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Abstract: This paper summarises the evidence regarding the impact of biofuels on equity, before going on to examine the equity dimensions of the most commonly used, formal methods of biofuel sustainability assessments - the EU's voluntary certification schemes. Although there has been an increased focus on the ethical dimensions of biofuels in the academic literature, equity does not yet feature in a robust way in these forms of sustainability appraisal and therefore the extent to which poverty or social inequalities are reduced or exacerbated for those affected remain unknown. It is suggested that the inclusion of multiple voices and perspectives within sustainability assessments are likely to help fill this 'equity void' and deliver more sustainable and equitable outcomes for people affected.

Key Words

Biofuels; Equity; Sustainability assessment; EU.

Highlights

- Peer-reviewed papers on the social disparity resulting from biofuels are limited.
- In addition, few papers or sustainability appraisals specifically address equity.
- An equity focus is necessary so that the least powerful do not bear the costs
- Including multiple voices and perspectives in sustainability assessments will help.
- Filling the 'equity void' will deliver more sustainable and equitable outcomes.

Introduction

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2 Renewable, low-carbon forms of energy, including biofuels, are regarded by many as essential
3 components for underpinning economic and human development while avoiding environmental
4 degradation and the exhaustion of finite natural resources^[1]. By following sustainable development
5 principles^[2] renewable energy sources can help reduce global social inequalities through the
6 provision of access to energy for all whilst reducing greenhouse gas (GHG) emissions. Since the
7 1990s, biofuels have been promoted as a sustainable alternative to fossil fuels, particularly in the
8 transport sector. The current policy landscape consists of 31 national biofuel mandates in addition to
9 26 state or provincial level and, in 2013, production totalled 87 and 26 billion litres of ethanol and
10 biodiesel respectively^[3]. The lack of alternatives to petroleum and diesel created political support
11 for biofuels despite controversies concerning relative carbon savings^[4-6], competition with food
12 crops^[7,8], and land use change^[9-11]. Many of these issues highlight the potential for an unequal
13 distribution of the benefits and burdens associated with the production and consumption of
14 biofuels. Whilst biofuel policies have not been withdrawn as a result of these concerns, some
15 governments have introduced sustainability criteria, involving mandatory sustainability assessments,
16 to minimise the negative impacts of biofuels^[12]. These assessments have largely focused on so-
17 called first generation biofuels i.e. those produced from food crops, commonly sugarcane and maize
18 for bioethanol, and soy and oil palm for biodiesel. However, even with a shift to second-generation
19 biofuels, which make use of agricultural and food wastes or by-products, environmental and social
20 impacts will occur and there are important lessons to be learnt from the experiences with first-
21 generation biofuels. In particular, it is important to consider how sustainability criteria might be
22 strengthened to incorporate equity matters and thus ensure the benefits for some are not
23 outweighed by worsening the economic, environmental, health and social wellbeing of others^[13].
24 This paper focuses on the equity dimensions of a set of the most commonly used, formal methods of
25 biofuel sustainability assessments – the voluntary certification schemes of the European Union (EU).
26 It shows that, although there has been an increased focus on the ethical dimensions of biofuels in
27 the academic literature, equity does not yet feature in a robust way in these forms of sustainability
28 appraisal. Therefore, the extent to which poverty or social inequalities are reduced or exacerbated
29 for those affected remains unknown. This paper summarises evidence regarding the impact of
30 biofuels on equity, arguing that the inclusion of multiple voices and perspectives within sustainability
31 assessments are likely to help fill this ‘equity void’ and deliver more sustainable and equitable
32 outcomes for people affected.
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Equity, justice and biofuels

