Chapter 3
Test Auditing of Socio-Economic Indicators for Biofuel Production

Rocio Diaz-Chavez and Anni Vuohelainen

Abstract The EU funded Global-Bio-Pact project developed a set of socio-economic impact indicators. The purpose was not to create a new standard or scheme for bioenergy production, but to compile a set of socio-economic sustainability criteria and indicators for biomass production and conversion which could be used by developers, governments, nongovernmental organizations or as an aid to existing standards. The set of indicators was tested in two locations in South America, which comprise the two case studies reported in the chapter. The selected indicators are introduced and discussed here, along with an assessment of the results from their application in the field.

Keywords Sustainability audit · Field test · Indicators · Case studies

3.1 Introduction

A number of socio-economic sustainability criteria and indicators were identified in the EU funded project Global-Bio-Pact (see Chap. 2). These indicators aim to measure socio-economic impacts of biomass production and cover a wide range of aspects related to socio-economic sustainability, including contribution to local economy, working rights and conditions, health and safety, gender, land rights and conflicts, food security and a range of environmental impacts that could affect local communities.

The general methodology used to select the indicators is presented in Fig. 3.1.

The general steps to develop the set of indicators included:

- Benchmarking of standards for environmental and social indicators
- Identification of impacts mentioned in selected Global-Bio-Pact case studies

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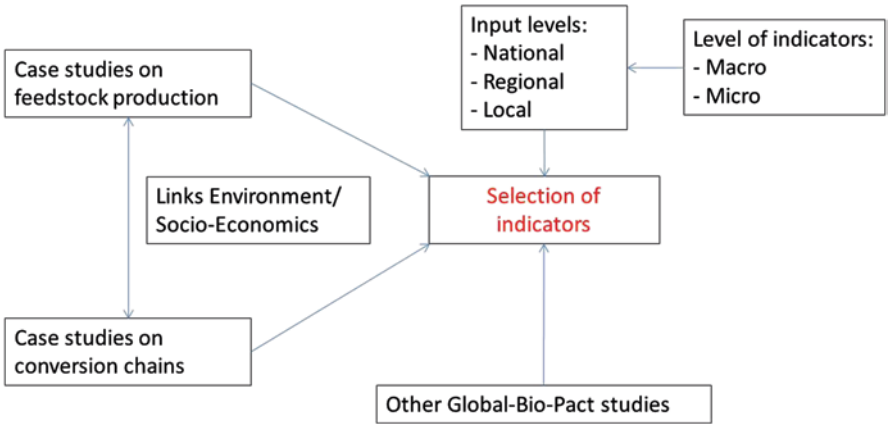

Fig. 3.1 Methodology for the selection of indicators

- Identification of socio-economic impacts in supply chains
- Links between environmental and social impacts
- Preselection of criteria and indicators
- Workshop with experts from the Global-Bio-Pact project
- Final selection of indicators

To further develop and improve these indicators, it was considered essential to field test the set of indicators for different feedstock, production models and geographical contexts. To this end, two case studies were selected for the field test of the Global-Bio-Pact set of socio-economic indicators. The field tests were carried out in two operations and surrounding communities. J. Pilon S/A—Açúcar e Álcool is a Brazilian sugar cane producer company in the town Cerquilho, in the state of São Paulo. J. Pilon S/A uses sugar cane to produce sugar and ethanol in its processing mill. Viluco S.A. is an Argentinean agro-industrial company that produces a number of crops, including soy that it uses for the production of soymeal and biodiesel in its processing plant. Viluco S.A. cultivates fields in the provinces of Tucumán, Salta, Santiago del Estero and Catamarca and has a processing plant in Santiago del Estero.

As a part of the field tests, both of the operations were asked to fill in a questionnaire that covered different aspects of the indicators. This was followed up with a visit to the facilities and selected agricultural fields of the two operations, during which key staff and a sample of employees were interviewed. The assessment team also visited surrounding communities and carried out community surveys to capture community perceptions of the impacts of the operations.

This chapter presents a selection of results obtained from two field tests, comprising a summary, for each indicator, of the data collected, followed by an assessment of the clarity, availability, relevance, measurability and temporal availability. The report does not aim to compare the results obtained in the two different countries or subject the data into further analysis of the impacts of the specific operations.

Table 3.1 Surveys applied in each case study

Type of survey	J. Pilon S/A (Brazil)	Viluco S.A. (Argentina)
Workers	31	30
Community	40	32
Outgrower	9	4
Contractor companies	0	1
Associations and government representatives	3	1

3.2 Methodology of the Field Tests

The two operations were visited as a part of the field tests, the first visit was to J. Pilon S/A and the town of Cerquilho, Brazil on 27–29 July 2012. The second visit was to Viluco S.A. and the fields and communities in the province of Tucumán, as well as the industrial operations and community in the town of Frias, Santiago del Estero on 10–12 September 2012.

