Chapter 2
Indicators for Socio-Economic Sustainability Assessment

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Abstract Indicators have been used to organize, monitor and assess information in different contexts. During the last twenty years indicators have gained more importance, being used to assess sustainability performance of different activities through the implementation of standards. This chapter explores the evolution of the use of socio-economic indicators and their applicability in a relatively new production area, that of biofuels. The use of indicators has been more focused on environmental issues and compliance with voluntary schemes. Socio-economic indicators have gained more attention as a result of concerns with production of biofuels in developing countries. A set of indicators is proposed to monitor the possible impacts (both negative and positive). It is suggested that monitoring may help initiatives at national, regional and local level and may be combined with voluntary performance schemes in order to promote a sustainable production of biofuels.

Keywords Indicators · Socio-economic sustainability assessment · Criteria · Biofuels · Certification

2.1 Introduction

Many efforts for the development of sustainability schemes, dedicated or related to bioenergy crops have focused on environmental impacts, such as deforestation, biodiversity loss, water availability and quality, soils, and greenhouse gas (GHG) emissions. However, the increased use of biomass for biofuel production may generate conflicts along with synergies between socio-economic and environmental impacts, particularly in the context of developing countries. The last two years have seen an increment in the number of standards that have been developed for bioenergy purposes. In 2012, the European Commission had recognized twelve voluntary schemes (EC 2012). These standards have also improved the balance between environmental and social issues, although they largely rely on compliance indicators.

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The chapter contextualizes the growing importance of indicators in the wider agenda of sustainable development, which highlights the need for balancing the social, economic and environmental objectives and impacts of development initiatives. It reviews existing standards that include socio-economic indicators in bioenergy production, discussing the role and challenges involved in creating and using indicators, before it presents a specific set of indicators developed for application in the biofuel sector.

2.2 Indicators and Sustainable Development

The last twenty years have seen a growing interest in use and selection of indicators in the context of sustainable development and in debates on sustainability, although there is no universal consensus on the theory, methodology and use of indicators. Yet, international protocols and agreements, have contributed greatly to the development and use of sustainability indicators, on economic, social and environmental issues (Diaz-Chavez 2003). Since the 1992 Rio Summit, many initiatives have been undertaken to promote sustainable development as well as to measure progress towards it, with chapter 40 of Agenda 21 calling for the development of indicators for sustainable development specifically (UN 1992).

Indicators have since gained much greater importance and have been used for a wide range of purposes (Siniscalo 2000), particularly for monitoring trends and changes in any particular process, and for identifying challenges. Yet, indicators and indices are only useful for describing or helping to describe a given situation, rather than explaining it. International and national institutions (e.g. GBEP 2011, OECD 2000a, b; UN 2007) have been using indicators to assess performance and change on a number of dimensions, such as income, education, health and welfare, both at the regional and national levels (Diaz-Chavez 2006).

In the context of sustainable development and sustainability, there has been a tendency for emphasis to be placed on the economic and environmental dimensions, to the relative detriment of social and cultural dimensions. Nevertheless, as established in Agenda 21 (UN 2012), the functions of indicators is to provide a solid basis for planning and decision-making on all dimensions so as to contribute to the sustainability of integrated environment and development systems.

Sustainability indicators can be useful in showing how changes in the economy, the environment and society interrelate. The key function is to simplify information, so that there is a balance between accuracy and concision. The applicability of indicators at the local level is crucial in helping both the public and decision-makers to identify and solve problems of sustainable development (Diaz-Chavez 2003).

Most of the attention paid to indicators has focused on environmental issues and indicators, which have been used largely for ecological purposes for quite some time (e.g. water quality indicators). Less attention has been paid to social and economic indicators (Diaz-Chavez 2006).

Growing interest on biomass for biofuel and bioenergy production has evidenced the need for standards that address sustainability goals. This requires ensuring that any particular production system is environmentally, socially and economically sustainable. In addition, this entails contributing to a reduction of greenhouse gases (GHG) emissions, creating no negative impacts (environmental or socio-economic), as well as contributing to positive social outcomes.

