Conceptual framework for considering life cycle and watershed vulnerability analysis in the environmental performance evaluation of agro-industrial innovations (Ambitec-Life Cycle)

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Since 2001, Embrapa performs impact assessments of agro-industrial innovations with the Ambitec-Agro system (Rodrigues *et al.*, 2003). Ambitec-Agro integrates social and environmental impact indicators in weighing matrices designed to compare the performance of an innovation against other existing technology, focusing the analysis at the innovation-adopting establishment scale. This study presents a conceptual model that aims to expand the scope of the Ambitec-Agro System by including life cycle and watershed vulnerability analyses to the environmental performance evaluation.

The life cycle assessment (LCA) of agro-industrial products is growing up with the development of models that consider emissions from the use of agrochemicals and their impacts on the environment. Although these models and the supporting agro databases were developed to Europe environmental conditions and need to be adapted to the environmental conditions of developing countries, the life cycle thinking can be promptly adopted, allowing the inclusion of other production phases beyond those specific of the agro-industrial establishment.

The consideration of the environmental vulnerability of a natural system that receives emissions related to production, use or disposal of agro industrial innovations is also important, since each system is affected differently depending of its socioeconomic and environmental characteristics. This concept is usually linked to the following factors: systems' exposure to pressures, sensitivity and adaptive capacity. These factors can be studied in a watershed scale to evaluate its vulnerability, considering agro-industrial environmental issues.

In order to develop this conceptual framework, the steps proposed by Malczewski (1999) to the delineation of a multi-criteria decision support model were followed. Figure 2 presents the conceptual framework of the Ambitec-Life Cycle model, showing a sequence of actions that need to be followed in order to plan the environmental performance evaluation of an innovation, to conduct the environmental vulnerability analysis of the watersheds where each life cycle phase occurs, to conduct the environmental performance analysis in each life cycle phase and in the overall life cycle. The framework includes four life cycle phases to the environmental performance evaluation of an agro-industrial innovation as compared with an existing substitute technology: raw material production, technology production, technology use and its final disposal. A set of indicators evaluates the vulnerability of the watersheds where given phases of the innovation and of existing technology life cycles are placed. The vulnerability index enters as a weight to those environmental performance indicators that are related to local or regional agro-industrial issues. The environmental performance evaluation, in a life cycle phase, is carried out by a set of environmental performance indicators that are aggregated in criteria, principles and in a phase index. The values assumed by the environmental performance indicators in each life cycle phase are aggregated in total indicators values, in criteria, principles and in the final life cycle index of an innovation and of the comparative existing technology. This framework provides a broaden view of the environmental performance of an innovation, shedding light on technological improvements along its entire life cycle.

References

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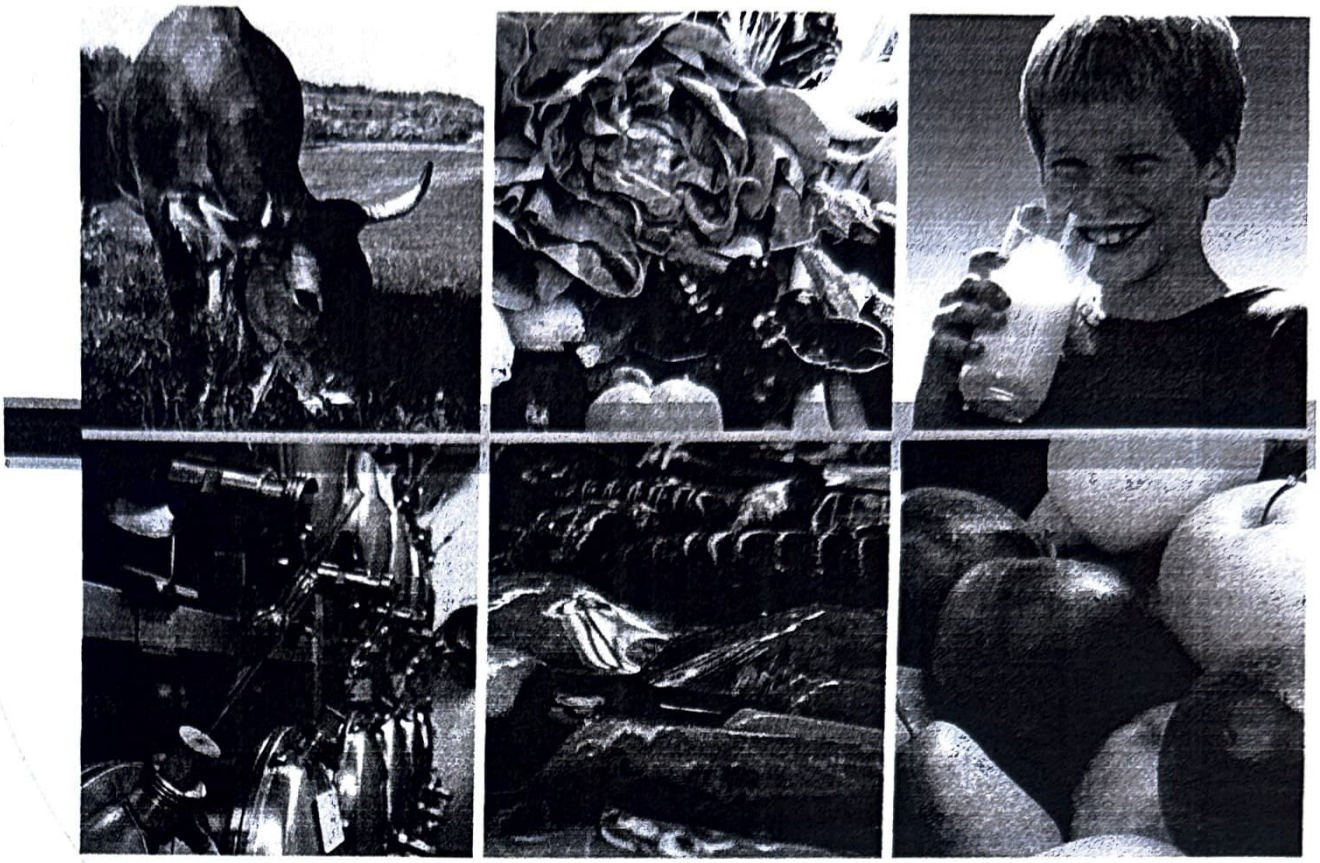

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