In the field assessments, the data from each operation was collected in four ways:

- A questionnaire was sent to both operations prior to the field visit. The questionnaire included different aspects related to the indicators. Staff in charge of different areas of the operation filled in the questionnaire and sent it to the assessment team.
- A visit to the operations was carried out. During this visit, the assessment team completed the information sent by the operation via interviews with staff in charge of different areas of the operation (e.g. agricultural manager, human resources, quality manager).
- Fields, offices and processing facilities of the company were visited and questionnaires were applied to employees of the operations.
- Questionnaires were applied to outgrower and contractor companies of the operations where possible. In some cases other stakeholders such as representatives of government or associations were also interviewed.
- Communities located in the vicinity of the operations were visited and community surveys were carried out.

The number of surveys applied per case study is presented in Table 3.1.

The selection of indicators must be based on sound criteria, the availability of information, or human and economic resources for collecting data. As Webber and Alexander (1997) note, it is necessary to use real, available or easily calculated data. Some of the factors for selecting indicators, as noted by a number of authors (Avérous 1997; Webber and Alexander 1997; Hart 1999; Segnestam 1999; OECD 2000; Stanner et al. 2009; Dahl 2009) are summarized in Table 3.2.

The following chapter presents a summary for the information collected via different methods. The summary of the results is followed by an assessment of each indicator. The assessment is based on two sources: some of the interviewees were asked to evaluate the indicators they had been interviewed on and the assessment team evaluated each of the indicators based on their experience of the field test. Following criteria were used to assess the indicators:

Table 3.2 Synthesis of factors to consider when selecting indicators. (Source: Diaz-Chavez 2003, 2006)

Factors	Description
Reliability and quality	The accuracy of the data; a measure of the information collected. Based on theory and science when possible
Validity	Whether the indicator truly measures what it is supposed to measure
Realistic and practical	The collection of the data or information should be accurate and easily collectable, assuming the costs of collection
Spatial and temporality	Consider temporal and spatial scale as well as changes over time
Simplicity and clarity	Clarity in design and simple in format; understandable for any person
Comparability	To allow comparisons at the adequate level
Consensus	Among different actors (local, national, international, sound groups)
Measurability	According to the data they are interpreting (qualitative/quantitative)
Reviewability	Considerations to update the information
Limitation and balance	In number. Extensive sets of indicators are not in use any more. They should be short in number and balanced in the three dimensions of sustainability
Links	To show casual links among indicators or relevant data (even processes) and to strengthen links among institutions
Relevance	Direct relevance to the goal or objectives of the set of indicators
Cost/benefit	To show a relationship

- *Clarity*—Is the indicator clear in design and simple in format, is it easy to understand what is being measured?
- *Availability*—Is the data readily available from the source of the information?
- *Relevance*—Is the indicator relevant for the socio-economic impact that it aims to measure?
- *Measurability*—Can the indicator be easily measured?
- *Temporal availability*—Is the information readily available from the specified time period?

Each indicator was graded on the scale of 1–5, where 1 = poor, 2 = fair, 3 = good, 4 = very good and 5 = excellent.

3.3 Case Studies

J. Pilon S/A is a Brazilian sugar cane producer company that owns sugar cane plantations and a sugar/ethanol mill in the town of Cerquilho, in the state of São Paulo. The company was founded in 1953. The company currently has 5,070 ha of own land under sugar cane production and also produces sugar cane on 5,206 ha of rented land. It also has a processing mill that is used to produce both sugar and ethanol. As a by-product of the processing, the company also produces electricity and

Fig. 3.2 Map of Cerquilho. (Source: Wikipedia 2012a)

is energy self-sufficient. Between 40 and 50 % of sugar cane processed in their mill originates from the lands of independent outgrower. Cerquilho, São Paulo, Brazil (Fig. 3.2) is a municipality with a population of about 35,000 inhabitants and an area of 128.86 km^2. It has three small distilleries producers of *cachaça* ('firewater') and one mill that produces sugar and ethanol.

The case study in Argentina was conducted at Viluco S.A., an Argentinean agro-industrial company that produces soy, corn, wheat, sorghum and chick peas. The company produces crops on 22 fields located in north-eastern Argentina, in the provinces of Tucumán, Salta, Santiago del Estero and Catamarca (Fig. 3.3). The company has 25,170 ha of own land and 10,000 ha of rented land. In addition to the agricultural fields, Viluco S.A. has a soy crushing and biodiesel plant in the town of Frias, Santiago del Estero. The plant started its operation in 2010 and 2011 was the first full year of operation for the plant. The soybean crushing and biodiesel plants produce soy flour, husks and biodiesel. Over 70 % of the soybeans crushed in the plant are sourced from independent outgrower. The plant also sources soy oil from other suppliers. Viluco S.A. is a part of a business group called Grupo Lucci. Apart from Viluco S.A. the group includes three other companies that focus on the production of lemon and lemon derivatives, livestock and sugar cane.