In the discussion on sustainability indicators, key concepts are often used interchangeably, although there is often conflation. Here, a ‘standard’ refers to a set of principles and criteria to be used consistently as rules and guidelines to ensure that materials, products, processes and services meet their purpose. A standard will also define indicators and methods used to gauge compliance with principles and criteria. A standard incorporates:

- **principles**: defined as ‘general tenets of sustainable production’
- **criteria**: the conditions needed to achieve these tenets and which help to define the indicators to be answered
- **indicators**: the individual questions that demonstrates how a producer meets a particular criterion (Woods and Diaz-Chavez 2007).

An index in turn is a composite indicator derived from individual indicators that are compiled into a single index, on the basis of an underlying model of the multi-dimensional concept that is being measured (OECD 2012).

2.3 Indicators: Role, Choice and Challenges

It must always be born in mind that the ideal indicator does not exist. A second-best proxy is often used to develop an indicator, a practice that is thought to be both acceptable and effective (Segnestam 1999).

After selecting and measuring indicators, it is necessary to interpret them. The absolute level of the indicator can serve as a diagnostic tool to be compared with future trends. In some cases, control groups can be used to measure conditions in areas not affected by a project or the activity. In other cases, modeling techniques should be used to predict what would have happened had the project not been implemented.

There is also interest in concise and balanced sets of indicators that provide meaningful information on the key dimensions of sustainable development to policy-makers and the general public. Sets of indicators reflecting key trends and policy variables are useful instruments to respond to common policy goals. Core sets are useful for comparison and can be adapted for different purposes, including tracking performance against plans and budgetary information (Siniscalo 2000).

Indicators are generally meant to be used for decision-making processes at the national level and so not all indicators will be applicable in every situation. Countries will choose from potential indicators those which are relevant to national priorities and goals (UN 1992).

Some of the key limitations of indicators include the fact that they may simply constitute parameters, the fact that a methodology needs to be fine-tuned to better reflect the requirements of sustainable development, and the lack of indicators that mesh together environmental, social, economic and institutional aspects (Hens 1996). Also, for the most part, indicators are quantitative measures, whilst environmental and social indicators are often not suited to economic evaluation. In particular, the value of ecological functions is often underestimated in traditional economic and accounting models. For this reason, indicators of sustainability are not always quantifiable, and at times, may also be subjective (WTO 1996). In addition, it has been noted (Briassoulis 2001) that indicators still need to be developed to address critical dimensions (e.g. social, cultural, institutional and political), and so are indicators that integrate all the dimensions of sustainability and track progress towards sustainability, or indicators that account for spatial relationships (e.g. horizontal and vertical).

2.4 Socio-Economic Indicators of Sustainability

Social impacts tend to be more difficult to monitor and quantify as they require more in-depth studies, such as household surveys, which are time consuming and expensive to conduct. Thus, the implementation of standards might provide an effective means of bringing together organizations that are already monitoring impacts and certifying activities. Still, a key difficulty is that in most standards the monitoring refers more to compliance than to the actual impacts.

A further issue is the need to consider the interactions between environmental and socio-economic indicators when examining impacts (for instance, the link between the use of water for the feedstock production and the use of water by the community).

Socio-economic indicators are used to analyze a particular social phenomenon or society as whole. They are useful for monitoring developments over a period of time; they are appropriate for including within a standard or certification scheme; they may be derived from qualitative and quantitative data; and they can be applied on a supply chain (e.g. feedstock production and conversion).

Indicators are expressed in real values, or they can be expressed in binary units, such as zero or one. This mode is often used to depict the presence or absence of a circumstance or event. Often, several indicators are used together. When their combined values are expressed as a single value, these indicators are said to form an index or an aggregated indicator. Indices can be further manipulated by ascribing weights to their components (Webber and Alexander 1997).

