Task 4.7.2 Qualitative and quantitative assessment of social sustainability

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1 Introduction

Even though social sustainability reporting is on the rise now and soon will became mandatory for many European companies, there is still no effective technique available for measuring and assessing the varied direct and indirect impacts that bioenergy production have on social well-being of communities along the entire value chain. Each bioenergy value chain, depending on the feedstock and the geographical location has its own specifics that should be considered and analysed when social sustainability assessment takes place. There is no generally agreed set of social and economic indicators and measuring technique that could be applied to any bioenergy value chain. In order to define which value chain is better or worse, the framework of how specific bioenergy value chain can be assessed on its social sustainability performance should be created. That framework should show the way of how all players involved into particular biofuel production are linked with the value chain and how they potentially affect it. Benchmarking of bioenergy value chains can be used as an effective management tool for multi-scale assessment and measure of the efficiency and effectiveness of company's value chain. It is also helps in understanding of inter-related socio –economic issues and supports the decision-making around land and water use, interactions with food production, global trade and acceleration of bioenergy technology transfer process, while ensuring that social sustainability is quantified and that minimum standards and requirement for labour practice, human rights, society and product responsibility can be guaranteed.

The purpose of this task was to define critical social sustainability criteria to be taken into account at the planning stage and to develop an assessment tool that can be used at the company level that would advise to look after potential social impacts across the supply chain. The following questions will be answered: What are the priority components of social sustainability should be selected for certain value chains and how they can be measured? How to build the specific tool that will allow displaying both qualitative and quantitative indicators and criteria? How to use the specific tool to benchmark the future and current potential of existent bioenergy value chains?

2 Bioenergy Value Chains

The common principle of the value chain is to describe the wide range of activities that happen on order to bring a final product or service, through the different stages of production, including all kinds of product 's physical transformation all, delivery to end user, and final disposal after use. The concept of value chain was first presented by Michael Porter in 1985 and has been further developed by other scholars. According to Porter and his modern followers, the concept of value chain assessment is the essential instrument for examining the activities a company performs and their external and internal interactions with a view to identifying the sources to gain competitive advantage. (Porter, 1985)

Successfully performed value-chain analysis may show which type of competitive advantage company have to follow and how to implement it. Should it be done through R&D investments, creation of new policy and standards, capital investment, marketing communication, and/or community education and society outreach? High level of global completion for efficient and cheap sources of energy and increasing focus on innovation are the trends that drive the need for operations-oriented analysis from a value-chain perspective. Knowing the value offered to a community allows one to operate a sustainable enterprise.

Value chain is not policy-neutral. This is true especial considering modern bioenergy value chains that have a rather wide geographical spread. Government policy, environmental regulations, and taxes affect all dimensions, stage and supporting activities of the bioenergy value chain. (Dale et al. 2013)

Value-chain analysis helps to evaluate the sustainability at each stage the value chain. Going from one stage to another company evaluate all dimensions of sustainability by including social, environmental and economic values into the analysis of an energy-production or energy-use process. Bioenergy sustainable value chains consist of wide range of activities including supplementary services inputs, pre-processing, transformation processes, transportation, storage, handling co-products and etc. (Dale et al. 2013)

Most biofuel production companies engage in hundreds, even thousands, of different activities in the process of converting feedstock into final product. Table 1 represents an example of some currently available bioenergy feedstock and their sources.

Table 1 Bioenergy feedstock

1. Forest industry value chains – Black liquor and extractives based biofuels at pulp mills – Solid wood based biofuels at pulp mills and other biorefineries – Woodchips production for CHP – Biofuels produced from recycled fibre and agro-fibre residues
2. Plant oils processing at large oil refineries (including Jatropha)
3. Sugar cane based biofuels from southern hemisphere
4. Straw, energy crops and food industry residues to next generation biofuels – Ethanol and other components from straw – Biogas to natural gas grid and independent filling stations
5. Municipal solid waste – Electricity from burning – Landfill gas – Compost or biogas production
6. Potential options of algae and aqua biomass

In terms of bioenergy production the key elements of the value chain are presented in Figure 1.