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48 In line with Brundtland sustainable development ideals^[2] if biofuels are used, rates of consumption
49 should not hinder the natural replenishment of the environmental systems on which they rely. Their
50 consumption should also contribute to the pursuit of social and economic development that
51 improve qualities of life, reduce social inequalities, and reduce poverty. Furthermore, biofuel
52 developments should respect environmental justice principles, especially distributive justice to
53 promote inter- and intra-generational equity^[2,14].
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58 Distributive justice can generally be defined as the ways in which the benefits and burdens of our
59 lives are shared between members of a society or community^[15]. More specifically, it is concerned
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1 with the fair allocation of resources among diverse members of a community, including the total
2 goods to be distributed, the distributing procedures, and distribution of the associated outcomes
3 ^[14,16]. These goods are wide-ranging and diverse but can be defined as the benefits which improve a
4 person's capabilities to enjoy a decent quality of life, and include access to adequate shelter,
5 nutrition, meaningful employment and the ability to take part in community life with safety, dignity
6 and respect ^[17,18]. A close connection is evident between distributional justice and other dimensions
7 of environmental justice, such as procedural justice and recognition. For example, there is greater
8 opportunity for a more equitable distribution of outcomes if decision-making processes recognise
9 affected stakeholders and give their perspectives adequate attention and respect. Outcomes are
10 likely to be more equitable where these processes are inclusive, robust, transparent and fair ^[14,19,20].
11 Relevant decision-making processes, include those that seek to reduce the negative impacts of
12 biofuel production and consumption on communities and environments, such as voluntary
13 certification schemes ^[12]. To respect sustainable development and environmental justice ideals, the
14 development and use of biofuels should help to improve qualities of life for all those affected or, at
15 the very least, should not exacerbate or intensify existing social or environmental inequalities.
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21 This paper defines equity in terms of matters of recognition, distributional and procedural justice
22 and, within this context, this paper argues for a greater focus on equity in assessments of biofuel
23 sustainability. Furthermore, making judgements about the equity of biofuel systems requires an
24 understanding of contextual factors, including political processes, local institutions and the initial
25 social conditions ^[18]. A judgement about equity will depend on the dimension of equity that is the
26 focus at any one time and who is making that judgement ^[21,22]. Our intention here is that by
27 revealing and exploring equity matters, practices and procedures might be adapted or re-shaped to
28 ensure effects that are claimed to be unjust are adequately identified, investigated and resolved.
29 The focus is therefore to seek improved understandings of who is affected and involved in framing
30 what is just or unjust and how ^[23,24]. Not least, from this new knowledge, it may be possible to
31 ensure that the poorest and least powerful actors, often those living near sites of feedstock
32 cultivation, do not bear the burdens associated with increasing global demand for biofuels.
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39 Taking this as the normative rationale for understanding equity issues within assessments of biofuel
40 sustainability, it is apparent that social and environmental dimensions have equal significance to
41 sustainable development ideals and equity matters. Yet current sustainability assessments of
42 biofuels are generally stronger regarding environmental sustainability and, in particular, the GHG
43 balance ^[25-31]. This is of concern since populations in the Global South, where much biofuel
44 expansion is occurring ^[3], are likely to bear a greater proportion of the costs of growing demand for
45 biofuels. In 2011, the Nuffield Council on Bioethics called for the sustainability of biofuels to be
46 considered against the extent to which there is more equitable sharing of the burdens and benefits
47 across those involved or affected by the production and consumption of these fuels ^[32], a view
48 echoed elsewhere ^[28,33,34]. Increasing equity in biofuel systems will require greater transparency and
49 legitimacy, in order that multiple voices are taken into account in all phases of the biofuels value
50 chain, particularly those of less powerful actors.
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57 ***Reviewing the evidence on biofuels and equity***

