

## TBP01x - Best Practice - Week 6b

Hello, my name is Arnaldo Walter. In recent years sustainability of biofuels has been the subject of most of my research activities, and this is the subject of this session.

Sustainability is a normative concept, that means that it depends on the values and judgments of each person. In this sense, sustainability is a very broad concept. In case of biofuels production, for some people the main issue can be avoiding impacts on biodiversity, for others minimizing impacts on water resources is the priority.

Sustainability has been explicitly required from bioenergy, in general, and more specifically from liquid biofuels. This tendency started in 2007-2008, in the context of the food supply crisis and, also, as consequence of some concerns raised regarding the actual contribution of biofuels for reducing greenhouse gas emissions in comparison to fossil fuels.

In Europe, the main legislative driving force for sustainability of biofuels and bioenergy is the Renewable Energy Directive, from 2009. In US the regulation for the whole country, except California, is the Renewable Fuel Standard. The main sustainability criteria of these regulations are related with the following aspects:

- A minimum greenhouse gas saving is required, right now the minimum is 35% in Europe for instance;
- Feedstocks cannot be produced on land with high biodiversity value, such as primary forest;
- No raw material can be obtained from converted high carbon stock land (continuously forested areas is an example)
- And there is a maximum amount to be produced from food crops,

This presentation focusses on important aspects regarding the production and use of ethanol currently produced from sugarcane, in Brazil. As it is impossible to address many topics in short period of time, we decided to prioritize just two: greenhouse gas emissions and socio-economic impacts.

Here, we will not talk much about the "food versus fuel" issue because it is recognized in Brazil that large-scale production of ethanol, that occurs since mid-70s, has not been responsible for food supply problems or starving that, unfortunately, still exists in some regions, in Brazil. Food supply is related to aspects such as food availability and to the affordability to food. Generally speaking, in Brazil, there was an improvement of these two aspects in the last 40 years at the same time sugarcane production enlarged.

It is important to call your attention to particularities of the Brazilian case, as Brazil has plenty of land and weather conditions are, in many areas, adequate for agriculture.

Let's talk about greenhouse gas emissions. In Brazil these emissions have been accounted for many years. As reference, some papers with the main results of these assessments are presented in this slide.

Among all liquid biofuels currently produced, ethanol from sugarcane, as produced in Brazil, is the one with the best results.

All emissions along the life cycle of biofuels and fossil fuels should be considered, in order to have a good comparison figure. That means, in case of biofuels, it is necessary to consider the emissions of producing the feedstock, converting to biofuels and so on, down to the end use.

When feedstock production induces land use change, the positive or negative impacts of this change should be considered as credits or debits to the biofuels. Negative impacts can occur in case sugarcane displaces natural vegetation and positive impacts can occur when sugarcane is cropped in degraded lands, with low carbon stocks.

In case of Brazil, most of sugarcane production occurs in traditional areas, that means not causing land use change, or even displacing pasturelands, in case of expansion.

In case of greenhouse gas balances, as currently required in US, it is also necessary to take into account the possible impact of sugarcane expansion due to indirect land use change. An example is the deforestation that can be caused due to sugarcane expansion over pasturelands and the movement of livestock over natural vegetation. That impact can be only evaluated using economic models.

You can see in the figure the results of evaluations done taking into account the methodologies of the two main regulations in US and in Europe. In case of the regulations in US the credits due to fuel production are impacted by surplus electricity production using residual biomass of sugarcane.

For the EPA case that corresponds to US, the result presented in the figure corresponds to an average figure of surplus electricity production in Brazilian mills. The second difference is the value of emissions due to land use change, both considering direct and indirect impacts.

EPA has recognised the specific realities of ethanol production in Brazil and the impact is not so large. The avoided emissions, in the scenario that is shown - and this is one of scenarios that is accepted - would be reduction of 60% regarding gasoline.

The European directive doesn't consider the credits of electricity production and, so far, neither takes into account the emissions of indirect land use change. However, there is a proposal to consider these effects and an emission factor of 13 grams of CO<sub>2</sub> per Mega joule was presented. Considering this value, the result of avoided emissions would pass from 74% to 60% regarding gasoline.

What can be done in order to get better results? First, with mechanized harvesting it would be possible to reduce emissions due to direct land use change, even in case of sugarcane expansion. Second, with best agricultural practices it would be possible to enlarge yields, and the impact would be significant. Third, moving towards a more complex biorefinery, it would be possible to share the same emissions with more products. In particular, the impact

of larger surplus electricity would be huge, as already accepted in US. And fourth, transporting the feedstock and the fuel in a more rational way would also have an impact on the final emissions. Basically, all these are on-going actions in Brazil.

Socio-economic impacts, especially to those directly involved with biofuels production, have been considered a very important sustainability aspect. Both the directive in Europe and the Renewable Fuel Standard in the US do not have specific criteria on this issue, but all existing certification schemes have principles, criteria and indicators related to it.

On this matter, I would like to address four aspects: (1) number of employments and wages, (2) working conditions on manual harvesting, (3) labour law enforcement, and (4) well-being conditions in municipalities with large sugarcane-production.

The Government in Brazil uses to mention the results of an annual Census in order to give a figure of employees involved with sugarcane sector: by the end of 2010 this figure was about 1.2 million people, but from this total only 700 thousand were active employees; the difference corresponds to people that miss their jobs at the end of the harvest period.

A second important aspect to highlight is wages. On average, the formal education of the sugarcane employee is low (less than 6 years). The average income in 2010 was 390 Euro per month, that means about 60% higher than the minimum wage in Brazil at that time. Comparing to other agricultural activities, only the soy industry has higher wages than the sugarcane.

However, working conditions in the agricultural side are tough, mainly for sugarcane manual harvesting. [Slide 6] To give an example; when the Brazilian government launched a social program for improving labour conditions in the sugarcane sector, the picture used in the cover of the document showed exactly sugarcane cutters.

Fortunately, the tendency in the main producing regions is moving to mechanical harvesting. In some areas about 80% of sugarcane is harvest mechanically. But, on the other side, mechanization will cause unemployment of workers with very low skills, and policies are necessary in order to reduce social and economic problems in the regions they live. A single harvester displaces 90 workers.

In Brazil there is a regular audit of working conditions in the agriculture. This is done by the Federal Government and, in some states, this is also done by the local authorities.

The slide shows the evolution of irregularities, in sugarcane producing companies, in the period 2006-2011. The graph shows a stable or even declining tendency. A non-conformity does not necessarily represent an important violation of the labor law.

At the University we have developed studies in order to assess life quality in municipalities in which sugarcane and ethanol production occurs. The slide shows some results for the three main producer states in Brazil, from 1970 to 2010. Eight indicators have been considered, in

order to reflect wealth, wealth distribution, access to basic infrastructure, education and health conditions.

The results show that, comparing municipalities of the same population range, there is no single case in which the municipalities without sugarcane industry have better results than those in which sugarcane is important.

More than that, in some case, as in São Paulo, that is the main producer region, all indicators (except one, in 2010) of sugarcane producing regions are statistically better than those without this economic activity.

What can be done in order to get better results? Regarding the future of this issue I have a positive view. In Brazil people and the companies are much more conscious about sustainability and the relevance of socio-economic aspects.

With mechanical harvesting, working conditions will improve, but it is still necessary to develop policies for giving opportunities for people with low skills. And, for sure, the socio-economic dimension is very dynamic, and it is necessary to pay attention to all coming changes.

I hope you have enjoyed this session. And, hopefully, you'll have the opportunity to get information of other relevant sustainability aspects, such as biodiversity and water resources.

Thanks for your attention!