Figure 1 Stages of bioenergy value chain

In order to determine and tackle social sustainability issues company need to perform multi –scale system analyses that will allow to see all inter-related social sustainability issues and perform effective decision-decision-making on the topics around natural resources and land use, interaction with food production chains, social acceptability, local and global trade, marketing communications and acceleration of new bioenergy technologies. At the same time company has to ensure that social sustainability issues are quantified and that minimum requirements can be guaranteed.

3 Qualitative and quantitative assessment measures for social sustainability

Numbers of global initiatives related to sustainability of biomass production and utilization have been created in the recent years. Not all initiatives consider social sustainability issues. Global Bioenergy Partnership (GBEP, 2011) and the Roundtable on Sustainable Biofuels (RSB, 2010) are the most responsive. Additionally, the Global Reporting Initiative (GRI) defined numerous social sustainability indicators. In deliverable 4.7.1 (Fedorova and Pongrácz, 2014), we have defined a list of necessary and sufficient social sustainability criteria and, in compliance with GRI, GBEP, RSB standards, minimum requirements have been defined for key criteria.

Qualitative and quantitative analysis of social issues mentioned above is needed in order to detect the trouble spots along bioenergy value chains. However, the complexity of modern value chains requires a huge and diverse amount of data and expertise to come up with a holistic description and context of socio conditions and this data may not be accessible or it may not be collected at all at the local level (ERIA 2013). As a case in point, Figure 2 illustrates the key social sustainability indicators for some key biomass and supply chain stages in Finland.

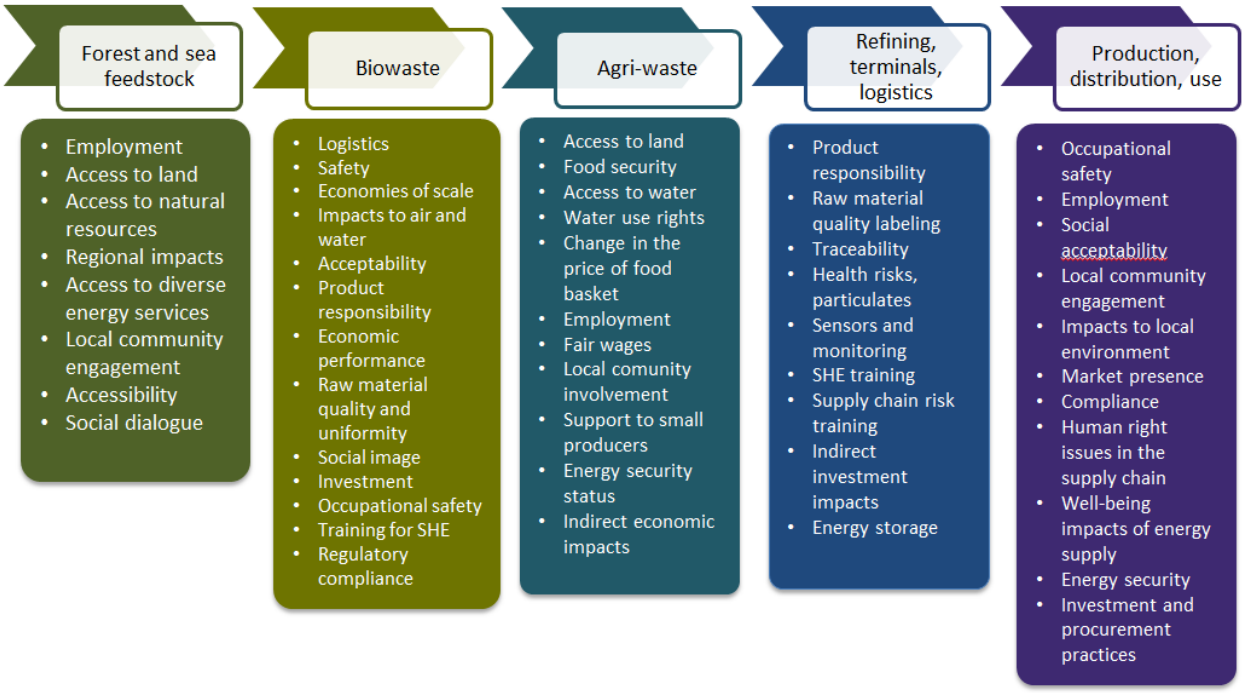

Figure 2 Important social sustainability indicators for key feedstock and supply chain stages