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1 A 2013 review found that evidence was limited regarding the social impacts of the expansion of
2 biofuels at the household scale ^[35]. At that time, there were only 17 peer-reviewed articles
3 presenting primary data and, whilst none specifically focused on the equity impacts, all highlighted
4 social impacts that reflected an inequitable distribution of benefits within the system. Ten of the
5 seventeen papers found biofuel introduction had led to increased social disparity ^[36-45]. The majority
6 alluded to the differential concentration of wealth to richer farmers, since the required assets (e.g.
7 irrigation infrastructure and investments needed to comply with sustainability certification schemes
8 or become integrated with supply chains that provide access to European markets) limit involvement
9 to those with more capital or greater access to information ^[29,45]. Similarly, other authors ^[36,39,46]
10 have concluded that negative livelihood implications are more likely for poorer smallholders,
11 especially vulnerable groups such as female-headed households.
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16 Peer-reviewed, primary research published since 2013 regarding the social impact of biofuels at the
17 household scale in the Global South has found similar results. Given limited space, here we focus on
18 two biofuel feedstocks that have generated controversy, *Jatropha curcas* (hereinafter Jatropha) and
19 oil palm, of which there are two common species *Elaeis guineensis* and *Elaeis oleifera*. With regard to
20 Jatropha, most studies have found mixed social impacts. For example, Favretto et al. ^[47] found that
21 Malian smallholder farmers could benefit from rural electrification, as well as from the use of
22 Jatropha fences to clearly demarcate land and reduce land conflicts. In Mozambique, Mali and
23 Tanzania, Romijn et al. ^[48] found some evidence of disputes over land access and compensation
24 coupled with positive food security perceptions. Also in Mozambique, Slingerland and Schut ^[49]
25 found that benefits primarily accrued to actors involved in Jatropha production rather than
26 throughout the entire value chain, who were typically located in areas which already had good
27 infrastructure. In Ghana and Ethiopia, Timko et al. ^[50] found that a lack of local consultation had led
28 to a decrease in local household landholdings, with concurrent negative impacts on livelihoods, food
29 security, and socio-economic status. Acheampong and Campion ^[51], also in Ghana, reported that
30 land loss led to violent conflicts between biofuel investors, traditional authorities and local
31 communities.
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39 Turning to studies that have focused on oil palm, in Indonesia, Lee et al. ^[52] found adverse
40 environmental impacts resulting from agricultural expansion by both smallholders and large-scale
41 private enterprises. To control expansion, Sayer et al. ^[22] argue for greater governance focused on
42 the alleviation of rural poverty. In Guatemala, Mingorría et al. ^[21] conclude that while oil palm
43 plantation workers may earn more, it may have detrimental on other aspects, such as food security
44 and social relationships. Cramb ^[53] found unequal access to information was leaving customary
45 landowners vulnerable to exploitation from joint-venture schemes with large-scale plantations and
46 producers in Malaysia. Finally, in response to the large-scale expansion of oil palm, Yengoh and
47 Armah ^[54] call for local-level land needs assessments in order to ensure sufficient land is available for
48 biodiversity corridors, food-production and other social and cultural activities. However, whilst these
49 papers address the social impacts resulting from the expansion of these feedstocks, no paper
50 specifically dealt with the impacts on equity, which results in a lost level of detail, particularly
51 regarding distributive justice. Further, these studies focus on stakeholders in producer regions and
52 thus exclude a broader focus on equity matters across all those affected by global biofuel supply
53 chains.
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1 More than a decade has now passed since political support for biofuels emerged and yet, as the
2 papers briefly reviewed here show, there remains little primary research on whether and how the
3 increased production and consumption of biofuel improves or exacerbates social divides, inequities
4 and poverty. However, such information is key in order to fully integrate the equity impacts of
5 biofuels into sustainability assessments and awareness of the importance of equity is slowly
6 increasing in the academic literature. For example, recent research, which uses an equity lens to
7 examine the sustainability outcomes of biofuels, has shown that the promotion, cultivation and
8 consumption of biofuels results in an uneven distribution of winners and losers ^[55]. This research,
9 which compares the sugarcane-ethanol systems of Brazil, Ethiopia and Guatemala, demonstrates
10 that explicit consideration of equity outcomes alters the conclusions of sustainability assessments.
11 Other recent papers that begin to explicitly incorporate equity do so in hypothetical manner, not
12 grounded in primary data, but providing a conceptual basis for how to proceed. Creutzig et al. ^[28]
13 argue that a place-specific perspective is important, as it highlights the distributional consequences
14 that are a crucial complement to aggregate outcomes. The authors argue that place-specific case
15 studies should be coupled with global models in order to integrate livelihood and equity
16 considerations into scenarios of future bioenergy deployment. This connection is also raised by
17 Florin et al. ^[56] who argue that much of the indicator-based literature does not acknowledge the
18 importance of case-specificity nor the link between the processes and circumstances that drive
19 indicator results. These authors have developed a conceptual model that links drivers (such as
20 decisions and circumstances of a biophysical, socio-economic and governance nature with relevance
21 at field, farm and higher levels) with indicators in order to justify the relevance of the indicators. This
22 paper builds on others and concludes that particularly relevant indicators for equity include,
23 transparent community consultation, compensation for losses, terms of contracts, equitable access
24 to resources that facilitate livelihood activities (particularly land, but also credit, skills, energy and
25 labour) and descriptive accounts of patterns and changes in access to such resources ^[56-59]. Venghaus
26 and Selbmann ^[60] go further and argue that the consideration of distributive justice alone is
27 insufficient, and contend that procedural and compensative justice must also be included. These
28 authors create a framework for incorporating these distinct elements of justice, as shown in Figure 1
29 and which is explained at length in their paper.

