Sustainability concept in LFS research orientations

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Abstract: The emergence of Livestock Farming Systems research area in Europe is closely associated with the spread of sustainability as a framework paradigm for development in the 1980s. The ethical contents of the concept led animal scientists to search into complex systems thinking as bases for for developing a general methodology supporting decision-support to farmers and livestock production stakeholders and policy decision making. On-farm studies of a large array of livestock farming systems including traditional, intensive and extensive livestock systems made by an array of European research groups support a general understanding of livestock farming systems as complex adaptative systems associating social and natural systems. Such a view has many consequences on the understanding of research orientations and methods to develop in animal production sciences in supporting farmers and livestock production stakeholders under the sustainable development scope. In particular it implies to give major consideration to the variety of purposes and objectives of livestock production stakeholders and their role on decision-making in farm management. It supports also the understanding of the need for research designs additional to existing ones in animal sciences to support efficiently progress in advances and transfer of scientific knowledge. Interdisciplinarity, on-farm research and participation with livestock stakeholders and a renewed approach to simulation modelling appear as basic pieces for it. In this paper, we give an account of the approaches developed at the level of both livestock-production units and wider complexes, such as the local region or the food chain. Current advances and main topical issues attached to research into sustainable development of livestock production are discussed in light of ethical principles that ground the research area.

1 - Introduction

This session of the 2007 Meeting of the EAAP organised by the Ethics WG of the EAAP in cooperation with the LFS Commission offers a welcomed opportunity to review the philosophical background of the approach to sustainability in LFS research and to assess potential directions for future advances in LFS research area. LFS research is a new- born area in animal production sciences, which developed as a research and development approach to sustainable development of livestock husbandry (Gibon & Flamant, 1994). FS research built a specific methodological framework for assessing real-life livestock farming systems and building decision-support to farmers and stakeholders of livestock husbandry development such as advisers and policy decision-makers.

In a first section of the paper we present briefly the orientations of LFS research studies and their common scientific fundamentals. In the second one, we account for the basic framework principles of scientific approaches to sustainable development of agriculture, and the way they are integrated in the LFS research background. We provide also an insight into some recent developments in sustainability sciences which appear us of potential special value for developing further the LFS research area. In the third section we re-assess LFS research orientations in the light of these new perceptions. They reinforce the scientific legitimacy of the general framework approach to sustainable development of livestock farming adopted in LFS research. They also provide LFS research area with useful guides for refining its approaches for an enhanced contribution to sustainable livestock-farming-systems development. This could in particular help handling the questions arising with respect to long-term change at farm-level or change in livestock farming systems at the rural area scale. In the last section we suggest some directions for international research projects that could support this process.

2 - The LFS research area and its fundamentals

2.1 general purpose and framework research orientations

Livestock Farming Systems research built up as an emerging process from a series of research and development studies run at various research groups in European research institutes (Denmark, France, Germany, The Netherlands, Spain, UK, etc.). All these research groups used complex adaptative systems theories to develop empirical models to gain insights into the complexity and variety of real-life livestock production units in local contexts with the view to support efficiently their

sustainable development[1]. The scientific fundaments of these case-study approaches were elaborated into a general methodological framework from a series of international symposia and workshops in the course of the 1990s (cf. Gibon et al., 2003). A first outcome of these exchanges was the building of a common awareness that development of livestock systems might be considered within a similar general framework approach whatever their socio-economic and natural context. The condition for it has been grounding scientific exchanges on the elucidation of a common view of how to address the process of farm development rather than attempting to build a universal view of directions for change to apply in the production systems. In the first stages of the emergence of the LFS movement, the process was supported by giving the international LFS symposia a strong focus on methodology and an explicit statement that it was impossible to speak about good or bad methods in the area xxx independently of the concrete context of the research studies. The recommendations of the international scientific steering committee to participants were to account explicitely for it before presenting the methodology they developed. Therefore the variety in views for suitable directions for change in local agricultures could be overcome.r

The basic principle of LFS research area is an account of the duality: real-life livestock farming systems (LFS) as a human activity system as well as a production process (Gibon et al., 1996). Animal production systems are therefore understood as a part of indissociable complexes that links tightly the animal production process to the social groups involved in their management. These views were developed into a generic model of the livestock farm as a complex adaptative system (Figure 1). This model is explicit in terms of the normative dimension. It supports an understanding of livestock systems management as responding to a range of material and immaterial purposes and values which go far beyond the performance of animal production process alone. It supports also an understanding of the structural and functional variety in livestock farms within a given natural and socio-economical context as depending for a large part of differences in farm conditions and social systems rather than a mere outcome of differences in development efficiency and adoption of technological progress[2].

