on their operations. In particular, the pressures to embrace a responsible socio-environmental behavior, increasingly considered as essential to sustainable growth and welfare of mankind.

The environmental concerns are countless. Nowadays, however, one of the most discussed issues is the climate change. Even the most skeptic people accept now the difficult idea that the available time to prevent a global catastrophe is dangerously short. This concern has forced some

countries to accelerate their searches for renewable sources of energy, modifying the current energy standard and reducing greenhouse gas emissions.

The ethanol is a fuel produced from renewable sources and has low carbon levels. These two characteristics give ethanol a strategic importance to fight against the intensification of greenhouse effect and its effect on global climate changes, which represents an alignment with the principles of sustainable development.

The sugar and ethanol sector has had important opportunities resulting from this increasing environmental concern about the energy issue. Ethanol has gained strength as the knowledge about the finiteness of fossil fuels increased, in addition to the knowledge about the serious damages to the environment caused by the use of a non-renewable source of energy. The high oil prices in the global market and the international pressure to reduce greenhouse gas emissions are accelerating the expansion of sugarcane crops intended to larger productions of ethanol for both domestic and foreign markets.

Brazil is one of the countries with the highest potential to produce fuels from biomass. The Brazilian program of bioethanol, with over 30 years of experience, has achieved high levels of competitiveness through technological advances and economies of scale. Brazil can be, in this sense, the main platform of renewable energy of the world and be ahead of an energy revolution.

The sugarcane has the beginning of its important history in the colony and it is worth it to point out that the Brazilian history has never had a similar situation: all previous moments, from redwood cycle, in the beginning of 16th century, to the sugar cycle in colonial age, as well as to gold, diamond, latex and coffee cycles, over the last century, were driven strictly by exogenous interests. When the external preference changed, the local productive substrate collapsed instantly. This time, through its

domestic market, Brazil is leading the use and production of renewable energy (Macedo, 2005).

This is the most professionalized sector of Brazilian agribusiness and has the opportunity, with ethanol, to correct last mistakes and contribute to the planet in an important moment of transition to a sustainable development. The sector expansion and current moment is a fact. Brazil is responsible for planning and organizing this expansion. In this sense, the analyses of socio-environmental impacts of this sector must be priorities, so that new pattern of behavior, new strategies and new public policies can be generated. Additional duty and responsibility may come together with the opportunity. The sector needs to promote a socio-environmental awareness urgently, taking to all its stakeholders this new pattern of behavior.

This is a moment for the sector to write a new history of the sugarcane industry, which is not dissociated from the history of Brazil. It is an opportunity not only to ensure the best conditions to perform its own activities, but also to give significant contribution to issues of the greatest institutional importance to the country.

The objective of this study is to analyze the socio-environmental impacts of the sugar and ethanol sector and start a discussion about the sector sustainability in face of the increase of ethanol demand and about the efforts needed to create public policies that regulate the sector and its expansion. In a later stage, through development of case studies, it will be possible to assess what companies in the sector have been doing to minimize the socio-environmental impacts. This article brings preliminary appointments of a broad study about the impacts of the sugar and ethanol sector.

2 EXPANSION OF THE SECTOR AND ENVIRONMENTAL IMPACTS

The production expansion as in the Brazilian ethanol program, with

an increase of 30 million hectares in Brazil and other countries, would be enough for ethanol to replace 10% of the gas used worldwide. The water is a small portion of the two billion hectares of planting areas worldwide (Goldenberg, 2007).

There are 86 new projects with defined schedule. Of them, 17 projects start in 2007 and 2008, 31 are planned to start in 2008 and 2009, 30 are expected to start in 2009 and 2010 and 8 are planned for 2010, 2011 and 2012. Furthermore, there are 61 potential projects under feasibility study. They totalize 147 new projects spread in several regions of Brazil (Unica, 2007). This reality brings up an intense concern about the environmental impacts caused by expansion.

The expression "environmental impact" had a more accurate definition in the 1970s and 1980s, when several countries realized the necessity of setting guidelines and criteria to assess the adverse effects of human intervention on nature.

The legal definition of environmental impact in Brazil is expressed in article 1 of Resolution 1, of 01/23/86 of National Environment Council (CONAMA), under the following terms:

it is considered environmental impact any change of physical, chemical and biological properties, caused by any form of matter or energy resulting from human activities, which direct or indirectly affects: health, safety and welfare of the population; economic and social activities; environment; aesthetic and sanitary conditions of the environment and the quality of natural resources.

The environmental impact is the change of the environment or any of its components due to certain action or activity. These changes must be quantified, because they present variations and can be positive or negative, big or small changes.

