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## Towards social sustainability: Screening potential social and governance issues for biojet fuel supply chains in Brazil

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## ABSTRACT

Social dimension appears to be the least developed of all dimensions of sustainability, not receiving the same attention as environmental or economic dimension. While biomass utilization is considered to have considerable impact on the social well-being of farmers and local communities, a better understanding of its social sustainability is urgently needed. The process for determining social issues, however, is subject to relatively arbitrary decisions, and lacks comprehensive structure. Social issues must be based on those social objectives and indicators that can be empirically measured and analyzed using at the existing level of knowledge and data available. This study, therefore, aims to identify the most important and relevant social and governance issues for the biofuel sector, and also to determine the issues for which reliable data and practical methods may become available and ultimately simplified for understanding by stakeholders. The sugarcane biojet fuel supply chain in Brazil was used as a case study with a research design of two steps: literature review and expert survey. From the literature review, 13 social issues and 5 governance issues were selected for inclusion in the expert survey. The survey results showed that highly relevant issues were generally perceived as highly important. Furthermore, very practical issues were also perceived as very reliable and simple issues. It was concluded that future research should mostly focus on quantitative assessment of human health and safety, labor rights, working conditions, which were perceived very important but less reliable, practical, and simple. Moreover, this study showed that all governance issues are certainly regarded as important for sustainability, but insufficiently recognized in conventional sustainability assessment schemes. The current certification schemes cover only a limited number of social issues and require addressing social issues more broadly. Learning from this study helps decision makers to extend understandings of the social dimension of sustainability.

### 1. Introduction

Concerns over both climate change and rapidly declining stocks of fossil fuels, due to ever growing fossil energy consumption, has driven the need to search for alternative fuel options. Biofuels have been developed as a cleaner alternative to fossil fuels, and are especially relevant to sectors which cannot easily use other renewables, such as the long distance transport and aviation sectors. As a result, global production of biofuels has increased continually over the last decade. Agreements, such as the recent ICAO aviation target for renewable fuels have further driven the demand for biofuels worldwide [1]. In turn, this is expected to further benefit biofuel producers and other supply chain actors over the world [2]. However, the expansion of biofuel production has been linked to a number of negative impacts, such as biodiversity loss, food insecurity, infringement of labor rights, the loss of

indigenous or minority communities, and land tenure issues. We are witnessing, therefore, an increased debate at local, national, and international levels concerning negative impacts of the expansion of biofuel production. Although several notable studies exist in the field of biofuel sustainability, these focused mainly on the environmental and economic performance of sustainability rather than the social performance [3–8]. As noted by several authors, thinking around the social performance of sustainability has been relatively neglected, and is far less developed than discourse surrounding economic and environmental dimensions [9–12].

In order to assess the social performance of the biofuel sector, it is necessary first to define the relevant social issues. Often, studies on sustainability lack a prescribed procedure to decide upon the set of social issues to be examined. As a result, studies with otherwise similar approaches examined widely different social issues [13]. In the case of

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biofuels, only a limited number of studies have attempted to define social sustainability issues and indicators [14–16]. These studies, however, which defined issues for the three dimensions of sustainability (environmental, economic and social), did not consider the social issues in depth. In addition, these studies have primarily focused on the evaluation of management practices and their associated social effects, rather than on practically quantifiable social objectives. Social issues must be based on those social objectives and indicators, which can be empirically measured in accordance with the current availability of data and level of knowledge. Furthermore, despite a need for defined quantifiable criteria, social issues of sustainability should not be based on a uniform framework, and rather be selected on a case-by-case basis [15]. Selecting appropriate issues is crucial and considerably affects the assessment results, since these issues are also dependent on national and regional contexts [13,15]. In addition, effective and well-defined governing strategies will likely improve not only social sustainability, but also interconnections of sustainability dimensions (i.e. environmental, economic, and social). Very little attention, however, has been paid to the role of governance issues in sustainability, and specifically social sustainability, thus far [17]. Therefore, it is necessary first to select social and governance issues that are important, i.e. issues essential in assessing the sustainability of a supply chain; and second, selecting social issues that are relevant, i.e. issues that are appropriate and contribute to a better understanding of the social sustainability. A set of relevant and important issues alone, however, is not sufficient for the assessment of social sustainability. Other factors paramount here are the availability of reliable data (that the assessment results are reliable and reproducible), and if there are suitable scales, measurement units, and/or methods that can process these data. Moreover, social issues should be simple and understandable for stakeholders and the results of social sustainability assessment should be audible.

