Farm Sustainability Assessment using the IDEA Method. From the concept of farm sustainability to case studies on French farms

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From Common Principles to Common Practice

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From the concept of farm sustainability to case studies on French farms

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Abstract

Although many indicator sets have been developed to characterize sustainability, a lack of available methods and operational tools to assess the sustainability of a farm is often reported. The use of specific indicators can be an interesting if farmers can use them in a process of self-assessment. First, the French IDEA method (*Indicateurs de Durabilité des Exploitations Agricoles*) of farm sustainability indicators illustrates the scientific approach adopted by the authors in this paper to translate the concept of farm sustainability into a system of 41 sustainability indicators covering three dimensions of sustainability. Secondly, some results are presented from different case studies illustrating tests of the IDEA method. Thirdly, the way of building the indicators is discussed on the basis of some results and feed back from users. In conclusion, a recent work linking the IDEA method with national data bases is noted.

Keywords: IDEA method, sustainability indicator, sustainable agriculture, assessment, farm, method.

Introduction

Although the definition of sustainable development put forward in the Brundtland Report is now generally accepted ("mode of development that meets the needs of the present without compromising the ability of future generations to meet their own needs"), its application in agricultural operations still raises many scientific questions.

Since the United Nations Rio Conference (UNCED, 1992), the European Union has been working to integrate the transversal character of sustainable development into its policies in all the different sectors of activity. The last reform of the Common Agricultural Policy (CAP) (2003) partly expressed the EU's determination to establish sustainable development as one of the guiding principles of European policies by establishing the principle of cross compliance[1] and support for types of agriculture that favour the environment (Article 69 of the CAP regulation N°1782/2003).

The European Commission also supports the elaboration of indicators of sustainability in agriculture with a view first to orient policies in favour of sustainable farming and then to assess them (European Commission, 2000, 2001). However, these political objectives raise the question of the conception of new indicators to evaluate the degree of sustainability of an agricultural production system. How can we go about translating the concept of sustainability into operational terms on the level of individual farms? In France, this question has led to scientific consideration of how to comprehend sustainability through indicators.

In this context, the essential purpose of this paper is to present some results of a French multi-disciplinary research project which has given the concept of sustainability practical expression in the elaboration of the IDEA method (*Indicateurs de Durabilité des Exploitations Agricoles or Farm Sustainability Indicators method*) (Vilain *et al*., 2003). This method, conceived as a self-assessment grid for farmers, provides operational content for the notion of agricultural sustainability.

This paper begins by going over the main concepts underlying a system of sustainability indicators. Secondly, the scientific method developed for the elaboration of the IDEA method is presented, moving from the concept of agricultural sustainability to a system of indicators on the scale of

1 The Sustainable Agriculture Contract is the French contract to subscribe an agri-environmental measure.

the farm. Thirdly, we present the results of different case studies in France using results from different farms surveyed and then discuss different points on the scientific building of the method. We conclude by presenting a few prospects for research.

1. General considerations on sustainability in agriculture and on indicators

The need for a definition is a prerequisite for the elaboration of a conceptual framework for sustainable agriculture

Several definitions of a model of sustainable development exist. In 1988, the Consultative Group on International Agriculture Research considered that "sustainable agriculture should involve the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources." Harwood defines sustainable agriculture as "a system that can evolve indefinitely toward greater human utility, greater efficiency of resource use and a balance with the environment which is which is favourable to humans and most other species" (1990 in Bonny, 1994). It is the consensual definition given by Francis and Youngberg (1990, in Bonny, 1994), which is today commonly accepted to qualify sustainable agriculture: "Sustainable agriculture is agriculture that is ecologically sound, economically viable, socially just and humane."

We will consider that sustainable farming is based on three essential functions; the function of producing goods and services, the function of managing the territory and the function of playing a role in the rural world. As for the conception of a sustainable farm operation, we propose that given by Landais: "a farm operation that is viable, liveable, transferable and reproducible" (1998).

Applying the concept of sustainability to agriculture leads us to extend the demand for indicators to take the different dimensions of sustainability into consideration

On the level of the farms, the indicators must characterize the key concepts taken from the definition of sustainable agriculture (Zahm *et al.*, 2004).

Viability involves, in economic terms, the efficiency of the production system and securing the sources of income of the farming production system in the face of ups and downs on the market and uncertainties surrounding direct payments. This concept can be analyzed by making a judicious choice of common indicators.

Liveability focuses on analyzing whether the farming activity provides a decent professional and personal life for the farmer and their family. These indicators may place the farmer in relation to certain social references, such as income or working times, for instance, but may also tackle more subjective aspects such as participation in the community and associations or openness to non-farmers, *translating the experience of farmers and the form of relationship they have with society*.

Lastly, *the environmental reproducibility* of the ecosystems linked with the farms can be analyzed using agri-environmental indicators in particular, which characterize the impacts of farming practices on the environment. In most cases, these indicators will provide information primarily on risks for the environment linked with farming activities.

The definitions to qualify an indicator are many, but they are all directly linked to the objective assigned to the indicator. For Gallopin (1997, in OCDE 1999a) indicators are given a wide range of names: variables, parameters, measurements, statistical measurements, indirect measurements, values, indices, meters, empirical models of real conditions and telltale signs. We propose to take as a definition: "indicators are variables that provide information on other variables that are less easily accessible. They also serve as a guide when making a decision" (Gras *et al*., 1989).

Sustainable development applied to agriculture requires indicators to be established combining the following three dimensions:

- *systemic:* this consists of apprehending, at one and the same time, the economic, environmental and social aspects of agriculture;
- *temporal and spatial:* here the purpose is to assess the effects that are likely to occur over time and in space, given that a system that is balanced in appearance can generate imbalance locally or over the long-term; and
- *ethical:* sustainability is founded on a system of values such as the need to conserve natural and human heritage, or at least to use it as sparingly as possible (Vidal *et al*., 2002).

Regarding its expected qualities, an indicator must be objective and scientifically sound, relevant to the issue being studied, sensitive, easily accessible and comprehensible (Girardin *et al*., 1999).

What is the best approach to constructing a sustainability assessment method?

Our purpose here is not to give a detailed presentation of the research questions and the general scientific approach involved in the construction of sustainability indicators. These aspects have already been explained in the specific papers of Mitchell (1995) or Girardin (1999), who propose an approach to constructing indicators in five stages:

1. defining objectives;
2. choosing hypotheses and the most important variables;
3. creating the related indicators;
4. determining the reference thresholds or choosing standards; and
5. validating by testing.