In this context, the agriculture, as well as all anthropogenic activities, generally, must be redirected in order to consider environmental factors as vital elements of management, which can be incorporated into its agro-

ecosystem in order to obtain a sustainable yield. Thus, the economic activity must be properly located and extract from the natural environment, not more than its support capacity (Ometto, 2000).

The impacts of sugar and ethanol sector on the environment include the effects on air quality and global climate, land use and biodiversity, soil preservation, water resources and use of pesticides and fertilizers. The ethanol, compared to oil and its derivatives, present low toxicity and high biodegradability, facts of great importance in case of accidental spilling and leaking of fuel to shoreline, soil, surface water and groundwater. That means that, in case of accidents, the ethanol environmental impacts are significant lower and the environment recovery is faster than the fossil fuels.

2.1 AIR IMPACTS

The air quality degradation in urban centers is one of the most serious environmental problems in the world. Due to high octane levels, the ethanol has successfully replaced the use of toxic lead-based antiknock additive. In terms of air emissions, the use of ethanol contributes to reduce important pollutants such as carbon monoxide (CO), sulfur oxide (SO_x), particles and several toxic organic compounds such as benzene, toluene, xylene and 1-3 butadienes. Furthermore, several studies indicate that the total emissions (volatile compounds and exhaust gas) present less potential to form photochemical smog than oil (Macedo, 2005).

The main effects of using ethanol (pure or mixed with oil) in urban centers are: elimination of lead compounds from oil, reduction of carbon monoxide emissions, elimination of sulfur and particulate matter, emissions less toxic and photochemically organic compounds reactive.

The sugarcane agroindustry is related to impacts on air quality in two manners very distinctly. The use of ethanol has improved considerable the air quality in urban centers. On the other hand, burning sugarcane straw on the field, in a very different scale, causes problems of particulate matter

dispersion and smoke risk (Macedo, 2005).

Burning sugarcane straw on the field is a practice that has been used for centuries in many countries. The main objective of this practice is to make the manual sugarcane harvest easier and even safer. It consists in using a controlled fire to burn straw (leaves and tips). This burn, different from the common sense, occurs in a small and very well limited area and is extremely fast (average of 10 minutes), so that the stem of the sugarcane is not burned in the process. Alternatively, the sugarcane can be harvest mechanically, avoiding the burn (Macedo, 2005).

For Macedo (2005), the interest in reducing the pollutants (mainly the unburned carbon, which causes residues in urban areas) and the risks of fire make it necessary to leave this practice. However, this cannot occur in an abrupt way because a great portion of rural workers is still hired for manual harvest (in 2006 70% of the sugarcane harvest in Brazil was manual) and a fast transition to mechanic harvest would create an unbalance in the labor sector. This mechanization process is occurring in a gradual way and there is a fixed commitment to reduce it until 2020.

Aiming at the regularization of air pollutant emissions from industrial sources, the National Environment Council approved the Resolution Conama No. 382/2006. Regarding the emissions of boilers that burn the sugarcane straw to generate thermal energy, the emission limits of particulate matter and nitrogen oxides were defined. These requirements have national scope, but the Resolution establishes that the State governments can apply more restrictive limits where necessary (Macedo, 2005).

2.2 IMPACTS ON WATER

Although Brazil has the greatest availability of water in the world, with 14% of the surface water and the equivalent to annual runoff in underground water, the practice of agricultural irrigation (all of it) is very small (an average of 3.3 million hectares, compared to 227 million hectares in the world). The sugarcane in Brazil is basically not irrigated, unless for

small areas (supplementary irrigation); this is a great advantage in relation to other regions in the world. Consequently, the environmental problems about water quality resulting from irrigation (entrainment of nutrients, pesticides, erosion) and industrial use are considered less common in other parts of the world; the sugarcane is classified, in this aspect, in the level 1 – no impact in the water quality (Embrapa, 2007).

The sugarcane industry in the Central-South of Brazil (which represents 85% of national production) presents very low average consumption of water for each tone of sugarcane produced and processed (comparing to other regions worldwide). The industrial systems are practically all closed, with high level of recirculation. In agriculture, sugarcane is not irrigated and uses quite all rainwater (Macedo, 2005).

The collection of surface water or underground water is controlled by the State, depending on the concession granted by environmental authorities. In the State of São Paulo, this concession is granted by Department of Water and Energy under State Decree No. 41.258/96. In addition, the State of São Paulo will start charging the users of water resources for collection volume, consumption and discharge of organic effluents. This charge meets the Federal Law 12.183/05, regularized by State Decree No. 50.667/06. The charge will be done in a decentralized way by each of the 21 River Basin Committees of the State of São Paulo, as they know better the conditions of the water resources (availability, quality, collection) of each region of the state (Macedo, 2005).