Quantitative indicators are useful as they may provide additional information rather than just describing the state of the environment (Segnestam 1999). Also, information that can be collected and presented as a ratio or percentage is of more value than presenting absolute numbers in isolation. The choice of an indicator or index requires consideration of the methods to be employed for collecting, analyzing and disseminating data. Seasonality is also important as it will impact on trends and changes over time. Another important factor for the choice and use of indicators is whether an indicator or index can be ascribed targets, which can be long or short-term (Webber and Alexander 1997).

The measurability of indicators can be placed along a continuum. At one end, there are indicators that cannot be measured at all, whilst at the other end, there are indicators that comprise an inherent measure. In other words, some components may be of more importance than others and should therefore be weighted more heavily (Hart 1999). However, it is also extremely difficult to determine a weighting which is reliable and valid (Webber and Alexander 1997).

In particular, indicators are needed that describe the social-environment interface and address issues of social sustainability. There is still a gap between the demand for sustainable development indicators, the measurability of underlying data sets and the actual use of such indicators (Diaz-Chavez 2011). The interactions between social and environmental dimensions are also complex and many of their links need to be examined (e.g. environmental degradation and social impacts). Similarly, economic and social relationships may have environmental consequences, but their links may be difficult to ascertain with precision (OECD 2000a; Diaz-Chavez 2009).

A further issue is the need to consider the interactions between the environmental and socio-economic indicators when examining impacts. For instance, the link between the use of water for the feedstock production and the use of water by the community has to be investigated (Rettenmaier et al. 2012).

International and national institutions have been using indicators to assess the regional and national performance and development in social issues: income, education, health and welfare. Table 2.1 provides some examples of socio-economic indicators.

Socio-economic indicators are used for statistics to analyze a particular social phenomenon or a society as whole. They are useful to:

- monitor developments over a period of time (against a baseline)
- be considered along a standard or certification scheme
- employ with qualitative and quantitative data
- apply on a supply chain (feedstock production and conversion)
- employ with certification schemes

Given the diversity of environmental problems and of projects, either causing them or designed to address them, arriving at a set of "universal" indicators (e.g. applicable to all situations) is not feasible. Nor is it practical to develop an exhaustive list of all possible indicators.

2.5 Socio-Economic Indicators in Current Voluntary Schemes

A comparison of different international certification systems for general management, environment and supply chain, forest production and agriculture activities, has been carried out by different authors, in order to identify whether these systems

Table 2.1 Selected social indicators. (modified from Jannuzzi 2001)

Theme	Indicator
Demographic and health	Birth rate
	Demographic increase rate
	Child mortality rate
	Life expectancy at birth
	Rate of death per causes
	Morbidity and health attendance
	Under nutrition
	Malnutrition rate
Educational and cultural	Illiteracy rate
	Average schooling
	Information and culture access
Employment (Labor market)	Unemployment rate
	Average income
Income and poverty	GDP per capita
	Average familiar income
	Gini Index
	Theil Index
	Poverty rate
Housing and urban infrastructure	House condition
	Urban services accessibility
	Transport infrastructure
Quality of life and Environment	Satisfaction with house, neighborhood, city and basic infrastructure
	Crime and homicides
	Environment (air condition, water, waste treatment, garbage collection)
Development	Human Development Index

Table 2.2 Selected standards or systems. (Diaz-Chavez 2010)

Sector/crop	Operational	Early implementation
Forestry	FSC, PEFC	GBEP
Oil Palm	RSPO, SAN, ISCC	RSB, GBEP
Soy	AAPRESID, SAN, ISCC	RTRS, RSB, GBEP
Sugar cane	BSI, SAN, ISCC	RSB, GBEP
Other	Fair trade, ISEAL, SAI	

might be of relevance to biofuel production and supply chain environmental assurance (see Diaz-Chavez 2007, Diaz-Chavez and Rosillo-Calle 2009, van Dam 2010).

Considering the extensive number of possible applications (van Dam 2010), twelve standards and systems (ISEAL and GBEP are not standards) were assessed that were considered directly relevant to bioenergy and bio-products and that also include social and economic issues (Diaz-Chavez 2010). Table 2.2 shows those that were selected.