2. How the IDEA method was built

We propose, on the basis of these general principles presented above, to illustrate this approach by presenting a practical case conducted in France: the construction of the IDEA method.

First stage: Explain the principle of sustainability in the form of clearly identified objectives within a conceptual framework

To give meaning to the notion of sustainable agriculture, it is first necessary to transcribe the concept of sustainability into a conceptual model based on clearly identified sustainability objectives. This conceptual stage is indispensable scientifically, because it enables us to state the conceptual hypotheses clearly and therefore to engage debate later. Aside from the necessary conceptual rigour mentioned, this approach has the advantage of being pedagogical by serving as a guide for the user to understand and interpret the indicators that are constructed.

Thus, in the IDEA method, this prior in-depth conceptual analysis revealed the main objectives underlying each of the indicators. They concern:

- on the one hand, the preservation of natural resources (water, air, soil, biodiversity, landscape and mining resources); and
- on the other hand, social values that are characteristic of a certain degree of socialization and are implicit in sustainable agriculture (ethics, quality, socially-aware practices, etc.).

This method is structured around objectives which are grouped together to form three sustainability scales. Each of these three scales is sub-divided into three or four components (making a total of 10 components) which in turn are made up of a total of 41 indicators.

The objectives of the agro-ecological scale refer to the agronomic principles of integrated agriculture (Viaux, 1999). They must enable good economic efficiency at as low as possible an ecological cost. Those of the socio-territorial sustainability scale refer more to ethics and human development, essential features of sustainable agricultural systems. Lastly, the objectives of the economic sustainability scale specify the essential notions relating to the entrepreneurial function of the farm.

A single objective can contribute to the improvement of several components of sustainability.

Table 1: The sixteen objectives of the IDEA method.

Consistency	Careful management of non-renewable natural resources
Preservation and management of biodiversity	Local development
Soils preservation	Citizenship or socially-aware practices
Preservation and management of water	Human development
Atmosphere preservation	Quality of life
Product quality	Adaptability
Ethics	Employment
Landscapes preservation	Animal well-being

The objective of consistency merits particular attention. While it is not specific to sustainable farming systems, analysis of various recent publications on sustainability in agriculture (Andreoli *et al.*, 2000; Bastianoni *et al.*, 2001; Rigby *et al.*, 2001; Pacini *et al.*, 2003; Cornelissen *et al.*, 2001; Tellarini *et al.*, 2000; Tisdell, 1996) shows that this objective of consistency was not explicitly emphasized, despite the fact that this principle is the very foundation of any analysis of the sustainability of a system. The importance of the objective of consistency was highlighted recently by Cloquell-Ballester who proposed a methodology for validating the performance of indicators based on the work of Bockstaller and Girardin (2003) on indicator validation from three fundamental points of view: conceptual consistency, operational consistency and utility. Conceptual consistency determines the correct relation between the indicator and the measuring object (environmental/socio-territorial, economic). Operational consistency determines the correct definition of the internal operations of the indicator (Cloquell-Ballester *et al*., 2006) which correspond respectively to design validation, output validation and end-use validation.

This explains its high frequency in the IDEA method (Table 1). Indeed, while intensive systems possess very great technical consistency, generally turned towards the search for maximum yield in the short term, they often pollute and waste resources. It is therefore a different value system that pervades sustainable agriculture. This gives rise to *another form of consistency*, more global and more transversal, concerning the farmers not only in their function as agronomists and company chiefs but also on a personal level, as protagonists in society and as citizens.

As well as this, we must make the distinction between technical consistency and consistency in terms of "citizenship." Technical consistency refers to a set of farming practices which, working together, amplify each other and produce effects that are greater than the sum of individual effects. For example, consistent cropping plans, rotations and operational sequences make it possible to combine profitability, quality of production and protection of the environment. As for *consistency in terms of "citizenship,"* this refers to socio-economic behaviour that enhances sustainable agricultural and rural development. It is therefore no longer specific to sustainable farming systems.

Second Stage: Build a matrix combining the target objectives with the indicators used to characterize them

To move from the conceptual framework of the objectives to measuring achievement, the intermediate stage is to propose indicators intended to translate these objectives into measurable criteria. In this phase, it is useful to build a matrix including the objectives and indicators. The matrix of the IDEA method is constructed with 41 indicators providing information on 16 objectives.

Figure 1: The indicators/objectives matrix of the IDEA method.

3 scales, 10 components and 41 indicators	Component	Indicator number	Coherence	Biodiversity	Soil preservation	Water preservation	Atmosphere	Food quality	Ethics	Local development	Landscape preservation	Citizenship	Management of non-renewable resources	Human development	Quality of life	Adaptability	Employment	Animal well-being
Agro-ecological scale	Diversity	A1	X	X	X						X							
		A2	X	X	X						X							
		A3		X							X							
		A4	X	X														
		A5	X	X														
	Organization of space	A6	X	X	X						X							
		A7	X	X	X	X					X							
		A8	X		X					X	X		X					
		A9	X	X	X	X					X							X
		A10	X	X							X	X						
		A11	X		X	X									X			
		A12	X	X	X	X		X			X							
	Farming practices	A13	X			X	X	X					X					
		A14				X	X						X		X			
		A15	X	X	X	X	X	X							X			X
		A16						X	X						X			X
		A17		X	X	X							X					
		A18			X	X							X		X			
		A19	X				X						X					
Socio-territorial scale	Quality of the products and land	B1						X		X		X		X				X
		B2	X						X		X			X	X			
		B3									X	X	X		X			
		B4	X						X		X	X			X			
		B5	X						X	X		X		X				
	Employment and services	B6	X							X								
		B7								X		X						
		B8							X	X		X					X	
		B9								X		X		X	X			
		B10								X					X		X	
	Ethics and human development	B11	X						X				X	X				
		B12	X							X				X	X			
		B13	X												X		X	
		B14												X	X			
		B15													X			
Economic scale	Economic viability	C1	X							X					X	X		
		C2	X													X		
	Independence	C3	X												X	X		
		C4	X													X		
	Transferability	C5	X							X		X			X	X	X	
	Efficiency	C6	X			X							X					

(16 objectives; X = shaded cell)

Source: *Vilain et al., 2003*

Third Stage: Set out the initial hypotheses and choices for the construction of the indicators and their calculation method

The question of a hypothesis and method of calculation

Any method based on indicators implies an initial formulation of a hypothesis which will be tested, then the choice of a method of calculation is determined and the determination of reference values made. These reference values or thresholds are necessary when developing a tool to assist in decision-making/action.