3.4 Selected Indicators and Assessment

This chapter presents a selection of indicators from the set presented in Chap. 2 and in Diaz-Chavez et al. (2012). The indicators of the set include three main topics: background information, socio-economic indicators and environmental indicators. These last indicators are focused on the impact on the social issues within the region or the community. The indicators are presented by chapter, number and name.

Fig. 3.3 Map of Argentina with the province of Tucuman. (Wikipedia 2012b)

3.4.1 Land Area Under Cultivation

While information about the operations' own and rented land area was readily available for both operations, in the case of Viluco S.A. the operation purchased 70 % of the soybeans it used from independent outgrowers (Table 3.3). Since soybeans can be readily stored and transported for long distances before they reach the processing plant, the plants often have limited information and control over their outgrowers, which makes it difficult to obtain information about the agricultural operations of the outgrowers. It would be also important to make a distinction between the total area under production and the area that is harvested annually, as the total area harvested yearly typically varies, due to crop rotation and replanting (in the case of sugar cane). It was not possible to obtain exact information about the previous

Table 3.3 Land area under cultivation in both case studies

J. Pilon S/A (Brazil)	Viluco S.A. (Argentina)
Own land: 5,070.79 ha Rented land: 5,206.07 ha Of this around 8,000 ha is harvested annually Independent outgrowers: 6,553.35 ha (harvested), total area cultivated by them ~ 8,000 ha Total area harvested in the year 2011/2012 = 16,830.21 ha	Own land: 2,5170 ha Rented land: 10,000 ha 72.58 % of the soybeans processed in the biodiesel plant are purchased from independent producers, there is no information about the exact land area farmed by them. The plant also purchases crude soy oil from others, but the information on the quantity of this was not available at the time of the visit

Table 3.4 Expansion of land area in ha at the J. Pilon S/A plant

Year	Own land	Outgrower	Total
2007	216.56	372.10	588.66
2008	0	22.49	22.49
2009	60.55	0	60.55
2010	195.22	112.02	307.24
2011	209.66	214.30	423.96

5 years in the case of J. Pilon S/A. The biodiesel plant of Viluco S.A. has only been in operation since 2010, so information was only collected from year 2011, as this was the first complete year of operation.

3.4.2 Expansion of Land Area

J. Pilon S/A reported the expansion of area in the last 5 years for both, their own land and the outgrowers' land (Table 3.4).

Viluco S.A. reported there has not been expansion of own or rented fields. Information from the independent producers was not available. While information about the operations' own and rented land area was readily available for both operations, in the case of Viluco S.A., the operation purchased 90 % of the soybeans it used from independent outgrowers. Since soybeans can be readily stored and transported for long distances before they reach the processing plant, the plants often have limited information and control over their outgrowers, which makes it difficult to obtain information about the agricultural operations of the outgrowers. For soybean (and other annual crops) it would also be important to assess the total area of the farm under crop production, as soybean is generally produced in crop rotation and the land area under soy production typically varies annually. This indicator was deemed particularly relevant, as many negative socio-economic or environmental impacts can increase with expansion of land area under production.

3.4.3 Certification

This information about certification was readily available from both of the operations. J. Pilon S/A reported that they do not have any certification at the moment. Viluco S.A. reported that for their own and rented fields, they are certified by the Roundtable on Responsible Soy (RTRS). The soy suppliers for Viluco S.A. are also RTRS certified. The plant for flour production is certified with the Good Manufacturing Practice (GMP) and for the production of biodiesel they are certified by the International Sustainability and Carbon Certification scheme (ISCC). This indicator is relevant, as the indicators of the schemes could be used to assess impacts of certification in the future.

3.4.4 Production Cost

Information on production costs was not available at J. Pilon S/A. Viluco S.A. was able to provide this information for both, processing plant and its own agricultural production. They reported 255.79 €/t of soy (processing plant, including cost of soy purchased from outgrowers) and 24.93 €/t of soy from their own agricultural production. It is advisable to further refine this indicator to account for feedstock produced on own, rented and outgrowers land. Furthermore, it would be more useful to assess this value for a liter of biofuel, instead of quantity of feedstock. This value would account for the whole chain from agricultural production to processing. This indicator is relevant mainly in relation to the following indicator (value added), as the production cost alone does not give an indication of the economic profitability of the feedstock production.

3.4.5 Contributions Made by the Operation to Allied Industries in the Local Economy

Both operations provided information on costs of feedstock, which was not requested for this indicator. The information from J. Pilon S/A also included labor costs, but information could not be obtained on the percentage paid to allied industries. They reported an average of 65 % for sugar cane allied industries and 35 % for other costs (inputs, maintenance, labor).

