

CRITICAL VARIABLES TO PREDICT TECHNOLOGICAL EXPANSION IN TRADITIONAL SUGARCANE PRODUCTIVE REGION OF NORTH-EAST BRAZIL

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Abstract

Several critical variables are used to predict the technological expansion of traditional sugarcane productive region of Brazil's northeast (NE). Variables were selected after retrospective evaluation, present diagnosis and validation by expertise of the sugarcane sector. After the selection, the variables were classified based on impact level and predictability. The matrix for morphological analysis was carried out to indicate the technological expansion pathway. It is possible to conclude that technological expansion of sugarcane production in this traditional region could be limited or enhanced by agricultural, social environmental and economic variables. In this study, a total of twenty five parameters were designated to evaluate the sugarcane expansion in this region, being eight agricultural, six natural resource, six market and five social variables. Therefore, straight analysis of the scenario lead to the possibility of immediate actions in agricultural sugarcane production, natural resource preservation and social relationships variables, on the other hand the market actions agreements are more complex and complicated to apply.

Keywords: bioenergy; ethanol; production; environment; social and economy

INTRODUCTION

Prospective scenarios still incipient in the agriculture, but these are widely used worldwide in business and finance. This is due to the concern of the organizations in making the right decisions, ensuring their survival in the increasingly competitive market (Costa and Marcial 2001). Experiences point out that as the potential problems are identified early, preventive actions can be formulated, allowing the maintenance of competitive advantage. Predicting the events allows analyzing the uncertainties and considering the options for decision making, looking for the target, creating and building day-to-day the desired future (Scandiffio 2005).

The interest in energy crops, dedicated to biomass production will require thorough planning, organized expansion of the production chain, ensuring competitiveness and sustainability of the production environment. In this viewpoint, the use of scenarios could have probably reduced the losses of the soybean agro-industrial in 2005 and 2006. However, the agricultural area is slightly covered by these studies, as a result of the insufficiency of information on prospective scenarios. On the other hand, the sugarcane industry has some work in prospecting scenarios, involving trend, exploratory and even normative analysis. However, as a large country, with contrasting production systems, the traditional areas of sugarcane in the Brazil's northeast still need such information.

Elaboration of perspective scenarios is a "creative

process", which according should not stick to a strict script, however, there is a consensus on concepts and preparation methods (Buarque 2003). Even with variations in the methodology, one of the key steps is the identification of critical variables, which can be limiting or impellers for the analysis, besides its classification level of future uncertainty. The identification of these critical variables is based on both retrospective evaluations as in the current diagnosis, while the level of uncertainty is based on knowledge of experts, which is an indispensable stage for the applicable work results. A mistaken identification of the uncertainties can lead to irrelevant results and low impact on future decisions.

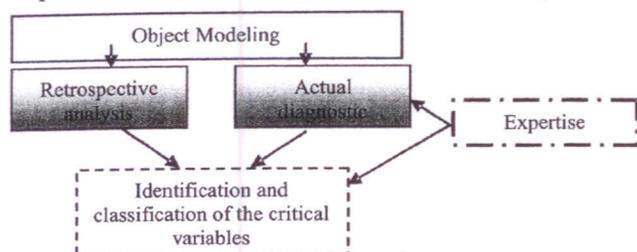
In this context, this study aimed to determine the critical variables for a possible expansion of technology in the traditional productive sugarcane sector of Brazil's northeast region.

MATERIAL AND METHODS

The determination of the critical variables was achieved after limiting the subject matter scope, modeling and retrospective analysis of the factors that influence the development of sugarcane production, as well as the current diagnose of the sector situation (Fig. 1). Validation of these variables was carried out with experts, aware of making changes in all the inconsistencies identified in the process.

The variables classification was achieved in a workshop attended by experts in different fields of knowledge. These variables were classified according to their potential impact on sustainability, competitiveness and

efficiency, further than the level of predictability. In the next step, a cross-consistency matrix for morphological analysis (MA) was used as a tool for decision making, selection of the variables of low predictability and high impact on the possible expansion of technology in the



sugarcane productive sector to attend traditional regions in Brazil's northeast and to construct hypotheses for the future.

Fig. 1. Schematic representation of the steps used in the identification and classification of the critical variables that may impact the traditional sugarcane production regions in Brazil's northeast (NE).

For purposes of this study, the areas considered as traditional have sugarcane growing for more than 20 years. The retrospective analysis and actual diagnosis were based on current issues and criteria (Ramos et al., 2007), involved in the sugarcane production and processing with some modifications, as follows: (i) land use (as theme) - soil, climate, planning, and competition capability for food production (as criteria), (ii) biodiversity - disturbances in the flora and fauna, and planning, (iii) quality of natural resources - water, soil and atmosphere, as well as management and conservation of the soil-plant system, (iv) generation and residues/by-products - water, slop, straw, bagasse and filter pie; and (v) energy - energy balance, integrated production of biodiesel and ethanol, energy planning and insertion into the carbon market.

RESULTS AND DISCUSSION

The critical variables identified and validated by experts, that can be limiting or impellers for the technological intensification of sugarcane in the traditional Brazil's northeast areas are listed in Table 1. There was an overlap of some variables in different areas, such as: agro-ecological zoning in agricultural areas and market; certification in social and market areas; irrigation in agriculture area and water use in natural resources, among others. This emphasizes the potential impact of these variables that can be limiting in some areas and impellers in other.