This model was developed within the family-farming context of western Europe. It was further generalised to corporate large- scale farming in central and eastern Europe (Gibon & Mihina, 2003).

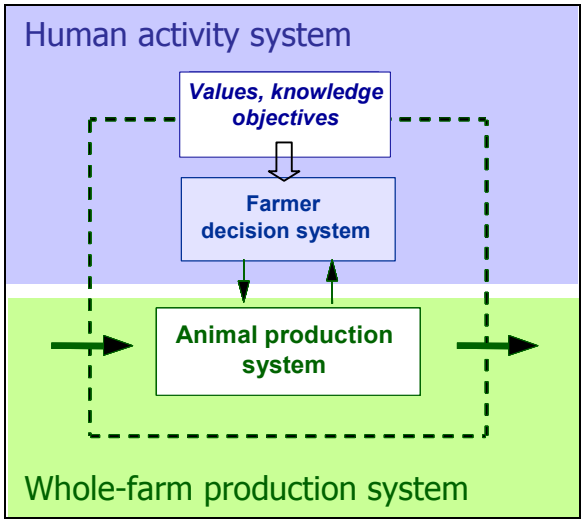

Figure 1: An integrated model of the livestock farm as a dual adaptative system (from Gibon et al., 1996)

[1] It is noticeable that all these studies where developed within regional or historical contexts bringing out particularly accute challenges for agricultural development (Gibon et al., 1996). The first type of context constists in regions of difficult socio-economical or natural environment conditions in Europe and abroad. The second one corresponds to periods of deep change in societal options and in public development policies, such as the beginning of the 1990s in Western Europe (PAC reform) and the beginning of the 2000s in Central and Eastern Europe (move from centralised to market economy).

[2] Therefore, when assessing the efficiency of farm management and operation, a preliminary understanding of the LFS socio-economics is a prerequisite for a sound evaluation of the indicators and models of animal production processes to apply. This leads also to a revewed attitude to knowledge and knowledge transfer than the classical one in core animal sciences. For example cooperation with farmers in harsh natural environments began to teach scientists about animal production processes and their management in suboptimal conditions before extensification policy and environmental concerns turned it into a topical area of general interest (Bocquier et al. 2004).

2.2. LFS methodological orientations

Using a framework model has many methodological implications. Its operationalisation into research and development studies for sustainable development of livestock farming systems requires in particular :

- **cooperation among a wide array of disciplines** in social and nature sciences, and also within animal sciences (Figure 2); therefore LFS scientists identified themselves as “general practionners” in animal sciences, at the core of interdisciplinary research and development devices.

- **close communication with farmers and livestock farming development stakeholders** for assessing suitable directions for livestock farm development; LFS scientists have to adopt methodologies unfamiliar to or marginal in core animal sciences, such as participatory research and on-farm research; they developed the use of specific assessment methods, such as surveys; on-farm research based on case-studies and farm monitoring (Gibon et al., 1996);

- **specific methodologies and indicators** for elaborating a **complex of “soft” and “hard” data** into sound scientific assessments and decision-support models; LFS scientists invested into a variety of methods (Gibon et al., 1999), such as conceptual models of livestock system management accounting for risk and uncertainty; new developments in management indicators such as body condition scoring; stochastic computer simulation models allowing to account for differences in management practice, livestock farming system typologies, etc.