In Viluco S.A. the soy production and biodiesel plant are managed by two different entities, which is why the information for the soy production was often not integrated with the information from the biodiesel plant. Therefore, information on this indicator was only available from the biodiesel plant. The estimated production inputs were of 7,944,541 € while the services from contractors were estimated at 822,270 €. Viluco S.A. did not provide information about labor costs, so the percentage of production costs could not be calculated.

Further guidance should be given on the calculation of production costs and allied industries should be defined more clearly, in order to obtain more useful information from this indicator.

3.4.6 Feedstock Production Farmed by Smallholders or Suppliers

Information on the feedstock production by smallholders or suppliers was readily available from both companies. J. Pilon S/A reported an average of half of the production every year produced by the outgrowers with an average of 150 suppliers per year as follows:

- 2007 = 48.9 %
- 2008 = 50.9 %
- 2009 = 40.6 %
- 2010 = 45.9 %
- 2011 = 47.6 %

Viluco S.A. reported that around 72.85 % of the soy processed in their mill was produced by 242 independent producers in 2010/2011. Additional information was gathered through the survey applied to outgrowers (see Vuohelainen and Diaz-Chavez 2012). The indicator was clear, measurable and relevant for estimating the contribution of outgrowers to the biofuel production.

3.4.7 Employment

Both companies provided information on the number of employees and the categories within each company. In 2011 J. Pilon S/A reported around 1,000 employees in the following categories: Administration: 30; Agricultural sector: 731 (381 permanent workers and 350 temporary workers); Industrial sector: 263 (238 permanent workers and 25 temporary workers). Temporary workers work 6 months per year.

Viluco S.A. reported for the industrial sector 230 permanent employees and in the agricultural sector 50 permanent employees. Viluco S.A. also works with 27 contractor companies for agricultural operations by Grupo Lucci (approximately 20 of them for crop production). Nevertheless, the quantity of companies used for soy production was not available.

This indicator requires both, information about the number of employees and of man-days worked per year. While the information about the number of employees was readily available for both of the companies, the concept of man days was not clear to the respondents and neither of the operations had easily accessible records on total man-days worked. Therefore, it would be easier to use the number of employees and the average number of months worked by temporary workers.

It is also important to consider that most of the agricultural work in the Argentinean soy sector is carried out by independent contractors. The contractor companies work in different regions of Argentina and are not under direct control of the producer companies. This makes it difficult to obtain accurate information about the total impact each producer company has on employment creation. This indicator is considered relevant, as job creation can be one of the most significant socio-economic impacts of biofuel production.

3.4.8 Ratio Between Local and Migrant Workers

Information on the ratio between local and migrant workers was easily obtainable from both operations and it was also easy to obtain this information from the workers interviewed. J. Pilon S/A reported that 20 % of workers are temporary migrant workers during the harvest period, while Viluco S.A. reported that 85 % of employees are from the local area (Tucumán and Santiago del Estero).

Additional information was gathered through the survey applied to workers where they reported on their birth place, as shown in Fig. 3.3.

3.4.9 Community Investment

J. Pilon S/A reported for the last 3 years an average investment of 7,000 €. These are monetary contributions to different community and educational projects and events. In addition to these, the company has contributed to community projects with in-kind contributions, including among others, land, labor and other donations. Viluco S.A. reported that through their main company Grupo Lucci, it carries out community investment via the 'Vicente Lucci foundation' that had an annual budget of 725,336.74 € in 2011. The budget included operational and personnel costs, volunteer program, communication and community relations program, organized visits to the biodiesel plant, educational projects and donations to community organizations

While the concept of community investment was clear to all of the interviewees, there are some problems with this indicator. In the case of J. Pilon S/A, the indicator only accurately captured the monetary value of investment, although a qualitative description of in-kind contributions for community investment was also provided. Thus the monetary value does not necessarily accurately capture all of the community investment activities of the company. For Viluco S.A., the total budget of the Vicente Lucci foundation was given. While the amount that the company spends in community investment is indicative, it also included personnel and operational costs of the foundation. Furthermore, the Vicente Lucci foundation is ran by the Grupo Lucci, which owns a number of companies and agricultural operations. Thus it would be impossible to differentiate which amount of this budget originates from soy and biodiesel production.