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41 **<insert Figure 1 here> Figure 1.** Structural overview of sustainability requirements related to biofuel
42 production and use ^[60].

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The following section bounds the review of sustainability assessments to those regarding biofuels entering the European market. Such assessments typically focus on the production end of the value chain, where many of the negative social and environmental impacts of biofuels occur. However, as Hodbod et al. ^[55] argue, it is also important to consider the processing and consumption phases of biofuels in order to ensure that the distribution of the impacts along the entire value chain are incorporated.

Sustainability Assessments of Biofuels in the EU

The EU has been a key player in the promotion of biofuels, and the 2009 Renewable Energy Directive (RED) created one of the biggest global markets for biofuels. It is also one of the few markets to address the sustainability impacts of biofuels and does so via mandatory sustainability criteria, which

1 all biofuels sold within the EU are required to meet. The principle aims of the criteria are to ensure
2 minimum GHG emission reductions, and to prevent the conversion of areas of high biodiversity and
3 high carbon stock for the production of raw materials for biofuels ^[61]. There are also voluntary
4 criteria for soil, water and air quality, and some social criteria regarding the impact on food prices
5 and adherence to International Labour Organisation conventions ^[62]. In order to demonstrate
6 compliance with the criteria, suppliers must show their biofuels conform to one of nineteen schemes
7 that are recognised by the EU. Member States are responsible for ensuring these criteria are fulfilled
8 and must accept all certification systems recognised by the European Commission; however, as each
9 Member State is entitled to develop its own criteria (which could also be stronger than the EU
10 scheme) this means there could be 28 different national certification schemes recognised by the
11 Commission ^[63]. This has created a great deal of variation in scope and coverage of environmental
12 and social issues across these schemes. Some schemes go beyond the baseline criteria in the EU
13 RED, while others include no social criteria at all, as shown in Table 1 ^{[Footnote 1] [12,34,57,64, 65, 66]}.

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21 The social component is not the primary focus of the EU's sustainability assessment – in fact, it
22 appears that social issues are an afterthought in terms of regulatory mechanisms that seek to
23 mitigate the impacts of biofuels ^[34]. As a consequence, only a small proportion of biofuels consumed
24 within the EU have been accredited by schemes that consider the wider social issues for local
25 communities in producer regions (see Table 1). Instead, the vast majority of certificates awarded
26 were for ISCC and 2BSvs certification standards ^[65], the latter of which contains no social
27 components ^[55] whilst several authors have found weaknesses in the ISCC's approach to social
28 sustainability ^[34,57]. While comprehensive, inclusive stakeholder engagement (including local
29 community consultation) is considered a bedrock of the sustainability assessment process ^[28,56],
30 Table 1 shows that only three schemes include indicators for local community consultation (RSPO,
31 RTRS and RSB) and these are not commonly accredited schemes. Furthermore, although the
32 certification schemes are required to take the whole supply chain into consideration – i.e.
33 production to end use ^[66] – there is little evidence to suggest that impacts and issues relating to
34 consumers are considered in sustainability assessments, raising further questions about recognition,
35 procedural and distributional justice.
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43 ***Discussion and Conclusions***