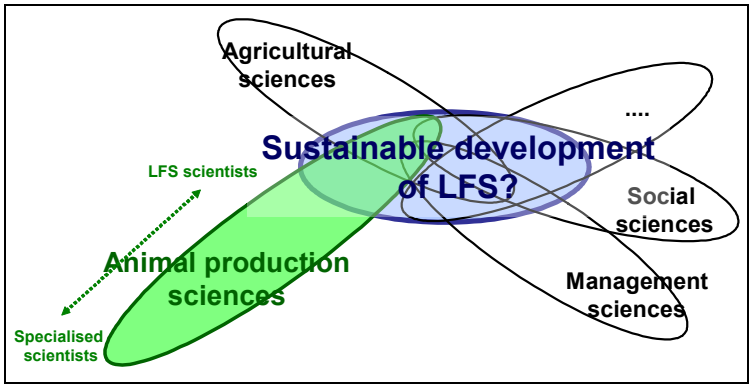

Figure 2: A framework of the interdisciplinary approaches to livestock farming systems (from Gibon, 2000)

LFS research built its progress on the examination and discussion of practical methodological advances gained in the framework of local interdisciplinary case studies, as a support for the emergence of a general methodology. This framework approach was applied to a variety of topical issues for sustainable development of LFS depending on the local socio-economical contexts and in understanding how challenges for sustainable development were perceived by both the research teams and their local partners.

2.3. LFS research topical issues

Primary topical issues in LFS research are attached to the sustainable development of livestock farms in local contexts. Investigations into the local variety in livestock farms support the assessment of conditions for sound local research and development orientations. Research and development efforts include decision support tools for farm management in relation to an array of sustainable development concerns, such as environmental impact (c.f. Halberg et al., 2005), the interaction between land use, landscape and ecological services (c.f. Gibon, 2005), the production of quality food products (Rubino et al., 2006), or alternative production systems such as organic farming (Kristensen and Halberg, 2003).

The evolution in the societal understanding of sustainable development requirements brought out a progressive enlargement of the scope of LFS research studies for addressing organisational levels of LFS above the farm scale. For example, a number of recent LFS research studies address the organisation of livestock farming at the landscape and the watershed level in relation to sustainable land use (mitigation of pollution, e.g. Ondersteijn et al., 2003; Mignolet & Benoît, 2000; biodiversity conservation, e.g. Etienne et al., 2003; landscape encroachment e.g. Bernues et al. 2006; Mottet et

al., 2006). Another area of importance is participarory research into organisation of the food chain at local-scale in reference to change in consumer and societal views (high quality products, e.g. Napoleone & Boutonnet, 2006; Ligda et al., 2006; preservation of local breeds, e.g. Pacini et al., 2004; between-farm coordination for an organic farming practice, e.g. de Witt et al., 2006).

Empirical case studies support the understanding of the integrated framework model of the livestock farm as a valuable basic concept for addressing wider levels of LFS organisation. Nevertheless, they also point out the need for further development of a framework methodology to cope with specific challenges into sustainable development at these levels such as e.g. the understanding of the role of the institutional organisation of rural communities and their change, the farmer coordination processes, etc. (cf. Rubino et al., 2006; Gibon, 2006).

3 - Framework approaches to sustainable development

Research into sustainable agriculture requires the adoption of a way to conceptualise it (Thompson, 1997). To say that the purpose of LFS research is to provide a support to sustainable development of livestock farming systems is to say in fact several things. It means that:

(1) value-laden purposes included in the concept of sustainable development of agriculture are adopted as a philosophal (an ethical?) framework for the assessment of livestock farming systems and the valuation of their changes

(2) the research methodology developed is consistent with this ethical framework

We address successively these two dimensions in the following sections of the text.

3.1. the concept of sustainable development

Since the World Commission on the Environment and Development Sustainable Development in 1987, sustainable development is considered as an important societal requirement. In reference to global change, it is considered as a development “that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Bruntlandt, 1987). The concept was operationalised as an objective in the development policy agenda of United Nations in a series of World Conferences and Summits. It is also included in policy at a number of states and international development institutions. A wealth of literature explores this ambigous and abounding concept both from the policy and the scientific point of view. The main common philosophical ideas considered in LFS research with respect to sustainable development can be summarised as follows (e.g. Gibon et al., 2003):

1. sustainable development implies considering **long-term impacts** of development options and not only the short-term ones;

2. the concept requires considering together three basic dimensions of development: the **ecological, economical, and social dimensions** (e.g. FAO, 1992). They are *"interdependent and mutually reinforcing pillars" of sustainable development as economic development, social development, and environmental protection”* (UN, 2005)

* **ecologically** sustainable development refers to a conservative use of natural resources and the mitigation of detrimental impacts of past development (depletion and pollution of natural resources; damage on ecosystem functions)

* **socially** sustainable development includes a reference to an array of political and ethical concerns with respect to the living conditions of human beings, first of all food security and safety; social equity and reproducibility of social institutions, justice; and many others, such as animal welfare. According to who speaks, it can be applied at a variety of scales such as the Earth or a state, etc., or even a farm (e.g. Landais, 1998).

