

## **THEMES AND CRITERIA SELECTION FOR AN AGRO-ENVIRONMENTAL DIAGNOSIS OF SUGAR CANE PRODUCTION CHAIN**

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**ABSTRACT:** The purpose of this study was to select themes and criteria to be used in agro-environmental diagnoses of the sugar cane (*Sacharum spp.*) chain for ethanol production. The selection of the themes and criteria was done after a literature research; interview with specialist, participation in meetings for ethanol production and the final union of all information. As a result the following themes and criteria were selected: 1) Land use (listed as theme) – soil and climate, land use planning, competition for food production (listed as criteria); 2) Biodiversity - disturbance of flora and fauna, planning and management of biodiversity; 3) Quality of natural resources – residue emissions for surface and ground waters, residue emissions to the atmosphere, recycling of residues, management and conservation of soil/plant system, yield planning and traceability of the product 4) Waste generation and recycling – water, vinasse, bagasse, straw or cover residue, oil and filter cakes and toxic waste and 5) Energy – energetic balance, integrated ethanol and biodiesel production, energetic planning and carbon market insertion.

**Key-words:** renewable energy, agroenergy, biofuel, ethanol production

**RESUMO:** O objetivo do trabalho foi selecionar temas e critérios a serem utilizados em diagnóstico agroambiental da cadeia produtiva da cana-de-açúcar (*Sacharum spp.*) para a produção de etanol. A seleção dos temas centrais e dos critérios dentro de cada tema foi baseada em pesquisa bibliográfica, consultas a especialistas e participação em eventos de produção de etanol, com posterior cruzamento de informações. Como resultados, foram selecionados cinco temas e vários critérios dentro de cada tema, sendo: 1) uso da terra (como tema) - aptidão pedoclimática, planejamento e competição por alimentos (como critérios); 2) biodiversidade - distúrbios na flora e fauna e planejamento; 3) qualidade dos recursos naturais - emissões para águas superficiais, emissões para a atmosfera, reaproveitamento de resíduos, manejo e conservação do sistema solo/planta, organização da produção e rastreabilidade; 4) geração e uso de resíduos - água, vinhaça, palha, bagaço, torta e embalagens de agrotóxicos e 5) energia - balanço energético, produção integrada de etanol-biodiesel, planejamento energético e inserção no mercado de carbono).

**Palavras-chaves:** energia renovável, agroenergia, biocombustível, produção de etanol.

## INTRODUCTION

Ethanol and Biodiesel are rated as fuels that come from biomass or renewable sources taking part in the Brazilian energy matrix along with petroleum, mineral charcoal, natural gas, hydroelectric, nuclear and other biomasses. When it is associated to the bagasse, which is used in the energetic co-generation, it can represent up to 13.5% of the energetic matrix, a value that is close to the 14% for hydroelectric energy in this matrix (Souza, 2006).

As an option to expand ethanol's participation in the current clean energy frame, many sectors advocate an expansion by incorporation of new areas or an increase in the Brazilian sugar cane (*Sacharum* spp.) productivity. However, incentives of this nature should be associated with a detailed planning, built strategically to subsidize decisions in the political, economic, social and especially environmental order. In this sense, CREM (2006) supports a bigger energy offer should be done in a way that the competition with food or the degradation of biodiversity are avoided, at the same time that the biomass production with high energetic yield is stimulated.

Noronha e Ortiz (2006) questioned the renewable and clean properties of the energy used in agriculture, since biofuels originated by deforestation, expelling farmers from their land to make room for monocultures in large areas, are not sustainable. In addition, CREM (2006) raises questions such as: "what are the social-economic effects of the biomass production in local communities?" or "what are the impacts in the long and short term?" to evaluate the social and environmental impacts of these energetic sources.

On the other hand, strategic planning, built on reliable information on impacts, can lead to a sustainable production of the sugar cane production. This involves the usage of non-productive land to produce energy, the erosion control in degraded pasture lands, based on good soil management techniques, oil crops in rotation with sugar cane to be used in biofuel production, the usage of waste for the energetic co-generation, which contributes for the reduction of CO<sub>2</sub> emission and climate changes; among others.