44 Although there has been an increased focus on biofuel equity in academic literature, equity matters
45 do not yet feature adequately – if at all – in many of the most commonly used, formal methods of
46 biofuels' sustainability appraisal, such as the voluntary certification standards used to demonstrate
47 compliance with the EU RED. Rather, social impacts have been an afterthought in regulations that
48 primarily seek to mitigate the negative environmental impacts of biofuels ^[34]. This paper has argued
49 that lack of consideration of equity works against sustainable development ideals such as inter- and
50 intra-generational equity ^[2]. At the moment, intra-generational equity should remain the focus of
51 sustainability certification schemes, since ensuring the wellbeing of environments and peoples in
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58 ¹ Other schemes recognised by the EC, but not included here are: Biograce GHG Calculation tool, HVO
59 Renewable Diesel Scheme, Gafta Trade Assurance Scheme, KZR INIG System, Trade Assurance Scheme for
60 Combinable Crops and the Universal Feed Assurance Scheme
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1 this generation, the next generation is likely to inherit healthy societies and ecosystems – catering,
2 to some extent, for inter-generational equity.
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4 Policy formation driven by engagement with diverse stakeholders from the outset is perhaps the
5 ideal, and yet this has rarely taken place. This paper suggests that, where biofuel policies have
6 already been enacted, understanding the nature of existing equity issues can help re-shape and re-
7 define practices to help rebalance the associated social and environmental inequities. Even with the
8 biofuel certification schemes approved by the EU, standards vary greatly in their scope and coverage
9 of environmental and social issues ^[12]. For those schemes that have incorporated multiple
10 stakeholders, how these actors have been identified is unclear, meaning that it is difficult to assess
11 diversity, inclusivity, and whether stakeholders are given the opportunity to state how they are
12 affected by biofuels. Furthermore, while some attention has been paid to the recognition of multiple
13 voices in standard setting, this is yet to be enjoyed within the assessment processes themselves. This
14 would help to provide a more informed view of whether and how levels of poverty and social
15 inequalities are affected by biofuel developments. In practice this would require multiple actors to
16 be part of the assessment process, and would most likely draw on qualitative data to support more
17 quantitative indicators and documentary evidence. Furthermore, dissemination of results to
18 stakeholders along the biofuel supply chain would be important for enabling learning about the
19 nature of the issues raised. This could also help to facilitate the adoption and strengthening of those
20 practices that led to more sustainable and equitable outcomes. It will require skilled practitioners
21 who can facilitate meaningful engagement with diverse actors along the supply chain, and who are
22 supported to go against the prevailing power dynamics if required. Such practices would allow
23 essential contextual factors to be understood and taken into account in sustainability assessment
24 processes.
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33 In sum, the evidence summarised in this paper suggests that the inclusion of multiple voices and
34 perspectives within biofuel sustainability assessments is likely to help fill the current ‘equity void’
35 and to deliver more sustainable and equitable outcomes ^[14,20,32]. However, a focus on distributional
36 and procedural justice alone will not guarantee more equitable biofuels ^[18]. Indeed, as this paper has
37 shown, an understanding of the context within which biofuels are embedded is critical for assessing
38 the equity outcomes, and this will require in-depth studies that generate primary data from
39 producer regions. The inclusion of equity into sustainability assessments of biofuels will present
40 numerous theoretical, methodological and practical challenges, but it is vital that equity matters are
41 incorporated into a unified framework that considers the distribution of ecological, social and
42 economic outcomes in different contexts ^[32,65].
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23 **Acknowledgements**