* **economically** sustainable development includes a general reference to growth, which is an area of important public and scientific controverse but it can be also applied to economic viability of business or livelihoods.

LFS scientists invested into clarifying their common understanding of a scientific approach to sustainability, from debates and reflection with philosophers (cf. Sorensen, 1997). It is noticiable that, on the contrary, there has not been in fact an important effort to come into a common understanding of the contents of the sustainable development for use in LFS research studies. This can be easily

understood if considering the view of Robert et al. (2005) that in fact, "*the concrete challenges of sustainable development are at least as heterogeneous and complex as the diversity of human societies and natural ecosystems around the world. As a concept, its malleability allows it to remain an open, dynamic, and evolving idea that can be adapted to fit these very different situations and contexts across space and time.*"

In the next section of the text we present the understanding of scientific approaches of sustainability on which LFS research built during the 1990s. In the following one, we address further developments in sustainability sciences that appear us of interest for assessing recent methodological advances in LFS and guiding its further development.

3.2. Basic approaches to sustainability in agricultural sciences

Methodologies applied to sustainable development differ in the first place in the basic conceptualizing of sustainability they rely on. Thompson (1997) and Thompson and Nardone (1999) describe two basic methodological approaches to sustainable livestock production: sustainablity as resource sufficiency and sustainability as functional integrity.

Resource sufficiency stipulates that "a practice is sustainable when the resources needed to carry the practice on are foreseeably available". This approach includes the identification of rates at which resources are consumed. Accounts of the consumption of critical resources lead to prescribe conservation or substitution. Conservation of critical resources requires either reduced consumption or increased efficiency.

The notion of **functional integrity** considers sustainability as "the capacity of a system to reproduce over time". It presupposes an account of a system having crucial elements that are reproduced over time in a manner or at a rate that depends upon previous system states.To say that agricultural systems have functional integrity is to say that the systems have feedback mechanisms that prevent the reproduction of crucial elements from increasing without limits or from disappearing from the system. "Functional integrity implies maintaning the natural and social system's capacity to regenerate". Such an approach was poorly represented in core animal sciences untill the few last years, which priviledged a resource sufficiency approach to sustainable development of livestock production sytems (cf. Thompson & Nardone, op. cit.). However, as stressed by these authors, the systemic and interdisciplinary methodology developed in LFS research constituted a first application of a functional integrity approach in animal sciences. Such an approach is also being applied in areas as welfare (Alroe et al., 2001) and breeding issues in organic farming (Boelling et al. 2003; Gamborg et al.2005).

The two approaches are not to be understood as opposite, but complementary. Thompson & Nardone (1999) state that "*truly sustainable system for livestock production must meet criteria that reflect both of these approaches*". But the use of the one or the other as a guiding principle for farming research studies results into a distinct philosophical attitude to sustainable development of livestock production. Within a functional integrity approach, **sustainable development** is understood as **a trajectory** with certains bounds, rather than a particular state (Fuentes 1993). **Sustainability** is therefore understood as "**a direction that guides constructive change rather than an end-point**" (Vavra, 1996). Such an understanding calls in particular for careful reflexion when searching for sustainability indicators. It also requires the developmeent of adequate concepts to support the understanding of sustainable development as constructive change in complex relationships between natural and social systems. New insights in the matter are offered by recent advances sustainability science.