In face of these facts, the need for instruments that enable to identify the current and future is clear, for instance: the analysis of the strategic situation, which evaluates the strong and weak points, besides opportunities and threats, the construction of scenarios, which in the environmental analysis seeks to reduce uncertainties, the formulation of strategies, which contemplate actions to increase the competitiveness of the adopted system (Aulicino, 2002) and in the case of agroenergy, the terms viability and sustainability can be included.

The prospective analysis, based in scenarios, increases the possibility of obtaining answers for these questions because if you anticipate opportunities and treats it is possible to forecast the outcome of actions in the present (Porto et al, 2001). Thus, the knowledge of past and present situations is inevitable to draw a future scenario (Franco, 2007).

Recognizing the current situation can be done by a diagnosis, in this case, an agro-environmental evaluation, which involves themes and criteria to lead the research on productive activity and environment. These themes should mirror the main topic to be addressed on both, negative and positive prospects. For a better definition on the

diagnosis, these themes can be evaluated using different criteria, which easily characterize the object of study.

For agriculture productive chains the literature is still scarce and controversy when discussing themes, criteria, descriptors and indicators which can be followed later. In 2000, Paixão et al, proposed a certification system for the social-environment and for the sugar and biofuel sector, which was not adopted at that time, since the sector did not visualize the benefits for the market. Nevertheless, there is a worldwide trend of certification and tracking, which brought the discussion into light again. In this context, this work aims to select themes and criteria to be used in an agro-environmental diagnosis of the sugar cane chain for ethanol production.

## MATERIAL AND METHODS

This study is part of the project “*Social-economics and environmental impacts and scenarios construction for sugar cane cultivated in traditional and expanded areas*”, included at the Plataforma de Agoenergia da Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA). This platform was created in 2006 and it focuses on a sustainable agroenergetic future, which includes the sugar and biofuel sector, in face of a growing and disoriented demand for energy-oriented crops, such as sugar cane.

The selection of themes and criteria was made by a bibliographic research involving:

- a) acquisition of accurate data;
- b) analysis of position papers, scientific articles, dissertations and thesis;
- c) interview with specialists;
- d) workshops and functions addressing the theme.

After defining the themes and criteria, the subjects were divided in three levels: strategic, tactic and operational. Strategic issues were directed to forecast consolidated trends and uncertainties, directed, mainly, to formulate future scenarios. The tactic and operational matters were organized using a questionnaire, which will be sent to all members of the productive chain.

## RESULTS AND DISCUSSION

The bibliographic research and consults with specialists showed the relevance of many topics, from which the following five were selected: 1) Land use; 2) Biodiversity; 3) Quality of natural resources; 4) Waste generation and recycling and 5) Energy (Figure 1).

In reference to the theme “Land Use”, there is a concern in society with the land concentration in large production areas and also the replacement of cultivation areas to energy (CREM, 2006). Sugar cane is a typical example of a chain based on monoculture, with more than 70% of its area run by groups in the sugar and fuel sectors and the rest in divided between big, medium and small size suppliers (CONAB, 2007). The centralization of the production, with 82% of the Center-South occupied, is another worrying characteristic, which has called for efforts from the Brazilian government in the sense of expanding to other regions to reduce sanitary risks (Brasil, 2006).

Associated to the centralization of the sugar cane production, it is the eminent possibility of expansion to other areas, nowadays occupied with other crops and animal production. In this context, Ferraz (2007) says that São Paulo state uses 19 million

hectares for agricultural activities, which are divided in annual crops (beans, corn, soy, vegetables), perennial plants (citrus, fruits, rubber tree), semi-perennial plants (sugar cane, banana), animal production (meat, milk, honey), e reforestation (pinus, eucalypt). Thus, an expansion in 1.3 million of hectares of sugar cane represents a 26% occupation in agricultural land, compared to the current 20%, what at first sight is not significant. However, it should be considered the lack of new unexplored agricultural areas, which imply that the growth of a certain crop should be done by replacing a crop already deployed.