Currently, the charge is limited to: R\$ 0.01 for cubic meter collected; R\$ 0.02 for cubic meter consumed; and three times the sum of the first two for each cubic meter of effluent discharged back in the water. For Macedo (2005), with the charge, there will be a natural induction to reduce the collection and consumption and to use the water better.

In the ethanol and sugar industry, the levels of water collection and discharge have been reduced significantly last years; from around 5 m³/ t

of collected sugarcane (in 1990 and in 1997) to 1.83 m³ / t of sugarcane in 2004 (samples of São Paulo). The efficiency of treatment for discharge was above 98% (Macedo, 2005).

In any case, its growth must be planned, considering the biodiversity and water resources preservation, mainly in sensitive areas (riverheads that go toward Pantanal and Guarani Aquifer recharge area).

2.3 IMPACTS ON SOIL

2.3.1 Use of pesticides and fertilizers

The Brazilian law, including standards and controls from production to use and disposition of material, covers all important issues. The sugarcane does not present special problems regarding the use of pesticides and fertilizers, being user of great programs of biological control of pests (Macedo, 2005). The protection against pests and diseases is considered strength in Brazilian production: It is based on the continuous supply of resistant variety of sugarcane than on phytosanitary barriers, enabling the producers to operate with a great diversification.

The use of pesticides in sugarcane crop is lower than the use in citrus, corn, coffee and soybeans crops; the use of pesticides is low and the use of fungicides is virtually zero. Among the important sugarcane pests, the control of borer (most important pest) and leafhopper are biological controls; the borer has the largest program of biological control in the country. Ants, beetle and termite have biological control. It has been possible to greatly reduce the pesticides with selective applications (Macedo, 2005)

The methods of weed control has been modified often due to technologic advances; in Brazil it is used more herbicides in sugarcane crops than in coffee or corn crops, but less than in citrus crop; and the same amount that in soybeans crop. There is a strong tendency to increase the raw sugarcane crop area, with reminiscent straw in the land. Today it is

not possible to completely eliminate the herbicides in these cases, as it was expected, due to the appearance of pests so far uncommon (Macedo, 2005).

Sugarcane diseases are combated with the selection of the most resistant varieties, in great programs of genetic improvement. For Macedo (2005), this procedure has been enough to solve, by replacing the varieties, occurrences of great proportions such as mosaic virus (1920), coal and rust virus (1980's) and SCYLV virus (1990's).

Brazil stands out in sugarcane biotechnology. It was concluded in 2003 the identification of the 40,000 sugarcane genes in Brazilian laboratories, there are twenty groups working on the functional genome in programs of genetic improvements (experimental phases). Commercial results can be reaped in the following five years.

There are four programs of sugarcane genetic improvement in Brazil (the greatest two are private programs), they use quarantine and two hybridization periods, with germplasm bank.

The use of fertilizer in Brazilian agriculture is, in general, relatively low, although it has increased the past thirty years greatly reducing the need for new areas. Among great crops in Brazil (area bigger than 1 M hectare), the sugarcane uses less fertilizer than the cotton, coffee or orange and the same amount that soybeans. The use of them is also low if compared to sugarcane crops of other countries (Australia uses about 50% more) (Macedo, 2005).

According to Macedo (2005), the most important reason is the recycle of nutrients with the application of industrial residues (vinasse and filter cake), considering the limit conditions of topography, soils and environmental control. Significant increases of potassium in the soil and in the yield are verified. The nutrient recycle has been optimized, and the straw still has to be implemented. Everything will be very important in the expansion areas.

2.3.2 Byproducts and soil conservation

The erosive process is the greatest cause of agricultural soil degradation. The sugarcane crop is performed in Brazil for centuries, in many cases in the same area, however, in Brazil, it is considered a conservationist crop. The soil loss with soybeans is 62% higher than with sugarcane, and with castor bean, 235% higher.

Vinasse is the product of the wine distillation (fermented sugarcane juice) for the production of ethanol. A long ago it was recognized that vinasse could be a valuable organic fertilizer (replacing the application of potassium) and an important source of water reposition to the soil. Thus, it has been used by sugarcane industry in the fertirrigation of crop soil, replacing salts and other nutrients extracted from the sugarcane during its growth and maturation. The fertirrigation, in addition to bring great benefits due to the reduction of water and chemical fertilizers used, it is an economic and sustainable way of recycling and giving an end use to this byproduct (Macedo, 2005). A great number of studies related to leaching and the possibility of underground water contamination by vinasse recycle indicates that generally there are no damaging impacts for applications lower than 300 m³/ hectare.