The selected standards or systems were assessed according to the following criteria:

- Description of the initiative (organization, geographical coverage, feedstock/raw material)
- Description of system (biofuels, co-products, technologies)
- Standards description (principles, criteria, indicators) including number of each one and categories (e.g. social, legal)
- Compliance: legal, voluntary, international/national/regional approach

The review of standards and systems focused on the social and economic issues addressed by them. The review aimed at identifying the key topics of the schemes. Table 2.3 shows some of the general characteristics of the systems.

Most of the standards reviewed focus on qualitative indicators or information to be monitored. Only GBEP has indicators that measure both forms qualitative and quantitative.

Most of the standards include principles related to the working conditions, health and community benefits (including Corporate Social Responsibility). Table 2.4 shows the comparison of the different principles in most of the standards. ISEAL is not included as it provides guidelines for the development of schemes. GBEP was also not included because it is not a standard. Some points to consider from this overview include:

- Some standards call for national interpretation (e.g. RSB) and others such as PEFC already have national interpretations.
- Most standards consider the feedstock or the final product and few of them look at different parts of the supply chain.
- Very few have a specific principle or criteria for gender inclusion, although most call for community participation.
- There is little differentiation between the different parts of the supply chain except where the certification specifies chain of custody.

From the standards and systems reviewed it is apparent that ISEAL Impact Code and GBEP offer the possibility of developing and/or using available indicators that refer to the whole supply chain of bioenergy feedstock and their co-products as well as the possibility for monitoring impacts.

Social impacts tend to be more difficult to monitor and quantify as they require more in depth studies, normally household surveys which are time consuming and expensive. Therefore the link with the impacts from the application of the standards could be a good possibility to link with organizations that are already monitoring and certifying activities. Nevertheless, one of the main issues is that the monitoring refers more to compliance than to actual impacts.

Table 2.3 General characteristics of the standards and systems. (modified from Diaz-Chavez 2010)

Acronym	Standard's Name	Year	Region	Level	Type	Certification	Social	Econ
RSB	Roundtable on Sustainable Biofuels	2007	Global	Project	Standard	Y	√	√
RSPO	Roundtable on Sustainable Palm Oil	2006	Global	Project	Standard	Y	√	√
RTRS	Roundtable on Responsible Soya	2004	Global	Project	Standard	Y	√	√
Bonsucro	Previously BSI Better sugar Initiative	2011	Global	Project	Standard	Y	√	√
SAN	Rain Forest Alliance Sustainable Agriculture Network	2002	Global		Standard	Y	√	√
FSC	Forest Stewardship Council	2000	Global	Project	Standard	Y	√	√
PEFC	Program for Endorsement of Forest Certification	1999	Global	Project	Standards at National level	Y	√	√
SAI	Social Accountability International	2004	Global	Project	Guidelines (standard in development)	No	√	√
ISEAL	International Social and Environmental Accreditation and Labelling Alliance	2006	Global		Code of Practice	No	√	√
FLO	Fair Trade Organisation	2008 (FLO-cert)	Global	Project	Standard	Y	√	√
AAPRESID	Argentinian Association of Producers for No Tillage	1989	Argentina	Project	Standard	Yes	√	√
GBEP	Global Bioenergy Energy Partnership	2008	Global	National	Indicators	N	√	√
ISCC	International Sustainability and Carbon Certification	2006	Global	Project	Indicators	Yes	√	√

Table 2.4 Comparison of principles of selected standards. (Diaz-Chavez 2010)

