Thomaz Fronzaglia; Renata Martins. "BRAZILIAN ETHANOL'S GOVERNANCE: IMPLICATIONS FOR SUSTAINABILITY", p.217-240. In Luis Augusto Barbosa Cortez (Coord.). **Sugarcane bioethanol — R&D for Productivity and Sustainability**, São Paulo: Editora Edgard Blücher, 2014.
http://dx.doi.org/10.5151/BlucherOA-Sugarcane-SUGARCANEBIOETHANOL_24

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BRAZILIAN ETHANOL'S GOVERNANCE:

IMPLICATIONS FOR SUSTAINABILITY[1]

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INTRODUCTION

A new dynamism has been established in the sugar & alcohol innovation sector since the re-definition of role of the State in the 1990s and the elimination of the Institute for Sugar and Alcohol. More recently there has been a change of public policy to ensure better use of state resources, through the establishment of cooperation networks between public research institutions and the private sector to improve research on competitiveness and sustainability issues

Interest on sustainability of ethanol have intensified as a result of recent expansion of the sugarcane sector in response to increasing demand after the successful introduction of flexi-fuel vehicles, both for the domestic and international markets (VEIGA FILHO *et al.*, 2008). Monitoring and identifying critical uncertainties have therefore become imperative and also the need to define strategic priorities in the sector and identify organizational and institutional weaknesses that may hinder sustainable development in the sector. Such issues require well planned scientific and technological research.

The application of economic research on organizations and institutions has a relevant role to play because issues of ethanol sustainability go beyond the whole sugar & alcohol chain – ranging from production to consumption, the role of externalities, and institutions; government systems or coordination of transactions. The issue of sustainability therefore calls for debate on the various factors along the whole ethanol production chain. Such analysis should be the focus of research in investment policies in order to promote institutional and organizational innovation in the sector.[2]

This chapter addresses demand for social science research that can be applied to the sustainability of ethanol, but focused on the relationship between the players of the ethanol industry and the potential impacts of regulation that their productive activity can have upon society. This chapter discusses the results of a Research Workshop on Ethanol Sustainability – an effort of *foresight*, organized by the Institute of Agricultural Economics – IEA, – at the São Paulo Agribusiness Technology Agency – APTA, under the project "Public Policy Directions for the Ethanol Industry of São Paulo State" as part of the Public Policy Research Programme, financed by the São Paulo State Research Support Foundation.

[1] The authors thank all the participants and collaborators of the project "Public Policy Directions for the Ethanol Industry of São Paulo State" as well as the participants of the Research Workshop on Ethanol Sustainability which took place in June 2007 at IEA/APTA. The content of this Chapter is a compilation of several contributions received in the event, consolidated on the sole interpretation of the authors who take responsibility for any misinterpretations. The content of this Chapter does not in any way reflect the opinions of the institutions to which the authors are linked.

[2] The study of such a broad issue accomplished through foresight could not define problems for research projects, but only point out questions within important themes of ethanol sustainability which should be targets for public policy including research and development. When defining research problems it is the role of researchers to submit research projects for competitive grants capable of funding research based on the main issues consolidated through foresight exercises.

FORESIGHT AS A POLICY DEVELOPMENT APPROACH

The literature on prospective analysis describes the relevance of planning for science, technology, innovation, business strategies and public policies. The methodological outline discussed in this section describes a wide range of techniques and identifies links between them which are used in the process analysis.

Prospective studies seek to obtain information for decision making within future events in an attempt to anticipate and understand scenarios, behaviour, characteristics and effects of the innovative processes, as well as institutional and technological changes (COELHO, 2003; ZACKIEWICZ, 2001). The application of technological procurement and its many forms of analysis could be important in the allocation of resources and for focussing on the identification of knowledge gaps that need to be addressed by research organizations.

Foresight is a multi-dimensional process for understanding the long term drivers that should be taken into account when formulating plans, public policy decisions and business strategies (COATES, 2001). Qualitative and quantitative techniques are used to monitor signs, indicators and tendencies of the subject in evolution. COELHO (2003) considers that intuitive methods based on specialist consultations are more appropriate and cover a broader range of applications in this process. Even though *foresight* in itself doesn't define policies, it can develop insights into how the future can be constructed (SANTOS *et al*., 2004) and is more appropriate when applied to the formulation of policies, programme assessment (and their implications), leading to the elaboration of more robust policies that can be enforced more flexibly in accordance with conditions that change over time. However, these processes of *foresight* are becoming increasingly more complex, and therefore new techniques are being applied to reduce the complexity within *foresight*, through the creation of *roadmaps* (SARITAS, 2004).

Roadmapping is a process centred on planning (PHAAL *et al*., 2004) that has been used for a wide spectrum of purposes and applications, including support behind strategic and long term planning, intra-organization and sectorial inter-organizations from the private sector, based on science and technology through public companies and government policy agencies. It is a systemic process (GARCIA, 1997) which involves an organ for systematic monitoring, providing a tool for analysis of the external environment using prospective techniques like scenario structuring (SCHOEMAKER, 1995). The *roadmap* combines scenario drivers and their interrelation with markets, products, knowledge, resources, development and the implementation of policies.

The creation of a policy *roadmap* might support different levels of analysis, arrangements and future interests such as socio-technical transitions on the macro level and institutional changes, industrial organization, interaction in the supply chain and the organization of research networks. A *roadmap* is capable of encompassing these levels of analysis in order to identify threats or opportunities for company or sectorial sustainability and identify an agenda for public policies. It also involves impact analysis through simulations and prioritizes the most appropriate approaches depending on how the future unravels.

On-hand information in support of public policy making through *roadmapping* can be supplied by specialist technical panels that identify challenges and gaps in knowledge. These gaps correspond to calls for research where resources can be allocated in the hope of resolving problems in the long term. In the short term, emphasis lies on the flow of information and assigned competences capable of influencing policy content and policy making processes. Both forms can interact through mutual adjustment.

PORTER *et al*. (1991) classifies the following set of methods and probing techniques that can be used in the *foresight* process. These are described below in order of their enhancement, promptness, and address of information:

- *Creativity*: interaction of information generating a number of new ideas.
- *Specialist panel*: detection of tacit knowledge and the slightest signals that show ambiguities which are used when information cannot be quantified or modelled.

- *Monitoring and intelligence systems*: sources of pre-organized information for the identification of tendencies and critical events, their relationships, opportunities and threats. This however requires a large amount of information from several sources which, if badly managed, results in information not being systematized, analyzed, or selective.
- *Scenarios* are formations of future alternatives through the analysis of dominant tendencies considering possibilities of disruptions to exploratory or normative processes.
- *Assessment and decision*: are methods for reducing uncertainty and complexity when multiple interests and dimensions are being taken into account.
- *Participative methods* become key elements for *foresight* processes due to the application of democratic principles bringing social legitimacy into their results and have the ability of involving diverse players, creating collective arrangements and processes in harmony with decision and implementation processes. Another important aspect is the fact that information building is more effective because there is widespread strategic information sharing among players in the process. For these reasons the methods need to be well conducted.
- *Impact evaluation* can be complementary when carried out ex-ante, based on the scenarios achieved through survey analysis. This analysis is therefore fundamental to provide innovation systems with instruments presenting concrete elements to support decision makers.

The present prospectus is based on diverse techniques such as creativity, specialist panels, scenarios and participation levels stemming from a reference document designed to restrict the scope, identifying the main issues and levels of analysis. The workshop was divided into four parts. Firstly the *Term of Reference* (FRONZAGLIA, 2007) was elaborated by the workshop coordinator and presents a conceptual approach to the main subjects for discussion concerning ethanol sustainability, including the critical aspects of the present day situation organized into different themes. Secondly, specialists were called on to form four debate panels for each theme, each being made up of lecturers and debaters. Each lecturer (FURTADO, 2007; VIAN, 2007; PAULILLO, 2007; and FERRAZ, 2007) then prepared and presented their *position paper* to the debaters who prepared their own arguments for presentation in the workshop. In stage three, researchers from several learned areas and ethanol industry specialists were invited along with project members and researchers. All participants were heavily involved in energy matters and research activity in the sugar & alcohol sector and specialized in agriculture, environmental institutions, organizations and their coordination mechanisms and governance. Once the debate forum had been organised several contributions were received regarding research and policy topics which were debated and recorded, consolidating the fourth stage.

The event sought a research agenda based on arguments presented in the established scenarios and in accordance with the *Term of Reference* and with the investigation of institutional setups which have the implications on ethanol sustainability in mind. The process for prospective institutional innovation demands resulted in the present report. It comprises specialist opinions on the matters presented by the lecturers serving as substratum for scientific, technological and innovative policy making with ethanol sustainability in mind.

