

## ASSESSMENT OF SOCIAL AND ENVIRONMENTAL IMPACTS OF CANOLA ON THE BIODIESEL PRODUCTION CHAIN IN SOUTHERN BRAZIL

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### ABSTRACT

This research aimed to assess the social and environmental impacts of canola on the biodiesel production chain, as well as to analyze sustainability indicators in a reference farm where canola is produced in the Passo Fundo region, state of Rio Grande do Sul, Brazil. Methodology included extensive literature review and application of two impact assessment tools: a) an Eco-certification system for rural activities (*Eco-cert.Rural*) with 24 criteria for evaluating production chain impacts, based on the input of 15 experts knowledgeable on the diverse segments of the biodiesel chain in the region of the study, and b) a System for weighted environmental impact assessment of rural activities (*APOIA-NovoRural*) with 62 indicators based on detailed interview and field analyses with a canola-producing farmer. The assessment led to the conclusion that in the Passo Fundo region the biodiesel production chain based on canola brings mostly positive impacts on the environment and for the livelihood of people involved in its production. Since it increases the use of farming inputs and off-farm resources, the aspects related to input and resources demands were less favorable. Canola production brought important contributions for the sustainability of the reference farm, with a general index of 0.77 (in a 0 to 1.0 utility scale).

**Key words:** Biofuel, canola, impact assessment, sustainability indicators, APOIA-NovoRural

### INTRODUCTION

Cultivation of canola (*Brassica napus* L. var. *oleifera*) in Brazil has increased markedly in recent years, reaching around 35,000 ha in the 2009 cropping season; in the southern states of Rio Grande do Sul (24,552 ha) and Paraná (8,364 ha) as well as in the central states of Minas Gerais (450 ha) and Goiás (200 ha) (TOMM, 2010). The acceptable levels of productivity obtained with the crop in the country are due to technologies recently adapted for the different growing regions, and to the adequacy of the production system based on succession to soybean crops under no-till management.

The Brazilian canola crop is essentially destined to the edible oil sector, with some interest on energy applications, stimulated by the Brazilian Agroenergy Plan. The use of vegetable oils for biodiesel production has been proposed as a renewable alternative to fossil fuels, while much controversy is still in place regarding possible negative impacts on natural resources conservation, as well as on social factors such as income generation and distribution, farmer training and technology adoption, food security among many other issues. These concurrent and potentially conflicting objectives may be better understood through environmental impact assessments, as proposed in the present study.

Numerous environmental impact assessment tools have been made available in the scientific literature, for the most varied scopes of analysis and working scales. Among the methodological alternatives consolidated for application at the agricultural production chain scale, a 'Base system for eco-certification of rural activities' (*Eco-cert.Rural*; RODRIGUES et al., 2006) has been used for studies in the agroenergy sector, allowing the analysis of criteria associated with socio-environmental impacts of implemented productive activities (RODRIGUES et al., 2007).

On the other hand, sustainability indicator systems have been proposed for application at the rural establishment scale, specifically addressing environmental management decision-making. Among these methods, a 'System for weighted environmental impact assessment of rural activities' (*APOIA-NovoRural*) has been applied toward the environmental management of oleaginous crops, under biofuel production contexts, in several regions of Brazil (RODRIGUES et al, 2009; RODRIGUES et al, 2010).

Building upon these methodological propositions and as continuation to previous studies, the present paper aims to assess the socio-environmental impacts of biodiesel production based on canola, both at the local production chain and the rural establishment scales, in the region of Passo Fundo, Rio Grande do Sul state, Brazil.

## METHODS

This work includes an extensive literature review and application of two environmental impact assessment tools, one directed toward the local production chain scale, and the other directed toward the rural establishment scale, as follows:

a) a 'Base system for eco-certification of rural activities' (*Eco-cert.Rural*), comprising 24 socio-environmental criteria and 125 indicators, assessed with basis on the input of experts knowledgeable on the diverse segments of the biodiesel chain in the region of the study. The data were obtained in a Delphi-type workshop, involving 15 institutional representatives who expressed their knowledge about the expected and observed impacts of the increasing demand on canola crop for biofuel production;

b) a 'System for weighted environmental impact assessment of rural activities' (*APQIA-NovoRural*), comprising 62 indicators formulated toward the systemic assessment of rural activities, according to five sustainability dimensions: i) Landscape ecology, ii) Environmental quality (atmosphere, water and soil), iii) Socio-cultural values, iv) Economic values and v) Management and administration. Data were obtained in a detailed interview and instrumental field and laboratory analyses, in a reference canola farm. The method entails multi-attribute analysis of the effects of the rural activities, with automatic calculation of sustainability indices expressed in utility values (0 to 1.0 scale, sustainability conformity level standardized at 0.7), according to appropriate weighting factors and best fit conversion models (RODRIGUES et al., 2010).

At the end of the study Environmental Management Reports were formulated and sent to the reference farmer and all participating experts. These reports emphasized positive and negative impacts, as well as technology adoption and alternative management practices, contributing toward local sustainable development. For methodological details, please refer to RODRIGUES et al., 2007; 2010.

