Distribution of impacts in Biofuels Industry: applying Social Life-cycle Assessment

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Abstract

This paper considers how Social Life-cycle Assessment (S-LCA) might support the inclusion of equity issues into ethanol production decision-making. We have conducted a case study of a particular sugarcane bioethanol mill, interviewing 36 stakeholders based in and around the site of production in Sao Paulo, Brazil. The conclusions indicate the stakeholders have an overall positive perception of the local mill, presenting just minor caveats that can be mitigated or solved with management measures.

Defining equity

Equity matters are a core component of sustainable development objectives, including the reduction of social inequalities and poverty (WCED, 1987). Environmental justice literature defines equity issues as how different communities or social groups bear the risks, burdens or benefits associated with environmental impacts resulting from particular activities, policies, plans, developments or technologies (Gross, 2007, p2729; Walker and Bulkeley, 2006; Edwards, 1995, p36). Distributional justice and procedural justice are interlinked, core components of environmental justice (Walker and Bulkeley, 2006; Schlosberg, 2007); distributive justice is concerned with the social patterning of costs and benefits as a result of a phenomenon and procedural justice describes the fairness of decision-making processes (Walker, 2012; Schlosberg, 2007, p517). It is thought here that these concepts provide a useful means of approaching an assessment of inequalities associated with the production and consumption of a product, such as a biofuel.

The 'equitable distribution' of impacts or an 'equitable decision-making process' are difficult assessments to approach. Competing value judgements about what is fair or just will exist as people's particular socio-economic circumstances, cultural beliefs, or the extent to which they regard themselves as 'winners or losers' may affect their judgements (Walker, 2010). Judgements are contextual, dynamic and subject to change (Stankey and Shindler, 2005) and there will always be flexible, heterogeneous and plural discourses of justice (Schlosberg, 2007). There will be great scope for disagreement about what constitutes a 'good' or sufficiently robust analysis (Walker, 2010).

Dealing with equity, however, need not be a matter of seeking agreement as to whether or not there is a single 'distributional justice' overall, or attempting to 'make all things equal', as the social costs and benefits associated with a particular product or biofuel's use are likely to be many, complex and varied. Rather, equity matters can be 'opened up', explored and brought to the fore through an assessment process of the nature described in this study, with information obtained used to improve knowledge and understanding of the system and present back to different stakeholder groups for dialogue and deliberation about how particular issues might be tackled or mitigated. Inclusivity and participatory processes handled well, however, are paramount to this process and the quality of distributional analysis and subsequent policy decisions as a result of this assessment (Grineski, 2006; Walker, 2012, p62; Stirling et al, 2007).

S-LCA as a framework to explore equity matters

Life-cycle Assessment (LCA) is an established method for sustainability appraisal, despite its only partial coverage of sustainability ideals. LCA provides a means of mapping environmental impacts of a

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product's life-cycle from production to disposal, using quantitative information about the use of natural resources and energy inputs/outputs (UNEP, 2009). In relation to biofuels, LCA is commonly used to assess greenhouse gas (GHG) emissions reductions compared with fossil fuel use. Social Life-Cycle Analysis is a tool that aims to extend coverage of the more traditional and environmentally-focused LCAs by allowing qualitative information to be gathered through stakeholder engagement along the product's life-cycle (UNEP, 2009). S-LCA aims being to help include a diverse range of knowledges and worldviews into LCA assessments, provide more holistic analysis of a product's sustainability and help identify 'hotpots' along the chain where particular negative or positive issues concentrate (UNEP, 2009, p5; Isaksson et al, 2010). Guidelines currently fall short of prescribing how stakeholders might be identified to ensure diversity and inclusivity or how the distribution of the impacts or equity issues might be considered. It is rather a 'top-down' process; to date the method has not been fully tested; completed assessments appear to have involved mainly desk-based research rather than stakeholders' interviews (for example, Blom, 2009) and there is a need for carrying out S-LCAs empirically (Lorek, 2011). This paper shows how the current approach might be extended to cater better for equity issues both in terms of inclusivity of stakeholders as well a means of being able to see how impacts are shared amongst people involved or affected by a particular product (in this case, a biofuel).