In the State of São Paulo, the vinasse application on the soil is regularized by Technical Standard P4.231 of Environmental Sanitation Technology Company (CETESB), environmental agency connected to State Department of Environment. This standard sets all the issues related to: risk areas (prohibition), allowed doses and technologies. The Technical Standard perfects the common practice because it establishes limits of vinasse application on crop soil based, among others, on the concentration of potassium (K) in the soil. It also sets a number of measures for environmental protection, including a follow up of the underground water quality in areas where vinasse is applied, preventing or controlling any occurrence of pollution (Cetesb, 2007).

Annually, the industries in São Paulo are enforced to present a plan of vinasse application (used in auditing actions) to Cetesb, showing the Standard fulfillment. The technical improvement of the Technical Standard of São Paulo tends to become a standard for application nationwide.

The bagasse is the lignocellulosic residue of the process of extracting sugarcane juice. As it has great amount of fibers, it can be used as fuel in boilers, replacing fossil fuels normally used in the country (fuel oil and natural gas). Today it is considered an important byproduct to increase the energy export by plants in future (improving the current processes). One of the main advantages of the bagasse is that the product does not result in air emission of sulfur compounds (SO_x) (Macedo, 2005).

2.4 IMPACTS ON BIODIVERSITY AND LAND USE

With regional differences of productivity, the Central-South region produced in 2004 85% of sugarcane in Brazil, in 219 units. It is important to note that, from 1992/93 to 2003/04, the sugarcane production in Central-South region increased from 176.2 to 281.5 M t (around 60%); but the increase occurred almost totally (94%) in the existing units in 1992, and only 6% in new units. Therefore, the great expansion, in fact, has not involved so far new agricultural borders in a significant way (Unica, 2007).

With 850 M hectares, Brazil has a great portion of its territory in conditions to economically support the agricultural production, keeping great forest areas with different biome. The agriculture uses today only 7% of the Brazilian territory (half of them for soybeans and corn crops); pastures use 35% and forests 55%. This is one of the countries with less occupied lands comparing to available lands (IBGE, 2007). According to Unica (2007), the sector expansion is occurring mainly in pasture areas, especially in degraded areas, located west of São Paulo State, Minas Gerais Triangle and Goiás State.

The cattle occupy an area of 220 million hectares (0.9 animals per hectare). Due to technological advances in livestock production last decades, it is estimated that 30 million hectares of pastures can migrate to crops without prejudice to beef production. In addition, there are around 100 million hectares of land suitable for crops to be exploited. It is estimated a potential release of area of 20 million hectares resulting from the increasing technological level in livestock (Embrapa, 2007).

Recent forecasts for the following ten years indicated that, to meet the domestic and export markets demand, it will be necessary to expand the sugarcane crops in three to four million hectares.

Instead, there was the replacement of crops. In this specific case, the sugarcane has replaced mainly orange crops and others, beside the pastures.

Forests occupied 82% of the State of São Paulo once, but they suffered constant reductions since the discovery of Brazil. The evolution of coffee crop areas was one of the greatest causes. Last decade, however, this tendency inverted; the last forest inventory registered an increase of 3.8% of natural vegetation area, as a result of the actions the sector has performed to preserve legal reserves and maintain forest areas.

The Permanent Preservation Area (PPA) related to riparian forests achieves 8.1% of the sugarcane area in São Paulo; of them, 3.4% have natural forest and 0.8% is reforested. The implementation of programs to recover riparian forests, in addition to protection to springheads and other watercourses, can help to promote the reposition of vegetal biodiversity in the long term (Macedo, 2005).

The greatest gain in productivity due to technological developments in sugarcane production was responsible not only for increasing the competitiveness of the sector, but also for reducing the need of occupying agricultural areas to increase the production.

For Goldemberg (2007), there are plenty possibilities of expansion without using areas that involve degradation. In São Paulo, the sugarcane production occurs in areas already degraded and there is more space to double or triple the production only using these areas. The author affirms that the ethanol production from sugarcane can be reproduced in other countries without great damages to natural ecosystems. In the whole world, around 20 million hectares are used for sugarcane crops, most of them for sugar production. If we make a comparison with the wheat, this occupies 250 million hectares in the world.

Regarding the environmental impacts, the greatest concern is still about the use of important soil and locations of Brazilian Cerrado, compromising one of the most important biomes of the country. The riparian forests of Cerrado, for example, are habitat of half of Brazilian endemic species and one fourth of the endangered species. However it must be a great concern.