In the IDEA method, the initial hypothesis postulates that it is possible to quantify the various components of a farming system by giving them a numerical score and then weighing and aggregating the information obtained to give the farm a score on each of the three scales being used to qualify sustainability: an agro-ecological scale, a socio-territorial scale and an economic scale.

Concerning the calculation method, it is based on a points system with an upper limit. The three sustainability scales are of equal weight and go from 0 to 100 points. All the information is translated into basic sustainability units determining the score allocated to each indicator. Maximum scores are set for each indicator in order to set an upper limit on the total number of sustainability units. The score of a farm on each of the three sustainability scales is the cumulative number of basic sustainability units (or points) awarded for the different indicators in the scale in question. *The higher the score, the more sustainable the farm is considered being on the scale in consideration*.

In the same way, each component is also limited to a ceiling value (generally 33 points). This calculation method allows farms a very large number of possible technical combinations resulting in the same degree of sustainability. Indeed, even though certain principles are common to all sustainable farming systems, we consider that there is not just one single model. The wide variety of contexts and production environments and the diverse production systems and technical combinations encountered mean that there are a very large number of possible ways of making progress. Certain technical or structural weaknesses can therefore be partly made up for by options that are more compatible with the general organization of the production system.

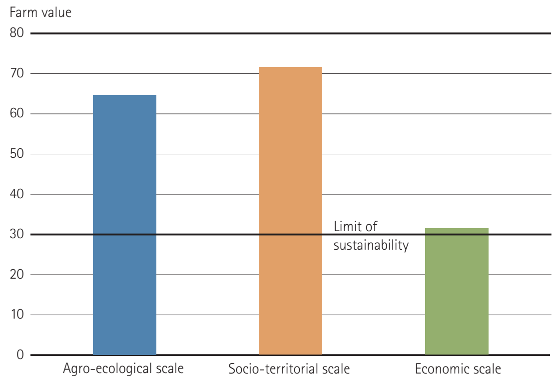
The question of aggregation to give a single global score to qualify sustainability

Once the principle of awarding sustainability points is accepted, two questions are raised: on the one hand, that of the aggregation of these points within a single component and then between the different components of the scale and, on the other, that of aggregation between the three scales of sustainability. From a scientific point of view, this raises issues on two levels:

- on the conceptual level, what is the meaning of a single sustainability score pooling the three scales (dimensions) of sustainable agriculture? The response depends to a large extent on the philosophical debate as to the meaning to be attributed to sustainable agriculture; and
- on the methodological level, how can we go about combining the points within a given component and then within the same scale? The response on this level can be instrumental in developing pertinent methods (simple models, multi-criteria methods, etc.).

These questions are complex by their very nature and worth presenting in their own right. The purpose of this paper, however, is not to answer them on the theoretical level. Thus, regarding the first point, we refer to the debate on the concept of sustainability initiated by Hansen (1996) and, on the latter point, to the various methodological studies of Mitchell *et al*. (1995), Cornelissen *et al*. (2001) and Bockstaller and Girardin (2003) on the aggregation and then validation of composite indicators.

Figure 2: The IDEA rule on attribution of the final farm sustainability score.



Source: Vilain et al., 2003

In the IDEA method, when it comes to the question of global scores aggregating the three scales, the authors allocate the lowest value of the three scales as the final numerical sustainability value, thus applying the rule of key constraints which is called for in the dynamics of ecosystems. Indeed, awarding an all-inclusive, single score would have no real meaning in that it would allow compensation between the results of the three scales (figure 2).

The question of the scale of values in the scoring system

Any scoring system requires the construction of a value scale and a meaning in order to situate the score awarded and therefore characterize the level of sustainability.

In the IDEA method, maximum marks translate the weight attributed to each indicator within the component to which it relates and, consequently, the weight attributed to each field in the sustainability scales in question. The maximum score awarded to each indicator is defined not with the aim of establishing an absolute optimal value, but rather practices, behaviour or levels of results that do not give rise to fundamental remarks concerning the notion of sustainability. Once tests had been conducted, the scoring scales are calibrated to achieve the greatest possible discrimination between farms.

However, for certain indicators, negative scores are allocated, highlighting critical situations in relation to sustainability. For example, the use of phyto-sanitary products of class seven,[2] zero grazing or straw burning cause elementary sustainability points to be lost and can lead to negative scores in the absence of factors to compensate for them.

Fourth Stage: Develop the content of the three scales, organize consistency within each scale and describe the construction of each indicator in detail

In this stage, the respective content of the three sustainability scales (agro-ecological, socio-territorial and economic scales) is formalized and organized to give them a meaning.

In the IDEA method, each sustainability scale is subdivided into three or four components which summarize the major fundamental characteristics of the sustainability diagnostic assessment (Tables 2, 3 and 4). A total of 41 indicators are proposed. Most are composite indicators established on the basis of easily quantifiable magnitudes, but there are also a few cases of more qualitative data.

2 Article 13 of Regulation n°1782/2003 of 29 September 2003 setting out the common rules for the CAP support system, OJEC of 21.10.2003, L 270.

Agro-ecological sustainability scale

This scale analyzes the propensity of the technical system to combine efficient use of the environment and the lowest possible ecological cost. This first scale includes the indicators illustrating the capability of the farms to be more or less autonomous in relation to the use of non-renewable energy and materials and to generate more or less pollution.

Table 2: The indicators in the agro-ecological sustainability scale.

3 components	19 indicators	Maximum values for each indicator and component	
Diversity	Diversity of annual or temporary crops Diversity of perennial crops Diversity of associated vegetation Animal diversity Enhancement and conservation of genetic heritage	13 13 5 13 6	Maximum total of 33 sustainability units
Organization of space	Cropping patterns Dimension of fields Organic matter management Ecological buffer zones Measures to protect the natural heritage Stocking rate Fodder area management	10 6 6 12 4 5 3	Maximum total of 33 sustainability units
Farming practices	Fertilization Effluent processing Pesticides and veterinary products Animal well-being Soil resource protection Water resource protection Energy dependence	10 10 10 3 5 4 8	Maximum total of 34 sustainability units
	Grand total	100	

Source: Vilain et al., 2003

The 19 indicators in this scale (Table 2) concern three components which are each of the same importance (33 points): diversity of production, organization of space and farming practices.

