



# 7<sup>th</sup> INTERNATIONAL WORKSHOP ADVANCES IN CLEANER PRODUCTION

“CLEANER PRODUCTION FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS”

## Analysis of the Life Cycle of the Bioethanol Production of the Sugar Cane. Case Study: Ingenio Risaralda S.A.

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### Abstract

The cultivation of sugarcane *Sacharum officinaru*, was introduced to Colombia in the fifteenth century, and due to the country's climate it has the advantage that it can be grown throughout the year. The Sugar Bioindustrial Cluster is located in the geographical valley of the Cauca River (Colombia). This productive sector was industrialized with its core business the specialization in the process of sugar production and then expanding its industrial activity to the production of biofuels (ethanol fuel) and to the generation of electricity. The main objectives for the sustainability of the sector are to seek the reduction of fossil fuel use in the world and the reduction of greenhouse gas emissions.

This work presents the results of the analysis of potential environmental impacts of the bioethanol produced at Ingenio Risaralda SA, based on Life Cycle Analysis (LCA) methodology. To obtain the results, the LCA stages were examined following ISO 14040 standard. Among these stages, the Life Cycle Inventory (LCI) phase was the most demanding, because it is the field data collection phase and its subsequent structuring for the LCA. With the inventory completed, the LCI information was introduced in SimaPro software, version 8.2.3. For the environmental impact analysis, the project focused on the ReCiPe Midpoint (H) method, which evaluates 18 impact categories. The system studied includes the bioethanol supply chain at the Ingenio Risaralda S.A. at the field, harvest, factory, distillery and electricity cogeneration phases.

It was found that the field phase is responsible for 4 of the 18 impact categories; that harvest phase contributes to 5 of the 18; the factory phase is responsible for 7 of the 18; the distillery phase contributes to 2 of the 18, and the cogeneration phase implies a positive environmental impact in the climate change category, since it uses the energy in the form of heat produced by the bagasse to generate steam and then through the use of turbogenerators to electric energy.

For 2015, the calculated emissions from the bioethanol production of sugar cane at Ingenio Risaralda S.A., were of 138 kg CO<sub>2</sub> eq / m<sup>3</sup>. This result is very good when compared to the data obtained by the climate change studies of the Sugar Cane Research Center (CENICAÑA) which for 2010 was 909 kg CO<sub>2</sub> eq / m<sup>3</sup> and for 2015 was 476 kg CO<sub>2</sub> eq / m<sup>3</sup>. The Ingenio Risaralda S.A. study showed an environmentally clean behavior, due to the non-use of coal in its heaters and boilers, besides it was assumed that the cogenerated energy sold to external customers was environmentally beneficial.

**Keywords:** sugarcane; bioethanol; Life cycle analysis; SimaPro software; potential environmental impacts.