The Cerrado is a Brazilian ecosystem that occupies 204 M hectares (24% of the territory); it has the second greatest biodiversity of South America (with approximately 6,500 species of plant, 300 species of vertebrate and a thousand genera of fungi, all catalogued), and it has the springheads of five great river basins. Practically ignored until 1960, it stands out today in the national agriculture and livestock. After the construction of Brasília, in the 1970's, a more technological advanced livestock economy replaced the shifting agriculture, extractive activities and extensive livestock. In 2000, Cerrado was responsible for 41% of the cattle of the country and 46% of the Brazilian crop of soybeans, corn, rice and coffee; and it had 50 M hectares occupied by cultivated pastures, 12 M hectares by annual crops and 2 M hectares by perennial crops (Macedo, 2005).

The expansion of sugarcane in areas originally occupied by cerrados was small and in most cases it seems to have occurred as a substitute to other covers that had already replaced the Cerrado. The total area for

sugarcane between 1993 and 2003 in all States where there was an extensive cerrado region (States of Goiás, Mato Grosso, Mato Grosso do Sul and Minas Gerais) was around only 300 thousand hectares (the sugarcane area expansion in Central-South region was 1.4 M hectares in the same period; and the total crop expansion in the region, between 1994 and 2004 was 7 M hectares) (Macedo, 2005).

However, what can be called degraded pastures under the productive view can also have an important source of animal and vegetal biodiversity, very adapted to traditional livestock. They are farms whose productive methods encourage the maintenance of forest surfaces and whose pastures preserve significant parts of the environment. The recovery of degraded areas occurs under an agronomic view, but this recovery eliminates the biodiversity still remaining in productive systems of pastures. The balance between the environmental loss resulting from this and the productive gain resulting from the new crop is not easy to assess. Therefore, the inspection of this process and the urgent need of elaborating and applying consistent policies of preservation and sustainable use of Cerrado biodiversity are very important, in addition to the improvement of management and controlling techniques, taking into account the climate change impact, agricultural expansion and vulnerability of biodiversity to these changes.

Brazil has the greatest biological diversity in the world, with a flora estimated from 50,000 to 60,000 species (Silva & Paglia, 2007). The priorities in biodiversity preservation were defined mainly between 1995 and 2000 and set under National System of Conservation Units.

Conciliating the socioeconomic development with environmental preservation is a critical and complex task. The satellite monitoring has been increasingly used, mainly in areas of Amazon, Cerrado and Pantanal. One of the strategies broadly used to combat such threats is the creation and implementation of protected areas that have to be strategically established so that the components of biodiversity, more sensitive or vulnerable to anthropogenic pressures, are protected. The protected areas

in Brazil include conservation units in public or private lands, indigenous lands, PPAs (river banks and topography with great slope in private properties) and legal reserves (a part of private properties that legally has to be kept for the purpose of nature conservation). All these types of protected areas are very important in a context of management integrated to landscape to ensure the conservation of critical species and ecological services (Silva & Paglia, 2007).

Throughout 2006, the Ministry of the Environment (MMA) and Brazilian Institute of Environment and Natural Resources (IBAMA) coordinated the review of priority areas for biodiversity conservation in Brazilian biomes.

The development and implementation of appropriate strategies for sustainable development will be increasingly based on knowledge management, with the incorporation of recent development in information technology and communication (Macedo, 2005).

The georeferenced information is extremely important to define the conservation strategies and sustainable use of biodiversity. However, there are still great gaps of knowledge about species distribution in the main biomes of Brazil.

The use of computer tools to model the species distribution enables not only to direct the field research and identify areas of greatest biological richness, but also to delimit areas rich in endangered or endemic species. It also enables the identification of species that could be used in works of environmental recovery and assess the threat potential of invasive species or the impact of climate changes on biodiversity (Macedo, 2005).

Systems of conservation units still need to be considerably increased and consolidated. It is perfectly possible to harmonize the conservation requirements with the development needs. In fact, if it is considered all areas already deforested in the country, it would be very plausible and reasonable to concentrate the anthropogenic use in these areas and plan a

more intelligent occupation in critical areas for conservation. There is no ecological, social or economic reason to justify new conversions of natural ecosystems into agro-pastoral ecosystems. The combination of the intensive use of areas already changed by man and the productivity increase by use of new advanced technologies makes the safer way to promote the sustainable development of Brazilian agribusiness.

2.4.1 Expansion and the conflict of land use for food

How far can we advance in the replacement of fossil energy for biofuels? Several renowned environmentalists are warning that the expansion of ethanol, biodiesel and charcoal productions for industry will compete with food production for scarce arable land (Sachs, 2007). Moreover this statement is rather demagogic, hunger is not a result of lack of food but a result of lack of purchasing power of those who starve (Sachs, 2007).

