Method for the evaluation of farm sustainability in Quebec, Canada: The social aspect

Diane Parent, Valérie Bélanger, Anne Vanasse, Guy Allard and Doris Pellerin

Faculté des sciences de l'agriculture et de l'alimentation, Université Laval, Québec, Province de Québec, Canada. diane.parent@fsaa.ulaval.ca

Abstract: *In Quebec, over the last two decades, the number of dairy farms has declined and the sustainability of the family farms and their rural communities has been questioned. In order to be sustainable a farm should be viable, liveable, transmissible, and ecologically reproducible. Thus the assessment of farm sustainability should be based on its economic, environmental and social aspects. A holistic method, named DELTA, was developed for the three aspects: environmental, technical-economic and social. To identify the indicators, we used a multiple stakeholder perspective (researchers, farmers, advisors). We report on the 20 social indicators that were selected and grouped in four components: quality of life, social integration, farm succession and entrepreneurial skills. Results are presented as a radar diagram for each farm with axis representing indicators; for example, we have axis for farmer education level, leadership, innovativeness and risk-taking that describe the "entrepreneurial skills" component. Each indicator was validated on 40 farms. This new assessment tool will serve to evaluate the sustainability of a farm at a given point in time and could be used periodically to follow its evolution over the years.*

Keywords*: sustainability, social indicators, dairy farm system, social construction*

Introduction

It seems that the concept of sustainable development (SD) is becoming widespread. Agriculture is no exception and agricultural systems will have to evolve in this direction. According to the FAO (1991), *a sustainable agricultural system is a system that preserves land and water resources, that preserves genetic resources of plants and animals, and that is both economically viable and socially acceptable.* But how can we assess the level of conservation of resources as well as the economic viability and social acceptability of an agricultural system?

In Quebec (Canada), several factors lead us to take a better look at the sustainability of our farms. The intensification of production and geographic concentration of certain crops and livestock have resulted in an increased pressure on water, air and soil resources. Also, certain economic conditions and an ongoing uncertainty about the future of milk quotas undermine the economic situation of Quebec farms. The decline of the number of dairy farms in Quebec is also a major concern. In addition, societal expectations are increasingly high towards the modes of production and towards the quality of rural areas in general. Therefore, the concept of sustainability has also become a challenge for social sciences. Many actors advocate greener farms but will there even be enough farmers to manage those farms, and will the farmers continue to like their work? The rate of farmer generation renewal continues to decline, going from 53% in 2001 to 35% in 2006 (Stat Can, 2007). Consequently, defining what a sustainable agricultural system has become a real necessity.

In order to meet this challenge, our research project's objective is to develop a method to assess the overall sustainability of dairy farms that integrates the three aspects of SD. The method, called *DELTA,* is a farm self-diagnostic tool that can follow a farm's progress on its path to sustainability by tracking its adoption of best practices. It was named *DELTA* because this word often represents a triangle at the confluence of several rivers. The purpose of this paper is to illustrate the approach that was used for the construction of this assessment tool, specifically the social aspect.

An all-encompassing definition of sustainable farming

The concept of sustainable agriculture boasts fairly extensive literature, but its application on the farm raises several interpretations. Few sustainability assessment tools or methods that include all three aspects of SD are available at the farm level. For the majority of people and organizations, SD was first and foremost an environmental concept and only this aspect deserved assessment (Häni, 2006). This was a misconception since sustainability is defined as environmentally livable, economically viable and socially equitable.

Even though it has been several years since SD was described, defining the sustainable farm concept is different. Our definition implies that the farm must be viable, liveable, transmissible and ecologically reproducible (Landais,1998 ;Parent, 2001). 'Reproducibility' is defined by the logical use of natural resources (water, soil, air) through good agricultural practices and the reproducible potential of those resources. 'Viability' depends on the good technical-economic performance of the farm and implies that the farm must be able to generate secure long-term income. 'Liveability' is a concept that reflects the quality of life of farmers and their families, both on the farm and in their community. Finally, 'transmissibility' expresses the farm's potential to be taken over through succession by the next generation as well as the role of agriculture in the dynamics of local development. This definition is a basic premise when the objective is to assess sustainability at the farm level.

Methods for the assessment of sustainability

Although literature is abundant on SD indicators and on the assessment of sustainability in general, few documents on overall sustainability include the three aspects. However, there are some tools that take into account environmental, economic and social indicators. Some conceptual approaches extend the assessment of sustainability to the social aspect, but there are very few of those approaches, and they are harder to discern (von Wiren-Lehr, 2001; Rasul and Thapa, 2004).

