Indirect Land Use Change Risk Certification for Biofuels

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Contributor: Beike Sumfleth, Stefan Majer, Daniela Thrän

Indirect land use change (ILUC) is considered a significant challenge, resulting from an increasing demand for biomass and bioenergy. On a political level sustainability certification of biomass-derived products is discussed as one potential instrument to manage the risk of ILUC. However, extending existing schemes towards a credible and reliable certification approach to account for ILUC-risks is still an open challenge. To develop such a certification instrument, so-called “additionality practices” are gaining relevance. Such practices include measures that an individual producer can adopt to provide an amount of biomass in addition to the business-as-usual feedstock production. In preparation of an integrated assessment framework for low ILUC-risk certification, a gap analysis is presented that examines whether trade-offs that may arise from the use of such additionality practices are considered already in existing sustainability certification schemes for biofuels.

Keywords: additionality ; assessment ; biomass ; certification ; low ILUC-risk ; trade-off ; sustainability

1. Introduction

Direct and indirect land use change (DLUC & ILUC) effects represent significant risks resulting from an increasing demand for biomass and bioenergy, induced by international trade in global markets [1][2]. In international trade, sustainability certification of biomass-derived products can help to understand and verify risks and establish a certain level of sustainability [3]. Product value chains are becoming increasingly complex as a result of globalization and outsourcing [4]. Therefore, standards and certification schemes can play an important role in co-regulated markets to pursue sustainable value chains [5]. Co-regulation is characterised by a combination of sustainability obligations for value chains in specific sectors, legislated by countries, and private control mechanisms (e.g., certification schemes) that allow companies to demonstrate compliance with these sustainability obligations [6]. A prominent example of such a co-regulatory approach is the use of private voluntary certification schemes recognised by the European Commission (EC) to assess biofuels [7]. These biofuels must meet a set of mandatory sustainability criteria, such as the conservation of high-carbon or highly biodiverse land, required to count towards the bioenergy targets set out in the European Union (EU) Renewable Energy Directive (RED) [8]. Therefore, to verify compliance with these sustainability criteria, voluntary certification schemes have been developed, focusing specifically on biofuel and bioenergy production and taking sustainability principles into account [9]. As biofuel consumption increases over time, the role of voluntary certification schemes to account for ILUC effects becomes increasingly important [10].

However, the development of a credible and reliable certification approach to address ILUC is still an open challenge [11]. To develop such a certification instrument, a risk-based approach aimed at certifying biofuels with low ILUC-risk has been discussed at the political and scientific level over the last decade [12]. Finally, at the policy level, the EU RED 2 has set out a low ILUC-risk approach for the certification of sustainable biofuels [13]. As recently reviewed, this approach is characterised by the use of practices that an individual producer can adopt and that aim to reduce ILUC risks by increasing relative efficiency and providing an additional amount of biomass compared to a reference case [14]. To date, however, there are no studies or publications available which analyse what trade-offs might arise from the use of additionality practices and whether and how voluntary certification schemes developed for certifying biofuels address these trade-offs.

In preparation of an integrated assessment framework for low ILUC-risk certification, a gap analysis of potential trade-offs that may arise from the use of additionality practices is presented. In this sense, a gap analysis is either a tool or a process for determining the difference between the current state and a desired future state of a system [15]. The following examples show various approaches to gap analysis that are used in research on the sustainability certification of biobased products. For example, Majer et al. 2018 identified relevant gaps in relation to existing certification criteria by comparing the results of a comprehensive literature review on certification schemes and standards with the trends and opinions formulated in expert interviews they conducted [11]. Moosmann et al. 2020 compared the main sustainability risks in the biobased economy identified in an expert survey with an inventory of policy documents on the biobased economy at EU and EU Member State level identified in a desktop research [16]. Mai-Moulin et al. 2021 developed a set of effective sustainability criteria for bioenergy based on a review of the sustainability criteria in the RED 2 and in existing national legislation and voluntary certification schemes, with the aim of identifying possible gaps and good practices in certification [17]. In **Table 1**, all abbreviations which have been used are shown.

Table 1. Abbreviations used.