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Figure

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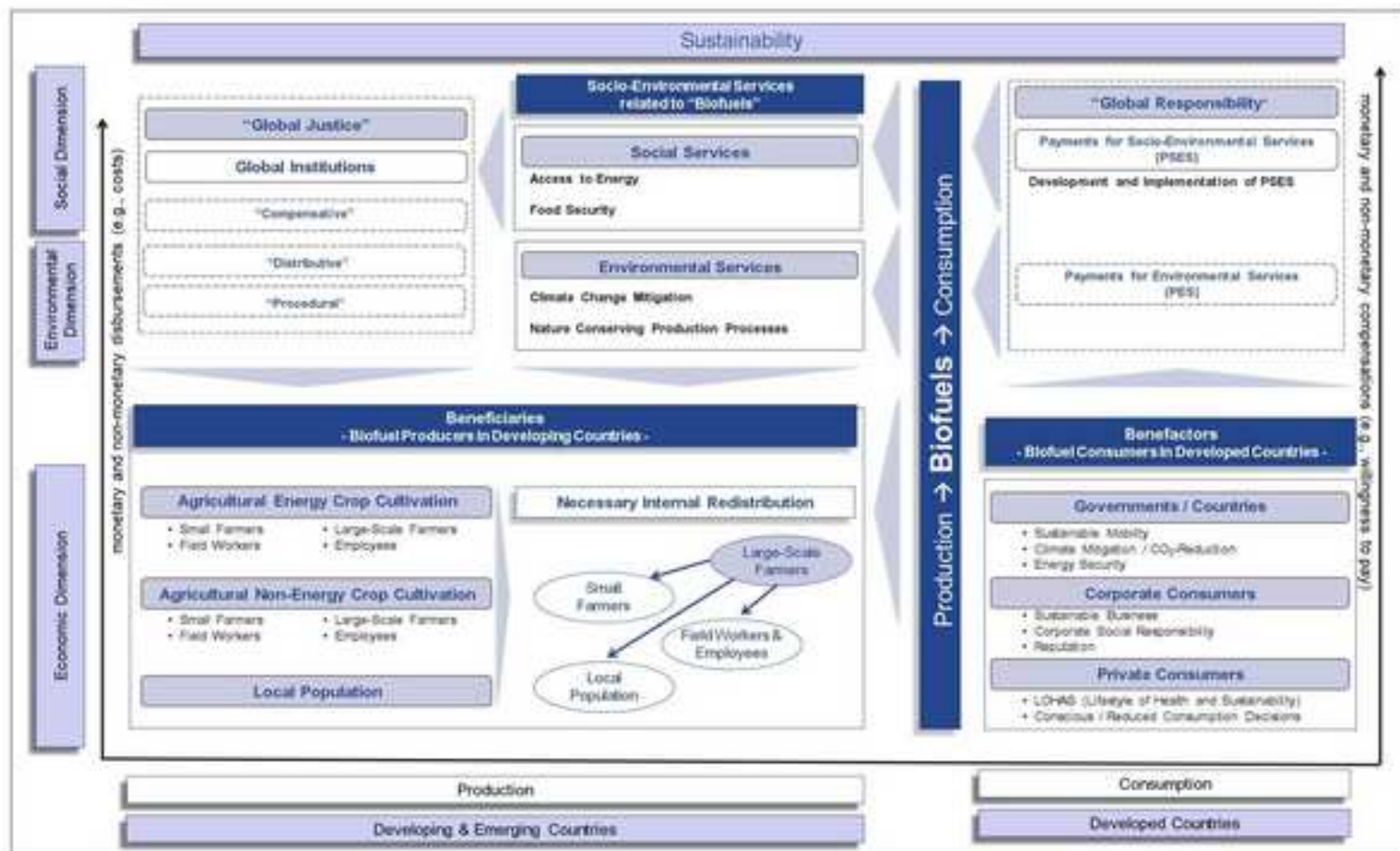


Table 1[Click here to download Table: 2015 0421 Table 1.docx](#)**Table 1.** EU approved voluntary certification schemes, coverage of social issues and number of biofuel suppliers accredited.

Scheme	Inclusion of social criteria ^[64]	Local community consultation ^[64]	Number of biofuel producers accredited ^[65]
International Sustainability and Carbon Certification (ISCC) Biomass Biofuels Sustainability Voluntary Scheme (2BSvs)	Yes (some required)	Insufficient guidance/detail	961
Roundtable on Sustainable Palm Oil (RSPO) RED	No	No	247
Roundtable on Responsible Soy (RTRS) EU RED	Yes	Yes	46
Bonsucro EU	Yes (but not required)	Yes (although unclear)	16
Roundtable on Sustainable Biomaterials (RSB) EU RED	Yes	Insufficient guidance/detail	15
Abengoa (RBSA)	Yes	Yes	1
Ensus	No	No	No data
Greenergy	No	No	No data
Red Cert	Yes (but not required)	Yes (for some criteria)	No data
Red Tractor	Workers' rights only	No	No data
	Limited	Insufficient guidance/detail	No data
NTA 8080	Yes, but not specifically required	Unclear	No data
SQC	No	No	No data