In the Netherlands, a study by Van Calker et al. (2005) presents the sustainability of dairy farms according to four aspects: economic, ecological, internal social and external social. In total, 12 components were assigned to the ecological and external social aspects, three to the economic aspect, and only one to the internal social aspect (Working conditions) while five indicators measure the external social aspect (Food safety, Animal welfare, Animal health, Landscape quality and Cattle grazing).

In France, several methods have been developed to assess farms from all angles. One particular method, which has been tested on many farms, is presented below. It is called the IDEA method which is an acronym for *Indicateurs de durabilité des exploitations agricoles* (Vilain, 2001). It assigns scores to the farmer's practices and behaviour and measures the sustainability of different types of farms in France by using three scales: the agroecological, socioterritorial and economic scales. These three scales of sustainability contain components, which in turn contain indicators. These indicators represent the variables to be assessed. There are 19 indicators for the agroecological scale, six for the economic scale, and 16 for the socio-territorial scale. These three scales of sustainability have the same weight.

Closer to home, researchers at the University of Guelph in Ontario, Canada, in partnership with Switzerland, have developed a tool for assessing the overall sustainability of farms (Häni et al. 2003). Their tool is called RISE, which stands for Response-Inducing-Sustainability-Evaluation. Table 1 summarizes the strengths and weaknesses of the existing methods that were just reviewed.

Table 1. Summary of the strengths and weaknesses of the existing methods presented.

Method	Origin	Strength	Weaknesses
Van Calker et al.	Netherlands	• Takes into account the 3 aspects • Touches the social aspect • The indicators are specific to the dairy sector	• Only one economic indicator • No indicator on the quality of life of families
Vilain et al. (IDEA)	France	• Allows a constant evolution of the method • Takes into account the 3 aspects • The indicators are related to sustainability goals • The indicators are grouped into components	• Indicators are not specific to one production • The calculation of scores requires a lot of data
Häni et al. (RISE)	Switzerland and Ontario (Canada)	• Small number of indicators (12) to cover the 3 aspects • State and pressure on the resource for each indicator	• Few social indicators • Indicators are not specific to one production

Although far from exhaustive, this overview of literature nevertheless gives us an idea of the indicators that play a role in the assessment of each dimension of SD. It is vital for Quebec to develop its own suitable and adapted method.

Why use indicators?

The indicator concept is not new. In the past few years, the social and economic domains have been using several trusted indicators that have proven to be valuable governance tools. Examples include the gross national product or the civil status of citizens. Indicators of SD have also been recently integrated into agriculture. Extensive literature exists about these indicators, but since they were developed at the political level, they are often only applicable at the national or international levels. Not a lot of work has been done on the development of indicators that are applicable at the farm level.

Indicators are variables that provide information on other variables that are more difficult to access. They can be used as reference points to make decisions (Gras et al., 1989 cited by Bockstaller and Girardin, 2003; van der Werf and Petit, 2002). An indicator is a tool that reduces the complexity of descriptions and integrates information from a system (Giampietro, 1997 cited by von Wiren-Lehr, 2001). Therefore, the selected indicators must reflect the hard-to-collect information of the farm. For example, soil erosion, which is difficult to measure on the farm without expensive measuring tools, can be indirectly determined through related variables such as soil cover in the fall or the presence of riparian strips, etc.

Certain criteria are essential in choosing the right indicators in order to identify if some indicators are not suitable for a farm-level assessment tool. Table 2 shows these criteria and with which questions they are related to. A distinction is made between criteria used to evaluate the usefulness and criteria used for practicality.

Table 2. Questions asked to evaluate each indicator in regard to each criterion.

Practicality	Easy to implement	-Is the data for this indicator already being measured for another purpose? -Is the data easily available on the farm?
	Comprehensible immediately	-Does this indicator need a level of technical expertise to be comprehensible?
	Reproducible (reliability)	-Will this indicator be calculated the same way on each farm, year after year?
Usefulness	Sensitive to variations	-Will this indicator be able to follow the evolution on the farm, will the result increase or decrease depending on the management practices adopted by the farmer?
	Adapted to the objectives	-Does this indicator answer the objectives: "self-diagnosis" and "decision aid tool"? -Is this indicator linked with environmental sustainability objectives overall?
	Relevant for users	-As a primary goal, is this indicator useful for farmers or for other groups as well (advisors, stakeholders, etc.)