Abbreviation	Full Form
2BSvs	Biomass Biofuels Sustainability Voluntary Scheme
AFi	Accountability Framework initiative
AP	Additionality practice
AP Chain integration	Improved production chain integration of byproducts, waste, and residues
AP Increased yield	Increased agricultural crop yield
AP Livestock efficiencies	Improvements in livestock production efficiencies
AP Loss reduction	Reduction in biomass losses
AP Unused land	Biomass cultivation on unused land
BIKE	Biofuels production at low ILUC Risk for European sustainable bioeconomy
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DLUC	Direct land use change
EC	European Commission
EoL	End-of-Life
EU	European Union
GHG	Greenhouse gas
ILUC	Indirect land use change
ISCC	International Sustainability and Carbon Certification
ISEAL Alliance	International Social and Environmental Accreditation and Labelling Alliance
ISO	International Standard Organization
LCC	Life cycle cost
LUC	Land use change
RED	Renewable Energy Directive
RSB	Roundtable on Sustainable Biomaterials
RSPO	Roundtable on Sustainable Palm Oil
RTRS	Round Table on Responsible Soy
SAF	Sustainable aviation fuels
SOC	Soil organic carbon
SQC	Scottish Quality Farm Assured Combinable Crops
STAR-ProBio	Sustainability Transition Assessment and Research of Bio-based Products
SURE	Sustainable Resources Verification Scheme
TASCC	Trade Assurance Scheme for Combinable Crops
UFAS	Universal Feed Assurance Scheme
WHO	World Health Organization

2. Indirect Land Use Change Risk Certification for Biofuels

Additionality practices are defined as any improvement process, increasing the efficiency of already used resources, and any measure that enables the planned use of previously unused resources for the production of an additional amount of biomass compared to a baseline scenario. In addition, additionality practices avoid displacement effects of existing users and are produced under schemes appropriate for the sustainability certification of low ILUC-risk biomass-derived products (modified from [13][14][18][19]). **Table 2** provides an overview of additionality practices that are potentially to be applied in the sustainability certification of low ILUC-risk biomass, identified by the STAR-ProBio project [19] and a recent review of additional literature and practices [14]. For each additionality practice, the authors identified potential methods for implementation and verification in certification practice.

Since the publication of Sumfleth et al. 2020 [14], the EC has adopted an Implementing Regulation on 14 June 2022 that addresses, among other things, criteria for low ILUC-risk certification. It focuses particularly on increased agricultural crop yields and biomass production on unused land, as well as how to demonstrate the additionality of low ILUC-risk biomass. In particular, for increased agricultural crop yield, the regulation proposes so-called “yield increase additionality measures” that economic operators can apply to increase their yields and produce additional biomass eligible for low ILUC-risk certification. These measures are grouped in categories, such as mechanization, multi-cropping, and management. For example, management includes the following additionality measures: (1) soil management, (2) fertilization, (3) crop protection, (4) pollination, and (5) other (to leave room for innovation). Because these measures are intended to increase crop yields without compromising sustainability, the regulation emphasizes the need to consider trade-offs between short-term yield increases and medium- or long-term deterioration of soil, water, and air quality, as well as pollinator populations and the homogenization of agricultural landscapes [20]. The assessment of such trade-offs represents one of the key challenges for low ILUC-risk certification presented in **Table 2**.

Table 2. Overview of additionality practices (AP) with their main characteristics, an example of an approach for determining the amount of low iLUC-risk biomass, and challenges for certification practice, modified from [14][19].