The Workshop had methodological-conceptual aspects as collateral or background themes whereby lecturers were requested to focus their *position papers* on sustainability indicators, their implications for regulation and managerial decisions as well as the methodological and conceptual gaps in existent and proposed indicator systems.

Sustainability penetrates all levels of decision within the economical, social and environmental dimensions which can be addressed in several units of analysis: from the level of allocation and employment of resources, governance of transactions, regulation, property rights and the role of the State, as to the diffuse levels of social tissue and culture that are pervasive in society (WILLIAMSON, 2000).

The role of institutions (NORTH, 1991) and organizations in the coordination of mechanisms that involve ethanol sustainability are therefore

considered relevant, emphasizing the approach to transactions in the production chains and the systemic vision of networks/supply chains reflecting important indicators to the sugar & alcohol sector which might direct decisions towards sustainability (FARINA, 1998). In this approach they also discussed the sugar & alcohol sectorial organization (FLIGSTEIN, 2003) and the strategic vision of the sector to the issue of sustainability.

In summary, the conceptual approach considered:

- The relevant role of institutions and organizations and that Sustainability implicates all decision levels.
- Supply-chain management perspective and transaction analysis.
- The Strategic view of the sector for Sustainability.
- Prospection of Institutional Innovation demands.
- The Proposal of public policies in R&D for ethanol sustainability.

Finally, the various sustainability themes were organized according to the conceptual approach taken, in such a form that its organization was easily identifiable in the different panels as follows: bio-energy scenarios and impacts of sugarcane production expansion; coordination for the ethanol market; governance of the sugar & alcohol sector as well as social and environmental responsibility.

RESULTS

Sustainability questioned in the sugar & alcohol sector

The discussion on the search for sustainable energy was amplified beyond the simple substitution of fossil fuels for renewable sources of energy. The debate goes beyond aspects related to the impacts generated by such renewable sources of energy. This chapter addresses innovation in institutions and organizations in the administration of sustainability in the ethanol industry with the following query:

- How can one assess impacts and decide on which private governance systems or regulation with which to address technological development and thereby guarantee more efficiency in the long term in the production and use of ethanol, when considering the environmental, social and economical impacts of this activity?

Research is somewhat disperse between several factors, both promoting and restricting ethanol sustainability. However it is important that we discuss the systems which are capable of governing investment in organizational and institutional innovation, in addition to technological innovation, focusing on the sustainability of the sugarcane agribusiness in São Paulo, ranging from production as much as in its commercialization and consumption.

This section portrays four themes including these governance systems. The first focuses on the bio-energy scenarios and the role of research in identifying and in regulating the impacts of this activity through public policies. The second, addresses the aspect of transactional coordination or ethanol supply chain management, which is relevant for enabling this product to be economically sustainable when facing various problems that degrade transactions and the operation of the chain. Thirdly, it discusses corporate governance, social responsibility, and the signalling mechanisms of sustainability protocol compliance certification in the sugar & alcohol sector. This seeks to discuss what impediments and opportunities on indicator mechanisms between capital markets and consumers can offer sustainability. The fourth theme discusses the application of certification systems for environmental management.

Bio-energy scenarios and the impacts of sugarcane production expansion

Premises

The major public interest in this product and the effects of the industry on society is reflected in the important role of demand surrounding labour and the quality of the environment. Organized civil societies, academics and the State have been endeavouring to raise these issues in discussions with the sector.

In the new millennium the Brazilian government resumed its vision on the strategic character of ethanol considering that bio-fuels substitute

their fossil equivalents and reduce the exposure of the economy to the price of petroleum. The State performed the regulating role of this sector between 1940 and 1990 and was also an important player in promoting development of the innovation system for ethanol, mainly through Proálcool.

Besides being a generator of renewable energy contributing to the substitution of fossil fuels and developing a promising bio-energy scenario, the expansion of sugarcane production also made this segment a major transformer of regions around it, resulting in impacts brought through job profile modifications, the environment, local economies and international negotiations.

These micro and macro extents of sustainability opened up the discussion in such a way that a systemization of the factors into economic, social and environmental dimensions is necessary as well as origins and effects of the impacts of the different players involved in regions and the links in the supply chains at their differing decision levels.

Diverse studies on impacts are using indicators in different dimensions with diverse methodologies. However, it is important to Meta-analyze the results of recent research:

- Is there correspondence between results? Have the results contributed to the identification of effective system indicators for monitoring, evaluating and deciding on the impacts of the sector?
- What are the implications of regulation or managerial decisions on these systems, in search of sustainability for the sugar & alcohol sector?
- What are the main methodological shortfalls?

The global demand for liquid fuels from renewable sources can be gradually met by ethanol, keeping the feasibility of new generation technology for the conversion of different raw materials in mind. In this sense, the sustainability of ethanol presented by sugarcane production in relation to other ethanol sources should firstly take scenarios of traditional technology of energy conversion into account in relation to emerging technology which bears the future.

Sugarcane plantations in São Paulo presented a productivity growth rate of 5.92% in tons per hectare between 1996 and 2006. Productivity earnings in recent years have also increased – such was the agricultural (harvesting) year 2005/2006, where there was a growth rate of 3.3% compared to the previous harvest and a record 82.9 tons per hectare. In the 2006/2007 harvest, productivity increased by 2%. This recent progress doesn't guarantee that it will continue. A coordinated effort for directing research investment is necessary between the many research institutions interested in the sector, be them public or private. This raises a serious question:

- What are the uncertainties in relation to economic sustainability of the ethanol sector in the State of São Paulo, considering global scenarios of technological evolution in bio-fuels?

Sugarcane production activities in São Paulo have been expanding at alarming rates. The area harvested in the state grew by an average annual rate of 4.83%, from 2000 to 2006. An expansion of 9.39% was registered in the agricultural year 2005/2006 alone and was much higher than the average rate in the country. The planted area shows an expansion rate of 25% (821.9 thousand hectares – representing an acceleration of 49.45% in relation to the previous year's expansion) adding to the production area of 3.2 million hectares; and resulting in the harvest of 4.2 million hectares in the 2007/2008 harvest. This means that there was a rapid acceleration in the planted area and expansion growth rate. The production area is expected to double in size in the next few years, following the implantation of 40 new alcohol distilleries and drastically changing the agricultural profile of the State of São Paulo regions.

Among the socioeconomic impacts, labour linked to other agricultural activities is being displaced where new mills are being set up. On the other hand the sugar & alcohol sector is a major employer along with significant job quality improvements (BALSADI, 2006). With major progress in automated harvesting without burning (FREDO *et al.*, 2008), it is expected that a reduction in the harvesting period by 2014 (flat areas) and 2017 (sloped areas) will result in the use of five times more harvesting machines and less than 50% of

the area being burned.[3] This implies a reduction of jobs of about 210,000 cane cutters in the Central-Southern region, of which 163,098 will be in São Paulo State alone. It reinforces incentives against inhumane labour of manual cutting even more so when compared with the efficiency of an automated cut. The disappearance of this manual employment category is expected in 2017. As sugarcane is one of the last crops to be totally mechanized more positive employment indicators are yet expected.

Remuneration per land usage and market indicators are mechanisms which are unable to direct the use of land and manual labour towards sustainability because market forces lead to the allocation of higher marginal utility, incurring transaction costs while social interests clash with the allocation of sugarcane activity. The presence of the State can therefore point to marginal utility from the social use of natural resources and bring price incentives thus maintaining the social cost of negative externalities from the adjustment among supply chain players, thereby bringing it into equilibrium with society and creating incentives for sustainable land use within sugarcane activity. There is therefore a relevant role for incentives created through the regulation of social interest activities such as environmental protection and the maintenance of food producer *clusters*. For example, livestock systems integrated with sugarcane activity can benefit from technological progress – and with positive social and environmental outcomes (SPAROVEK *et al.*, 2007). Similarly the income generated by land rentals, new and qualified employment and tax collection in municipalities creates a new socioeconomic profile in production areas. However it is not clear if there will be a direct connection between the injection of resources and local development through the creation of opportunities for those in the community who lose their jobs. Therefore, one must question the destiny of this unemployed workforce and if it will be possible to re-train the manual labour force and reallocate it. The substitution of agricultural activities is a process that should be kept under the eye of public administration and adjusted through public policy and programs.[4]

Results

Among the arguments from workshop participants was a scenario based on research reports elaborated scientifically by the Interdisciplinary Nucleus of Energy Planning – Nipe at the State University of Campinas – Unicamp, in partnership with the Foundation of Development of Unicamp and the Centre of Administration and Strategic Studies – CGEE, linked to the Ministry of Science and Technology. They suggested that in order to substitute 5% of the gasoline in the world by 2025 (around 2 trillion litres) without introducing new technology or progress in the agricultural and industrial areas, 102.5 billion litres of ethanol production would be needed. To substitute 10% of the global gasoline in the same time span, 205 billion litres of ethanol would be necessary (LEITE, 2006). However, the North American market alone demands 320 billion litres of alcohol and a further 40 billion litres in Brazil, totalling 360 billion litres.