Diversity of production takes account of the complementarities and natural regulation processes allowed by farming ecosystems. It is apprehended through five indicators qualifying the diversity of species or crops. However, the interest of a diversified production system can only be expressed if it is designed to make the best possible use of the natural assets of the area and to limit its handicaps and any damage to the environment. These aspects are dealt with by the indicators concerning the organization of space and farming practices.

Socio-territorial sustainability scale

This scale characterizes the integration of the farm within its territory and in society. It seeks to assess the quality of life of the farmer and the weight of the market and non-market services rendered to the territory and to society. In this respect, it allows us to look into issues that go beyond the farm itself.

Table 3: The indicators in the socio-territorial sustainability scale.

3 components	16 indicators	Maximum values for each indicator and component	
Quality of the products and land	Quality of foodstuffs produced Enhancement of buildings and landscape heritage Processing of non-organic waste Accessibility of space Social involvement	12 7 6 4 9	Maximum total of 33 sustainability units
Organization of space	Short trade Services, multi-activities Contribution to employment Collective work Probable farm sustainability	5 5 11 9 3	Maximum total of 33 sustainability units
Ethics and human development	Contribution to world food balance Training Labour intensity Quality of life Isolation Reception, hygiene and safety	10 7 7 6 3 6	Maximum total of 34 sustainability units
	Grand total	100	

Source: Vilain et al., 2003

In practice, it combines and weights practices and behaviour that are easily quantifiable with essentially qualitative elements (architectural quality of buildings, landscape quality of surroundings). Certain indicators like probable farm sustainability, labour intensity, quality of life and the feeling of isolation are determined on the basis of the farmers' declarations. Some indicators concern the family and not the farm itself in the strictest sense, because experience shows the importance of the family-farm link in the sustainability of agricultural systems. Indeed, aside from the purely economic finalities, personal objectives and countless relational links also interfere with the life of the company. The three components of socio-territorial sustainability have the same weight and an upper limit of 33 on a maximum scale of 100.

Certain questions dealt with by the indicators in the socio-territorial scale can only be analyzed through qualitative factors. Quantifiable or observable items can nevertheless be combined with qualitative elements, as long as they have a meaning on the territorial scale. In this respect, the self-evaluation approach as proposed is a pragmatic way of assessing complex phenomena, and has its place in an awareness-raising approach.

Economic sustainability scale

The last scale, in which the indicators result from the technical and financial orientations of the production system, analyzes the economic results looking beyond the short-term and the ups and downs of the economic situation.

Table 4: The indicators in the economic sustainability scale.

3 components	6 indicators	Maximum values for each indicator and component	
Economic viability	Available income per worker compared with the national legal minimum wage	20	30 units
	Economic specialization rate	10	
Independence	Financial autonomy	15	25 units
	Reliance on direct subsidies from CAP and indirect economic impact of milk and sugar quotas	10	
Transferability	Total assets minus lands value by non-salaried worker unit	20	20 units
Efficiency	Operating expenses as a proportion of total production value	25	25 units
	Total		**100**

Source: Vilain et al., 2003

Apprehended through six indicators, this dimension has been studied for longer by agro-economists who make frequent use of a large number of economic and financial management ratios. Evaluation of economic sustainability, however, goes further than the analysis of purely short-term economic performance. In fact, although the sustainability of a farm depends firstly on its economic viability, its economic independence, transferability and efficiency also come into play.

Economic viability characterizes the economic efficiency of the farming systems in the short- and medium-term. This is an essential piece of data which must be relativized in light of the following indicators. *Economic and financial independence* generally guarantee the medium-term future of the farms by making it possible for production systems to adapt more easily to the inevitable changes in public aid, and to have the capacity to adapt the farm through new investments.

Transferability is a factor in analysis of the long-term. Indeed, the sustainability of agricultural systems is also based on their ability to carry on from one generation to the next. In case of succession, the amount of capital required to run and take over can end up leading to the farm being broken up.

The *efficiency of the production process* is used to evaluate the economic efficiency of the inputs used. This item assesses autonomy, that is to say the capacity of the production systems to make optimum use of their own resources, and guarantees their sustainability over the very long term.

One last stage: Analyze the results of surveys, apprehend the limits, validate the indicators

This last stage is presented in the two next parts 3 and 4 of this paper.

3. Presentation of results of different case studies

The following results come from studies over the period 1998–2002 involving tests on French farms representing different cropping systems.

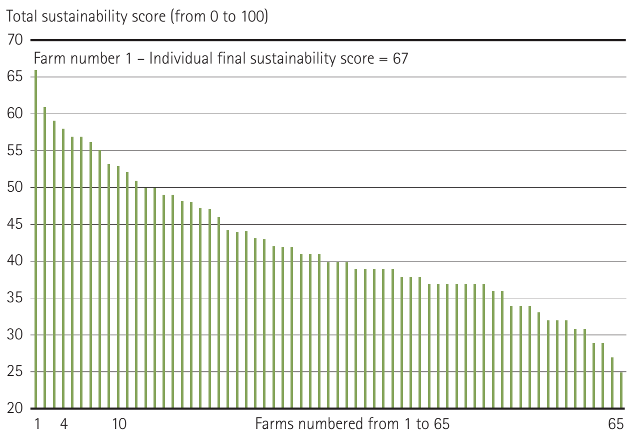
One of the most important results to be underlined is that the sensitivity of the IDEA method is such that it is capable of observing differences in sustainability between production systems as well as within the same production system. We will begin by presenting case studies highlighting the intra-system sensitivity of the method (in the arable crops system in this case) then other studies will be presented to show differences in sustainability observed between several types of production.

3.1 The method can show variability in sustainability between farms with the same production system: An analysis in the arable crops system

■ Variability in all-round sustainability is shown

Sixty-five farms were surveyed in three different arable zones (*Loiret* and north of *Indre et Loire* administrative countries and *Poitou Charentes* region), of which 18 had a livestock unit. The IDEA method revealed very high variability in sustainability scores over the population tested as a whole, as is shown in Figure 3. In this sample, the sustainability scores vary from 25 to 67 and correspond to the lowest score of each farm among those obtained on the three scales (agro-ecological, socio-territorial and economic) (Viaux, 2003).