Adapted from Girardin et al., 1999, Hagan and Whitman, 2006

The development of the *DELTA* method: a social construction of indicators

Although the scope of this method seems promising for farmers and the surrounding environment, its interest also lies in its methodological approach which is based on a multidisciplinary approach and the participation of local actors. The Delphi technique (described below) and focus groups were used to consult with experts (researchers, farmers and stakeholders) in order to build and select the indicators. Creating a tool requires a knowledge from the base, i.e., from the field. It also requires an ongoing exchange between the researchers and the people in the field. This approach in the research world is called the inductive exploratory approach (Lessard-Hébert et al., 1996). In the field of agriculture, researchers more frequently use the hypothetico-deductive approach, which consists of making hypotheses and then confirming or disproving them (Van der Maren cited by Lessard-Hébert et al., 1996). This epistemological reminder allows us to better understand how the *DELTA* method was developed with the help of other techniques described below.

The Delphi technique

The Delphi technique was used here to identify the needed elements for the construction of the indicators for the three aspects of sustainability. It is important to mention that the Delphi technique is done remotely. First, a form containing a question regarding the research subject was sent to the selected experts. In our case, the respondents were asked to list elements to be considered when assessing the sustainability of dairy farms. Potential indicators were compiled and submitted to the same 25 experts who rated them for their relevance and easiness of on-farm acquisition (van der Werf and Petit, 2002). Thus, the participants, or experts, have the opportunity to make their points of view evolve. The main features of the Delphi technique are its anonymity, which aims to reduce the influence of "superexperts", and controlled feedback (Mayer and Ouellet, 2000).

The downside of this method is that it does not take into account the evolution of points of view that often arises in a group (Clément and Madec, 2006). Also according to Rigby et al. (2001), using consultation in order to define the indicators and their weighting can help build a consensus between actors who have different technical opinions. In our case, this recommendation has been included in our methodological process. The focus groups that followed the Delphi enabled us to benefit from these group dynamics.

Focus groups

Three focus groups were conducted, each with different experts, depending on the aspect. Focus groups are specific to the inductive approach and allow collecting new information that would otherwise be less accessible (Mayer and Ouellet, 2000). The focus group members were selected among the participants of the previous Delphi technique. Threshold values were determined for each selected indicator. The indicators were also grouped by component, and their weighting discussed by the group members. For example, the social aspect contains a component called *Farm succession* that includes the following four indicators: Continuity value, Presence of farm succession, Preparation for retirement, and Farm succession integration. Indicators are grouped this way for all three sustainability aspects.

The selected experts all had very different backgrounds. For the social aspect, the experts consisted of entrepreneurship researchers, farmers, farm transfer consultants from the regional farm succession centers and psychologists working mostly in the agricultural community coming to talk about quality of life. Table 3 illustrates our project's methodology by summarizing the experts' participation at each stage of the project and by giving the number of statements that have been put forward.

Table 3. Series of consecutive steps of participatory processes.

	Environmental aspect		Technical-economic aspect		Social aspect	
Steps	Number of experts	Number of statements kept at the end of the process	Number of experts	Number of statements kept at the end of the process	Number of experts	Number of statements kept at the end of the process
Initial sending	29	0	19	0	32	0
1st Delphi	25	102	19	139	27	166
2nd Delphi	20	23	19	20	18	30
Focus group	12	13	10	8	11	20

As shown in the last line of Table 3, the tool now contains 13 environmental indicators, 8 technical-economic indicators and 20 social indicators. Table 4 lists the components and indicators for the social aspect of sustainability, more specifically addressed here. The final choice of indicators was first achieved by the experts who were attending the focus groups.

Points were awarded by the experts to each component and each indicator in different ways depending on the aspect of sustainability; at the social level, the weight of each component determined by the expert is: Quality of life (25%), Social integration (15%), Farm Succession (30%) and Entrepreneurship (30%). Moreover, each indicator has its own score (see Table 5). Several social indicators are qualitative and in these cases, Likert scales are used to measure perception. For each scale, a weighting score is attributed. An example is presented below in section five. Finally, the results are added up for each indicator, which gives a final score of 100 for social sustainability.

Table 4. Four components and 20 indicators for the social aspect of the *DELTA* method.