Based on this perspective, for Brazil to become a major exporter of ethanol, the involvement of human resources and land are necessary factors. One therefore can ask what the state role of São Paulo is in all this. The question doesn't only refer to the São Paulo State Government but to the whole group of São Paulo institutions, organizations, production factors and their performance implications in conjunction with other units within the Brazilian Federation.

There is certain distrust abroad that Brazil is not capable of regularly supplying the volumes of ethanol needed for the addition to gasoline in developed countries, uncomfortably contrary to the desires of those countries and leading to avoid-

[3] Combine harvesting manufacturers are divided into market niches, one like John Deere, Case and Santal who are specialized in heavy machinery for Primary and Secondary harvests of 100 to 200 t/ha, and others like Civemasa, Star and Motocana specialized in small machines for other harvests smaller than 100 t/ha.

[4] Initiatives restricting percentile of area for sugarcane in municipal districts through restrictions on new mills might not be the best form of offsetting inefficient regulation of production activities nor of attending sectorial pressures which compete for factors involved in production.

ance of energy dependence on restricted supplier sources. However, scenarios indicate that so long as privileged production capacity is given, and if technological progress is then incorporated, Brazil will be able to maintain its prominence in the supply of ethanol and even export technology to other countries.

The creation of this market also holds difficulties like the breaching of international trade barriers and the implementation of policies for the addition of ethanol to gasoline in those countries. The challenges are enormous and incidentally – that market still doesn't exist. Besides the addition of ethanol to gasoline, the increase of internal market due to flex fuel cars caused an enormous increase in the demand spurring production and the expansion of mills in several states (TORQUATO, 2006).[5]

The main issue is linked to land distribution and the way in which sugarcane occupies the territory being quite intense nowadays. Production intensity and consumption in the Central-Southern region of Brazil will, in the coming years grow even further, considering the installation of new mills in the area and the use of already installed infrastructure. It therefore becomes important to identify other areas of the country with the potential for ethanol production.

If Brazil was to produce for supplying the projected market, plantations would have to occupy the Central-West region and the rural districts of Bahia state in Brazil, counting on potential improvements on cane varieties towards a drought resistant strain. This would increase producing regions on the maps around consolidated logistics to traders or final consumers. This alternative was expressed in studies as policy for decentralization in search of models for economical development associated with lower cost factor procurement in order to avoid the over exploitation of natural resources, whilst taking advantage of earnings from the formation of energy producer *clusters* based on sugarcane agribusiness.

Mapping shows considerable expansion areas for cane production omitting areas under restriction like Amazonia and sloped areas, and counting on areas with good conditions for cane – soil and climate. Another 12 possible areas are identified in Brazil when other variables are considered for crop expansion, like infrastructure logistics, being 40% in the North-Northeast region and 60% in the Central-Southern region. A study is currently underway to understand climate and soil conditions and favourable areas for cane and the installation of new mills. With current technology each mill (organized in *clusters* of 15) would have a milling capacity of 2 million tons of cane per season, resulting in a total of 22 million hectares of cane in the country – equivalent to the current area for soy. That production would enable Brazil an annual distillation of 195 billion litres of ethanol and would also offer 15% of the electricity demand. Electricity generation induces development. The impacts on the Brazilian economy were assessed and there would be an increment of 12 billion in the GDP (equivalent to the State of Rio de Janeiro). As a result of this type of land organization, the level of development of several areas of Brazil would improve. This process should be planned as part of a national development plan, through the Federal Government multi-yearly Development Plan.

However there are several critical points to be overcome. Sugarcane agribusiness activity on the agricultural front still has a lot to be improved in technological terms along with the creation of human resources to handle the production of 600 new mills throughout Brazil. Where will these technically qualified people come from to work at all these decision levels? We know what happens on expansion and occupation of the soil and in occupied areas, and this is the perspective for as yet unoccupied regions even considering the swings between positive and negative outcomes.

According to FURTADO (2007) supply was historically never an obstacle. In Brazil the problem was always demand because there were always problems of excess supply. The first petroleum crisis brought a major impulse to Proálcool. Later with the petroleum counter-crisis in 1985 came the growing demand for sugar that regulated growth. Continuing the historical perspective of

[5] Sugarcane occupies a relatively small area in Brazilian agriculture, occupying 1,62% of the national agricultural area with sugarcane plantations, taking third place behind soy beans and maize. An eighth of the area in São Paulo State is occupied by sugarcane.

sugarcane agribusiness, traditionally there are complementarities between sugar and alcohol products that benefit in allocation terms because of relative prices. Nowadays the sector positions itself on energy supplier perspectives as the future appears to point to ethanol – especially in the light of instability in petroleum prices. Ethanol has also come to respond to other challenges such as environmental questions like the greenhouse effect.

During the 1990s the demand for ethanol remained stable due to the increased consumption of dehydrated alcohol associated with gasoline. At the end of the nineties and beginning of the current decade the market resumed hydrated alcohol production in anticipation of a new petroleum crisis. With this there was increase in the price of petroleum derived products in the internal market, increasing the difference between the prices of gasoline and ethanol. The introduction of flex cars is responsible for the new demand. Today hydrated alcohol is the main product in the internal market when compared with dehydrated alcohol. The market is stably divided between sugar and ethanol, with grand synergies (FURTADO, 2007).

What is unsatisfactorily is that this expansion in ethanol supply is heavily concentrated in the state of São Paulo. According to FURTADO (2007) the expansion might occur within, or indeed outside this area, certainly being outreaching to other outlying areas – though always around São Paulo. Technological progress can of course, contribute to the expansion of production without the increase of planted areas and new mills. The tendency is that concentration will remain in São Paulo State because sugarcane is competitive in areas with more expensive production factors principally close to large centres where ethanol is mixed and/or distributed. São Paulo has better logistical infrastructure aspects compared with the rest of Brazil. In other words, the cost of transport of sugarcane to the mill, and from the mill to the consuming market is the second reason. The Northeast region could resume in the market as an exporter of ethanol due to its locality. Another aspect is innovation considering technology available. In other words, there has been a virtuous combination in relation to investments and knowledge in the state. There have been large government incentives for expansion and innovation. São Paulo leads in agricultural and industrial productivity accompanying these dynamics and there is an enormous dependence on information. The sugarcane agribusiness became a knowledge-dependant activity, and above all, knowledge of quite a tacit kind, allowing little space for movement. The relationship between the mills, the capital goods industry and inputs became quite intense and close. This reality is not found in other Brazilian regions. In technology terms these efforts have been maintained since the 1920s.

Towards the end of the years 1960-70 structural changes took place with enhanced research into São Paulo sugarcane. Productivity has been growing since the 1980s in particular. Besides becoming highly knowledgeable, sugarcane production activity demands geographical proximity and interactive dynamics between production and research so much in agricultural as in industrial production. São Paulo state unites these conditions which results in the concentration of sugarcane production. Energy and the potential for sugar and alcohol exports are enormous incentives for expansion of plantations in São Paulo state which is not desirable – confirmed in a study carried out by the Unicamp Interdisciplinary Nucleus of Energy Planning.

Brazil can afford to expand sugarcane production but the tendency of concentration, be it economical, or land oriented, aggravated by the inauguration of ethanol pipelines is not desirable. However this is already so and has brought social, environmental and economical impacts. There is a difficult and complex conflict of choices to address which need in-depth study. Technology helps minimize those impacts as long as scientific and technological policies also seek the decentralization of the activity. São Paulo should thus maintain its technological supremacy and will have an important role in the diffusion of already incorporated technology, albeit that the presence of the State is necessary through the national plan for bio-fuel addressed in policies for decentralization. Economical, social and environmental impacts should therefore be addressed, respecting the role of public policies.

The predominant euphoric attitude at this moment – although desirable – is of auto-regulation towards a society of bio-civilization, however some

impacts of that expansion are put in check which is a great dilemma.