Standard	Principles
SAN	Social and Environmental Management System
	Fair Treatment and Good Working Conditions for Workers
	Occupational Health and Safety
	Community Relations
SAI	Child labor
	No Forced labor
	Health and safety
	Freedom of association and the right of collective bargaining
	Discrimination
	Disciplinary practices
	Working hours
	Remuneration
	Management systems
RTRS	Legal Compliance and Good Business Practice
	Responsible Labor Conditions
	Responsible Community Relations
	Environmental responsibility
	Good Agricultural Practice
RSPO	Commitment to transparency
	Compliance with applicable laws and regulations
	Commitment to long-term economic and financial viability
	Use of appropriate best practices by growers and millers
	Responsible consideration of employees and of individuals and communities affected by growers and mills
	Responsible development of new plantings
	Commitment to continuous improvement in key areas of activity
FSC	Compliance with laws and FSC principles
	Tenure and use rights and responsibilities
	Indigenous peoples' rights
	Community relations and worker's rights
	Benefits from the forests: ensure economic viability and a wide range of environmental and social benefits
	Management plan
	Monitoring and assessment: to asses activities and social and environmental impacts
	Maintenance of high conservation value forests
	Plantations shall be planned and managed
RSB	Planning with impact assessment and management process and an economic viability analysis
	Not violate human rights or labor rights, and shall promote decent work and the well-being of workers
	Contribute to the social and economic development of local, rural and indigenous people and communities
	Biofuel operations shall ensure the human right to adequate food and improve food security in food insecure regions
	Maximize production efficiency and social and environmental performance, and minimize the risk of damages to the environment and people
	Biofuel operations shall respect land rights and land use rights

Table 2.4 (continued)

Standard	Principles
BSI	Obey the law
	Respect human rights and labor standards
	Manage input, production and processing efficiencies to enhance sustainability
	Actively manage biodiversity and ecosystem services
	Continuously improve key areas of the business
Aapresid	Legal Obligations (including land property)
	Labor Obligations (labor conditions and ILO compliance)
	Social Obligations (consideration of traditional communities)
Fairtrade	Social development: Fairtrade adds to Development
	Socio-economic Development and environmentally-sustainable development
	Environmental Development
	Labor conditions: ILO Conventions organizations to meet the ILO requirements as far as possible
ISCC	Good social practice regarding human rights/ labor rights compliance
	Land rights compliance
	Priority for food supply/food security

2.6 Developing a Set of Indicators

The set of indicators reported here were derived from information obtained through a number of steps. They included benchmarking of standards for environmental and social indicators; identification of impacts from relevant case studies (in the Global-Bio-Pact project); identification of socio-economic impacts in supply chains; examining the links between environmental and social impacts; and analysis of macro and micro indicators from relevant case studies (Diaz-Chavez et al. 2012). The development of impact indicators also took into account two timescales. Firstly, a comparison was carried out between the conditions of the area prior to the establishment of the production unit (e.g. plantation) and the situation after establishment, with a view to comparing the overall impact of operations. The standards under consideration generally assume the need for Environmental Impact Assessment to be conducted before the start of operations, although this will not apply to operations that are long-established. Secondly, monitoring of operations and their impacts should be on-going, and this is a requirement in the standards examined. The criteria and indicators proposed here are meant to provide a clear and balanced set, rather than comprising a certification or verification system. Nevertheless, it is expected that the set of indicators will be used by different stakeholders for a number of different purposes, such as assessing a bioenergy proposal or project; assessing the sustainability of feasibility studies for specific bioenergy projects; monitoring impacts at the local and regional level; employing it alongside a standard. Assessment of the effectiveness of the indicators was based on four key characteristics. Indicators were chosen according to measurability (e.g. how easy to use in measuring the impact); easiness of gathering data (e.g. how easy and cost-effective the requisite data can be gathered); usefulness for assessing socio-economic impacts

Table 2.5 Impacts and examples of indicators. (Diaz-Chavez et al. 2012)

Impact	Examples of indicators
Basic Information	
Framework conditions	Location, average yield
Socio-Economic Impacts	
Contribution to local economy	Value added, employment
Working conditions and rights	Employment benefits
Health and safety	Work related accidents
Gender	Benefits
Land rights	Land rights and conflicts
Food security	Land converted from staple crops
Environmental Impacts	
Air	Open burning
Soil	Soil erosion
Water	Availability of water
Biodiversity	Conservation measures
Ecosystem Services	Access to ecosystem services

(e.g. whether they actually assess the impact); and temporality (e.g. whether time-frame for usefulness of indicator is set out).