Figure 3: Sustainability scores of 65 farms surveyed.



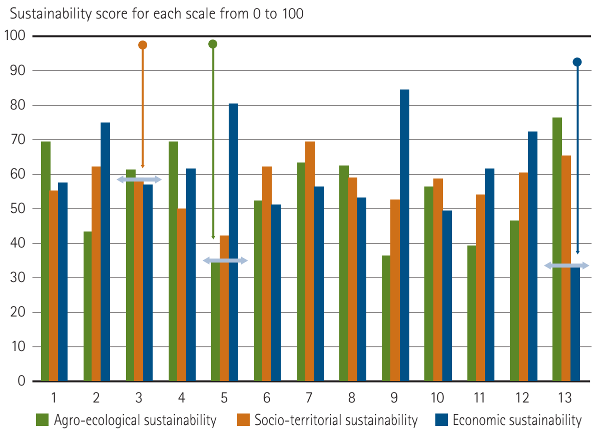
Source: Viaux, 2003

On the basis of these case studies, the sensitivity of the IDEA method was confirmed. This is of great importance in that the method can therefore be used to establish comparisons between farms which are in the same type of production (arable crops in this case) and very similar local contexts (soil and climate).

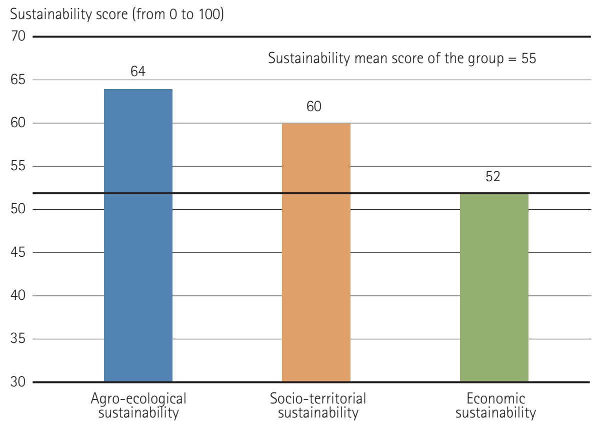
This sensitivity (in the mathematical sense of the word) endows the method with very particular interest in that it can show differences between farms either on the level of the three scales or their components, or on a particular indicator. The graphs (Figure 4) show two examples of sustainability measurements in groups of farms in the north of Charente Maritime (farms group A) and in the Loiret (central France) for the farms group B.

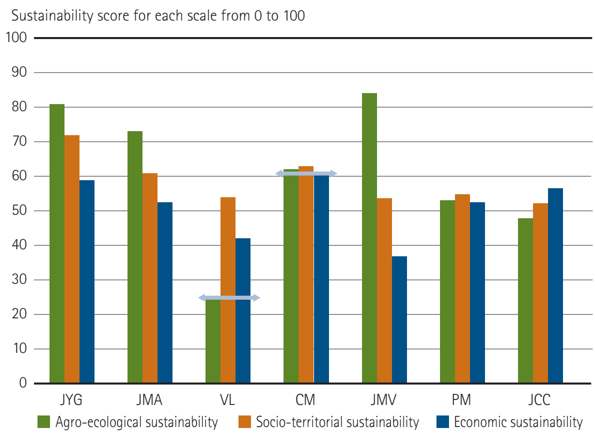
Figure 4: Sustainability of two groups of farms (A and B) and durability scores per scale.

Group A (13 farms in Charente Maritime, France).



Group B (8 farms in Loiret, France).



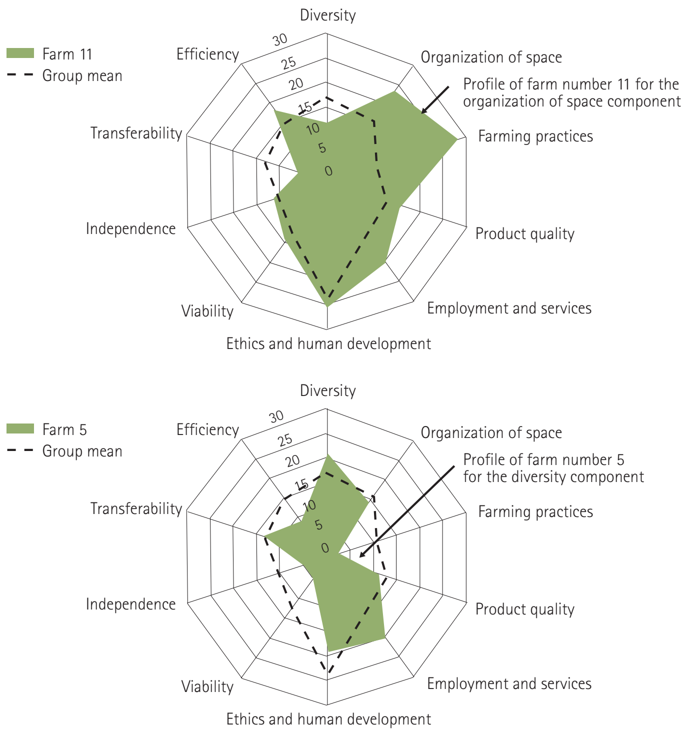


Source: Viaux, 2003

These two cases show that mean sustainability can differ greatly from one group to another, since in group A, it is agro-ecological sustainability that is the limiting factor, while in group B it is economic sustainability. If the results are analyzed for each farm, the same variability is shown within each of the groups, with high sustainability levels (a score of around 60 for farms "3" in group A and "CM" in group B) and low levels (farms "5" and "VL" respectively) being identified in each. The factor limiting sustainability may be agro-ecology (farms "5" and "VL"), economy (farms "13" and "JMV") and, more rarely, socio-territorial aspects (Viaux, 2003).

Moreover, each farm has a profile that can be viewed, for example, in the form of a radar chart (Figure 5), and the fact that no two farms resemble each other proves that the IDEA method gives a fairly precise reflection of differences in the situation and management of the farms. Conducting an IDEA diagnosis with a group of farmers from the same small farming region can prove to be highly profitable. We will take the example of a group of farmers from the Aunis area (Charente Maritime). The two graphs in Figure 5 present an overview of the 10 IDEA components on two farms (numbered 5 and 11). It can be observed that the IDEA method is sufficiently sensitive to highlight large differences in sustainability between farmers in the same small farming region with the same production system.