Another polemic and important issues is "Biodiversity", since the questioning of disturbing effects is a growing trend, in the fauna and flora, in the production environments and around them. As an example of a disturbance CREM (2006) cites an introduction of invasive species, damaging local biodiversity. This last example is included in the criteria for biodiversity proposed (Figure 1), evaluated as "Planning and Management of Biodiversity". However, the criteria used for this topic is already in discussion, because there is not a protocol clearly defined to evaluate the abundance of species in relation to the size of an area occupied by an agro ecosystem.

The subject, "Quality of Natural Resources" was selected considering the potential effects that the sugar and fuel sector may bring to the available natural resources, given the following criteria: effluents and agrochemicals emissions for surface and ground waters; gas and solid particles emission to the atmosphere; high possibility of using waste in the sector; soil and plant management and conservation in the agricultural activity; yield planning in the agriculture and industrial area and on the eminent possibility of using tracking devices (Figure 1).

Polished information evaluating the actual impact of the sugar cane activity over natural resources are under study at the scientific circle. There is a consensus that more research projects are necessary, especially considering the changes taking place in the productive sector, such as the harvest mechanization and without burning crops, the monitored use of the vinasse, using the cover residue to generate energy, among others. In this sense, some studies evaluating the environmental impact in the sugar cane production, with a manual harvest and burned plants, showed negative results in terms of soil conservation, being the sugar cane responsible to 14% of all erosion cases in São Paulo state (IEA, 1991). In the same research line, Fiorio et al. (2000) showed that the disorientated sugar cane expansion without land planning use causes a negative impact, with great soil erosion, where the intensified sugar cane activity triggered a 50% reduction in the Vila Artemis (Piracicaba-SP) dam from 1978 and 1995, caused by intense silting. However, also in the study, the authors observed that the increase in the native forests and maintain forests near rivers in the years studied, showing that productive were abiding to environmental laws.

In reference to the theme "Waste Generation and Recycling" by the sugar and fuel activity, many criteria were pointed to be evaluated, seen in Figure 1. Among these criteria the vinasse is a residue used under extensive study. This kind of waste is used as a fertilizer in sugar cane fields as a source of potassium. Andrioli (1986) did not register changes in organic components, in the silting, microsporocyte of *Latossolo*, when he used up to  $1.200 \text{ m}^3 \cdot \text{ha}^{-1}$  of this waste. In addition, Camilotti et al. (2006) obtained similar results in four successive annual applications, while Canellas et al. (2003) notices that in one *Cambissolo* cultivated with sugar cane had an increase in organic carbon 35 years later after the vinasse application. This suggests that the soil's organic component can increase after a streak of applications done in a long period of time.

Studies conducted with other forms of waste have also shown positive and negative effects over the environment and in the agriculture activity. The most recent ones involve the straw or cover residue and the bagasse, which is used in the energetic co-generation. The concepts of *Biorefinary* has been highly spoken about, where a lot of waste are extensively used as the main raw material in the generation of drugs, cosmetics and other value-added products.

Referring to the “Energy” issue, the criteria (energy balance, integrated ethanol-biodiesel production, energetic planning, and carbon market insertion) were considered priorities, mostly by specialist. The efficient energy usage will reduce gas emission in the greenhouse effect by replacing fossil fuel by renewable ones. A concern with the bagasse usage in the sector in the energetic co-generation or “agroelectricity”, since this activity contributes even more for a positive energy balance, with real possibilities on inserting in the market based in clean development mechanisms.

The criteria “integrated ethanol-biodiesel production” was added because there are high possibilities of energetic benefits and improvement in the soil’s productive capability. Nevertheless, a trend toward this direction was not yet identified in the market.

Evaluating all themes and criteria it is possible to considerate that although some uncertainties should be worked, the results of this study have shown an alignment and growth in future trends. Thus, the agro-environmental diagnosis, based in this model to be adjusted, will contribute to design hypothesis and premises to be considered on the elaboration of future scenarios for the sustainable expansion of the sugar cane production and with high certainty will meet the demands for tracking and environmental certification, for the ethanol.