The indicators were selected bearing in mind that they can measure an impact over a period of time. For this reason a baseline was suggested for the field test work.

The indicators were classified in basic or background information, socio-economic indicators and environmental indicators (Table 2.5):

- **Basic information**: data that provides background information from the selected case study
- **Socio-economic indicators**: these include the impacts caused by bioenergy crops production and the different stages of the supply chain to produce biofuels
- **Environmental indicators**: in the context of the Global-Bio-Pact project refer to the environmental impacts that affect the socio-economic characteristics of the communities

Each indicator is linked to a measurement, monitoring process or unit depending of its nature. For instance, the “Average yield of the feedstock” is measured in t/ha/yr. The set includes further guidance on how to measure or monitor the indicator. Tables 2.6–2.8 present the indicators developed within the Global-Bio-Project. Furthermore it is indicated from where the data could be accessed: Processing company or plantation (P); Government (G); Community (C); Non-Governmental Organisation (N); Worker (W).

The set of indicators proposed by the Global-Bio-Pact project is balanced and includes the main topics of impacts selected by a clear process with the aid of expert partners of the project. Furthermore, the topics reflect the main identified socio-economic and environmental areas which can be measured in order to monitor and if possible to eliminate negative impacts and to promote the benefits if a sustainable production is in place.

Table 2.6 Global-Bio-Pact set of impact indicators: Basic information. (Diaz-Chavez et al. 2012)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
1.1	Name and location	Name and geographical location of the operation	Location map	P
1.2	Land area under cultivation	The total area of land cultivated by the operation (ha)	Breakdown of land under different feedstock and under different tenure (own land, rented land, smallholders, outgrower)	P
1.3	Expansion of land area	Additional land area under production (ha/year)	Additional land under feedstock production within the last 5 years. Previous land use of the land area.	P, G
1.4	Average yield	Average yield of the feedstock (t/ha/yr)	Annual average yields of the feedstock within the last 5 years	P
1.5	Annual production	Annual production of feedstock and subsequent products (t)	Annual production of the feedstock and the subsequent products and by-products within the last 5 years	P
1.6	Certification	Is the operation certified? If so, which certification(s)?	Type of certificate	P, N
1.7	Sectorial associations	Is the operation involved in sectorial associations, if so which association(s)?	Registered membership of associations	P, N

2.7 Conclusion

Any sustainability standard must include the three key components: economic, social and environmental aspects. Furthermore, a political and institutional new pillar has to be included as many of the issues implied in sustainability are regarded of political nature (e.g. targets) (see Diaz-Chavez 2003).

Most of the research on standards works on a monitoring and compliance basis but few have indicators which can actually be monitored under quantitative or clear qualitative parameters. The set of indicators of the Global-Bio-Pact project was created to be able to indicate the state of the impact and to be able to monitor it over time. It is expected that these indicators can be useful for different users from project developers, government and standards.

There is still a need to include other socio-economic indicators that can contribute to avoid some negative impacts of biofuel production. The use of these indicators will help the different users in promoting the sustainable production of biofuels.