In the agricultural area (Table 1) many variables related to the production process itself were identified. These variables showed potential for improvement, but at the same time depend on technical, economic, environmental and social efforts in order to become

reality. This emphasis on agriculture may be a result of lower productivity in this region compared to other production regions in Brazil. In regards to the natural resources, variables identified were common to other bioenergetics crops such as soy, eucalyptus and palm oil. The social area was some peculiarities of the sugarcane industry, like the payments form to suppliers, degrading working conditions and mechanization of agricultural operations. Furthermore, the market area was more specific, with the identification of requirements as the creation of an ethanol regulator inventory and the government grant for the region under study.

Variables selected as high-impact and low predictability by experts are presented in Table 2. In the agricultural area, the genetics variable surprised with the classification as low predictability. According to experts there is still large uncertainty in the progress in sectors as, drought tolerance and the lack of investment in materials aimed to increased fiber production. Regarding the natural resource variables, water use and environmental laws were upheld as uncertainty in the northeast region. In the social area, the payment form to sugarcane suppliers was also unidentified, and can significantly influence the sustainability and technology intensification.

In the market area, Table 2, the variable governmental financial support and zoning implementation were classified as high impact and low predictability, which can compromising the region's technological intensification. The zoning variable was expected to be included, since its non-compliance could close external markets. For governmental grants, at first it seemed natural that the intensification technology could expand production and reduce significantly the need for subsidy, but it was not cited by experts. It is also worth noting, that the potential to overcome tariff and nontariff barriers were very complex and difficult variables to be controlled and changed, since they depend thoroughly in the interference from other countries.

The exercise of listing and building alternative for variables that impact a particular sector is a great help to anticipate problems and opportunities. Realizing the opinions and knowledge of experts in a guidance document can facilitate the decision-making, including direction changes within an area. Thus, areas such as natural resources and social may be changed by the action of the sugarcane industry itself. The same argument is valid for the agriculture area. On the other hand, the market area depends on fluctuation of the global economy.

It should be noted that the present work organized a simplified list of impact variables (Table 2), but it was enough to generate interest of experts for possible future technological intensification of sugarcane traditional

Table 1. Critical variables with possible impact on technological intensification in traditional sugarcane regions in Brazil's northeast.

AGRICULTURAL	NATURAL RESOURCES	SOCIAL	MARKET
1- Genetics (fiber x sucrose)	1- Water use	1- Generating income	1- Expansion required to participate in the internal and external supply;
2- Use of genetically modified organism (GMO)	2- Land use	2- Job offer	2- Potential for overcoming non-tariff barriers (social, environmental) to export;
3- Efficiency of agricultural production	3- Indirect land use change impacts (ILUC)	3- Degrading working conditions	3- Potential to overcome tariff barriers to exports;
4- Changes in seedlings supply	4- Greenhouse gases emission	4- Local and regional public policies	4- Competition with the Central-South region;
5- Tillage systems	5- Soil conservation	5- National public policies	5- Competition between ethanol x sugar x electrical energy;
6- Fertilization	6- Preservation of biodiversity	6- Living conditions for the municipalities (HDI)	6- Availability of credit lines;
7- Irrigation	7- Competition with food	7- Land issues	7- Development of cleaner energy technologies;
8- Phytosanitary control	8- Environmental legislation	8- Action of social movements	8- Implementation of the national agro-ecological zoning;
9- Harvesting operations (raw x burns)	9- Energy efficiency	9- Payment form to sugarcane suppliers	9- Sugarcane grant;
10- Zoning	10- Residues utilization	10- Manpower training	10- Logistics distribution terms;
11- Logistic	11- Traceability	11- Mechanization of agricultural operations	11- Creation of inventories;
12- Management	12- Clean technologies	12- Certification	12- Certification and traceability;
13- Research	13- Payment for environmental services	13- Diversification for suppliers and industries	13- Price conditions;
14- Agricultural inputs cost	-	-	-
15- Operation cost	-	-	-
16- Technical assistance	-	-	-
17- Use of new technologies	-	-	-

Table 2. Critical variables with high impact and low predictability, in the behavior on the technological intensification of sugarcane in the traditional areas of Brazil's northeastern.

AGRICULTURAL	NATURAL RESOURCES	SOCIAL	MARKET
Genetics (fiber x sucrose)	Water use	Living conditions for the municipalities (HDI)	Potential for overcoming non-tariff barriers (social, environmental) to export
Irrigation	Greenhouse gas emission	Payment form to sugarcane suppliers	Potential to overcome tariff barriers to exports
Phytosanitary control	Soil conservation	Manpower training	Development of cleaner energy technologies
Logistic	Environmental legislation	Certification	Implementation of the national agro-ecological zoning
Management	Energy efficiency	Diversification for suppliers and industries	Sugarcane grant
Research	Residues utilization	-	Certification and traceability
Agricultural inputs cost	-	-	-
Use of new technologies	-	-	-

production region of Brazil's northeastern and clarified the possibility of working with a future regulatory framework, where actions can be done in this order to attain the desired future.

CONCLUSIONS

The technological intensification in the sugarcane production in traditional regions of Brazil's northeast may have limitations and opportunities for agricultural, social, environmental and even economic. Special attention should be given to eight variables related to agricultural production, six variables of natural

resources and market, and five social variables. There is the possibility of immediate actions in agricultural production, preservation of natural resources and social interaction, as the market relations are more complex and difficult interference.

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