As it can be seen from Figure 2, the range of social sustainability issues is very diverse, at different stages of the supply chain and also for different feedstock. The question is, what are the priority components of social sustainability and how they should be selected for certain value chains and how they can be measured and weighed against each other? In order to fulfil theses question we chose the approach of multi-criteria analysis, which is a suitable decision-making tool for the energy sector, where the final decisions have to consider for a range of aspects, and can be utilised as well for deciding on appropriate energy feedstock.

4 Multi-criteria Assessment Framework

Multi-criteria analysis (MCA) is a subfield of operations research; it is employed for the comparative evaluation of a number of options in order to establish the best possible alternative or alternatives, on the basis of a set of objectives that the decision-maker has identified, and for which it has established measurable criteria to assess the extent to which the objectives have been achieved (Kylili et al., 2014). MCA is not only used to distinguish a single most preferred option, but also to rank options, shortlist a limited number of options for subsequent detailed appraisal, and identify acceptable from unacceptable possibilities (Department for Communities and Local Government 2009). The theory of MCA is based on the decision-maker's choice for the definition of the objectives and criteria, the significance (or weights) of each, and up to an extent, the capability of each option reach the objectives. This may be presented as a biased analysis, although the aim is to satisfy the decision-maker's own objectives. In addition, unbiased data, such as prices, can also be included in the analysis (Kylili et al., 2014). MCA is a formal approach that seeks to take explicit account of multiple criteria in helping individuals and groups explore decisions (Belton and Stewart, 2002). MCA stands in contrast to single goal optimization and approaches using 'unifying units' to offset poor performances of one criterion by good performances of another criterion, as is done by cost–benefit analysis using monetary values assigned to parameters therefore allowing for substitution and compensability between criteria (Buchholz et al, 2009).

The employment of MCA methods is considered suitable when several criteria have to be considered for the solution of a problem, such as in the case of energy-related issues. Policy, business, and investment decision-making related to the energy sector are greatly dependent on a variety of considerations, including technological, economic, social, environmental, risk, financial, quality, and reliability (Ramanathan 2004). Various multi criteria decision analysis methods have been put forward as an excellent candidate to perform sustainability assessment recently, and a variety of applications have emerged (Cinelli et al. 2014).

MCA methods require data to be normalized in order to obtain comparable scales. A common method is the ratio normalization that attributes value 1 to the best performance on a criterion and a proportional value to the other performances (Dias and Domingues 2014). The objective of this method is to provide an easy to use screening tool for assessment and comparison in the design phase, in order to point out key aspects that need to be improved on or further explored. In some cases, we have amended this method in way that the most preferred performance was valued 1 while detrimental performance was valued 0 and, if applicable, the third value normalized in between.

5 Measuring social sustainability of bioenergy value chains: Key indicators and units of measurements

In terms of social sustainability metrics there is a tendency of shifting from purely statistics evaluation of indicators toward ***hybrid set of indicators*** that include both quantitative and qualitative data. While reviewing recent changes in measuring sustainability it is easy to see the need for a tool that will combine traditional social indicators and social sustainability indicators. It is evident that traditional social indicators such as unemployment rate are directly connected to targets rather than intentions. Such indicators and targets are collected and evaluated by regional and national statistics offices. However, some social sustainability indicators, such as equality and indigenous rights are concerned with the integration of multidimensional and intragenerational issues essential to the concept of sustainability are more difficult to quantify. Further, certain social sustainability indicators can be named process indicators since they tend to

analyse the processes itself through which social sustainability principles are defined and potential solutions found and implemented. Correctly defined sets of social indicators may help business perform the assessment the progress of the project towards specific objectives in a more interactive way than traditional social indicators.

The complexity and diversity of bioenergy social sustainability indicators that have been identified during previous research does not allow using pure quantitative methodology for its evaluation. That is why hybrid set of social sustainability indicators have been established.