Table 2.7 Global-Bio-Pact set of impact indicators: Socio-economic indicators. (Diaz-Chavez et al. 2012)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
Contribution to local economy				
2.1	Production cost	Breakdown of yearly production costs of the facility (incl. labor, raw material, energy, services, etc.) (EUR/t of feedstock)	Annual production costs within a 5-year period	P
2.2	Value added	Value added by the operation. Annual value of sales less the price of goods, raw materials (including energy) and services purchased. (EUR/t of feedstock)	Annual value added within a 5-year period	P
2.3	Taxes/ royalties paid to the government	Breakdown of payments made to the government/year (EUR)	Payments made to the government per year within 5 years	P, G
2.4	Contributions made by the operation to allied industries in the local economy	Percentage of total production cost paid to contractors, suppliers per annum	Percentage of total production cost paid annually to contractors and suppliers of raw materials (excluding suppliers of feedstock) within a 5-year period	P
2.5	Involvement of smallholders or small suppliers	Percentage of feedstock that originates from associated smallholders and outgrowers	Percentage of feedstock that originates from associated smallholders outgrowers within a 5-year period. Number of associated smallholders or outgrowers.	P, C, W
2.6	Amount paid to smallholders and suppliers of feedstock	Annual amount paid to smallholders and suppliers of feedstock (EUR)	Annual value paid to associated smallholders and outgrowers per unit of product within a 5 year period.	P, C, W
2.7	Employment	Total number of employees and person days of employment per year	Total number of people employed each year and total number of person days per year within a 5 year period. Breakdown should be given for categories of employment for operation (management/office/processor/field labor, male/female, contract/no contract)	P, W
2.8	Ratio between local and migrant workers	Ratio of employment from local area/ outside local area per category of employment (management/office/processor/ field labor)	Local area is defined as state or province (however, the assessor can further adapt this to local context). Absolute annual number of workers per employment category (including temporary/ permanent) within a 5-year period	P, G

Table 2.7 (continued)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
2.9	Percentage of permanent workers	Percentage of workers that have a fixed contract employment per category of employment	Annual percentage permanent vs. temporary workers within a 5-year period	P, G
2.10	Provision of worker training	Number of workers that have received training (for skills development, education etc.) each year, number of working days spent in training provided by the operation each year, type of training	Annual numbers should be given for a 5-year period	P, W
2.11	Community investment	Amount invested in community investment projects (e.g. CSR) (% of annual revenue) and qualitative description of investments including any projects specific for women	Annual values should be given for a 5-year period. This should be calculated as percentage of annual revenue.	P, C
Working conditions and rights				
2.12	Employee income	Average income of employees by category of employment (EUR)	Annual average income per employment category for a five-year period	P, W
2.13	Employment benefits	Employment benefits (e.g. housing, health care, holidays) provided by operation (description of benefits per employee per year)	Breakdown of average benefits given per employment category. Distinction should be made between the benefits that are mandated by law and those that are not.	P, W
2.14	Income spent in basic needs	Percentage of worker disposable income (by category of employment) spent on fulfilling basic needs (food, accommodation and transport)	To be estimated based on average salary per employment category, amount spent in food per day, accommodation per month and transport per day	W, C
2.15	Hours of work	Average daily hours of work per employee per employment category (h)	Average daily working hours per category of employment. This should be verified from employment records and worker interviews with questions addressing number of working hours/day.	P, W

Table 2.7 (continued)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
2.16	Freedom of association	Existence of labor unions	Existence of labor unions and whether workers have the right to join them. This should be verified by interviewing the management and the workers: Do workers belong to a union or other type of working association?	P, W, C
Health and safety				
2.17	Work related accidents and diseases	Number of work-related accidents per person days of employment per year, number of work related diseases/ person days of employment per year	Records of any work-related accidents or diseases.	P, W
2.18	Personal protective equipment	Percentage of workers that use appropriate personal protective equipment	To be calculated as a percentage of sample in a site visit	P
2.19	OSH training	Percentage of employees that have received OSH (Occupational Safety and Health) training	Training records and worker interviews	P, W
Gender				
2.20	Benefits created for women	Employment benefits that are specific for women	List any employment benefits that are specific for women (i.e. maternity leave, others)	P, W
Land rights and conflicts				
2.21	Legal title of land right	Operation has a legal title/ concession for the land that is not challenged.	Document of legal title	P, G
2.22	Communal/ public land	Area of land cultivated by the operation that is customary, public or community land (ha)	Report on public or community land within the project which would affect people living from subsistence agricultures, nomads, etc. Cross-check this information with the land categories listed under 'basic information'	P, C (N)

