LIFE CYCLE ASSESSMENT (LCA) OF VINASSE UTILIZATION IN BRAZILIAN SUGAR-ENERGY SECTOR

GARCILASSO, VANESSA PECORA[1]; COELHO, SUANI T.*[1]

*Corresponding author: Suani T. Coelho – e-mail: suani@iee.usp.br - phone: +551130912632

[1]Research Group on Bioenergy (GBIO)/Institute of Energy and Environment (IEE)/University of São Paulo (USP)

*Av. Professor Luciano Gualberto, 1289 – CEP: 05508-010 – São Paulo/Brazil

Topic 2. Sustainability, impacts and policies / Sub-topic: 2.2 Environmental impacts

Since the beginning of the Brazilian Alcohol Program, in 1975, the use of vinasse to fertirrigate sugarcane crops has been the selected solution for its adequate disposal by sugar-energy mills, considering the huge volume of this ethanol production by-product (10 to 14 m^3 of vinasse per m^3 of ethanol produced). Vinasse has an important content of potassium and other nutrients, which allows an increase in sugarcane agricultural productivity, in addition to the reduction in fertilizer consumption. Moreover, this vinasse disposal in sugarcane crops avoids its inadequate discharge in water bodies with negative environmental impacts. On the other hand, the practice of fertirrigation with vinasse can produce soil salinization and contamination of underground aquifers, if the dosage applied is not in accordance with the type of soil and sugarcane varieties.

In the state of Sao Paulo, as of 2006, the Environmental Company of the State of Sao Paulo (Cetesb) recommends the application of vinasse in the soil through the Standard P4.231, which determines the methodology to quantify the maximum volume of vinasse applied to the soil according to its physicochemical characteristics (mainly potassium content). The compliance with this rule avoids the excess of potassium disposal in the soil and contamination of underground waters. On another hand, the transportation of vinasse in long distances (considering the large areas of sugarcane crops) presents high costs, due to its high water content (95%). This problem has been addressed by some mills with the use of vinasse concentrators, which allows the reduction of vinasse sent to fertirrigation, as well as the expansion of the economic radius of transport. However, there are the additional costs of the concentration systems, not considered economical by several mills.

Vinasse fertirrigation has a high potential for greenhouse gases (GHG) emissions, including methane (CH_4) and nitrous oxide (N_2O). These emissions are due to vinasse high content of organic matter and nitrogen. The decomposition of organic matter under anaerobic conditions, that is, without the presence of oxygen, emits methane during storage and transport. To minimize these negative effects of the application of vinasse in the soil on GHG emissions, experts in the area recommend the development of best practices for the management of this residue.

As a possible solution to avoid such emissions, vinasse biodigestion appears to be an interesting option, since it reduces its organic load, also enabling the capture and use of the biogas produced in the process, mitigating methane emissions into the atmosphere. In fact, CO_2 emissions from biogas energy conversion or from its upgrade for biomethane are compensated in the photossynthesis process of sugarcane growth and can, in addition, be captured and stored (the so called BECCS – Bioenergy and Carbon Capture process). However, such process does not reduce the water content and the economic feasibility of its disposal in the cane crops continues to be a difficult.

The possibility of integrating the anaerobic digestion of vinasse with subsequent concentration is also considered, thus allowing to solve those important problems related to its disposal. The combination of biodigestion with concentration can be an advantageous option for sugarcane mills. With this combination, the biogas produced in the biodigestion process can be used to supply the energy consumption of the concentration process, in addition to the possibility of replacing diesel in the fleet used by the mill. The vinasse concentration system enables environmental and economic gains from the transport of concentrated vinasse, as it reduces the volume of vinasse sent to fertirrigation; in addition, it facilitates its distribution over long distances, avoiding the concentration of nutrients in the surroundings of the plants and eliminating the odor and methane emissions from vinasse decomposition.

In this context, this paper will analyse the impacts involved in the uses of vinasse generated in the sugar-energy sector, through LCA studies of different scenarios: (i) in natura vinasse (fertirrigation), (ii) vinasse biodigestion and; (iii) co-digestion (vinasse and filter cake joint biodigestion). In addition, LCA will also be performed adding vinasse concentration to each one of the above scenarios. For such vinasse concentration process, it will be evaluated a new process, under development in this project. This new process being developed corresponds to a vinasse electrolytic concentrator, a process under development on a laboratory scale. The figures obtained in the laboratory scale of this new process will be used in the LCA for each scenario in a near future, as illustrated in figure 1. The following impact categories will be analyzed in the study: Climate changes; Stratospheric ozone depletion; Human toxicity; Acidification; Ecotoxicity and Neutrofization. In this paper, the LCA results for each scenario will be addressed, but not yet with the electrolytic concentrator.

In fact, it is important to note that this work is part of a larger project (Project 56 - Potentialities in the Sugar-Alcohol Sector: valorization of vinasse, under development within the scope of the RCGI/POLI/USP).

Keywords: vinasse, sugar-energy sector, LCA

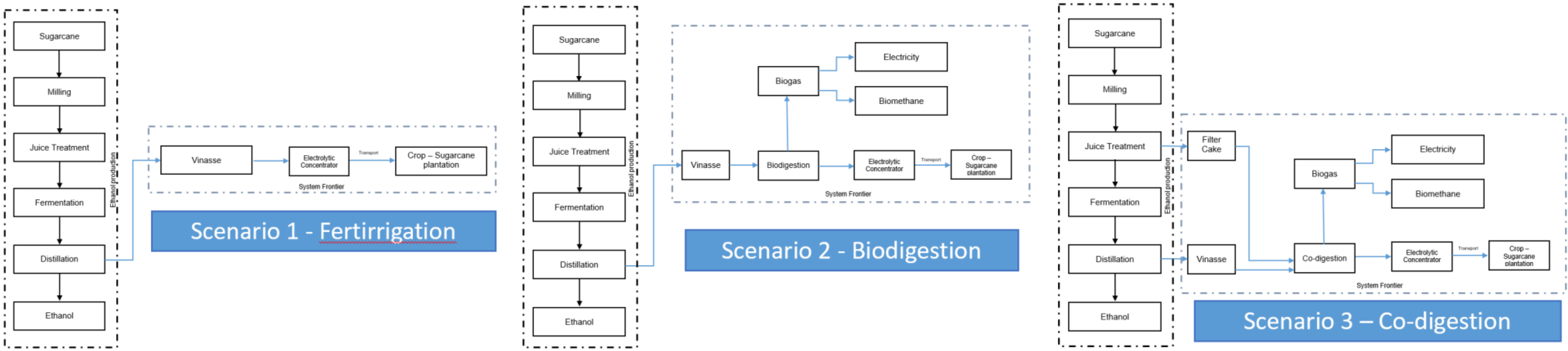

Figure 1. Assessment of the life cycle impact of the vinasse electrolytic concentrator in the sugar-energy sector. Source: Prepared by the authors.