The area occupied by sugarcane is today only 0.6% of the territory (0.3% is ethanol, which is already replacing 40% of oil). Therefore, there is no conflict, in Brazil, about the use of the land for food (which we are already great exporters) or for energy.

Different from the corn, the sugarcane does not create a direct competitiveness between the use for food and for fuel, which would be an adverse effect. With the current production of ethanol, the corn price has raised, making the product more expensive even in Mexico, where it is the basis of the diet (Goldemberg, 2007).

Goldemberg (2007) points that the ethanol production from sugarcane in Brazil is 16 billion liters a year, which requires three million hectares of land. The competition to use the land for food or fuel production has not been substantial: Sugarcane covers 10% of the total cultivated land and 1% of the available lands for agriculture in the country. The total area for crops (sugar or ethanol) is 5.6 million hectares.

In the economic exploitation of sugarcane, during the sugarcane crop renovation, there is the possibility of using other crops, whether to protect the soil, or to explore the extraction of grains. The most used crops to interchange with the sugarcane are the soybeans crop, peanut crop and other species used as green fertilizer. The crop rotation promotes a more rational use of the land, because it does not deplete the soil resource and uses it in a more differentiated way to serve for food crop production. The greatest environmental benefit of crop rotation is related to the soil that needs a diversification of crops to improve the crop production (Ometto, 2000). This is an important action to seek integrated systems of food and energy productions (Sachs, 2007).

From these preliminary analyzes, it is possible to observe that the sugarcane presents relatively lower environmental impacts than those of other crops. The sector has invested in technology and process innovation to minimize these impacts and make the sugarcane a more sustainable crop. Even though, its expansion is concerning, especially because it demands new areas and seems to be a threat to biomes such as Cerrado. The sugarcane, as a single crop, brings in its history countless problems, many of which have been resolved with inspection and initiatives of the sector. One of the greatest problems is still its social impact, issue to be discussed for the sector sustainability.

3 EXPANSION OF THE SECTOR AND SOCIAL IMPACTS

In addition to environmental impacts, it is equally important to analyze the social impacts that the sector causes and that its expansion will cause. The regional development differences are present in the work indicators of the sector; the poorest regions are characterized by lower salaries and higher use of manpower, adjusted by technologic use level (automation, mechanization). In the agricultural sector, the average education in North-Northeast region is half (in years) of that of Central-

South region.

Considering formal and informal jobs, the income of employed people in Brazil, in all sectors of economy, was: R\$ 801/month; agriculture, R\$ 462/month; industry, R\$ 770/month; and services, R\$ 821/month (PNAD, 2006).

In the Central-South region, people employed in sugarcane crops have income greater than the ones in coffee and corn crops, the same value than the ones in citrus crops, but lower than the ones in soybeans crops (highly mechanized, with more specialized jobs). In the North-Northeast region, the income from sugarcane is greater than the one from coffee, rice, banana, cassava and corn; it is equal to income from citrus crop and lower than the one from soybeans (Unica, 2007).

The income from formal work does not include Christmas bonus or any benefit. There were a lot of actions (isolated or integrated to more complete program) in the last decade. Regarding social impacts, the greatest problem is undoubtedly in relation to labor. The sector contributes for the growth of cities where the plants are installed, increases the GDP, generates direct and indirect jobs, in brief, promotes the development. However, much of this is still done through hard work, which needs to end.

One of the great tendencies of the sector work is to eliminate the sugarcane cutting as the mechanization brings significant benefits. In addition to improve the sugarcane quality and increase the plants profitability, the mechanization eliminates burnings, benefiting the environment. Moreover, the mechanization enables the extinction of this exhausting work of cutting sugarcane. Until 2020, in São Paulo, the burnings should be finished and the mechanization will occur in areas where it is possible. The ideal would be to have a shorter deadline, however, it is not possible to interrupt a job, leaving thousands of people unemployed.

Concerned about the future of rural people, some plants are investing in the employees so that they are not excluded from labor market. This is

the case of Santa Elisa Energy Company, Sertãozinho, State of São Paulo, that offers qualification training for rural workers, reallocating them in other areas of the company, preventing, them, the unemployment in the sector (Unica, 2007).

The mechanization, automation of productive process and modernization of industrial parks do not bring losses. In a short term, they undoubtedly increase the unemployment level of a sector, however, in a long term, they allow the extinction of jobs considered sub-jobs due to their inhuman characteristics. If these processes are allied to strategies of reallocation and training, the society gain will be huge. What happens is that, with the sector expansion, the excess of manpower as a consequence of mechanization has been absorbed by these new plants. Thus, in a slow and gradual process, without causing drastic impacts on employment, the mechanization will put an end to this activity. In this sense, it is important to always have inspection and commitment of government to demand these initiatives from the sector.