Table 2.7 (continued)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
2.23	Land conflicts	Area of land currently under dispute, land conflict. (ha) Did the operation have any land use conflicts, if so, what caused them, how were they resolved?	Land area currently under dispute. Qualitative description of any current or previous land use conflicts. If they were resolved, how this happened.	P, C, G (N)
Food security				
2.24	Land that is converted from staple crops	Land that has been converted from staple crops (ha)	Hectares of land that has been converted from staple crops to the feedstock production (assessor should define staple crops for the country) within the last five years	P, (G, N)
2.25	Edible feedstock diverted from food chain to bioenergy	Amount of edible raw material diverted into bioenergy production (t)	Annual amount of edible feedstock that was used in bioenergy production (5-year period)	P
2.26	Availability of food	Perceived change in availability of food after the beginning of bioenergy operations	Check (survey) at community level about perceived change	C, W
2.27	Time spent in subsistence agriculture	Change in time spent working in subsistence agriculture in the household	Check (survey) at community level about perceived change	C, W

Table 2.8 Global-Bio-Pact set of impact indicators: Environmental indicators. (Diaz-Chavez et al. 2012)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
Air				
3.1	Open burning on company level	Days open burning used in operations/year	Annual days open burning used in operations, 5-year period	P
3.2	Open burning area	Percentage of surface under open burning regime	% surface under open burning regime	P
3.3	Use of Best Available Technologies for reducing emissions	List of best available technologies in place	Review technologies used at company	P
Soil				
3.4	Implemented Practices	Percentage of surface under no or reduced tillage	Check practices on the fields	P
3.5		Fertilizer applied (type) (kg/ha/yr)	List types of fertilizer and the annual amounts applied per hectare (5-year period)	P
3.6		Herbicides and pesticides applied (type) (kg/ha/yr)	List types of fertilizer and the annual amounts applied per hectare (5-year period)	P
3.7	Soil Erosion	Feedstock cultivation area in flood prone region (ha)	Maps and data from company	P
3.8		Feedstock cultivation area in wind prone region (ha)	Maps and data from company	P
3.9		Feedstock cultivation area in slopes above 25° surface gradient	Maps and data from company	P
3.10		Implemented measures to control soil erosion	List measures implemented	P
3.11	Soil analysis	Frequency of carrying out soil analysis in the operation	How often is soil analysis carried out in the operation?	P

Table 2.8 (continued)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
Water				
3.12	Water consumption (irrigation)	Net non-recycled water consumed through irrigation per unit mass of product (l/t of feedstock)	Check water balances at the company level	P
3.13	Water Management Plan	Implementing a water management plan	Is there a water management plan, is it implemented?	P
3.14	Availability of water	Perceived change in availability of water by local communities (amount consumed)	Questions addressed to local community representatives, NGO or local authority	C, N, G
3.15	Quality of water	Perceived change in quality of water by local communities	Questions addressed to local community representatives, NGO or local authority	C, N, G
Biodiversity				
3.16	Reduction of biodiversity	Non-agricultural land or pasture that has been converted towards feedstock operation within a 5- year period (ha), type of previous vegetation of converted land	This can be check with the operation and cross checked with local or national authorities or environmental NGOs	P (G, N)
3.17	Impacts on fisheries/other aquatic fauna	Local perceptions on impacts on fisheries/other aquatic fauna	Questions addressed to local community representatives, NGO or local authority	C, N, G
3.18	Impacts on local fauna/ flora perceived by community	Local perceptions on impacts on local fauna and flora	Questions addressed to local community, NGO or local authority	C, N, G

Table 2.8 (continued)

No	Indicator	Measurement/ Monitoring Process/ Unit	Guidance	Data access
3.19	Conservation Measures	% of surface set-aside for conservation purposes	e.g. protected habitat, buffer zones, ecological corridors, riparian vegetation, etc.	P
Ecosystem services				
3.20	Access to ecosystem services	Reduction in local communities' access to hunting, fishing	Qualitative questions to local community representatives, and NGO(s)	C, N
3.21		Reduction in local communities' access to non-timber forest products	Qualitative questions to local community representatives, and NGO(s)	C, N
3.22		Reduction in local communities' access to cultural ecosystem services such as sacred and recreational sites	Qualitative questions to local community representatives, and NGO(s)	C, N

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