3.3. Evolutionary frameworks for sustainable development

Social and ecological systems are nested in time and space from the cell to the ecosphere, with numerous non linear feedbacks (Holling et al, 1998). The world wide crisis in resource management led many scientists in an array of disciplines, building on early proposals made by C.S. Holling (1978), to develop an understanding of social and ecological systems and their linkages as complex adaptative systems, the so-called "social-ecological systems". When considering the evolution in the relationships between social systems and natural systems, a new understanding of sustainable development can be gleaned by using the complex adaptive systems framework (Berkes and Folke, 1998; Holling et al., 1998). The evolutionary frameworks for sustainable development support the understanding of **development as the evolution of complex adaptative systems**. The concept is

widely applied now at a variety of scales in sustainability science, from the local up to the global scale[3]. Both types of the systems and the socio-ecological linkages can be assessed in the framework of complex adaptative systems marked with uncertainty and self-organisation properties. Berkes et al. (2003) consider therefore that the specific objectives in sustainability science are to investigate:

° how human societies deal with change in social- ecological systems and

° how capacity can be built to adapt to change and, in turn, to shape change for sustainability.

Change appears as a result of the evolutionary nature of adaptative cycles in the operation of complex social-ecological systems (Holling *et al*. 1998). This leads, therefore, to consider as a key-factor in the conditions for sustainable development, the properties in their operation that can sustain their **resilience**, *i.e*. the capacity of social and ecological systems to face hazards and pressures for change while remaining the same system (Berkes *et al.* 2003a). Resilience theory offers a vision of **sustainability, not as stability, but as persistence borne out of change, more specifically, out of adaptive renewal cycles** (Berkes and Seixas, 2005). Building resilience requires accepting the inevitability of change and adapting to live with uncertainty and surprise (Folke *et al.* 2003).

Considering social systems within such a framework requires including those dealing with governance, as in property rights and access to resources. Also of key importance are different systems of knowledge pertinent to the dynamics of environment and resource use, and views and ethics concerning human-nature relationships (Berkes et al., op.cit.).

3.4. Methodological implications

The sustainable development concept offered an integrated paradigm for bridging the fracture between human and nature systems and reintegrating scientific disciplines (e;g. Jollivet, 1992; Gladwin et al. 1995). The evolutionary framework offers a further insight into the wideness of the epistomological change requested by sustainability. This framework supports an understanding of sustainable development as depending on self-reorganisation properties of human-nature systems, in particular their capacity for resilience (cf. 3.3.): building resilience in integrated human and nature systems is a key for sustainability. Therefore, developing ways of assessing resilience is of practical as well as theoretical significance in sustainability sciences (Berkes et al., 2003). Berkes et al. (2005) suggest a framework based on four categories of factors for building resilience: (1) learning to live with change and uncertainty; (2) nurturing diversity for reorganization and renewal; (3) combining different kinds of knowledge; and (4) creating opportunity for self-organization. These authors identify five robust factors favouring persistence of social-ecological systems: learning from crisis, responding to change, nurturing ecological memory, monitoring the environment, and building capacity for self-organization and conflict management.

The evolutionary framework to sustainable development modifies deeply the view of the role of scientists in society. It supports the possibility for scientists engaged in R&D approaches to build scientific progress without considering themselves in charge of the full responsibility to state from progress in scientific knowledge about what is good or bad for society in the development of livestock production systems For example, according to (Holling et al., 1998), learning from traditional socio-ecological systems and combining insights gained in adaptative management may enhance institutional learning for resilience of the linked socio-ecological system in any society. The sustainability concept supports also a vision of the role of scientists as helping in envisonning the maximum stresses that various sub-systems can tolerate at various moments, and still maintain future options (Fuentes op.cit.). Participation methods are recognised as the basic way to nurtur self-reorganisation properties of human-nature systems (Berkes et al., 2003; Iyer-Raniga &Treloar, 2000).

Intense international scientific reflection on theroretical and practical aspects led to the conclusion that by structure, method and contents, sustainability science must differ fundamentally from most science as we know it to consider a specific methodology (e.g.; Berkes et al. 2003). The conclusions of the Friibergh Workshop on Sustainability Science (2000) offer an overview of the methodological changes requested: "*Familiar approaches to developing and testing hypothesis are inadequate because of nonlinearity, complexity and long time lags between actions and consequences. Additional complication arise from the recognition that human cannot stand outside the nature-society system. The common sequential analytic phases of scientific inquiry such as conceptualising the problem,*

[3] It was used for example in the Environmental Millenium Assessment (MA), the last in date in global integrated environmental assessments, as a basis for developing scenarios (see e.g. Alcamo et al., 2005).

collecting data, developing theories, and applying the results will become parallel functions of social learning, which incorporate the elements of action, adaptative management, and policy as experiment. Sustainability science will therefore need to employ new methodologies that generate the semi-quantitative models of qualitative data, build upon lessons of case studies, and extract inverse approaches that work backwards from indesirable consequences to identify pathways that can avoid such outcomes. Scientists and practicioners will need to work together with the public at large to produce thrustworthy knowledge and judgement that is scientifically sound and rooted in social understanding."