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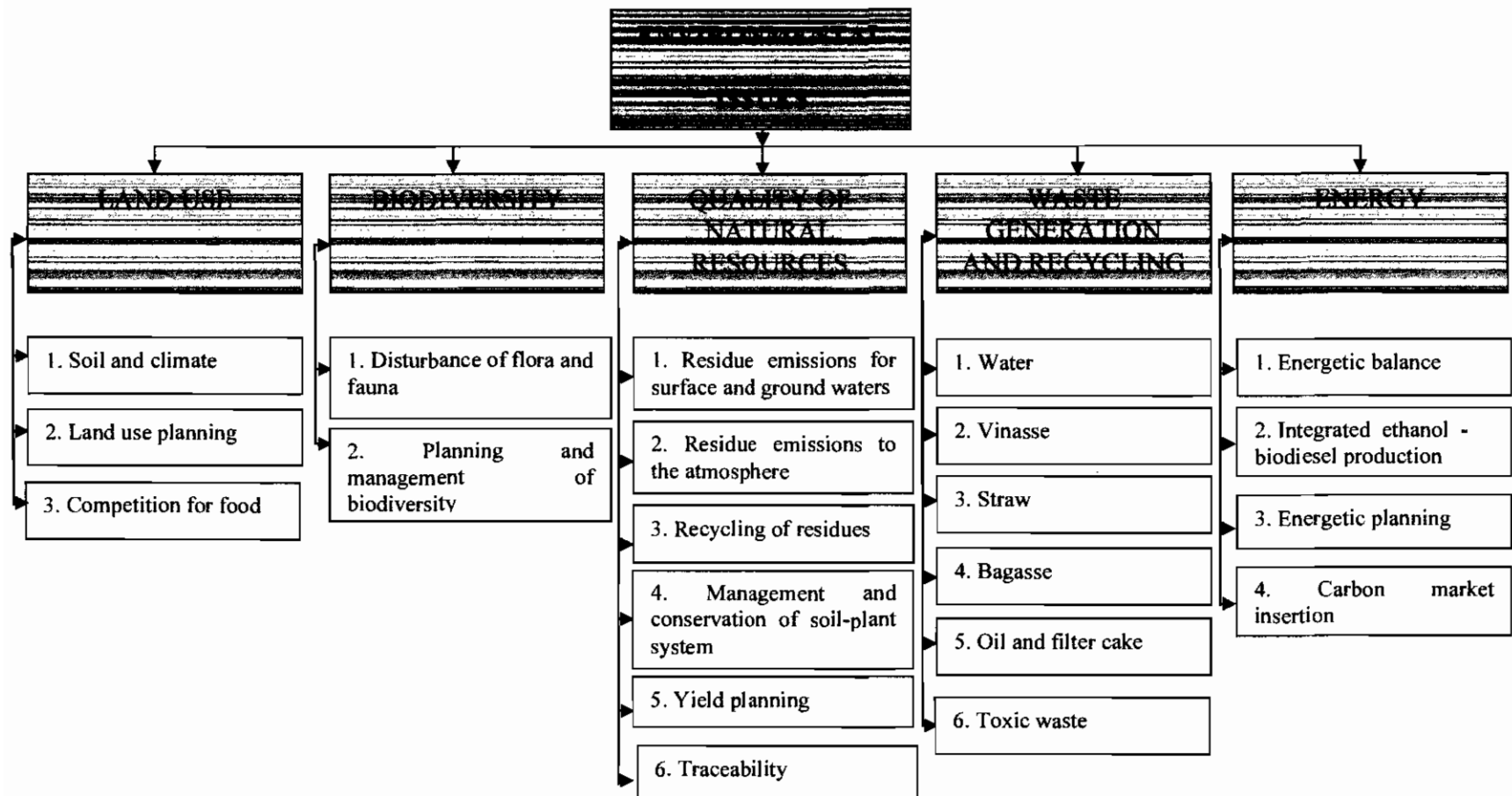


FIGURE 1. Themes and criteria considered for the agro-environmental diagnosis of sugar cane chain for ethanol production.