An area expanding by 5% and 40 new mills within a short term of 10 to 15 years show that in reality there are no policies restraining the overwhelming expansion and that measures should be taken urgently. Otherwise we will lose out in terms of regulation and territorial order. There are producing areas in which the whole sugar & alcohol setup is present with innovation systems – from universities and research institutes to innovative companies supplying equipment and technical support. Other areas just produce sugar and alcohol because they lack links in the network-chain. This is transmitted in the new producing areas of cane and in many cases social dynamics are transformed with the arrival of sugarcane farming. This calls for study considering that there are no solid diagnoses on the impacts of sugarcane in new areas. There are huge regional differences regarding this expansion in that the sector is highly consolidated and organized including what it refers to as technological innovation in the regions of Piracicaba[6] and Sertãozinho, concerning the capital goods sector – different from new areas like Araçatuba which just counts on inputs from farm suppliers. Producers are displaced from their traditional activities by the leasing of areas for concentration of sugarcane. SEADE data shows that 70% of the sugarcane production in several areas indicates the worst indices of Social Responsibility – IPRS (levels 3 to 5).[7] These are precious and precise empirical tasks focussing on regional differences and interested exclusively in the relationship with bio-fuel.

Considering the leasing price of land per hectare for sugarcane which can be as much as 1200 Brazilian Reals (according to IEA/APTA data), the implementation of mechanisms for reorientation of those investments is considered difficult. In the São Paulo state government there have already been attempts at restraining sugarcane expansion into undesired areas. It is the market which is regulating the activity, calling for public policy to better control the activity and trying to minimize the impacts. It is not that zoning is not an interesting option but there isn't a tradition of territorial planning in São Paulo State (or in other Brazilian states).

Instead, concentrated regions co-exist with diversified exploitations and there are mechanisms incentivizing intensive manual labour activities like Pronaf, rural settlements, governmental purchases (Food Acquisition from Family Agriculture Program – PAA), rural tourism and the development of family agriculture (FEAP) which go beyond exportation ambitions of well structured network-chains. There needs to be more concentrated effort on a development policy for family agriculture, mainly regarding the question of other raw material sources for bio-energy, as in the case of the oleaginous sources for biodiesel that can be synergic with ethanol.

In relation to the socioeconomic impacts in the municipal districts, those based on mono-cultures that produce only sugarcane don't attract service sectors, agri-processors or equipment suppliers and one sees only sugarcane burning, the financial situation of cane cutters, impoverishment and a resulting greater number of people included in the Family Benefit Programme where smaller amounts of ICMS tax are collected when the mill is located in another municipal district. These are municipalities that benefit from only a very small part of the ethanol productive chain when talking about agricultural production and the generation of temporary jobs.

On the matter of jobs there is a concrete fact. Sugarcane Industry Association – Unica – agreed with the São Paulo State Government to reduce the period for the eradication of burning in mechanized areas to seven years (by 2014), and brought the deadline forward by 15 years for non-mechanized areas (from 2031 to 2017). Public

[6] Dedicated capital goods and services sectors in Piracicaba have been there for more than 100 years.

[7] "The São Paulo Legislative Assembly, in partnership with the SEADE Foundation, developed a robust System of Social Responsibility Indicators, highlighting IPRS formulated in 2000 to express the degree of social and economical development of the 645 São Paulo municipal districts. The five groups of IPRS measured from 1 to 5 the differing income and growth levels, longevity and education and it can therefore be seen which municipal districts require more State attention through public policies. In other words, IPRS graduates from group 5 (worst economical and social development) to group 1 (best social and economical development)" (PAULILLO, 2007).

policies are needed at once so that social impacts on employment (more mass layoff of cutters and decreased wage) are softened and that studies seek to locate which occupations and people will be excluded and then how to reallocate the manual labour. As the manual workforce used in sugarcane production comes from areas of depressed economy, public policies must be applied as a way of compensating for the seasonal work lost due to mechanization of the harvest. Furthermore, accidents at work, deaths and contractual relationships all leave side-effects due to working conditions and the lack of public policies regulating the market. Diagnoses and compensations are thus objectives for important research.

Despite improvements in working conditions in cane cutting[8] we cannot fall into the pitfall of extending the burning because there is no affording the use of the manual labour that will be laid off upon total mechanization. The positive role of ethanol in environmental questions is being praised, so maintaining the manual harvest and the burning that this entails cannot be justified. Besides the economical advantages of the use of mechanization in the production we must see the introduction of new higher paid and technical activities. The decline in rural and non-rural employment (agricultural and non-agricultural) should be studied along with training and labour reallocation. These initiatives should be studied in order to have an outline of what solutions are feasible, duly certified in accordance with global demands and preferences for sustainability. This is therefore an important national subject not only in the light of environmental and social aspects but also in economical ones.

The situation regarding the occupation of land with sugarcane instead of being otherwise used for food production is expressive but not so important as part of the whole agricultural area. This could however affect occupation by family agriculture in a more dramatic way. This is the case for settlements that incorporate, or are incorporated by sugarcane through leasing. The cane also occupies flat land recently released through Agrarian Reform which through leasing creates an income for the owners but without however having any possibility of them working as cutters due to mechanization. This can permit leverage over other rural productive activities or make them become totally dependent on the situation of leasing without employing those who actually own the plot of land.

Despite State concern in São Paulo for the formulation of territorial policies and regulation of sugarcane exploitation, this will not be successful if solely aimed at São Paulo State. A policy is therefore necessary, but in harmony with the policies of other states and federal level policy. Policies of territorial character have recently been gaining national importance, many of them even overcoming municipal limits and directed at intermunicipal territories.

The need for planning cannot be disregarded despite the current taboo. Ethanol is an ever growing and important part of the Brazilian energy grid as an important generator of electric power so recognizing the necessity of a regulatory body makes sense.[9]

In summary, understanding social and economical impacts creates demands for studies to back up regulation mechanisms like the very zoning discussed in economical, social and environmental aspects with micro and macro analyses. This difference involves more specific aims behind local, state and federal public policies. There is a lot of demand for information and for indicators that can inspire sustainability policies. There are few indicators but there is a lot of disjointed research, lacking research group institutionalization. One option would be to create a network of research directed at that process. We have researchers with accurate but uncoordinated research, methodological gaps and a lack of unification of that research.

[8] The production sector has indeed been indicating its wish to end seasonal and privatized recruiting via informal contractors known locally as “cats” (“gatos” in Portuguese).

[9] This taboo derives from historical conflicts by some social segments against interventionalism which led to the extinction of the IAA. The subject of regulation cannot continue as a taboo in the sector, addressing only price controls and quotas etc., as the need to think about regulation is already present when, from an international perspective this is primordial.

Ethanol supply chain coordination

Premises

Inputs and sugarcane production

The presence of cooperatives and supplier associations that provide technical assistance bring more competitiveness to sugarcane producers (whether suppliers or mills) because these organizations have more bargaining power and logistic capacity for meeting larger input demand from agrochemical industries. The administration of these organizations is quite peculiar and a reasonable level of knowledge has been developed on agricultural cooperative management. There is however need for cooperative management training, separation between ownership and control, and for a better definition of property rights in which relationships between cooperative members also need improving. A diagnosis of these cooperatives and associations of suppliers in relation to their administration and economical-financial situation is thus essential, besides continuous professional training in the strategic management of those organizations seeking to improve the Orplana system – the vertical organization model for cane suppliers. One also needs to narrow the link between the Orplana system and the public research institutions, agricultural technology and its economics (FRONZAGLIA *et al.*, 2008).

From a historical point of view the relationship between cane suppliers and mills was always unstable and conflicting. Several papers have previously described this category well with their specificities and necessities. Today when we look at the different links of the sugar & alcohol production chain, we find that independent supplier production – which represents 25% of the cane produced in the state of São Paulo is not very well defined. The same is true for proprietors who lease lands to the mills. The statistics concerning these categories are confusing and reveal neither contract models, proportions of land rentals, shareholders, contractors and active suppliers amongst other "supplier" categories and partners, nor even their technological profiles and agrarian structure. This relationship between supplier (or leaser) and the mill is quite narrow and symbiotic. One therefore needs to question the necessity for studies seeking to improve the coordination of those relationships, technological transfer and maintenance of the competitiveness along with sustainability of the supplier production in conjunction with the mills and the economical alternatives for these producers.

Industrial Processing

This link in the sugar & alcohol production chain is technically quite efficient and requiring qualified professionals has undergone a process of intense training. The concentration process in the sector has reduced managerial costs dramatically. Foreign business groups are significantly encouraging still higher efficiency levels in the administration. The sugar & alcohol sector started to have ever broader interfaces with other production chains, and many new business models have emerged. There are huge synergies with other complex downstream processing, like the chemical, pharmaceutical, nutrition, electrical sectors and industrial equipment industries.