4 - Revisiting LFS research in the light of advances in sustainability sciences

The functional integrity approach (cf. 3.2.) offered in the late 1990s is a scientific justification to the view of the livestock farm as a duality of a nature system and a social system and the assessment of its sustainable development as a constructive direction for change in its operation. New developments in sustainability science methods justify also the methodological process used for developing LFS research. It relied indeed on building a framework approach from a collection of empirical case studies of real-life systems, cooperation with a range of disciplines in social and nature sciences, and participation with stakeholders for developing generic models and methods in support to sustainable development. LFS research area developed indeed from "*the acceptation of complexity and the investigation of diversity*" (Gibon et al., 1992). It also considers the role of LFS scientists as "*supporting communication between farmers and the rest of society*" (Sorensen, 1997b).

Current advances in sustainability science could support also further development the LFS framework methodology, in reference to new topical issues.. This appears us of special importance with respect to the understanding and the assessment of livestock farming systems at wider levels of complexity than farm operation itself that are increasingly in the focus of LFS research, e.g. the evolution of the livestock farms under societal and public policy pressure, and change in livestock farming at the rural area scale. If we consider evolution in the orientations of LFS case studies (cf. in particular Rubino et al., 2006), applications of evolutionary framework at enlarged temporal and spatial scales are yet under progress on an empirical basis. To paraphrase Berkes et al. (op.cit.), we can say that LFS research objectives now include investigating:

- how farmers and rural societies deal with change in livestock farming systems,

- how capacity can be built to adapt to change at both the farm and the rural area scale and, in turn, to shape change for sustainability.

Sustainability science can therefore help framing methodologies for operationalising these issues . The novelties evolutionary frameworks bring with them are the awareness of (1) the scientific need - and also the feasability- to go one step further in the application of the theories related to complex adaptative systems for modelling -not only the operation- but also the evolution of the real-life farm considered as a social-ecological system; (2) the interest into applying the same concepts at wider scales of organisation of livestock farming than the single farm.

We put therefore hope in the application of recent methodological developments of sustainability sciences for gaining an increased common understanding of the fundamentals of the LFS research area and supporting further progress in development of a common framework methodology.

Research directions in the LFS research area moved towards an increasingly strong reference to political decisions for sustainable development made at a variety of levels in societal institutions. Each scientist as a human being and a citizen has a personal understanding and political view of directions development policies should adopt, based on its own ethics. How to succeed making collective research advances on controversial societal issues of importance without implicitely falling into what would reveal to be an attempt to build and impose a common political view on the name of science?

We will exemplify our suggestions from the address of current major political challenges in European agriculture that ground political options and controversies. Public expectations of farming practices in the European context are changing from a demand for environmentally "sustainable farming practices" to farming making an "enhanced contribution to the development of the rural areas". At the same time, European food production in its present state is under heavy competition from food production in other parts of the world. We consider as a requirement for LFS research to avoid building a policital answer to such controversies but to attempt documenting them.

From our review of sustainability science literature, settling international LFS research projects based on comparative anaysis of case studies appears us as a priviledged way to produce knowledge of practical value for sustainable development of European livestock farming while supporting at the same time advances in the framework methodology of LFS research area. From the recent works of the LFS commission, the following directions appear us of special interest : (1) assessing structural and functional change under progress at the variety of local farming systems within Europe in reference to the CAP reform (cf. e.g. Pfimlin et al. 2005); (2) exploring the multifunctional role of livestock livestock farming systems in reference to local contexts (cf. e.g. Hermansen et al., 2005); (3) investigating scenarios for change in landscapes and ecosystems according to local contexts, in reference to change in livestock farming systems and climatic change (cf. e.g. Gibon et al., 2005); (4) exploring institutional reorganisation of LFS at the rural areas in reference to both the food chain and the local cultural context of LFS (cf. e.g. Matassino et al., 2006).