Some companies have already shown a concern about these workers an try to offer some benefits to neutralize the hard work they perform. Plants in the State of São Paulo had, in 2003, over 600 schools, 200 nurseries and 300 outpatient clinics. In a sample of 47 units (São Paulo), over 90% provided health care, dental care, transport and group life insurance, over 80% provided food and pharmaceutical care. Over 84% had programs of profit sharing, accommodation, dining areas and nursery. This evolution has been constant and essential. For the free negotiation, several benefits were ensured by workers in the last decades, among which we highlight the following: health care, dental care, optical care, pharmaceutical care, life insurance, meals, basic food basket, meal voucher, public transportation voucher, private pension plan, sick pay, funeral payment, school assistance, breakfast, Christmas hamper, grocery partnerships, financial loans, subsidized sales and access to credit unions (Unica, 2007).

An important step was the systematization implemented with Social Balance Indicators (Ibase model) four years ago in many companies; the results of 73 companies show resources of 24.5% of the payroll in areas such as profit sharing, food, health, safety, education, professional training and development. These indicators gradually started to be used for benchmarking among the companies, with accelerating effect in the introduction of programs (Unica, 2007).

Even though, some problems that the sector causes are serious. It is important to discuss and plan a little more so that the situation can be reversed. As said previously, the expansion is a fact that has to be faced, it is an important opportunity to the country. However, more important than that is the responsibility with the socio-environmental issues. It is essential to require an organized and planned expansion.

4 PUBLIC POLICIES: PLANNING AND INSPECTION

The sugarcane has presented good environmental results and sought a progression in their social impacts. This is a sector that has been in operation since the beginning of the history of Brazil. There are many processes and characteristics that need to be modified. There is an interest and a willing of this industry to modify a little of this history with investment and planning.

It is in this sense that the public policies must be created. It is necessary to plan, inspect and regularize this expansion so that the process can be organized and do not damage the greatest legacy of Brazil: its natural resources. It is important to have not only proper public policies, but also means to meet these policies.

The demands of public and private policies raised new projects and monitoring techniques of the agro-energy: identification and location of current and potential agro-energy crops; simulation of the local and regional impacts of new investments in agro-energy; suitability of the land use; zoning the use suitability of lands for energy crops yearly, multiannual

and perennial; optimization of the spatial location of ethanol and biodiesel plants; management systems for municipal territory to support local city halls in negotiations to implement projects of this kind in their territories (Miranda, 2007).

Private and government groups have required assessment of the socioeconomic and environmental impacts of agro-energy within evolutionary scenarios on territorial basis to base their decisions. The systems of management and territorial monitoring of the agricultural lands, developed, implemented and operated by Embrapa Monitoramento via satellite, provide indications to where the energy agriculture is moving in Brazil: territorial displacements and expansion, adoption of new technologies, new forms of organization in the areas of production, negative and positive environmental impacts (Miranda, 2007).

Before putting a project into practice, whether public or private, it is necessary to know more about the local where the project will be implemented, know better what each area has regarding natural environment (atmosphere, hydrosphere, lithosphere and biosphere) and social environment (infrastructure built by man and social systems created). Thus, the economic activity must be properly located and extract from the natural environment, not more than its support capacity.

Among the government tools to protect the environment, the item IV of article 225 of the Brazilian Constitution provides for the requirement of a previous environmental impact study for any work or activity that can potentially cause the degradation of the environment. (Brasil, 1988). This study has its form defined by law and its access and follow up are guaranteed to anyone interested. The Federal Law No. 6.938/81, which states about the National Environmental Policy, adopts as an instrument of this policy: the assessment of the environment impacts, the license and review of the activities effective or potentially pollutants (art. 9º, III and IV).

The licensing procedure is regularized by Resolution of National Environment Council (CONAMA) No. 237/97, and according to it the licensing depends on the elaboration of the Environmental Impact Study and the Environmental Impact Report (EIA-RIMA) by the interested person. The EIA-RIMA is a detailed study that covers the business description, productive process, including the product and byproducts processes, and the generation of residues and effluents. It also includes the environmental impacts assessment, even the potential impacts, in the area of the business and its surroundings; and also comprises the presentation of proposals to reduce these impacts. There are three types of license: The previous license (LP), which approves the location and the conception of the business, stating the environmental feasibility and sets requirements and demands; the installation license (LI), which allows the business implementation; and the operation license (LO), for the beginning of the business activities. During this procedure, public audiences may be conducted to discuss the business with the community.