The creation of these new enterprises requires an understanding of business analysis with even more complex synergies. The traditional business models should thus undergo a profound transformation being that the administration of *holdings*, creation of *joint ventures*, participation in *private equity* investments, the creation of technology-based companies (TBC), *spin-offs*, strictly coordinated downstream processing chains, the use of trademarks and high degrees of differentiation are just a few coordination examples that business models look for. These also raise questions concerning the capacity of the sector supplying information for the identification of value creation opportunities as well as the elaboration of contracts with effective benefits. Research between the interfaces of management, economics and law has a lot to contribute in this area.

Financial engineering and business simulation models might be important tools according to the degree of synergies between business units.

- Intellectual property and technological management with the monitoring of scenarios – as yet little developed in the Brazilian tradition of innovation – might well have very important applications for a knowledge and technology keen sector.

- Law, business and economics, particularly anti-trust policy are new and rare issues in Brazilian traditional law schools and may have very important implications in a sector that will undergo corporate restructuring and will adopt new mechanisms for investors in the financial markets as well as strategic alliances, coalitions and acquisitions, and international negotiations.

Commercialization of ethanol

The price of ethanol for the consumer started to suffer substantial increases of 27.5% in the second semester of 2005 and of 25.6% in the period between harvests (December-February 2006). In the mill this increase was 83.2% for hydrated alcohol and of 60% for the dehydrated alcohol in the same period. This price variation corresponded to an increase of 7.9% in the price of gasoline with direct impact on inflation – the primary target of discussion and public concern efforts. It was caused by heavy stockpiling, seasonality and exportation. Stockpiling is strategic for guaranteeing exportation contracts and taking advantage of associated seasonal opportunities. It is however very probable that these prices are maintained close to a parallel maximum of 70% with gasoline, since the demand indicators led to the drop in the world sugar stocks resulting in an overproduction and a price crisis in the harvest of 2007/2008. The price crisis stressed mill capacities and these couldn't meet the production in lieu of the intense consumer market demand, led by fuel distributers (FRONZAGLIA, 2007). Important objectives for research include these recurring crises that the sector is exposed to.

More important than the subject of increases and stockpiling is the relationship between market agents as well as the structure of the distributing market which keeps the ethanol market from degradation. It is worth remembering that the structure of the distributing market is overly concentrated.

The existence of an international market for ethanol and the transformation of the product into a commodity are important for the sustained development of the sector, since these enable financing and several price risk management mechanisms. Several studies are necessary to make standards feasible, elaborate contracts and define operational criteria. However, other coordination models such as vertical integration and long term contracts might offer more efficient coordination depending on the ethanol – its differentiation type, co-products or by-products (IEL/NC and SEBRAE, 2005).

Results

It is important to learn from the evolutionary history of the sector. Due to poor dynamics it was never capable of responding to structural questions. Today many new newcomers are making investments and as a result productive structures should be appraised and characterized for technological equivalence between units and productive areas.

In the ethanol market sectorial structural problems include the inability at self-regulation and sugar mill articulation. The state regulations brought by IAA in the early 1930s were down to the inter-regional competition (NE and SE regions). It generated the economy of the sector with income and fixed prices and the trade risk was administered by the State. IAA tried to resolve these subjects regulating prices, with export quotas and by sharing sugarcane production between suppliers. At the time there were large imbalances between supply and demand. Under this type of regulation there is no economical risk. However, criticism of the regulation as a barrier against expansion brought deregulation and dynamics such as product differentiation, decreased production costs, increased participation in the producing and exporter markets and the utilisation of contracts to bring sustainability to the activity. When the process of market regulation ended in 1999 sugarcane was the last product to be unconstrained – the first being sugar and ethanol soon afterwards.

In the process of seeking self-regulation the coordination model Consecana suffered several amendments and brought certain stability to the sector mainly by reducing the lulls with the warranty of supplies and guaranteed demand from the mill. In doing so they lessened transaction costs in the sector.

The major role of Consecana was to do the approaching for negotiations between supplier and mills as a middle man establishing basic rules.

However if on the one hand the state regulation (when present) didn't (better did not) manage to resolve the conflicts generated between suppliers and sugar mill owners, Consecana on the other didn't manage either. The issues of supply (lack of raw material) and other consents have been resolved in the courts. It should be up to the State to regulate these contracts as well as help in the compliance with them.

The Consecana model responds for only 25% of the supply and there are differences between players, classified as shareholders, third parties, leasers, contractors and partners. In the state of São Paulo, 25% of all the sugarcane harvested is produced by 13,000 cane suppliers organized by Orplana – an association that comprises other smaller organizations such as cooperatives and supplier associations. An analysis is important when seeking to reinforce that relationship created through Consecana.

The results Consecana achieved are important and cannot be overlooked but a broader regulation mechanism is necessary. Ideally the different types of suppliers would be studied – both large and small, identifying the different contractual relationships since the bargaining power of one is different from the other. However, for public policies it is essential to have the description of contract modalities of these different cane supplier categories in São Paulo state, along with the monitoring of each socio-economic and technological profile. The supplier/leaser/industry relationships should therefore be observed more closely. Public research should be covered by production costs, the Consecana negotiation system and the definition of prices, service mix in supplier associations and their vertical appearance in Consecana, with a view to creating contractual and market positioning alternatives and conducting efforts towards public policies among supplier categories.

Consecana made the relationships among suppliers and mills more transparent through the establishment of contract standards, encouraging the reduction of production costs. As well as São Paulo, other states sought to create other Consecanas to regulate the market and coordinate transactions so cane suppliers are paid in agreement with the price of ethanol. When the price falls, producer euphoria drops provoking the question of who will buy the ethanol. Observing the subject of price variations in this way one still sees big oscillations that make the activity quite unstable because supply responds in an uncoordinated form.

Consecana is gradually resolving the relationship problems among agents of the production chain. However, research that better addresses the supply sector is required. Research on suppliers is disperse and rare. There is not, for example, a detailed characterization of these suppliers and what their technological or organizational (amongst others) demands might be and available data comes from Orplana. There are several categories that need to be characterized like drawing up contracts and how they are complied between parties – or not. There are suppliers that are leasing lands to increase their supply. It is necessary to map the aspects of these relationships among agents in the productive chain, especially concerning technology transfers.

It would be interesting to achieve a proposed policy for technology sharing starting from partnerships with mills, or rather, the process for sharing IAC and CTC technology (among others) in order to give more access to small producers and the smaller, lower capacity mills. Coordination of technology in the sector is done by the CTC. The technological transfer to the suppliers and mills that have lesser access needs a policy for technological sharing. Some mills have also formed partnerships with public research setups like IAC/APTA.

The profile changes in the regions that cannot mechanize the sugarcane crop. The exigency for mechanization for some areas such as Piracicaba which are not suitable for mechanization will soon be a problem. What can be done? Some partnerships are being set up so that the cane is exploited in areas that are unsuitable but which still need to be made possible. A technological park exists for maintenance, mill production line and tools – so what is the future of this park? There is an initiative towards studying these variables in Piracicaba which could become unprofitable for cane even though they already contemplate all of the links in the chain. The studies are being developed by the Sugarcane Local Productive Arrangement (APL) in Piracicaba.

However, until a technological solution is feasible[10], regions like Piracicaba, which has the largest number of low volume suppliers and where steepness hinders mechanization, will have to seek to relocate their sugar & alcohol parks. Some 83% of the producers in that region plant up to 30 hectares. Some suppliers will continue in the sugar & alcohol activity while others will leave sugarcane production behind for other products through new strict coordination mechanisms which strategically reposition the mills like for example, differentiation and added value on co-products, residues and organic products, utilization of own trademarks. Ethanol refining can be an option besides functional foods. In other words there are other applications for sugarcane beyond energy.

Financial market demands are revealed by investors selecting projects and new mills covered by normative Instruction ISO 22000 or rather – those with standard coordination to upstream and downstream. Investors' expectations are therefore high in relation to coordination efficiency.

Coordination problems go beyond Consecana, because there is the question of old and new barriers in international trade like regulatory stocking, several taxes and logistical systems. Considering other production chain links (new mechanisms and products that appear like liquid and organic sugar), relationships start to be long term contracts creating more sustainability. This is not the case for ethanol which continues based on market coordination. However new forms of coordination were created, such as the trade organizations Brasil Álcool and Bolsa B, that didn't work due to problems of concentration and anti-trust policy. There are alternative arrangements for the commercialization of ethanol, with small parks where understanding how it all works is of the essence.