The approach adopted uses the S-LCA as a framework for conceptualizing and mapping the life-cycle of the biofuel from production to consumption, and then 'populates' it via a stakeholder analysis and then qualitative data gathered from semi-structured interviews with people from these different stakeholder groups to identify the ways in which they experience social and economic impacts associated with this trade. The results from this can be structured and viewed as a 'distributional analysis', where benefits and costs can be analyzed across stakeholders along the life-cycle as well as within particular stages (for example, at the site of production). This approach uses established human geography and social science research methods, including grounded theory and data analysis using a process of coding and allows a 'bottom-up' and inclusive approach to the analysis.

Although S-LCA allows the distribution of impacts to be considered across the complete life-cycle, for the purposes of this short paper, only the assessment of the production stage will be presented here.

Case study: testing the theory in Brazilian sugarcane bioethanol

Biofuels are controversial forms of renewable energy, attracting widespread debate and a plethora of publications contesting their ability to deliver sustainable ideals. Concerns over increased use of biofuels include how the environmental, social and economic burdens, risks or benefits are shared amongst different stakeholder groups involved or affected (NCB, 2011). A biofuel therefore makes an ideal product on which to focus this case study and test the approach advocated above.

In this case study, 36 interviews were conducted with stakeholders from localities at key stages in the supply chain from the site of production at the Usina Sao Joao (USJ), a family-owned mill in Araras, Sao Paulo, Brazil (summarized in Table 1). The mill has been in operation for over 70 years producing ethanol and sugar from sugarcane feedstocks and employs around 2,000 staff (Grupo USJ, 2004). Sugarcane is mainly grown on the USJ's own plantations therefore production and processing stages of the supply chain (in life-cycle terms) have been integrated into a single 'production' stage of the S-LCA process. USJ processes meet higher levels of biofuel sustainability standards than stipulated by EU law or the EU Renewable Energy Directive (EU RED) (Grupo USJ, 2004).

Table 1: Summary of interviews completed in Araras, Sao Paulo, Brazil (Production end of the supply chain)

Sector	Sub-category (identified from Phase 1 Research)	Totals
Public Sector	Local Government inc Health, Education, Environment and Social Inclusion Officers, Doctor, School Principals and staff	**8**
Private Sector	Sugarcane cutters, production and processing workers, local traders, large and small scale producers, fuel distributers/traders,	**13**
Research Community		**1**
Civil society	Biofuel auditors, NGOs, Voluntary Organisations, Trade Unions, families of workers, women, older people, people on lower incomes, young people	**14**
	TOTAL	**36**

**Everyone above consumes bioethanol in general fuel consumption but none are specifically included here as consumers of the bioethanol product from USJ. Sales of bioethanol from USJ for internal markets have not been tracked.*

Findings

A diverse range of positive and negative social and economic impacts were found to be experienced by stakeholder groups in and around Araras as a result of the production and processing of this fuel, with more positive impacts found than had been expected. The majority of interviewees, whether directly employed by the mill or living in the vicinity, talked positively of the USJ mill overall, its production and processing operations and the wide range of social, environmental and economic benefits this mill has brought to the area.

It was evident that the high level of corporate social responsibility exercised by this mill over many years – long before they were required to do so by laws or sustainability certification schemes – is a major driver of these largely positive findings. New laws and standards were found to have brought further benefits although the costs of meeting these schemes are high and are likely causes of some of the negative impacts being experienced by specific groups. The main impacts across individual stakeholder groups, identified by interviews conducted with these people, are summarized in Table 2 below.