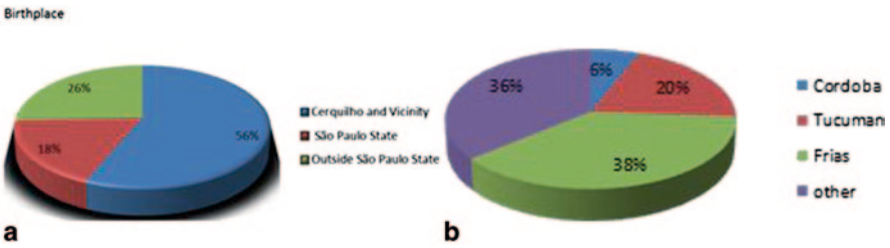

Fig. 3.4 Birthplace of workers at J. Pilon S/A (*left*) and at Viluco S.A. (*right*)

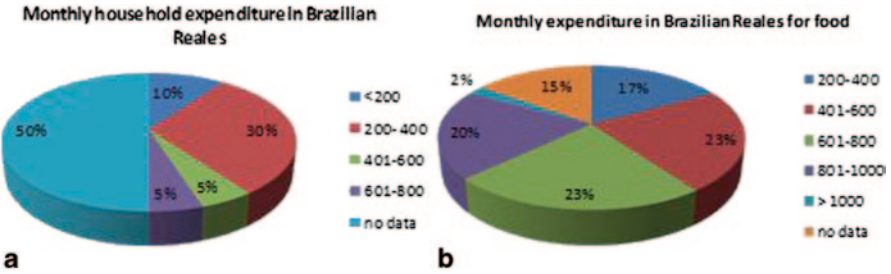

Fig. 3.5 Monthly household and food expenditure in Brazilian Reales

3.4.10 Income Spent on Basic Needs

The survey applied to workers provided information on the amount spent on food, but it was not possible to statistically correlate this information with the salaries of the workers. However, the survey included a question to enquire about the monthly household income, the amount varied according to the salary. The workers estimated the distribution of the income in food, transport and accommodation or household expenses (depending if they owned the property or lived with relatives). The data gathered for both case studies is presented in Figs. 3.4 and 3.5.

The indicator is important to understand the economic situation and well-being of the workers. It is possible to gather the data through the survey, but it should be better incorporated in the questionnaire with a higher level of clarity and detail. It was difficult for the workers to estimate the amount spent on the basic needs (food, transport, household expenses) in a monthly basis and some expressed the information per day or per week. These differences were also more evident according to the salary received by the worker. To be statistically valid a larger survey needs to be applied.

Table 3.5 Land converted for J. Pilon S/A production

Year	Pasture	Orange	Others (e.g. maize)
2007	470.93	88.30	29.43
2008	17.99	3.37	1.12
2009	48.44	9.08	3.03
2010	245.79	46.09	15.36
2011	339.17	63.59	21.20
2012	459.46	86.15	28.72

3.4.11 Benefits Created for Women

It was not clear to the interviewees whether this indicator referred to legally mandated benefits or additional benefits. As both of the operations only reported legally mandated benefits (i.e. maternity leave), no additional benefits for women obtained from biofuel production could be observed. In the case of the two field tests this indicator was not considered very relevant in terms of measuring socio-economic sustainability. In fact, this indicator more accurately reports on women's reproductive rights and so the indicator could be modified to relate to reproductive rights, as opposed to employment benefits for women.

3.4.12 Legal Title of Land Right

Both companies informed they hold legal title for all of their own lands and this is not challenged. Viluco S.A. reported that only one farm is rented and there is a rental contract for this. This indicator was clear to all of the respondents. Both of the operations were located in an area with very established land use and no evidence of unclear land rights could be encountered in the interviews with the company employees or communities. It was not possible to view the documents of legal titles during the field assessment.

3.4.13 Land Converted from Staple Crops

J. Pilon S/A reported the conversion of land mainly from pastureland, orange production and others. There is no information about land converted to sugar cane from crops considered staples by the local population (e.g. rice or beans) (Table 3.5).

Viluco S.A. reported that soy is currently farmed in rotation, whereby during summer 70% of land area is cultivated with soy and 30% with other crops (corn or sorghum) and if hydrological conditions of the field permit, wheat, chick peas, lentils and green peas are cultivated during winter.

For the purposes of the field assessments, it would be important to define what crops are considered staple in each country. Accurate information of exact quantities

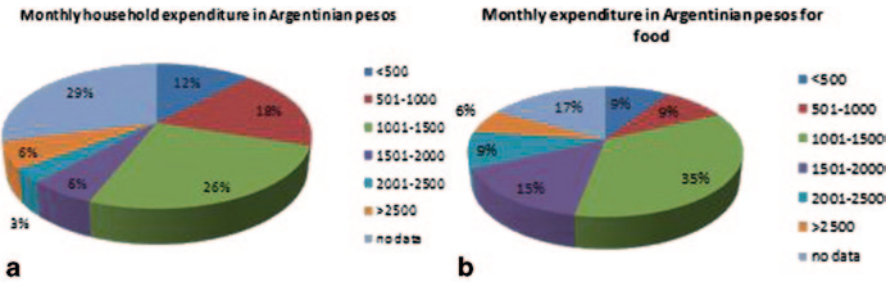

Fig. 3.6 Monthly household and food expenditure in Argentinian Pesos

of land converted from staple crops was not available for J. Pilon S/A. According to the operation, no land had been converted from other crops during the first years of operation of Viluco S.A. However, this indicator may not be entirely applicable for soy production, as soy is often cultivated in rotation with staple crops such as wheat. Information about conversion by outgrowers was not available for the assessment.