Aspects	Components	Indicators
Social sustainability	Quality of life (25%)	Work and workload, Holidays, Satisfaction, Social support, Health and stress, Social and professional relationships
	Social integration (15%)	Contribution in local services, Agricultural neighbourhood, Quality of non-agricultural relationships, Social contribution, Regional presence of agriculture
	Farm succession (30%)	Continuity value, Presence of farm succession, Preparation for retirement, Farm succession integration
	Entrepreneurship (30%)	Formation, Use of advisory services, Vision, Human resources management, Entrepreneurial abilities

The studied farm sample

Once determined, the indicators were tested on 40 farms in two contrasting regions of Quebec (20 farms in each region) referring to their different pedo-climatic conditions, social situations and contexts of production. The Bas-St-Laurent region (BSL) is a more isolated area than the Monteregie (M) region which lies near major urban centres. Even if the farms are in two different regions, general characteristics like herd size and land area are similar (Herd size average (number of cows): BSL=53 and M=58; land area average (number of hectares): BSL=140 and M=153). The supply management system in Quebec's dairy industry, as for the rest of the country, can explain those small differences between farms. Although Quebec has an increasingly diversified agriculture, the dairy sector was chosen because it remains the largest sector, with 23% of farms (Statistics Canada, 2007). Moreover, Quebec is the leading province in milk production in Canada (Statistics Canada, 2007). The contrasting regions enabled to verify if indicator calculations can be done in different contexts and if threshold values are robust enough.To test the selected social indicators, a questionnaire addressed to the farmers was developed, mailed and completed by the owner-operators of the farms.

Results for social indicators of sustainability

Table 5 presents the results for the social aspect of the sustainability that was evaluated in this project. The results are also presented according to each of the two main studied regions. Although the project's objective is not to compare these two regions, this separation of results allows us to see if the chosen thresholds for each indicator have amplitude or not.

The two regions are similar in terms of results. Some indicators (Work and workload, Farm succession integration and Regional presence of agriculture) have low scores compared to the maximum score for each indicator. The indicators *Satisfaction, Vision* and *Preparation for retirement* are slightly better but work still needs to be done by Quebec dairy farms in those areas. Social indicators are often qualitative and mostly assess the perception of farmers towards the subject. The following example illustrates the Likert scale and the weighting score for each category of the scale in the three questions asked in order to assess the farmers' satisfaction. The three questions are:

- "How much do you enjoy your regular farm activities?" A lot (3), Enough (1), A little (0), Not at all (0).
- "What is your level of satisfaction with your life?" Very satisfied (2 points), Rather satisfied (1), Rather unsatisfied (0) or Very unsatisfied (0)
- "How do you rank your overall net household income?" Very satisfied (2), Rather satisfied (1), Rather unsatisfied (0) or Very unsatisfied (0).

Then, the score for *Satisfaction* indicator is the addition of each answer. Consequently, the maximum score of this indicator is seven.

Another example of score attribution is for the *Presence of farm succession* indicator. The maximum score for this indicator is eight. First of all, experts desired to modulate the score in function of farmer's ages for retirement. Then, the score for this indicator varies between four possible answers. If there is a serious and interested farm succession; the score will be eight. If it is clear that there is no farm succession, the score will be zero. Between these two answers, two options are available. If the answer is: I don't know if there is farm succession for my enterprise, another question is asked about the time before retirement. If I am at least five years from my retirement, the score will be five and inversely, if I am at less than five years of my retirement and still do not have a farm succession the score will be only two. In summary, scores for this indicator could be zero, two, five or eight points.

Table 5. Results of the 20 social indicators for both regions.

Components	Indicators		Bas-St-Laurent	Monteregie
		Maximum score	Mean	Mean
Quality of life (25)	Work and workload	2	0.7	0.6
	Holidays	2	0.9	1.0
	Satisfaction	7	4.1	4.4
	Social support	4	3.3	3.0
	Health and stress	5	1.8	2.1
	Social and professional relationships	5	3.8	3.6
Social Integration (15)	Contribution in local services	2	1.5	1.0
	Quality of non agricultural relationships	6	4.5	3.8
	Agricultural neighbourhood	4	3.5	3.8
	Social contribution	1	1.0	0.8
	Regional presence of agriculture	2	0.8	0.9
Farm Succession (30)	Continuity value	9	7.4	8.4
	Presence of farm succession	8	6.6	6.9
	Preparation for retirement	7	3.1	4.1
	Farm succession integration	6	2.3	1.9
Entrepreneurship (30)	Formation	6	3.8	4.8
	Use of advisory services	6	5.6	5.4
	Vision	6	3.6	3.9
	Human resources management	6	4.3	4.7
	Entrepreneurial abilities	6	4.2	4.8
	TOTAL (score)	**100**	**66.3**	**69.7**

The assessment of perception can give reliable results, despite the fact that the indicators are qualitative and therefore more difficult to identify. Another good example is the *Vision* indicator. This indicator is verified by simply asking farmers if they have a clear vision of their farms in 10 years, and if they have a written document, or development plan, that expresses orientations, measures and objectives for the future of their farm. These two questions are answered by yes or no. As shown in table 5, for the experts, the most important indicator to assess social sustainability is the *Continuity value* with the highest relative-weight of 9 points, followed by *Presence of farm succession* (8) and Satisfaction (7).