Table 2 - Major impacts found across individual stakeholder groups

Stakeholder Group	**Perceptions**
Local residents	Positive economic benefits due to **increased employment opportunitie**s for workers of all levels, men and women in the industry or other local trades and businesses as a result of the mill's operations. **Development of local community services and infrastructures** across health, education, leisure and recreation facilities as a result of investments made by the USJ. Some interviewees talked of less investment in local community services recently which may be indicative of the high levels of investment the USJ has needed to invest in its own operations to comply with employment laws and sustainability standards. **Education services** were thought to have particularly benefited from this industry due to USJ-funded School and University. The School provides places for children from Araras as well as those whose parents are employed at the mill. **The reduction of burning** has helped create a more stable community due to reduced influx of migrant workers during harvesting periods and workers retained in the industry have longer-term contracts. This has helped improve educational attainment in the local state School as children and their parents build relationships with others in the community and become more settled. The reduced numbers of transient workers has helped reduce impacts and strains on local services and infrastructures during harvesting periods generally. One interviewee talked of concerns over environmental clean-ups due to the industry and reduced air quality during times of burning, however the general consensus was that this had improved considerably recently due to the new regulations. Some interviewees talked of poor air quality from dust from roads due to the high level of traffic, particularly trucks to and from the mill. **Displacement of food crops to surrounding states** had occurred over many years due to the sugar industry, not because of biofuels specifically. People felt that although food prices may have risen this was due to other factors in the system and they had risen in line with wages and economic development in general locally and therefore this was relative. Agricultural productivity was thought to have improved as crops were being grown where they grow best; surrounding states' climates were thought to have better environmental conditions more conducive to growing some of these food crops and the hot, dry climate of Araras was particularly suited to sugarcane. Food crops would need a lot more energy and natural resource inputs to grow well. Some interviewees were concerned about the **over-reliance on this industry for local residents** and talked about the dangers of specialization. There is a need for other businesses in the area to prevent economic collapse if the industry was to fail or was taken over.

Table 2 (cont) - Major impacts found across individual stakeholder groups

Stakeholder Group	Perceptions
Small-scale producers	The high investment costs needed to comply with national laws and higher level sustainability laws were found to be causing problems for small-scale producers; they are less able to compete with larger-scale operations and those with **access to resources and finances**. Problems were also talked about in terms of **young people not aspiring to go into the industry** in general, particularly small-scale farming. However, some were benefiting from reliable markets if they become an out-grower for a mill (i.e. which processed the feedstock for consistently buoyant sugar and ethanol markets. A local orange grower talked of the need to replace his orange groves with sugarcane because there is no market for this food produce and it is not worth harvesting the crop. Sugarcane production provides a steady and consistent income. All the costs associated with meeting employment laws and sustainability standards were felt to be falling on producers; consumers are not helping meet costs despite demands (particularly from European buyers) for higher sustainability standards and producers are unable to charge a premium for their product even if meeting a higher level scheme. Producers of bioethanol were thought to have been subject to much higher levels of scrutiny than other producers of other agricultural commodities.
Workers	Reduced numbers of cutters required due to mechanisation but **more skilled positions available**, re-training schemes (to become mechanics and drivers), longer-term contracts and better working conditions generally - **better and more highly paid** than in other parts of the agricultural sector. Professional development opportunities are available at all levels, for men and women, both directly within the industry or mill itself, or through auditing and certification bodies. The least educated are less likely to be able to access these opportunities and therefore this could be an area for targeted improvement by the mill and a means of attracting people into the industry.

Conclusions

The S-LCA framework is proposed in this paper as a means for identifying and exploring socio-economic impacts of a biofuel product through the collection of qualitative information from high levels of stakeholder engagement along the product's life-cycle. Although this work was completed across the entire life-cycle, from production to consumption, this paper focuses down on the production and processing stages of the chain which occur in this case, in and around a mill in Araras, Sao Paulo, Brazil.

Using grounded theory, rich information about the distribution of impacts across these stakeholder groups has been obtained and presented, which could be used to supplement other quantitative or environmentally-focused LCA data, to promote more holistic understandings of a biofuel's sustainability which includes equity issues. This information could be used by actors and institutions across public, private and civil society sectors as a basis for exploring and making decisions about trade-offs or adaptive policies and actions that can reduce negative impacts, increase levels of distributive justice or disseminate learning about how positive outcomes are being effected (which may be applied to other products). However, in order for this to be done effectively, it requires commitment to time and resources and social science research skills.

The information produced by these methods can provide a means of contesting claims about the industry or particular biofuel products through grounded evidence. It is recognized that this study is just one case and the reasons that more positive impacts were found than had been expected are largely due to the high levels of corporate social responsibility exercised by the USJ and strong national legislation being enacted in Brazil. While findings such as these may not be found across the whole of the industry the study demonstrates the potential for using this type of approach to bring forward evidence of impacts and equity issues across complete product life-cycles which could be used to identify and reduce negative impacts relating to specific products and technologies.

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