Figure 5: Example of sustainability assessment of farms 11 and 5 in comparison with a group of crop farmers (in the Aunis area, Charente Maritime, France).



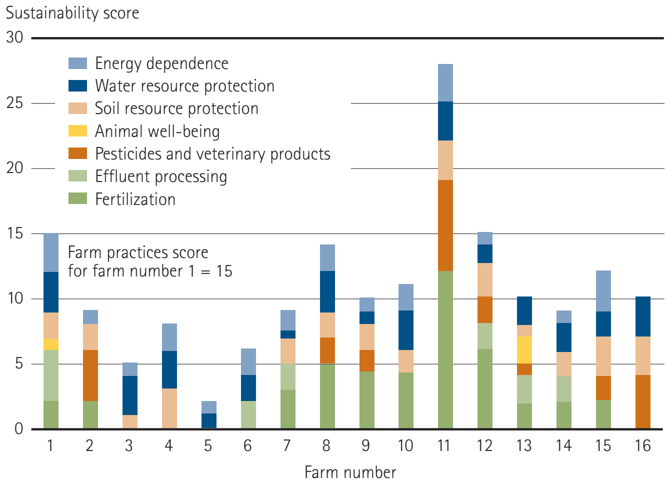
Source: Viaux, 2003

Farm 5 has a low sustainability area and, apart from the transferability and social items, all the other points are at levels lower than those of the group. Farm 11, in contrast, has agro-ecological practices (especially concerning space and farming practices) and economic results that are higher than the average for the group. We should note that this comparison within a group enables us to situate each farmer not in relation to an absolute sustainability objective, but in relation to what can be done in a given setting.

- The method also shows the diversity of farming practices for a given sustainability component.

Lastly, if we look in detail at the farming practices of the group as a whole, we can observe widely varying situations from one farm to another (Figure 6). This can appear surprising for farmers who have the same sources of information and work in the same soil and climate conditions. These differences between farming practices make it possible to identify one or several farms that are of interest in terms of sustainability and to get the farmers to discuss their own results among themselves with a view to getting them to make progress towards greater sustainability.

Figure 6: Differences in farming practices between cereals farms within the same small farming region (example: Aunis area in Poitou Charentes, France).



Source: Viaux, 2003

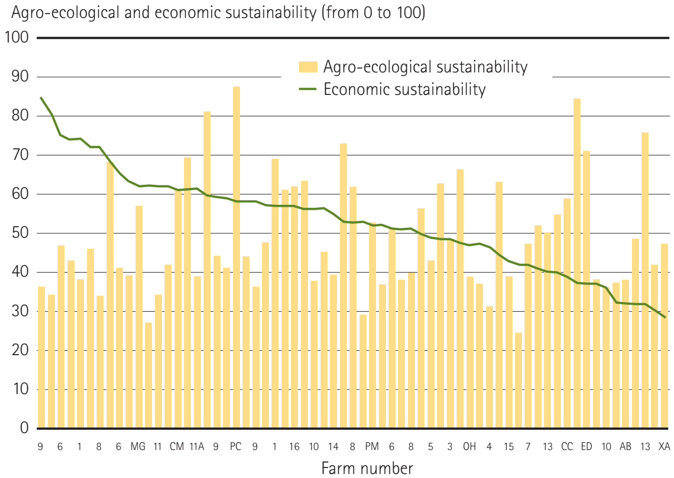
As presented in the second part, the higher the score, the more sustainable the farm is considered as being in terms of the scale in consideration.

Figure 6 shows that farmers have fertilization practices with scores varying between zero and 12 (extreme values for this indicator) and pesticide practices scoring between zero and seven. Detailed analysis of this data involves searching for the reasons for differences in the results, seeking to understand what technical reasoning (or what behaviour) led to this result and thereby identifying possible ways of progressing. Such an analysis can be made indicator by indicator and can identify one or several particularly interesting farms. For example, the results of farm 11 show that its farming practices are an excellent example of an integrated arable farming system: long rotation, weed control by a combination of mechanical and chemical means, limited used of pesticides and rational use of fertilizers etc.

- The method challenges certain notions regarding the cost of protecting the environment

Viaux *et al*. (2003) showed that by grouping together a large amount of farming data, it is possible to clarify certain general ideas on sustainability. We have seen, in certain graphs, that there seems to be a form of opposition between agro-ecological sustainability and economic sustainability, such as on farms two, five and nine in the St. Jean d'Angély group (Figure 4). In fact, this point is often raised as evidence that sustainability is utopian. In fact, if all the data from the farms is analyzed closely, it can be seen that there is no correlation between these two sustainability scales. This is highlighted in Figure 7, in which the farms are classified in decreasing order of economic sustainability. Agro-ecological and economic sustainability are independent of each other. It is therefore possible to achieve good economic sustainability while preserving the environment. This observation is backed up by analysis of the relation between the C1 economic viability indicator and the all-round score on the agro-ecological sustainability scale, which again shows that there is no relation between the two. This type of analysis is also capable of identifying the farmers who succeed in reconciling these three aspects of sustainability and who can serve as pedagogical examples for group work.

Figure 7: Analysis of the relations between economic sustainability and agro-ecological sustainability (65 farms).



Source: Viaux, 2003

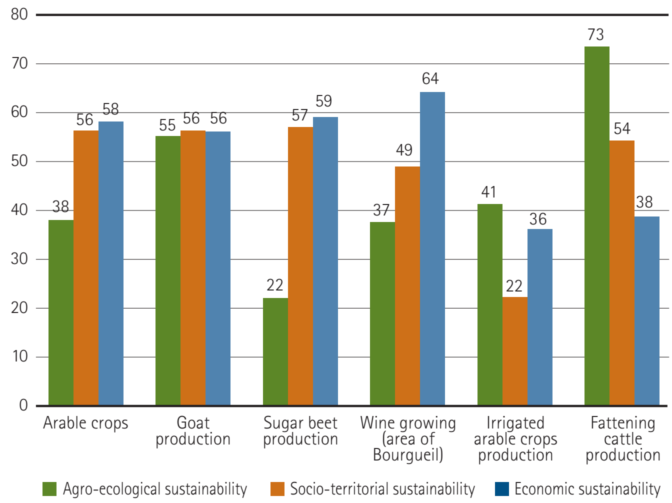
In this case studies, good economic results and good agro-ecological results are not incompatible in a cereal farming system (Viaux, 2003).