Semi-quantitative value chain assessment provides an intermediate scaling between the data evaluation of qualitative risk assessment and the numerical evaluation of quantitative assessments by using the score system for evaluating certain indicators (Colantonio, 2009). It allows performing the assessment and comparison of factors, risks and strategies when the precise qualitative data is not applicable or does not exist. However, all forms of semi-quantitative vale chain assessment require intensive research and analysis of all qualitative data available. The purpose of this method is to provide simplified but useful guidance to assess and measure social sustainability indicators impacts along bioenergy value chain. Additionally it will help rank bioenergy value chains in accordance to their level of response to social sustainability issues and identify troubled areas of value chain in terms of particular social impact.

Five main social sustainability categories have been detected along biofuel value chains that can be applicable to any geographical location and to both global and local value chains. Within these, set of social sustainability indicators can be defined that include both quantitative and qualitative data and applicable to selected value chains. These categories and indicators are as follows:

- ***Social development and well-being***
    - *Rural development*
    - *Employment*
    - *Training*
    - *Labour right and practices*
- ***Energy accessibility***
    - *Energy security*
    - *Energy diversity*
- ***Social acceptability***
    - *Consumer behaviour*
    - *marketing communication*
- ***Resource protection and accessibility***
    - *Food security*
    - *Water access*
    - *Land use*
- ***Human rights protection***
    - *Indigenous and underprivileged people*

In order to see how these indicators can be evaluated and compared along value chain, quantifiable measures need to be defined. Table 3 lists quantifiable units to measure social sustainability performance of these indicators. The table also provides a reference to sources of data and information.

Table 3 Assessment criteria and means of quantification

Category	Indicator (GRI based)	Units	Sources for data and methods
Social development and well being	***Rural (economic) development***	Percentage of money generated by the bioenergy venture remaining in the local economy (%)	*GRI 2011* ***EC8, SO1***
	Employment	Total number and rate of new employees hired by small scale bioenergy production enterprises (FTE)	*GRI 2011* ***LA2***
	Training	Average numbers of training per year per employee (Hours)	*GRI 2011* ***LA10***
	Labour rights and practices	Number of negative cases reported in the area	*GRI 2011* ***HR7*** *GRI 2011* ***LA1***
		Total workforce used by biofuel enterprise by employment type, employment contract, and region, broken down by gender	
Energy accessibility	***Energy Security***	Fuel price volatility; standard deviation of monthly price changes over one year (%)	*USDA or EIA bioenergy price data SOC2, IAEA, UN 2005*
		Share of household income spent on fuel and electricity (%)	
	Energy Diversity	Ratio of renewables production to local consumption of energy (%)	*Statistics*
Social Acceptability	***Consumer behaviour***	Public opinion; percentage of favourable opinion toward biofuels %	*Surveys, statistics*
		Ratio between biofuel and traditional fuel usage locally (%)	
	Marketing Communication	Amount of programs to teach rural populations about sustainable biofuels	*GRI 2011* ***PR6***
Resource protection and accessibility	***Food Security***	Percentage change in food price volatility	*FAO (2011)*
	Water Access	Percentage change of volumes used during production compare to local usage	*GRI 2011,* ***EN9,***
	Land Use	Area of land available for subsistence purposes	*GRI 2011,* ***EN11, EN26***
Human rights protection	***Indigenous and underprivileged people***	Total number of incidents of violations involving rights of indigenous people and actions taken	*GRI 2011* ***HR9***

After quantifiable data are found, the multi-criteria analysis method described earlier can be adopted to evaluate and/or compare the social sustainability performance of bioenergy value chains.

6 Benchmarking social sustainability criteria: Choosing best practices

Benchmarking approach can be viewed as a tool that improves organizational self-assessment (Taylor, 1998). Benchmarking should be considerate and used as one of the practices associated with quality management. High global competition and fast changing corporate environment, development of new innovative technologies and information systems force companies to be more flexible and use benchmarking practices. It allows companies to monitor changes inside the industry, be aware of new technologies and innovative processes and implement modern management strategies including corporate social responsibility. While performing benchmarking of selected bioenergy chains the driving forces should be also considered. Figure 3 represents relations between driving forces, social indicators and the value chain stages.