3.4.14 Open Burning on Company Level

Information about days of open burning was readily available from J. Pilon S/A and Viluco S.A. J. Pilon S/A reported the following days per year for open burning:

- 2007 = 207 days
- 2008 = 222 days
- 2009 = 228 days
- 2010 = 173 days
- 2011 = 182 days

In addition to this indicator, information about community perceptions on air quality was collected in community surveys. The results showed that the community had concerns related to the air quality related to the open burning practices of Cerquilho sugar cane farmers (Fig. 3.6).

In the case of Viluco S.A., open field burning is not used. The community surveys showed that the community members interviewed had some concerns related to air quality in the region, in relation to aerial fumigation of pesticides and bad smell from the soy processing mill (Fig. 3.7).

In addition to this indicator, some additional information related to air quality was collected in community surveys. The results showed that the indicator is very relevant in relation to sugar cane production, as concerns on air quality, due to burning practices, were mentioned by most of the community members interviewed for the survey. It would be useful to include an indicator that specifically relates to environmental impacts observed by community members.

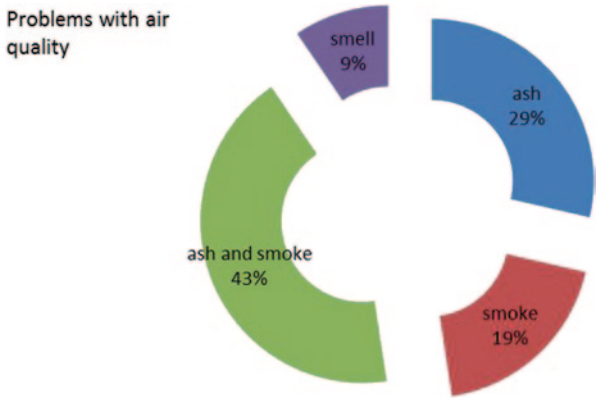

Fig. 3.7 Surveys result from local community in Cerquilho regarding air quality

3.4.15 Availability of Water

Surveys were applied to the communities of both case studies regarding their perception on the local environment. The problems nevertheless, could not be directly attributed to the biofuel production. This indicator is important and can be assessed qualitatively or quantitatively. The availability of water data can be obtained through other methods, for instance geographic information systems (GIS) calculations for a whole basin, data from the local authorities, or from the company. Nevertheless, this survey was based on the perception of the community which in some cases can provide information when they notice changes in the local availability of water for basic needs (drinking water, agricultural cultivation, washing). The data is difficult to assess in a qualitative form and the temporality can be an issue as it needs to be frequently monitored. It can be easily tracked to the consumption of the biofuel company.

3.4.16 Quality of Water

This indicator was also included in the survey applied to the communities to gather additional information regarding their perception on the local environment. The problems reported on water quality could not be directly related to the biofuel production. This indicator can be assessed qualitatively or quantitatively. However, the data are difficult to assess in a qualitative form and the temporality can be an issue as it needs to be frequently monitored. It can be monitored by the biofuels company through a water emissions assessment in the region. It can be also assessed through data from local authorities.

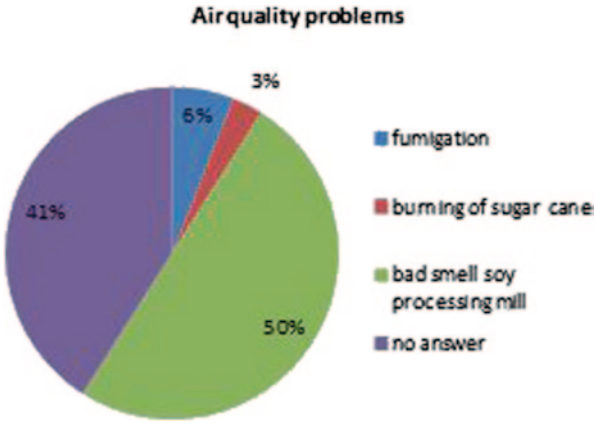

Fig. 3.8 Surveys results from local community in Santiago del Estero regarding air quality

3.4.17 Impacts on Local Fauna/Flora Perceived by the Community

The impact on local fauna/flora perceived by the community is a qualitative indicator based on the perception of the local population with information gathered through surveys. Figure 3.8 presents the results for the case of J. Pilon S/A (Cerquilho) and Fig. 3.9 for the case of Viluco S.A (Santiago del Estero) (Fig. 3.10).

