MASS AND ENERGY FLUXES OF BRAZILIAN AGRICULTURE PRODUCTION FOR EXPORTATION TO ASIA: SUGARCANE

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Extended Abstract

The Brazilian sugar cane agribusiness is an economic activity responsible for 2.2% of GDP, generating an income of over US$ 8 billion and creating approximately one million direct jobs: more than 400,000 in the State of São Paulo alone – the country’s largest producer State – as well as fostering the economic development of a large number of municipalities and contributing to the employment of a large number of workers in the rural areas.

The activity has a positive environmental differential that is the efficient production of fuel grade ethanol from sugar cane. The extensive use of fuel ethanol in Brazil, whether as a 25% blend with gasoline (gasohol), or used as a neat fuel in vehicles equipped with dedicated alcohol engines or used in the newly produced flex fuel vehicles, which can operate on neat ethanol, gasohol or any intermediate blend, places Brazil as a leader in carbon emission reduction and Greenhouse Effect mitigation. The production of ethanol in the 2003/2004 crop season will reach the significant volume of 14.4 billion liters and the Center-South region, which includes São Paulo State, will respond for 89.6% of the total 380 million tons of sugarcane. Moreover, the production of sugar reaches 24 million tons.

Brazil owns a positive handicap in relation to the rest of the world, regarding renewables use. During 2004, renewable energy contributed with with 43.9% of Domestic Energy Supply, while the world average in 2002 was of 13.6% and in the OECD’s countries of 6% (Figure 1 and 2). Moreover, as presented in Figure 3, most of Brazilian electric energy supply is based on hydro power plants (75.5%), either big or small (below 30MW).

Main figures of Brazilian trade with Asian countries encompassing agribusiness depict that sugar and ethanol trade is the second sector regarding mass flux, whilst the first place is occupied by far by soybean trade. Particularly, 30% of Brazilian trade with Asian countries encompasses agricultural products. In 2005 agribusiness was responsible for half of total exports of Brazil to Japan, Figure 6. This trade represents the 7th main destiny of Brazilian agro products, and taking into consideration only the Asian countries, it comes just after China, the main importer.

Brazil dimensions create a complex question when we analyze how to promote a development policy based on the expansion of agribusiness. In fact, most of the main transportation routes existing and to be finished crosses important ecosystems at several regions with a variety of biomes, namely at the Center-west, North and Northeast regions. The main producers States are São Paulo and Minas Gerais at the Southeast region, Paraná at the South, and Mato Grosso do Sul, Mato Grosso and Goiás at the Center-west. In 2005 the total production encompasses more than 6Mha of land. The evolution of land use to crop sugarcane is totally correlated with the increase in the total production, mainly since 2000. Moreover, during 2005 the ethanol production reaches 16 million m³. This figure puts Brazil as the largest producer and exporter of ethanol in the world.
Nevertheless, Brazilian sugarcane agribusiness became an important example of sustainable agriculture, mainly due to special combination of soil and weather conditions, presenting a high environmental performance based on the lower worldwide levels of erosion, as well as on the use of chemicals and pesticides, making use of biological control of plagues and of soil fertile irrigation with the organic residues from the sugarcane industrial processing.

The energy output/input ratio (either renewable or fossil) is 9.2, and the mean energy use in the sugarcane production as 190MJ/Ton of Sugarcane, and in the ethanol production as 46MJ/Ton of sugarcane, and took into consideration the figures of 1996 MJ/Ton of Sugarcane to the ethanol produced and 175 MJ/Ton of Sugarcane to the excess of bagasse.

The increase in the area of sugarcane crops for alcohol production causes the intensification of at least two great environmental problems: 1) the ecosystem degradation and atmospheric pollution related to the forest fires and, 2) the pollution of water resources due to the application of vinasse as fertilizer and irradiation.

The main mass fluxes within this characterization is described in the report “Assessment of GHG emissions in the production and use of ethanol in Brazil”, as issued in April 2004. The calculations the GHG emissions have been divided into four groups (MACEDO et al., 2004).

**Group 1** (the flows of Group 1 will not be calculated since the net balance is zero): Carbon flows associated with the uptake of atmospheric carbon by photosynthesis and its gradual release by oxidation.

**Group 2**: Carbon flows associated with the use of fossil fuels in the production of all chemicals and inputs used in the agricultural and industrial sectors for the production of sugar cane and ethanol, as well as in the manufacture of equipment, construction of buildings and their maintenance:

**Group 3**: The GHG flows not associated with the use of fossil fuels are mainly N₂O and methane; consideration was given to:

**Group 4**: This group includes what can be called “virtual” flows of GHG emissions; they would take place if, in the absence of ethanol, the fuel demand was met by gasoline and if in the absence of surplus bagasse, fuel oil was used. These emissions can be characterized as:

Regarding the GHG emissions, it can be divided into two groups: emissions derived from the use of non renewable energy (diesel and fuel oil) and emissions from other sources (cane trash burning, fertilizer decomposition). Figure 14 displays that for the first group the calculated value was 19.2 kg CO₂eq./TC, while the value determined for the second group was 15.3 kg CO₂eq./TC.

Moreover, the emissions avoided due to the substitution of ethanol for gasoline and surplus bagasse for fuel oil, deducting the above values, gives a net result of 2.6 t CO₂eq./m³ anhydrous ethanol and 1.7 t CO₂eq./m³ of hydrous ethanol.