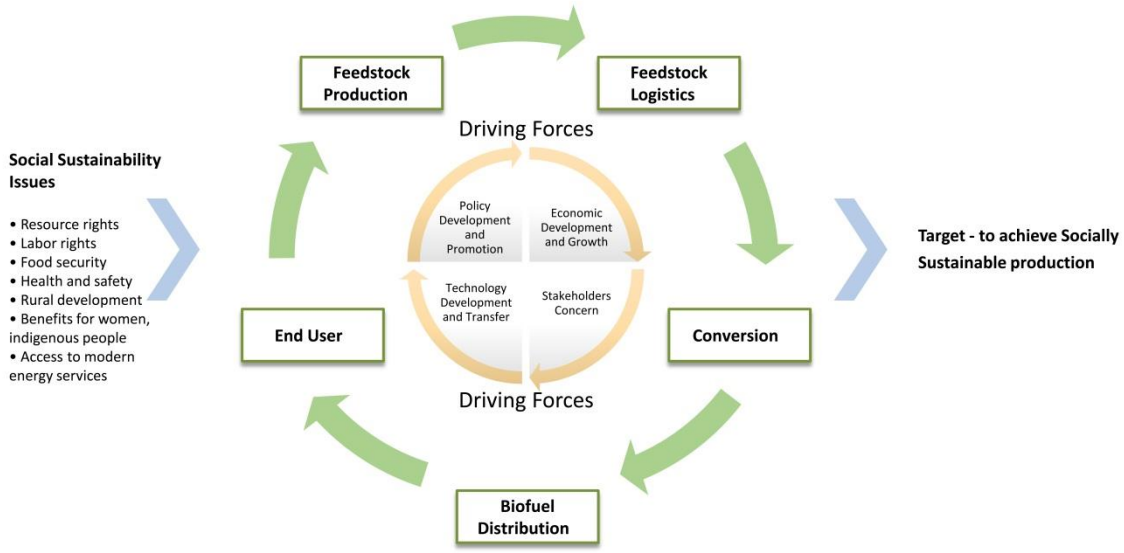

Figure 3 Relations between driving forces, social indicators and the value chain stages

Benchmarking of value chains based on their social sustainability criteria may serve several purposes. First of all, it may enhance transparency. By using benchmarking company can show weaknesses and strengths to decision-makers while choosing between several value chains. That will also enables stakeholders to judge how responsible company is and helps company to report on CSR (Corporate Social Responsibility). Additionally, stakeholders benchmarking can also benefit the company itself. It allows the company define its CSR efforts and show where to put more efforts in order to achieve certain goals.

Secondly, if a company wants to improve its performance and be competitive it has to adopt best practices in the industry. In order to be successful in this task company should constantly monitor changes that are happening inside the industry, evaluate new technologies and be aware of the best practices not only inside its own industry but also other industries. In other words, company should constantly perform benchmarking social sustainability aspects of value chains if there is intention to use them. Using benchmarking for best practices assessment and evaluation, company can implement those practices that are related to corporate social responsibility. Benchmarking activities create a competitive environment inside industry and facilitate implementation of corporate social responsibility practices. (Lee 2010)

7 Conclusions

The purpose of our study was quantifying the social sustainability indicators in order to develop and improve the tools and questions asked as well as to derive the better way of the biomass production with respect to social awareness. Bioenergy value chains are good examples of global value chains. Value-chain analysis can be used in the development of sustainable bioenergy strategies, where we can take into account simultaneously multiple social dimensions of sustainability and quantify social sustainability values added at each stage of bioenergy value chain.

Transferring feedstock production to third world countries entails the danger of "exporting" social problems: while downstream it has environmental and economic benefits, social problems "accumulate" upstream. However, when establishing bioenergy business in other countries and establishing local bioenergy chains, it may bring many benefits to local communities.

When assessing bio-energy value chains, we defined 5 basic social sustainability criteria which allows comparing chains in different countries and of different materials. These are: *Social development and well-being, Energy accessibility, Social acceptability, Resource protection and accessibility and Human rights protection*. The key indicators under these categories and quantifiable units and sources for data for each of them have been provided.

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