3.2. The method can show variability between different types of farming present in a territory

We have seen that IDEA is a tool that can help farmers progress towards sustainability. The many case studies conducted over the period 1999–2003 show that the IDEA method is also a relevant and highly interesting tool to appraise sustainability in different farming systems and to allow comparisons between the different types of farming present in a territory.

As an example of this, six case studies conducted on different farming systems in the Centre region (Viaux, 2000) are presented below (Figure 8).

Figure 8: Sustainability score per scale for six different types of agriculture.



Source: Viaux, 2000 (results with 1st IDEA edition)

In this example, the IDEA method highlights differences in sustainability within the same sustainability scale. For example, the two livestock rearing farming systems (goat production and fattening cattle production) have a higher agro-ecological sustainability score than the four other kinds of production presented. It is the quality wine production farming system, however, that boasts the highest economic sustainability score.

It can thus be shown that, quite generally, arable crop systems have good economic sustainability and quite low agro-ecological sustainability, while cattle rearing systems tend to be the opposite. These remarks will surprise nobody, given that cereals systems consume much greater quantities of inputs (fertilizers, pesticides, seeds, etc.) than a cattle breeding system on grass that has a less negative impact on the environment. The interest of IDEA is that it measures these differences objectively. The authors would like to point out, however, that the scores associated with these case studies in no way represent a mean regional or national value of the systems analyzed in these case studies.

This figure illustrates the suitability of the IDEA method as a high-quality, easy-to-use tool to evaluate European rural development policies in particular. For the main farming systems, the IDEA method can measure the progress made towards sustainability over time by a farm that has signed a Sustainable Agriculture Contract[3].

The IDEA method can also be used as an analysis tool by scientists and decision-makers to compare sustainability between different types of farming or to compare the sustainability of production systems such as conventional and organic farming systems (Viaux, 2003; Del'Homme and Pradel, 2005).

At least, the methodological work conducted over the period 2000–2003 gave rise to a second version of the IDEA method (Vilain *et al*., 2003) to take account of certain specialized crops (horticulture, market gardening, arboriculture, wine growing). Authors note that on the basis of tests on farms and feedback, it must be recognized today that the IDEA method indicators have difficulty measuring the agro-ecological sustainability of farms specialized in horticulture or market gardening. The specific nature of farming practices in these two types of farming system is at the moment not taken into account sufficiently in the current indicators of the method.

3.3. Implementation method and interest of discussion with groups of farmers

This method can be implemented by a farmer under the supervision of an advisory officer. It can also be conducted by a farm advisor, on condition that the farmer collects the information beforehand (accounts, field pattern, etc.) and that the information is processed by the farm advisor. The tests conducted show that most of the values of the indicators can be determined by the researcher in the presence of the farmer with a half day of work once the necessary documents have been gathered together.

Because of the construction of these indicators, different combinations of basic sustainability units from one farm to the next can result in the same score, thus enabling us to compare farms with radically differing patterns or practices. The interest of this resides in the fact that it allows individual monitoring over time while making it possible to conduct work in groups to compare farms with others and see how each of them can progress towards sustainability. It can also be of interest to have the whole group of farmers visit farms with interesting sustainability practices. This provides an opportunity to go into the details of the whole production system and possibly identify the skills deployed to master the most sustainable techniques.

3 The Sustainable Agriculture Contract is the French contract to subscribe an agri-environmental measure.

4. Discussion on the IDEA method taking account of tests from case studies

The indicator aggregation system

The authors resolved, for reasons of pragmatism, to add together the values of the different indicators, aware as they were of the fact that this approach implies compensation between the different components. In this way, favourable practices will offset practices with a harmful effect on such or such another component. This does admittedly constitute a real weakness for those focusing on the sole arithmetical value of the diagnosis. On the other hand, this addition does have a real meaning within the same component. For example, low animal diversity can indeed be partially compensated for by greater diversity of annual and permanent crops.

The scoring scales and weighting

The most delicate aspects concern the scoring scales associated with each indicator and the weighting attributed to each indicator. This work was conducted by a multi-disciplinary group of French experts comprising about 30 people. Scoring and weighting were established on the basis of a consensus starting out with the macro-issues (the scales), then moving down to the level of the components and finally to the indicators themselves. The lowest possible score associated with most of the indicators is zero. This score can mean quite simply that the farm is not concerned by the indicator. In this way, the animal diversity or endangered breed indicators will concern only livestock breeding, while the indicators in the socio-territorial or economic scales concern all the farms. For farms that are concerned by the indicator, a score of zero does not necessarily mean an insurmountable handicap or obstacle to sustainability, but shows that the farm has room for progress.

The pertinence of the model

The system of indicators proposed does not claim to be untouchable or to establish a model of sustainability that must never be changed. It has been drawn up using the expertise of a multi-disciplinary team working as a group and with the help of a large number of trips in the field. It has been tested for five years with many farmers, is the result of a consensus and seeks to give practical content to the notion of sustainability.

For example, the 16 indicators in the socio-territorial scale do not constitute a definitive, exhaustive list of the social and territorial dimension of agriculture. On the one hand, there are no indicators for the territorial function (services rendered to the territory and society) or for the social dimension of farming operations (*quality* of work, hygiene and safety, etc.). The absence of simple, pertinent indicators capable of assessing these complex notions has led us to leave them out for the moment. On the other hand, society is changing, with new needs, new demands and new regulatory or ethical requirements. Given that the agricultural world is connected with the rest of society, what was impossible yesterday can become possible tomorrow and the socio-territorial scale will necessarily evolve over time.

Validation of the hypotheses

If we take an epistemological view such as that proposed by Friedman (1953), a hypothesis does not need to be realistic. It must be judged on the basis of the forecasts that the model makes possible. However, seeking to validate the realism of the hypotheses of a sustainability model does pose the question of whether it is possible to validate it scientifically, as this concept of sustainability involves hypotheses taken from the experimental sciences but also from the social and human sciences.

Validation of the results of the indicators

Validation of the indicators constitutes the last stage in the construction of the IDEA method. An indicator is validated if, on the one hand, it is scientifically sound and, on the other, it meets the objectives for which it was created. In the first case, it is a question of "design" validation, notably through the criticism of scientific articles by peers. In the second case, the indicator is validated if it acquires use-value, serving as a diagnosis tool and actually being used as a tool to assist in decision-making (Bockstaller and Girardin, 2003).