Title of AP	Main Characteristics	Example of an Approach for Determining the Amount of Low iLUC-Risk Biomass	Challenges for Certification Practice	References
AP Unused land [1] 	• Taking an unused plot of land into agricultural production without expanding and replacing existing (biomass) users; • Land that has not been used to provide services for a certain period of time in the past (e.g., abandoned, degraded, or marginal land).	**Actual amount of harvested feedstock:** • Definition of unused land; • Site-specific investigation to demonstrate unused land status; • Assessment of land use rights; • Assessment of land cover and land use; • On-site audit to verify the results of the site-specific investigation (optional); • Determination of amount of low ILUC-risk biomass based on actual yields and the size of the previously unused area.	• Assessing potential trade-offs; • Avoiding free-riding issue; • Defining reliable and reproducible criteria for selection of unused land, applicable worldwide; • Demonstrating additionality; • Developing tools for the selection of appropriate land; • Considering low intensity land users, e.g., shifting cultivation.	[21][22][23][24][25][26][27]
AP Chain integration [2] 	• Increasing the number of products manufactured directly from existing, but inefficiently used or unused biomass; • Integrating biomass into other land-based production systems (e.g., livestock feeding), to use existing arable land for biomass production; • Applicable in feedstock production (e.g., wheat straw) and biomass conversion (e.g., oilseed meal).	**Establishing a positive list of EoL products:** • Definition of whether a material is an End-of-Life (EoL) product, such as waste; • Determination of a feedstock-region combination based on EoL product; • Certification scheme publishes a periodically updated positive list including feedstock-region combination; • If only a share (%) of the total annual production of the EoL product can be included in the positive list, only this part is low ILUC-risk.	• Assessing potential trade-offs; • Avoiding free-riding issue; • Demonstrating additionality; • Developing a single indicator from a variety of partially different approaches; • Identifying potential byproduct, waste, or residue streams; • Weighing between simplicity and high effort in identifying suitable biomass streams.	[21][22][23][25][26]

Title of AP	Main Characteristics	Example of an Approach for Determining the Amount of Low iLUC-Risk Biomass	Challenges for Certification Practice	References
AP Livestock efficiencies [3] 	• Increasing the productivity per unit area without taking more land into production (e.g., increase in cattle density per ha); • Establishing a livestock productivity baseline to compare that with an above-baseline improved productivity; • Amount of biomass produced on land become available from above-baseline livestock productivity could be certified as low ILUC-risk.	**Low ILUC-risk potential (cattle production):** • Definition of a baseline with no change in cattle productivity; • Comparison of the baseline with productivity improvements per animal or animals per hectare; • Area become available by increasing productivity per unit area; • Amount of biomass, which can be produced from this area could be low ILUC-risk.	• Adjusting the approach to arable farms cultivating cropland; • Assessing potential trade-offs; • Avoiding free-riding issue; • Demonstrating additionality; • Determining baseline livestock productivity and above-baseline livestock productivity; • Transferring this approach developed for regional ILUC-risk assessment to an indicator, tailored for certification.	[28]
AP Increased yield [4] 	• Efficiency improvements of an existing area of arable land; • Establishment of a baseline crop yield to compare that with an above-baseline crop yield; • Above-baseline crop yield and resulting amount of biomass could be certified as low ILUC-risk.	**Moving trendline yield:** • Trendline yield is compared to a dynamic baseline yield, which bases on yields of similar producers in the same region; • Trendline moves each year in relation to the actual observed yields; • First year trendline based on yields of year 0 and 1; • Second year trendline based on yields of year 0, 1, and 2, etc.	• Assessing potential trade-offs; • Avoiding free-riding issue; • Considering yield variations; • Demonstrating additionality; • Determining baseline yield and above-baseline yield; • Selecting an appropriate yield data source.	[21][22][23][24][25][26][29]

Title of AP	Main Characteristics	Example of an Approach for Determining the Amount of Low iLUC-Risk Biomass	Challenges for Certification Practice	References
AP Loss reduction [5] 	• Increasing the efficiency of a product value chain by reduction of biomass losses to produce additional biomass; • Additional amount of biomass is used directly for the production of biobased products that could be certified as low ILUC-risk; • Applicable in feedstock production (e.g., post-harvest losses) and biomass conversion (e.g., biorefinery concepts).	**Low ILUC-risk potential (post-harvest loss reduction):** • Definition of a baseline with no change in post-harvest losses (expressed in mass fractions of losses); • Comparison of the baseline with a post-harvest loss reduction scenario; • Amount of biomass prevented from being lost in the post-harvest loss reduction scenario could be certified as low ILUC-risk.	• Assessing potential trade-offs; • Availability of consistent data (e.g., post-harvest losses); • Avoiding free-riding issue; • Demonstrating additionality; • Determining baseline and loss reduction scenario; • Transferring this approach developed for regional ILUC-risk assessment to an indicator, tailored for certification.	[28][30]

[1] Biomass cultivation on unused land, [2] Improved production chain integration of byproducts, waste, and residues, [3] Improvements in livestock production efficiencies, [4] Increased agricultural crop yield, [5] Reduction in biomass losses.