In the current moment, with the expansion, it is necessary to create an own regulatory agency that could mediate the negotiations with foreign investors and assess the bioenergy projects from social, environmental and economic criteria, avoiding the traditional relation cost/benefit and the search for the lowest cost only (Sachs, 2007).

For Sachs (2007), the agency would be also responsible for encouraging the elaboration of programs of bioenergy insertion in the territorial or sub-regions development strategies, based on ecologic-economic zoning and emphasizing the integrated systems of food and energy. Furthermore, it would be important to create labor and social policies aimed at the sector.

The government role must be very effective, whether to analyze, license, inspect or regularize. The government should define regulatory framework for the sector.

Discuss regulatory safety in a context of strategy reflection of medium and long terms provide the understanding that the sector will operate under a specific regulatory framework and not subjected only to corporate laws, tax laws, labor laws and others applied to any economic activity. The biofuel and bioenergy production will surely be a regulated activity, especially under the strategic importance of the energy safety and climate changes issues.

Without clear standards, according to Rocha (2007), some problems can appear, such as supply and price fluctuation, which disorganize the productive sector, impair the sustainable growth and cause damage to the country. For the author, a first step was taken by government of the State of São Paulo last year, when it reduced the ICMS (State Goods and Services Tax) of the hydrate ethanol from 25% to 12%, a measure that resulted in a collection increase and made the product price competitive in relation to oil price. But it is still too little, it is necessary to clearly define the role of the ethanol in the Brazilian energy matrix, as well as the elimination of tax distortions and prospectives and openings of new markets. The institutional environment that we can have in the considered time horizon will depend on the consideration level of two main factors: the regulatory agencies and the process of policies elaboration. The poor formulation is at the root of many of the Brazilian infrastructure deficiencies, which represent, as we know, an important obstacle to economic growth. Any deficiency regarding the elaboration of general policies is particularly damaging in the case of sugarcane agroindustry, in which the regulatory process will be inevitably intense and important (Rocha, 2007).

It is possible and wise, in this context, to outline as clear as possible the regulatory agenda that must be followed by the sector, to be discussed with the Federal and State Executive Branch, with the Congress and, in some measures, with foreign authorities and private sector (Rocha, 2007). This agenda has the following issues:

1. Environmental standards (maintenance of priority areas, for example)

- and labor standards;
2. Configuration of energy matrix and place related to ethanol and bioenergy;
 3. Quality standards applied to products;
 4. Regulative and/or strategic store policy;
 5. Regulatory regime conducive to ethanol development such as commodity, including pricing mechanisms and hedge;
 6. Rules for generation of carbon credit due to the activities of the sector;
 7. Legal regime for logistic infrastructure;
 8. Commercialization regime in the domestic market, including aspects related to medium and long term agreements;
 9. Rules for export;
 10. State tax regime;
 11. Regimes related to access to foreign consumer market;
 12. Legislative and regulatory agenda on cogeneration;
 13. Institutional design for the sector.

It is likely that only few times such relevant sector of the economy had had a legislative and regulatory agenda so intense such this one that is imposed to the sugarcane industry currently. The regulatory framework to be elaborated will depend mainly on the competence of the sector to conduct the corresponding discussions. For Rocha (2007), the quality of the regulatory framework will also depend on the strength of policies elaboration, an issue which our history and political culture do not allow to be optimistic about. Therefore, the articulation ability and competence of the sector to influence in the relevant decisions, specially the regulatory ones, become very important.

This is an important moment for the sector to write a new history of the sugarcane industry, which is not dissociated from the history of Brazil. There is here the opportunity to not only ensure best conditions to perform its activities, but also to give significant contribution to issues of the greatest institutional importance to the country.

Just as the necessity of public policies, the sector needs to modify its position in relation to socio-environmental aspects. Internal strategies should be developed by companies in the sector to promote sustainable development. It is already possible to note some plants that develop strategies for sustainability and are concern about minimizing socio-environmental impacts of sugarcane crop.

6 PRELIMINARY CONCLUSIONS

The sugarcane crop, as all anthropogenic intervention, leads to social and environmental impacts. However, there have been advances in the reduction of the negative impacts of the crop. There are punctual actions and some institutional actions that can be identified. It is important to analyze these actions so that they can be incorporated as an example for the creation of a behavior pattern. However, more than that, it is necessary to have the active participation of the public sector in this agenda of changes, creating policies for planning, monitoring and regularizing the sector. It is also responsibility of the academic sector to study this process and require that both public and private sectors enable this dynamic that will promote the sustainability of one of the most important sectors of the country.

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