The subject of adulterated ethanol is being monitored in such a way that the warranty of product quality is maintained. As for the standardization of ethanol, there is a black market for fuel, adulteration and informal trade on behalf of the mills. These obscure courses of the product need to be studied and reoriented, starting from the creation of incentives for legalization. The government is studying forms of identifying both types of dehydrated and hydrated ethanol to regulate that market and to minimize the availability of low quality fuels. The State then, is not completely ignorant and controls several points over production chain links For instance government attributions in relation to the addition of ethanol to gasoline include export licenses and Cide tax. Abroad, the image that the government controls all ethanol production in Brazil still prevails.

Today ethanol is dealt with by several governmental Ministries, indicating the absence of central monitoring. So public policies do exist and should be improved without creating new policies. Shoddy registration of ethanol sales implicates in non-collection of revenues and taxations like PIS/Cofins. Therefore, in these aspects, the presence of the State is important to better structure these issues, position the external market, as much as address issues related to subsidies and what can be resolved in the OMC.

Variations in prices and regulatory stocks lead to a policy of strengthening the mechanisms for sector governance. One of these is the market of future's contracts for sugar and alcohol, due to the high operation costs, *player* concentration and tax problems in some states that hinder the dynamics of using this derivative for price risk management. Another is the use of financing stockpiling mechanisms through marketable certificates on a secondary market with financial clearance. It is worth remembering that there are times when excess world sugar stocks ebb the outflow of ethanol. Thus ethanol stocks in private company consortia aiming to reduce price flotation can be a way out. The arrival of new *players* like fuel companies brings new dynamics. A closer glance at the market structure should be taken and also at the relationships between mills and *traders* to define the stockpiling outline even for public interest if the case may be. It is necessary though to study

[10] 15% of sugarcane production costs are due to diesel, leading to ideas of installing biodiesel run mills so that costs can be reduced. On that line studies approaching the complementarities of crop rotation. And its use as source of fuel for cane production would be important. Manual labour assisted with light harvesting machines for steep areas are also being studied.

how to structure those mechanisms, which agents participate in it, and the role each plays.

In relation to financial governance there are two levels to be addressed. The first is the financial mechanism of commercialization which is more developed in the sugar market with structured operations. The second is the governance from financing to investment, which is based on third party capital – or rather, long term bank loans. The award of resources through the stock market is restricted and there are only three groups of mills that have released shares to the stock market implicating in the need for transparency and social responsibility. As this was very recent there is no way of assessing their achievements.

Thus the central question concerns what the government involvement should be in the current setting. There is opportunity for state participation through taxation, inspection, gasoline additives policy, and sectorial statistics along with in-depth research investment on these questions raised, counting on representative organizations as partners to create feasible solutions for implementation. This reflects the need for information and for indicators that can identify policies for productive chain sustainability.

Studies on this theme are disjointed and lack group research institutionalization as well as the inclusion of more essential subjects like cyclical crises of overproduction, impact assessment concerning the arrival of new foreign business groups in the country, the concentration effect on both competitiveness and competition as well as its impact on both internal and external sustainable market viability.

Regarding the database on supplier production it is the cane supplier associations such as Orplana, besides mill associations like Udop and Unica, which collect data. There is an enormous apparatus available, comprising universities and research institutions that could create a central database either for public knowledge interest, for project convergence and the construction of a solid base of knowledge integrated in several organizations, or incentivizing network arrangements – even inter-regionally, and of long term durations for the development of research on the issue.

Governance of the sugar & alcohol sector

Premises

The driving forces of several producing sectors of the industrial economy concentrate on the big players in these producing markets (FLIGSTEIN, 2003) as is the case for ethanol, this potentially international commodity where there is still no large global trader. The organization is left to vertical structures from sectorial representations to coordinate price negotiations and raw material standards. The intense and continuous concentration of the sector and the establishment of contracts have relevant roles in these coordination structures for guaranteeing the supply of the raw material, determination of standards and risk administration (ZYLBERSZTAJN, 2005). Centres of concentrated decision power and sectorial promotion have formed and allowed the establishment of sectorial strategies for sustainability of the ethanol industry (MELLO, 2005).

The new millennium opened with the three larger sugar & alcohol groups holding 63% of the cane production and 38% of the sugar production. Until now a lot of acquisitions have taken place despite the arrival of foreign groups. Supply stockpiling for export is a natural mechanism of making the international market feasible and the role of the trading companies is critical for Brazil to remain competitive in the international market. This is reflected in the concentrated stockpiling of ethanol. The strategy sought by traders is a guaranteed supply through vertical coordination which is also sought by large groups and reveals a phenomenon showing that concentration and vertical integration should be increased. The infrastructure for ethanol exportation should also be concentrated in the light of consolidation projects led by large joint venture business groups like Transpetro (Petrobras)/Mitsui, Brenco and the Cosan/Crystalsev/Copersucar/São Martinho consortium for the implantation of a network of dedicated ethanol pipelines ranging from the Central-Western region towards the ports in São Paulo.

Investments in new productive units has been achieved through financing from the National Bank of Economical and Social Development – BNDES, whose portfolio in 2007 totalled 62 operations in

the sector, equivalent to R$ 7.2 billion in investment support and totalling R$ 12.2 billion through public resources. This is subject to pitfalls like the 2007 oversupply crisis and the worsening 2008/2009 international financial crisis. On the other hand the sector is becoming more professional, unlocking capital for venture capital investors and launching shares on the stock market. This process already occurs within a few national groups – Cosan, São Martinho and the Guarani Sugar Group – whilst others are getting ready to make a debut in the stock market. This way the corporate governance of these groups becomes well developed reducing the risks to investments made with governmental financing of debt capital.

However, the control of these groups is more exposed to the rules of the market and to concentration. The positive aspect of this new relationship with investors is that they are subject to the preferences of the stocks in relation to sustainability. A second market exists but is reserved for companies with a higher level of corporate governance. There are also investment funds that invest in shares of companies with social and environmental responsibility. These markets have been demonstrating lower risk and better performance. The bilateral selection between funds and sustainable companies brings sustainability to investors as well as those involved in the production.

The possibility of creating a sustainability protocol is under discussion to regulate the parameters of sugar & alcohol sector expansion. Such private governance systems and their incentives have already been well looked into. However, the viability of certification systems and their indications to the market as a form of incentive to comply norms are still very onerous instruments such that their efficiency depends on a series of factors inherent to information costs.

Results

The Governance issue is complex and very wide ranging. The concept of corporate governance over companies also involves social and environmental responsibility, and sectorial vertical governance from the organizations representing the sugar & alcohol sector.

It is important to make the distinction between social and environmental responsibility and corporate governance. The recent momentum for globalization and market integration is accompanied by two occurrences – firstly of products between countries then information exchange, forming an up-to-date partnership. In other words, the impact of a mega-organization like *Nestlè* is global carrying global level consequences and implicating immediate externalities. There is financial turnover response in the case of the stock market. Financial turnover involves logics of risk association and benefits, with shifts in the capital.

Macro and micro policies have much smaller margins for manoeuvre because any deviation of conduct can involve future implications. The investor won't put resources where there is a black box. Transparency is essential. Share prices reflect the roles and preferences of large investors, institutional funds, and individuals.

Society changed its behaviour towards environmental and social aspects and made its requirements part of transparency and sustainability of the business and of market investments. Corporate governance is manifest in this backing. Accessibility to information brought consumer pressure groups, NGOs amongst others and with them, more information. In response to the big scandals in gigantic corporations the São Paulo Board of Stock Exchange created governance levels for differentiated markets – for those with better practices, and this issue is present in the energy sectors like the sugar & alcohol industry.

The aspect of corporate governance with sustainability leading to governance of the sugar & alcohol sector via sectorial governance is an enormous challenge which could help in the improvement of the governance of the sector as a whole. It represents a major challenge recognised as huge for the ethanol industry and a great opportunity to participate in the capital market.

Corporate governance and sustainability are directly associated while sectorial governance works as a lobby. The concept of sustainability is broad, socio-economical and environmental. The indicators are there like the Dow Jones Sustainability. The challenge of corporate governance in association with sustainability implicates in the sectorial governance of the sugar & alcohol sector

that, if prompted in its new activity schedule, has the task of devising educational activities.

Raising the subject of corporate governance, one considers the capital flow which is eager for good projects and investment opportunities. Ethanol is an example in this case. Will it be able to take advantage of this capital market? There are several modalities like private equity, stock markets, alliances, joint ventures etc. Will these models be predisposed to be adhered to by sugar mill owners with conservative characteristics, power focussed and culturally dedicated? Might the sugar mill owner be willing to be on the administration advice council along with finance market professionals?