As the main contribution to this regulation, a guideline for low ILUC-risk certification has been developed [31]. This is based on a low ILUC-risk methodology and an approach to pilot projects in specific regions to test this methodology [32]. The methodology is derived from the requirements for low ILUC-risk certification of biofuels set out in the RED 2 (see [13]) and the Delegated Act 2019/807 (see [18]) and is developed for yield increase projects and projects that take unused, abandoned or severely degraded land into production. For yield increase projects, a management plan including a dynamic yield baseline and the results of an additionality test is checked in a baseline audit. The additionality test is based on an analysis of the financial attractiveness or non-financial barriers of the project. Projects that take unused, abandoned, or severely degraded land into use must demonstrate the status of the land. For example, an economic operator must demonstrate that the land has been used for food or feed production in the past and that the cultivation of food or feed has ceased for biophysical or socio-economic reasons. In the case of abandoned and severely degraded land, additionality does not have to be verified by means of an additionality test. For other unused areas, however, an additionality test is mandatory [32]. It needs to be noted that the issue of demonstrating additionality and avoiding free-riding are important to any additionality practice, as can be seen in **Table 2**. In addition, the results of applying the methodology in each pilot project have been published [33][34][35][36][37].

The project BIKE (Biofuels production at low ILUC Risk for European sustainable bioeconomy) published a report on criteria and indicators taking into account the additionality practices of increased crop yield and growing crops on abandoned or severely degraded land for low ILUC-risk certification [38]. In another outcome of this project, a meta-analysis shows that there are significant opportunities in Europe to grow additional, environmentally friendly oil and lignocellulosic crops for biofuels using sustainable agronomic practices to increase the yield of such crops and to grow biomass on unused, abandoned and degraded land [39]. An outcome of the STAR-ProBio project is a practical, user-friendly tool for estimating the ILUC-risk of individual biomass feedstock producers, which also identifies how the use of certain additionality practices, such as increased agricultural crop yields, could substantially reduce this risk [40]. The project GOLD investigates the production of low ILUC-risk biofuels by growing selected high-yielding lignocellulosic crops on contaminated land, which can be attributed to the additionality practice of biomass cultivation on unused land [41].

A recently published study proposes to develop a national strategy to mitigate the risks of ILUC from industrial palm oil expansion in large palm oil producing countries such as Indonesia and Malaysia. To this end, an ILUC mitigation approach that could be applied as a novel additionality practice specifically in low ILUC-risk palm oil certification is proposed. The approach concerns industrial oil palm farms. The palm oil of these producers could be certified low ILUC-risk if the producer establishes one or both of the following two options: (1) integrating annual crops of small-scale crop farms that have been displaced and become landless as a result of the expansion of large-scale oil palm producers into immature oil palm plantations, and (2) integrating livestock of small-scale livestock farms that have been displaced and become landless as a result of the expansion of large-scale oil palm producers into mature oil palm plantations. With the integration of the displaced small-scale farms in the industrial oil palm farms, these small-scale farms do not need to take new land into production to maintain their production. Therefore, the palm oil produced on the large-scale oil palm farms that integrate displaced small-scale farms does not induce ILUC and can be certified as low ILUC-risk palm oil [42].

The International Sustainability and Carbon Certification (ISCC) considers, as part of the CO_2 emissions mitigation instrument CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation), the following additionality practices: (1) yield increase, (2) cultivation on unused land, and (3) use of byproducts, residues or wastes for low land use change (LUC) risk sustainable aviation fuels (SAF) feedstock production [43].

From the developments described above, researchers conclude, on the one hand, that there is an urgent need (EU policy framework for low ILUC-risk biofuels) and a high level of interest (research projects, publications, and practical applications of certification approaches for low ILUC-risk biofuels) for the additionality practices studied in [14]. Therefore, potential trade-offs that may arise from the use of these additionality practices are also likely to be of interest to policy makers, researchers, biofuel producers and certification practitioners. On the other hand, the additionality practices identified in [14] currently appear to represent the state of the art for certifying biofuels with low ILUC-risk. In particular, increased agricultural crop yield, biomass cultivation on unused land, and improved production chain integration of byproducts, waste, and residues appear to be of relevance for low ILUC risk policies and certification practices, as the work presented above shows.

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