Data are difficult to gather as it depends on the number of years that the interviewee has lived in the region or even the age of the interviewee. Nevertheless, with larger surveys and including several communities it is possible to assess the changes perceived by the population in a qualitative form. Another issue to consider is how to relate the changes directly to the biofuel production. It is very difficult to separate the general impact of agriculture from those derived from biofuels production, especially in cases were coproducts of food crops are being used.

3.4.18 Access to Ecosystem Services

The indicator related to ecosystem services includes the reduction of hunting and fishing opportunities.

Surveys applied to the local community provided the information for both case studies. In Cerquilho only 6 % of the interviewees replied that they noticed changes in the last 5 years on fishing. They explained it with the quality of water. There were no changes reported in these activities in the regions of Tucuman and Santiago del Estero. This is due to the fact that these activities are not practiced in the region. This is a qualitative indicator based on the perception of the local population. Data may be difficult to gather because it will depend on the number of years that the interviewee has lived in the region or even the age of the interviewee. The concept of ecosystem services is not very much recognized and this may create confusion with

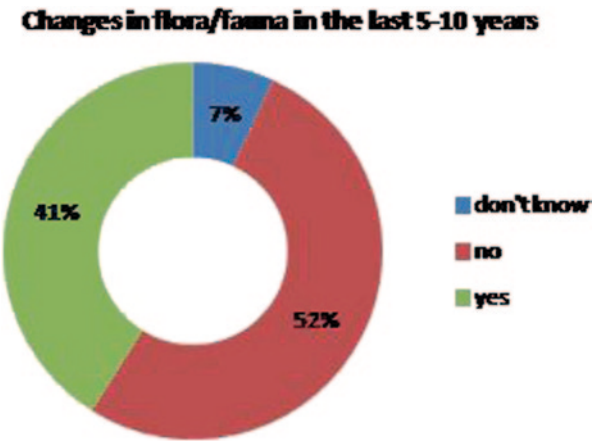

Fig. 3.9 Surveys results from local community in Cerquilho regarding changes in flora and fauna

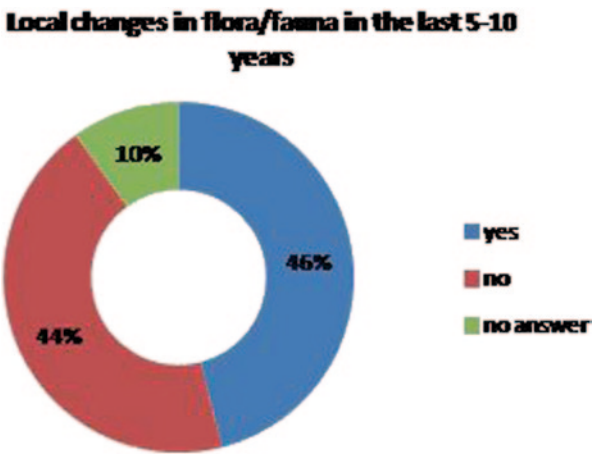

Fig. 3.10 Surveys results from local community in Santiago del Estero regarding changes in flora and fauna

general environmental knowledge or perception in the local population. Another issue to consider is how to relate the changes directly to the biofuel production.

3.5 Discussion

The selected indicators are summarized in Table 3.6. This is the assessment on the key criteria of indicators for both case studies on a scale 1–5 as explained in Chap. 3.2. There is no comparison between the cases, nor between the crops or the conversion process. The assessment was qualitative in nature, and should provide future guidelines to improving some of the indicators that had a score of three or lower.

Table 3.6 Selected indicators assessment for the two case studies

Number	Indicator/assessment criteria	Clarity	Availability	Relevance	Measurability	Temporal availability
Background information						
1.3	Expansion of land area	5	3	5	3	3
1.6	Certification	5	5	5	5	5
Socio-economic indicators						
2.1	Production cost	3	3	5	5	5
2.4	Contribution made by the operation to allied industries in the local economy	3	3	5	5	3
2.5	Production farmed by smallholders or suppliers	5	5	5	5	5
2.7	Employment	3	3	5	4	5
2.8	Ratio between local and migrant workers	5	5	5	5	3
2.11	Community investment	5	5	5	3	3
2.14	Income spent in basic needs	5	4	5	3	4
2.20	Benefits created for women	3	5	2	5	3
2.21	Legal title of land right	5	3	5	5	
2.24	Land that is converted from staple crops	3	3	4	3	3
Environmental indicators						
3.1	Open burning on company level	5	5	5	5	5
3.14	Availability of water	5	5	5	3	4
3.15	Quality of water	5	5	5	4	3
3.18	Impacts on local fauna/flora perceived by community	5	3	5	3	3
3.20	Access to ecosystem services (Reduction in hunting/fishing)	2	3	5	2	2

1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent

The indicators that require information from the community through surveys require a larger number of interviewees (e.g. indicators 3.18 and 3.20). Other indicators that applied directly to the operator or industry also require further development, such as for instance indicator 2.20 on benefits created for women, as most of the benefits are required to comply with the National Law.