The tendency for sectorial concentration can be positive if it implicates in professionalizing the sector. From the distribution of capital point of view a mega corporation that has 50,000 investors, might be better than traditional family owners of organizations. But reconciling pressure is necessary – on one side the shareholder, the other sustainability. Accounting is necessary over shorter periods for the quarterly profitability score. This challenges money generation in the short term and is the important aspect of governance.

Sectorial governance of the sugar & alcohol sector was always used more as a lobby (which is not socially efficient) than building governance and working with transparency for the market investor and for the consumer. The sugar & alcohol sector still doesn't understand the opportunity of capital market and the sugar mill owners avoid foreign capital. Either the sector begins to use the modern indicator mechanisms integrated into society or it will stay in the archaic industrial economy and easily be overtaken due to lack of financial and human capital access.

Corporate governance becomes ever more important for attracting investments according to growth perspectives with the arrival of big investors in the sector and new financial agents along with future international investors. Two aspects should be considered for sustainability – reputation and corporate governance. Either of these aspects is fragile. There is an immense risk to the country, considering that ethanol is the great protagonist in the energy grid and on export share and a major product in many São Paulo municipal districts that could suffer serious upsets caused by the closure of mills through lack of efficient corporate governance. These aspects must be resolved in order to attract investors instead of speculators. The development of a corporate governance culture is compromised with no market demands. The sector should look to professionalism in planning and build a reputation with Brazilian society as well as with national and international capital markets. This movement began with the São Martinho mill and the Cosan group, but it is also necessary to consider the centrality of that reputation in the sector's command network – or rather – the central command between Unica and Orplana.

There is still the problem of social and environmental responsibility reflected in the agricultural setting in productive advances and their impacts. Brazil is aligning itself with the USA to facilitated exports to this partner without seeking to break the import barriers of the EU. In other words, it is seeking the easiest markets without worrying about investments for sustainability and certification. This is a concerning attitude and culturally part of an "immediatist" industrial age.

The sugar & alcohol sector protocol on sustainability is a voluntary certification and not obligatory. As one can make sustainability certification work in several dimensions it should be made to do so with concern on international trade.

Recent research shows that 90% of sugar mill owners don't want executives involved in their administration, formal relationships with shareholders or long term strategic planning. They centralize their decisions, are not prepared for the future and don't believe in the ethanol market. The lack of professionalization therefore hinders the strategic target of the command unit (Unica) of achieving corporate governance in the sector. Corporate governance involves seeking importance independently from the business and seeks to meet sustainability requirements. When concerning external pressures like environmental, labour, and minority protection and consumer defence code legislations, social pressures etc., the financial markets tend to seek investments in sustainable businesses that don't present volatility or other similar risks. This demonstrates the value creation which is essential for the sector to be at-

tractive. Transparency is needed along with good managerial practices with commitment and always thinking in creating long term importance. Sustainability and corporate governance are ethical.

The process comes down to dialogue with the agents, creating indicators and reporting to the market. To be sustainable it is necessary to discuss it and unite agents. If this is not followed the sector won't receive investments and will be swallowed up by an alternative investment or professional international groups will take over production.

There is no doubt that we ought to have a certification system if we want to sell in the long term. Another important point to make concerns the divulgence of these conditions in the market investment.

From an association point of view a proactive role should exist, ready for inducing social responsible practices like the partnership between Unica and Ethos which is a start. In order to understand how to cope with the question of certification for ethanol, the experiences of other sectors should be observed like the case of coffee (Abic) that altered practices in the sector, especially as all efforts are for turning ethanol into a *commodity*. Certification occurs when the structural process is legitimate, creating a valuable alliance between several players.

In the market of alcohol and sugar, there are large uncertainties; so long term contracts built from strong relationships established over time are essential. Long term contracts bring many possibilities for sector enrichment and sustainability. This would indeed result in a differentiated commodity as today these aspects are not being incorporated into the prices. It is not a question of formal demand but voluntary adhesion, as is the example of the FSC. Aracruz is not certified, so suffers price variation. This however would satisfy only a fraction of the market, because voluntary adhesion by itself doesn't resolve the question. Sustainability doesn't depend on altruistic characteristics of entrepreneurs or companies.

Corporate governance involves price differentiation. So there will be two prices, one for the certified alcohol and one for the un-certified and there will be two supply networks. Informal arrangements are inherent in the Brazilian economy and there are a series of heterogeneities. Today there are various markets alongside a large informal market. The external market might demand the certified market product but the remainder stays internal without certification such is the case of informal milk and its corresponding black market.

Will the market forces lead to change in the behaviour of sugar mill owners? On certain terms the traditional model does not survive long term. The administration profiles of mills change when investors become interested in buying mills. The Vale do Rosário is the type of *private equity* model that puts sugar mill owners out of business. The reality is that the mills are being bought up. Either they change or they won't have access to capital. Sectorial governance is based on corporate governance for the strategic interest of capitalization, modernization and consolidation in the sector looking for more sectorial competitiveness. It is believed that the sectorial governance liaises with corporate governance as a strategy but studies should seek to understand if this is true.

Environmental Management

Premises

The magnitude of the socio-environmental impacts of sugarcane expansion is quite clear. The most serious environmental factors are related to the burning of the cane, vinasse residues and the use of farm chemicals. In other words, there are positive impacts related to the mechanization of the harvest as well as the protection of the soil, substitution of fossil fuels and a reduction in pollution coming from motor vehicles.

Possible technical barriers against export and harm to the social and environmental quality in the state of São Paulo are two concerns converging public interests with those of the sugar & alcohol sector leadership, in the search for the creation of a protocol that defines sustainable productive practices.

Results

The sugar & alcohol sector has a profile with differentiated issues. The objective of environmental certification is to seek access to the markets and avoid the restrictions of no-tariff barriers. For substitution of 10% of the gasoline, 220 billion litres of ethanol is required. Many mills are seek-

ing environmental licensing because an ocean of ethanol is required to supply the demand.

The expansion of the sugar & alcohol sector in Brazil brings several future scenario perspectives. How can one structure and regulate this growth? Environmental issues lack more questions and imply impacts which result from creating new mills in the country. It is necessary to identify who follows rules and who doesn't. There are fitting aspects in terms of conduct that require the role of the State to enforce the laws. One cannot imagine that the way to external capital will be the solution for sustainability, because there is not always a guarantee that sustainability issues will be respected.

An environmental commodity is one which scores well in social and environmental issues. Technology exists for bettering and performing several aspects as for example, organized production associated with the carbon credit market. Precision agriculture is another practice that facilitates environmental management processes.

Technology and the highest production per unit by factor is one of the important aspects when seeking sustainability, but expansion is inevitable anyway because ethanol being a cheaper input and used by more efficient engines make that factor more important creating demand for more cane production. Several phases of production show impacts. Burning and the application of pesticides and herbicides from the air generate an enormous social cost through an increase in respiratory problems.

The rule for new mills should be "no burning". If we were to consider analyzing life cycle systems, we would be thwarted half way. Mechanization leaves an amount of organic matter behind with micro-fauna, soil quality etc. There are machines that collect burned cane and do so better, competing with the manual cutters. Living organisms absorb soot and CO_2 levels are not exempt either. The air is contaminated with particles in suspension and there is a high mortality of animals from burning. Organic cane without burning brought reintegration of the flora and fauna. There is environmental liability in sugarcane regions that must be resolved. The elimination of burning had already been imposed by the Government, but its time limit was extended. Now they are trying to reduce that period again.

There is a close relationship between manual cane cutting and the slave trade and productivity expectation. Of 140 companies inspected, all had labour problems and their recruiting methods need to be studied and regulated. Cane worker earnings fell since the seventies from R$ 2.79 to around R$ 0.80 per ton today. These people risk disablement without access to retirement. Death through exhaustion is a big problem. Since the reduction of working hours people began to intensify their efforts. Shifts began to receive energetic foodstuffs to replace salts and make the person much more productive. The working life expectancy of a cane worker is 10 years. A slave lasted 15 years in the 19th century. Lodging, food and tool costs hamper the cutter from saving money in order to return to their hometowns. In other words they are detained as slaves in economical terms. Informal contracting methods for manual cane cutting and its correlation to deaths should therefore be studied.