Results are presented using radar diagrams, also called spider webs (Fig. 1). This type of diagram can help to clearly show the strengths and weaknesses of a farm. It contains as many axes as there are indicators. Each axis starts at the center point and ends at the periphery. The total length of an axis represents the maximum score that can be obtained for the indicator. Straight lines then link the axes, and a polygon is formed. Therefore, the shape of the web varies according to the results. A bigger polygon means a higher score. It is possible for a farm to have a radar diagram that illustrates its results compared to the regional average (Fig. 1). Comparing a farm to its region instead of the whole province helps to better guide the farmer concerning his results. This is because different regional contexts can create significant differences. For example, maize cultivation is very present in Monteregie but is rare in the Bas-St-Laurent region. The end result of the diagnostic tool will be these diagrams. The farmers will receive a copy of them after their evaluation. The means for each region will gradually appear as more and more farmers do the evaluation.

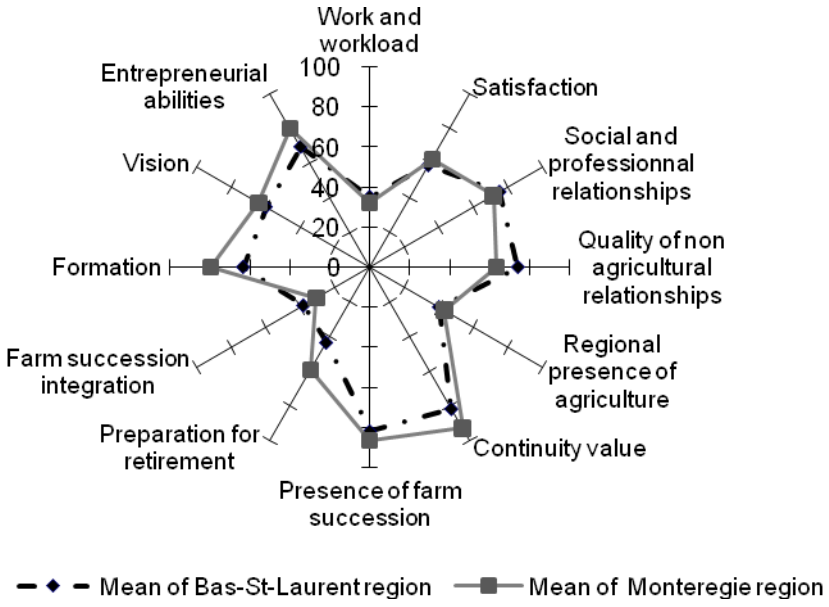

Figure 1. Radar diagram presenting both regions' means for 12 of the 20 social indicators.

Figure 1 contains 12 indicators and shows that the two regions have similar trends in terms of social sustainability. The shapes of the two polygons are similar, but Monteregie seems a little stronger when it comes to the Entrepreneurship component, especially when it comes to the Vision, Entrepreneurial abilities and Formation indicators. Cohabitation is stronger in the Bas-St-Laurent region.

Conclusion

In response to the growing popularity of SD, many organizations meet the challenge of building SD indicators for various sectors, including agriculture. We have also chosen to take on this challenge as part of our research project. *DELTA* provides farm-level indicators to assess the overall sustainability of dairy farms. One of the innovative aspects of this tool is that it contains indicators for measuring the social sustainability of dairy farms. The past and future work done with regard to this project clearly demonstrates that the concept of SD is a space where several disciplines meet, confront and collaborate.

A major step that has to be taken is the integration of the three aspects of sustainability. This will provide a new evaluation grid for farms and will illustrate the interrelationships that exist between the components. It will also be useful in order to have a better global and systemic understanding of the farm. This integration will highlight the issues that still need to be clarified concerning SD in agriculture. The grid will serve as a reflection tool for farmers wishing to enter an operational approach to sustainability in Quebec.

Combined with a long term vision, this method could help improve the effectiveness of environmental and rural policies and help establish the priorities for SD in the agricultural sector. Finally, our understanding of the principles of sustainable agriculture will have improved and an attempt to operationalize the concept of SD will have been made.

All in all, the creation of a sustainability assessment method will be an asset to the dairy sector in Quebec. In the words of Landais (1998): "The sustainable development discourse is actually a new social contract that is offered to farmers. And we cannot exclude that sustainability will play the same role in the next decade that productivity has played in previous ones." Hopefully our contribution will allow more farms to survive these next decades.

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