In light of these factors, the objective of this study was to identify the social issues based around the following characteristics: relevance, reliability, practicality, importance, and simplicity. A further aim was to define the most important governance issues. As the world leader in sugarcane production and exportation, the sugarcane biojet fuel supply chain in Brazil was chosen as a case study. In 2011 and 2015, sugarcane biofuel supplied 15.7% and 16.9% of the Brazilian national energy demand respectively [2,18]. Sugar crops, such as sugar cane, sugar beet and sweet sorghum, can be used as feedstocks for both conventional biofuels (ethanol via fermentation of sugar) and/or advanced biofuels. Fermentable sugars can also be converted to drop-in biofuels (i.e. biojet fuel). Brazil is predicted to soon become a leading domestic air traffic market. Currently using of 6 Mton/year in jet fuels and with a predicted 4.5% annual growth rate the required jet fuel in 2050 amounts to over 20 Mton/year. In line with ICAO agreements on emission reduction this should be fully replaced by renewable fuels [19]. Brazil therefore has a great opportunity to also become a global player in the area of aviation biofuel [2]. Over the past years, a number of piloted flights was operated within and to Brazil in order to show the technical possibility of safe air travel. However, the scale-up of biojet fuel for regular air transport is completely in its infancy and price levels are still high compared to fossil fuel (especially at today's oil price).

This study attempts to elucidate the major challenges, shortcoming, and barriers for comprehensive social sustainability assessment. Due to integrative nature of sustainability, attempts to address social issues, and measures of social performance not only may facilitate communication between different stakeholders, but also understanding how environmental decision-making can effect economic performance, or how social actions can influence the environment [20]. Hence, this study improves the focus of the scientific community to address the inter-relationships and interactions amongst the three dimensions of sustainability by means of governance. Therefore, defining the relevant and important social and governance issues can aid constructive dialogue for policy and decision makers who intend to form policies to improve the social performance of the biofuel sector in general and

biojet fuel supply chain in particular [16,21].

## 2. Methodology

The research design for this study was based on a two-step approach: 1. literature review, and 2. expert survey. First, a literature review was conducted aiming to identify the vast array of social and governance issues that are already in use by sustainability frameworks or empirical studies at global, regional or local scales within the biofuel sector. The literature review provided a conceptual perspective regarding sustainability issues and their practical applications in the biofuel sector. Second, these issues were presented to experts in the biofuel sector, knowledgeable and experienced in the biojet fuel supply chain, to capture a wide variety of perspectives. Using these two approaches in parallel brought not only multiple considerations to the table, but also highlighted critical areas, potential consensus and differences between literature and expert opinion.

### 2.1. Literature review

Literature review was performed to identify a list of social, and governance issues. In order to obtain a wide perspective regarding social issues, the review was focused on the bioenergy and biofuel sectors in general, given that biojet fuel technology and its market is still in a largely developmental phase and thus scientific reports and publications solely for this sector are limited. The current literature review focused on studies from peer-reviewed scientific journals and on scientific reports from different organizations, such as the Organization for Economic Co-operation and Development (OECD), Global Reporting Initiative (GRI), or the Food and Agriculture Organization (FAO). The time period was defined from year 2004 to 2016. The search engine Google Scholar and the databases Web of Science and Scopus were used for literature search. The search for studies was primarily through the structured keywords: sustainable development, sustainability frameworks, sustainable supply chain, sustainable biofuel, sustainable bioenergy, social sustainability, social and socio-economic issues, governance issues, sustainability issues (themes, sub-themes, attributes, aspects, criteria, and categories). The review process of this study consisted of three steps.

The first step was to identify the most widely discussed social and governance issues from the biofuel sector. In order to perform this step, the reviewed literature was considered as either conceptual or empirical [13]. In general terms, conceptual studies focused on the development of a common language, frameworks, and guidelines for sustainability assessment, whereas empirical studies focused on the analysis of actual observations or measurements of qualitative and/or qualitative data. The main reason for categorizing the reviewed studies as conceptual or empirical was to facilitate the second step of literature review. The literature review regarding conceptual studies was not restricted to bioenergy or biofuel sector, since there are a large number of sustainability reports and frameworks from different organizations such as GRI, OECD and FAO, that defined frameworks for sustainability in general with a useful approach applicable for all sectors. Two sustainability reports, namely the G4 Sustainability Reporting Guidelines' and the FAO Sustainability Assessment of Food and Agriculture systems (SAFA), were selected as benchmarks to facilitate the review process [22,23]. The G4 report on sustainability reporting guidelines, commissioned by GRI, includes a set of generic sustainability issues for industry, which were used in this report [23]. GRI, however, recognizes that each sector will have to develop additional sector-specific issues that reflect individual characteristics of different types of industrial activities. Therefore, to reflect the specific characteristics of the sector and better capture interests and concerns of the relevant stakeholders in the biofuel sector, it has been necessary to adapt or omit some of the GRI issues. SAFA guidelines, commissioned by the FAO, also defined the essential issues of sustainable food and agriculture systems along

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