Water is another factor utilised in ethanol production and this comes from the environment – 3000 litres per ton of cane. Corn uses even more water. The Guarani aquifer is covered by cane and there have been many warnings concerning its contamination with herbicides. In some areas it is impossible to find a spring that isn't surrounded by cane, leading to pollution by pesticides at source.

Residues like vinasse are 10 to 12 times more than the volume of ethanol produced. There is enough knowledge regarding the use of vinasse as a fertilizer and regulation exists for its handling, establishing that mills plan for discarding vinasse, but often this is not respected and vinasse channels are created through the sugarcane plantations contaminating the soil and subsoil where there is no inspection.

There are no more agricultural expansions in wooded areas in São Paulo State. Slash and burn doesn't exist any more. State wide there are 20 million hectares of arable land and cane is expanding into pasture areas in the north and northwest. Being a low productive livestock area this is positive and offers the opportunity for the better use and conservation of the soil in those areas while still offering livestock integration opportunities. Climatic warming is improving the conditions for producing cane and this expansion is increasing

its competition with food production. Like the scenario of global warming there will be a big increase in food prices on a global scale.

The work carried out by the Secretary of Agriculture through IEA/Apta, supporting negotiations on the sustainability protocol was important in subsidising a voluntary agreement, very similar to certification, addressing cilia forests, soil conservation, aquatic resources, the use of pesticides, empty pesticide packaging and effluents, putting weight behind the justification of no tariff barriers. They arrived at a much broader protocol for certification involving economical, social and environmental interests, especially focussing on the issue of burning and that new areas should implement automated harvesting, and through this the onus would be against burning, conservation of the cilia forests and control of pesticides amongst others.

With 3.8 million hectares of native vegetation remaining and cane reaching 5 million hectares, if we were to comply with current legislation, between 740,000 hectares, and 1 million hectares of conservation area should be set aside.

The law says that 20% of the property should be conserved for nature and this is not viable because each property has differing characteristics. The problem is how to make a conservation policy that covers the social cost aspect of the activity. There is no rationality in each property having its own legal reservation, but there still is a need of having compatible reservation areas suited to the needs of São Paulo. Somebody will have to pay for that. Therefore the sector that deforested should reconstitute a continuous area. It would not be rational to scatter 1 million hectares throughout the sugar & alcohol sector, but it is viable to adapt legislation and obligate the restitution of uninterrupted areas, else the cane production environmental certification would be far from reality.

There are many Brazilian certification initiatives in the sector, and they are formed voluntarily involving willpower between several players. We have concrete examples of certification systems like Imaflora that involves most technological aspects and the Ethos Institute concerned more with behavioural aspects. Why was there no adhesion? Because there was not a differentiated public policy for those who adhered to it. At the time there was no great demand for ethanol but when that demand came it increased the demand for certification and more requests for certification were lodged. There are already certified organic sugars being marketed in a differentiated way. Certification involves a system of accreditation and certifications from Imaflora are already demanded.

Noble areas are for agricultural production and areas that are unsuitable for agriculture could be used for legal nature reserves. All of the mechanisms like APP, Legal Reserves, AC – whichever – benefit is social and must be divided between all members of society. The environmental benefit is universal but the cost of the social benefit should be met indirectly by the sugar & alcohol sector which is responsible for devastated areas as well as for its environmental liability and should be targeted by regulators for restitution action, seeking decontamination and creating areas of preservation in non productive areas.

The cost of maintaining the area and its reforestation is not high. Safeguarding the area for 10-15 years is enough for it to recover. The issue of water shortage in some areas could likewise be improved. Several possibilities can be put into place like reforestation farming that has been working very well for family producers, and through this, one can reallocate the labour coming from cane with the recovery of cilia forest areas, biodiversity maintenance, combating erosion and generating water.

The environmental liability of properties is enormous. The shortages of water and bush that allow infiltration have low remedial implantation costs. This has to be put into context – just as the glifosato herbicide which was more intensively applied with the adoption of transgenic crops – in such a way that the value achieved in these impacts is bilateral. Reforestation, for instance is labour intensive and when manpower is dismissed it can be reemployed in re-creating vegetation areas. Although the examples available are not clear in terms of results, reforestation has alternative arrangements that have successfully enabled the implantation of this conservation objective.

One notes that recovered areas are concentrated in cane areas. The correct thing would be to reposition legal nature reserve areas in the

state. The certification for ISO 14000 and 22000 require that the whole chain be integrated for certification and often certifications are issued in umbrella form. Society will receive an enormous benefit from conservation and group certifications enable the cost to be met.

Financing the research institutions and universities so that these can attend the sectorial demand for certification in an appropriate manner involves suggested residue analysis amongst others and seeking public policies to provide and implement infrastructure. Environmental certification involves significant analytical requisites for laboratory characterization. In other words, it is necessary to improve Public Institute Research laboratory infrastructure to enable those analyses. In the European Union there is a policy for quality that involves the productive environment with economical and environmental social quality. In the future we will have to be prepared for the demands of a new paradigm of sustainability.

The Dutch Head Office for Sustainability that evaluates ethanol in Brazil shows a concentration of social problems although high technological efficiency. However, more should still be invested in the tendency towards vertical productive expansion. The itinerary should prioritize the consideration of new technology optimization like hydrolysis and mechanisms for training cane cutters with a view to new jobs. It should have a specific technical council to organize a forum for discussion in order to create mechanisms and means for certification. One cannot leave the problem for later. Solid public policy has to be reached to bring importance to environmental norms and certification. Zoning, like public policy is essential, including the establishment of cultural positioning and diversity to add stability to the system.

FINAL CONSIDERATIONS

On the agenda concerning ethanol sustainability as a component of leading Brazilian energy sources, debates related to the economical, social and environmental impacts have been gaining importance thanks to scenarios that point to large expansion of sugarcane for ethanol production. Aspects related to the sustainability of the whole sugar & alcohol sector are also put forward in the understanding of these new dynamics, calling for studies aimed at identifying research issues that contemplate public policies towards sustainability of the whole ethanol production chain.

This chapter had the objective of documenting the June 2007 " Research Workshop on Ethanol Sustainability", as part of the tasks related to the project "Public Policy Directions for the Ethanol Industry of São Paulo State", as part of the Fapesp's Research Programme for Public Policies – PPP.

The workshop was guided by a term of reference focused on several analyses involving economical, social and environmental aspects, whose conceptual approach prioritized the role of institutions and organizations, production chain administration perspectives, the sectorial strategic vision for sustainability, prospective demands for institutional innovation and the proposal of public policies in C&T,I – Science, Technology and Innovation. It sought to encourage discussion around systems of sustainability indicators, implications for regulation, managerial decisions, as well as methodological and conceptual gaps. The workshop was thus structured in four panels: bio-energy scenarios and impacts of sugarcane expansion; coordination of the ethanol market; sugar & alcohol sector governance and social and environmental responsibility.

One perceives a scenario of huge global demand for ethanol in partial substitution for gasoline in developed countries. The production of cane as a raw material for ethanol production is going through a moment of heavy expansion, causing impacts in several areas, calling for profound studies to evaluate economical, social and environmental elements focussing on territorial planning and regional analysis. The production chain with its many parts requires studies on organizational fragilities and multi-focussed coordination. Forms of coordination, governance and sectorial self-management in force have brought great enrichment to the sector but there is a long way to go through research and innovation coordination.

Improvement in commercialization mechanisms and sugar & alcohol sector production chain coordination are paramount. Social responsibility research programs and environmental certifica-

tion are welcome. There is need for understanding agent indications and understanding those that finance the activity, thus creating incentives for better managerial practices including social and environmental responsibility, transparency and professionalization interpreted through corporate governance, value creation which can be identified by society.

It is also suggested that more articulation is necessary between various agents that are devoted to socioeconomic and environmental studies in the sugar & alcohol sector, motivated by public policies enabling research of a consistent long term type avoiding intermittent efforts. A unification of databases from all of the organizations is suggested through the integration of all those organizations enabling more concentrated research efforts.

Network arrangements were also emphasized as well as the need to support them in a regional and inter-regional form. This includes research funding agencies, private financiers, public scientific and technological research institutions and the productive sector. In agribusiness one sees concrete examples of research consortia and sectorial development. This type of arrangement enables the integration of data sources, as well as between the institutions that deal with and stock information along with those that work with data research and sectorial representations.

Production sustainability and the sustainable use of ethanol in economical, social and environmental dimensions are in dispute for scientific, technological and innovative public policies that reflect the integration of research efforts in understanding agent behaviour in their political and business strategies, creating organizational and institutional alternatives that reflect the national and regional interests in energy generation activities, food production and environmental preservation. This way it hoped to produce concrete answers for Brazilian society.

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