Given their multi-criteria character, many of the IDEA indicators cannot be validated by comparing them with field data. They can only be compared with the results of models because there are no complete models for systems as complex as farms. However, the values of certain IDEA indicators can be compared with the values of other indicators. For example, the pesticide pollution pressure indicator was compared with the "I-PHY" indicator developed by the INRA in Nancy-Colmar (van der Werf and Zimmer, 1997). Likewise, the energy dependence indicator was compared with the results of the energy approach developed by the ADEME and the INRA Nancy-Colmar "energy" indicator (Pervanchon *et al*., 2004). For other indicators, experts other than the authors were asked to give an opinion on the calculated values and scores.

Certain difficulties relating to scoring and weighting were attenuated thanks to the tests that were conducted. These tests also provided an opportunity to check that the method allowed fruitful exchanges with the farmer or between farmers, thus leading to the experimental validation of its use-value. It fulfils its purpose if it prepares farmers to develop a better understanding of the mechanisms they will have to implement and to identify more clearly the factors on which they will be able to act if they should decide to undertake the switch towards sustainable agriculture.

The expected progress concerns primarily the socio-territorial indicators which are an innovative approach for which there are currently few references, and the analysis of the relations between these indicators and the other indicators. There is the question, for example, of a more comprehensive approach to the family as a collective group, the employment created locally by farming activity, hygiene and safety at work or even the topical issues of food safety. Regarding economic sustainability, the small number of indicators is explained by an intentional choice to limit ourselves to simple indicators expressing primarily the economic conditions necessary for the medium and long-term survival of the farms. This was considered as being guided in the long term by agro-ecological and social conditions. But it is obvious that the choice of practices that are respectful of the environment or the development of synergies on the scale of the territory have consequences in economic terms for the farms.

Conclusion, prospects for use and for related research

IDEA method is now accepted as being a tool that is easy to use. It provides a simple, faithful diagnosis tool that is sensitive and operational and gives a global analysis of the farming system.

These first results have been completed by studies conducted by some French agricultural organizations which wish to appropriate the IDEA method by testing it and to hold debates on sustainable agriculture on the basis of this awareness-raising and training tool. Moreover, French secondary and higher agricultural education now use this tool in pedagogical training to explain the concept of sustainable agriculture to their students and test it with farmers.

It allows appropriation of the concept of sustainable agriculture, and gives farmers suggestions for possible ways of modifying the management of their production system.

Used systematically, the method can answer certain questions on the feasibility of sustainable agriculture. Analysis of the results for the groups of farms mentioned above, for instance, shows that there is no relation between the three sustainability scales. We notice that agro-ecological sustainability is independent of economical sustainability, and vice versa. It is therefore possible to have good economic sustainability while preserving the quality of the environment. A more in-depth analysis shows that there is no relationship between economic viability (which is an indicator of farmer income) and agro-economic sustainability.

Today, this method can make a useful contribution for the implementation of Article 13 of the new CAP which specifies the new advisory system.[4] In fact, as of 2007, each Member State must be able to offer a system of agricultural advice to farmers who request it. At present, the content of this advice has not been defined on the European level and the tools needed to provide it are under discussion. The question of a minimum level of harmonization of the content of such counselling is therefore raised on the European level.

This method could also contribute to implementation of Article 69 of CAP-reform by helping to characterize the types of agriculture likely to benefit from additional financial support. The new system authorized by Article 69 allows Member States to keep up to 10 per cent of the amount of pillar one aid to support types of agriculture that favour the environment (but not defined in the regulation at the moment).

Thus, the extension of the IDEA method to a European scale could make it possible to meet these new needs. The research project associated with this objective could concern, in particular:

- the inclusion of all the main crops present in the European Union in the IDEA method;
- the specific points to be added to take better account of the links between the specific issues of a territory and its farms;
- the question of adapting the method to the specific aspects of the farms in certain new EU Member States; and

4 Article 13 of Regulation n°1782/2003 of 29 September 2003 setting out the common rules for the CAP support system, OJEC of 21.10.2003, L 270.

- the calculation of indicators with data from national databanks (like FADN[5]) and not from individual farmer surveys. This work would create the possibility, in particular, of evaluating the new data required and the *ad hoc* processing to be applied so that it could measure, in time, the contribution of farms to the new expectations of civil society (multi-functionality, environmental services).

As well as this, the IDEA method can also not only be a most interesting assessment tool to guide farmers who are conducting a farm audit prior to committing to agri-environmental measures (called Sustainable Management Contract in France) but also a tool for monitoring and assessing measures in rural development regulations. In the latter case, complementary research work would seem necessary to measure how the indicators in the method fit in with the main measures in rural development regulations.

Finally, the new rules of cross compliance on support for agriculture (CAP, 2003) will necessarily raise questions on how to go about increasing support for farms in line with the new expectations of consumers and citizens concerning the quality of products and the environment. As for the recent agreements at the World Trade Organization (2005), there are questions about the contents of the "green box" and types of agriculture which will still be supported after 2014 (deadline for next agreement regarding the future CAP). This is certain to become one of the stakes in international negotiations on agriculture. The European Union will be called upon to prove the link between the level of public aid, the multi-functional character of farms and sustainable agriculture. If the large-scale application of a reorientation of subsidies is to be possible, first the practical problems must be resolved relating to the definition of the criteria corresponding to these objectives, criteria which must be legible, simple and effective to use in the field.

The latest prospective research using the IDEA method aimed at the assessment of the level of sustainability for French farming systems by major production systems and by regions. It was based on the transposition or adaptation of the sustainability indicators in the IDEA method in order to analyze the sustainability of the principal French type of farming, no longer the sustainability of individual farms only. This study combines the set of indicators of the IDEA method with information from two additional databases (the FADN[6] and the farming census) (Girardin

5 FADN or Farm Accounting Data Network.

6 Farm Accounting Data Network.

et al., 2004). This preliminary work could be extended to other European countries where the FADN exists (all the 15 countries of the former EU). For the present authors, the INFASA international Symposium provided a great opportunity to propose that other research teams work on this theme, potentially as part of research work within the next 7th Research Framework Programme currently being prepared by the Community.

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