## RESULTS & DISCUSSION

The assessment of impacts in the canola productive chain for biodiesel, as expressed by the 15 experts participating in the *Eco-cert.Rural* Delphi workshop, indicated that the National Program for Biodiesel Production has favored the expansion of the crop, both directly and indirectly. The indirect influence is related with the strong displacement of soybean oil for biodiesel production, opening a market share for canola as edible oil. The direct effect is related with firsthand acquisition of canola oil by the biodiesel mills.

With respect to the impact assessment proper, the experts pointed out that the ecological performance (first eight indicators in Figure 1) has shown some negative indices for canola production, even if considering no-till management. These negative impacts were essentially related to use of inputs, resources and energy, due to an increased dependency on external production means under the incremented demand in the biodiesel chain context. Specifically, increased use of herbicides, fungicides and diesel for spraying operations were pointed out, although subjected to a high level of divergence among experts, as shown by the large standard deviation observed for the criterion (Figure 1).

The remaining ecological performance criteria have shown positive or unaltered indices, with soil quality being highly improved, as a result of the no-till production system (Figure 1). Small improvements have been observed also in the biodiversity conservation and the environmental restoration criteria, as influenced by integration of canola production into local productive arrangements for biodiesel, which call for compliance with legal nature protection legislation, as proposed by the participating experts.

The Socio-environmental performance criteria were invariably positive (Figure 1), with special reference to farmer training and technological capacity, income generation and income sources diversification, food security, and institutional relationship (which involves indicators of technical assistance, association/cooperation initiatives, technological affiliation, and continued training). These indicators explain also the positive influence observed in the farmer capability and dedication, and the trade arrangements criteria, as submitted to the improved conditions offered by the local organization of the biodiesel production chain.

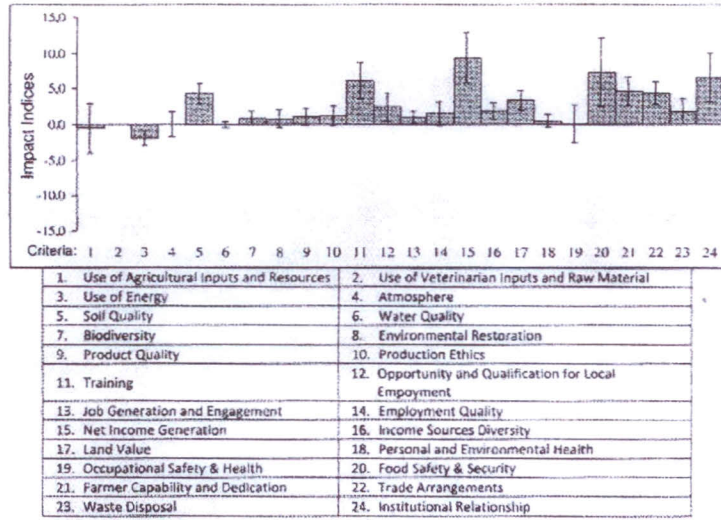


FIGURE 1. Mean values and standard deviations for the socio-environmental criteria evaluated with the *Eco-cert.Rural* indicators system, as expressed by 15 experts on canola production for biodiesel in the Passo Fundo region (RS, Brazil).

The farm sustainability analysis indicated that canola production has brought positive impacts in most of the dimensions considered in the *APOIA-NovoRural* indicators system (Figure 2). Only the 'Landscape ecology' mean index (0.62) was shown to be below the reference baseline (0.70), as the reference farm did not fully meet the requirements regarding mandatory Legal Preserve (defined in Brazilian legislation). It must be emphasized, however, that this condition has not been caused by canola production, but interferes negatively in the sustainability index, nonetheless. Conversely, the 'Environmental quality' dimension (atmosphere, soil, and water) presented indices above the modeled baseline, with special reference to water quality (0.90 – Figure 2). The dimensions related to Economic values as well as Management and administration also presented high mean performance indices (0.85).

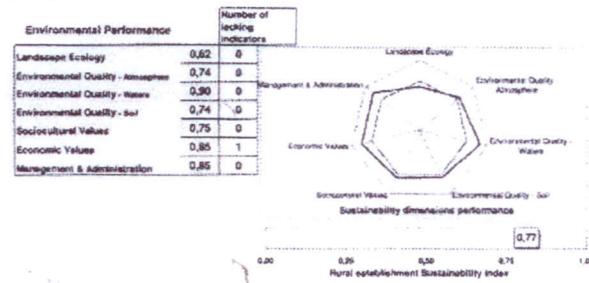


FIGURE 2. Sustainability index in the reference canola producing farm studied in Passo Fundo (RS, Brazil), according to the assessment dimensions of the *APOIA-NovoRural* indicators system.



**CONCLUSION**

Biodiesel production based on canola in the Passo Fundo region, Rio Grande do Sul state, Brazil, has shown to bring mostly positive impacts for the environment and for the livelihood of people involved in the production chain. On the other hand, increased oil demand under the biodiesel production context has imposed intensive use of inputs, resources and energy, causing the criteria related to ecological performance to be less favorable. Canola production has brought important contributions for the sustainability of the reference farm studied, with a general performance index of 0.77 in a 0 to 1.0 utility scale.

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