Indicators 2.20, 3.20 and 3.24 have scored 3 and less for more than one criteria. Indicator 2.20 on benefits created for women, as previously explained, will need to be reviewed to see if additional criteria from the legal framework at national level should be included. Indicator 2.24 will need to be linked to background information

on staple crops at national, regional and local level. Indicator 3.20 on access to ecosystem services (hunting and fishing) will need to be reviewed and the surveys applied will need to reword the question in order to define if the activity already existed or has not been practiced in the region.

3.6 Conclusions and Recommendations

The two field tests provided important information on the practical application of the Global-Bio-Pact set of socio-economic indicators and allowed for an assessment of the indicators using the predefined criteria.

The assessment showed that most of the indicators were clear and easily understandable for the respondents. Some of the indicators could, however, be further refined to make it clear what information is being requested. This was particularly the case for the indicators where parameters had not been clearly defined (e.g. wind-prone region). Particular attention should be given to specific concepts that may not be used in all countries and may thus be unclear for the respondents (e.g. man-day). This should also be taken into account when translating the indicators in different languages. For the two field tests the indicators were translated in Spanish and Portuguese and some terminology and concepts were difficult to translate to these languages.

Most of the information was readily available from both of the operations. For those that were not, the problem was that the company was not able to provide the data in the requested format. Most of the respondents did, however, agree that keeping records of the information would be useful for monitoring the socio-economic impacts of the operation. The field test also showed that companies had different ways of monitoring and managing data, which makes it difficult to collect standardized information across different companies. The issue of availability of data would probably be solved if the indicators were applied in a more formalized way, e.g. as a part of a certification scheme, and the companies would have systems in place to routinely collect the information from their operations.

The operational staff interviewed agreed that most of the indicators were very relevant for monitoring socio-economic performance of the companies. Overall, it would be useful to relate the collected information to some general parameters (e.g. average salary in the agricultural sector in the country) for a meaningful analysis of the performance of the companies. Alternatively, the indicators could be used to measure the change over time (e.g. before and after certification). Those indicators that were currently not considered as very relevant (e.g. water management plan), could be modified to increase their relevance by, for example, asking about management of waste water or measures to reduce water consumption.

Most of the indicators are quantitative in nature and thus easily measured. Not all socio-economic impacts can be, however, measured quantitatively, which is why some of the indicators are qualitative and thus somewhat more difficult to measure. While incorporation of qualitative indicators is considered important, the

assessment team considered that some of the qualitative indicators could be further standardized in terms of the information requested, thus making them easier to measure and compare across time scales.

Overall, there was a very low temporal availability of the requested information. For most indicators, the respondents were requested to provide information from 5 years prior to the assessment, but this information had often not been collected, or it was not easily accessible for the purposes of the assessment. Viluco S.A. had only been producing soy biodiesel since 2010, so it was not possible to collect information prior to 2010. Considering the low availability of information from previous years, it would be probably the best to collect information from operations only from the year of the assessment. This information could then be collected annually so as to monitor changes in the indicators.

The combination of company interviews with employee, community and outgrower questionnaires was considered to be a good method for collecting the information necessary for the monitoring of the indicators. The application of community questionnaires was particularly useful to be able to gain an indication of community perceptions of impacts. Due to time constraints, it was not possible to apply the questionnaires to a statistically significant sample of respondents, but the information obtained was, nevertheless, considered to be useful supportive evidence for monitoring the indicators. While community questionnaires provided a range of useful information about impacts, the clear limitation of this method was that it was often difficult to link the impacts mentioned to biofuel production. Thus the questionnaire data should be evaluated as supportive data to the information obtained with other methods.

In the practical application of the indicators it may not always be possible to use similar amount of time and resources for field assessments as it was employed in these two field tests (3 days with three assessors). One possible use of the indicators would be to ask operations to report annually on a subset of the indicators. Where possible, the reports could then be verified annually, for example, as a part of a certification audit.

An overall recommendation on the application of the indicators is that if the main objective is to measure socio-economic impacts in a region, this should be a joint effort of local authorities and the company. This will help to have a better use of economic, time and human resources. Furthermore, the information provided to the local community regarding the activities of the biofuel sector in the region not only will be complying with sustainability aims for both the company and the government, but will also help to strength links between the stakeholders in the region.

The results presented regarding the feedstock, are related to the agricultural and agro-industrial activities in the region as a whole and it is very difficult to differentiate the impact of the biofuels production area from those of the whole system. This is especially challenging for mixed food/fuel crops such as for example the investigated soy and sugarcane value chains.

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