4.1. assessing structural and functional change in local farming systems within Europe in relation to the impacts of the CAP reform

There is a controverse about the capacity of current European regulations and public policies for agriculture to support change in animal agriculture meeting both sustainable rural development and economical efficiency and competitiveness of animal production within a global perspective. As an example, recent prospects regarding their impact on farm restructuring at the local areas stress out the threat they bear for sociological and environmental sustainability of European rural areas with harsh natural environment (Pflmlin et al., 2005).Therefore it appears us of importance to document at the European level the question "*how farmers and rural societies deal with change in livestock farming systems*". An understanding could be gained from an array of case-studies at rural areas covering the variety of socio-economical and natural contexts. This would imply:

- identifying local key issues for sustainable rural development at each of the case-study areas with an objective to categorise the variety of pressures on livestock farming arising from the local environment;

- assessing the variety in the composition of the local population of livestock farms and its change with an objective to document the farm restructuration process;

- assessing the change under progress in the structure and operation at the livestock farm scale in reference to both the purposes and values of livestock farmers and the pressures of the environment (general pressure; local key issues for sustainable rural development) with an objective to document constructive change at farm level;

- prospecting further change in the farm population from previous knowledge in order to document the sustainability of change under progress at the rural area scale.

Current advances in the LFS research area with respect to the approach of livestock farms as a duality of a human activity system and a production process and the assessment of their local variety (farm typologies) would be used as the bases of the approach. LFS research advances support an understanding of structural and functional change at the farm scale not only as the outcome of pressure of the global economical environment and regional public policies and pressure of local natural environment, but also of pressures arising from local rural development orientations and the various objectives, purposes and values of the family or the wider social group that holds the farm (cf. section 2.).

From the methodological point of view, the implementation of such a project would imply:

- the selection of an array of case-study areas to be investigated each by an LFS research group and the elaboration of a common framework method for the project;

- the settling at each case-study area of a steering working group associating researchers in an array of disciplines, local rural development policy decision-makers and stakeholders, livestock farmers and main local actors in livestock sector; this group would be in charge to identify local key issues for sustainable rural development as a framework for the research study;

- the design of a farm survey supporting the assessment of the local variety of livestock farms under this perspective at each of the case-study areas; this should be done using a common methodology based on a set of common indicators for the assessment of livestock farm structure and operation, developed from the establishment of a common understanding of the range of key issues for sustainable rural development across the case-studies areas;

- the categorisation of local types of livestock farms at each case-study area and the assessment of their part in the local farm population; this could be done using existing LFS methodological advances for the establishment of farm typologies;

- an assessment of the functions of each category of farms with respect to local key issues for sustainable rural development at each case-study area; such an understanding could be gained from reflection of the local steering committee on the results of the previous step, supported by further research based on farm case-studies;

- an assessment of the weaknesses and strengths of each category of farms supporting prospects for their future and therefore prospective assessment of the impacts of differences in their prospective survival at the respective case study areas.

4.2. Exploring multifunctionality in European livestock farming systems in reference to changes in purposes and values at the livestock farm

Public expectations of farming practices in the European context to make an "enhanced contribution to the development of the rural areas" lead to consider livestock farming systems change towards the so-called multifunctionality. The term "Multifunctional agriculture" is not a well-defined term with a well-accepted meaning among different groups in society. OECD (2005) focuses on the added value potential in an economic sense of improved or diversified production processes, whereas FAO (2005) views the term in particular from a biodiversity perspective. For European Community (CE, 2000) landscape sustainability is a core element in multifunctional agriculture. Therefore it will be important to investigate how farmers do and can adapt to such pressures, expectations and opportunities, in order to build sound indicators for the assessment of multifunctionality. Under current conditions for development of animal agriculture in Europe (cf. previous section), consideration is to be given to :

- the interest of many farmers to look for other ways of generating income (Hermansen et al. 2005).

- the assessment of the current views about contribution of livestock farms to the array of rural development objectives according to their structural and functional characteristics and the local environment context;

- the directions for change regarded as constructive at both the farm and rural area scales, considering that at the regional livestock farming system, answers can be searched not only at the individual farms, but also at their coordination.

We suggest therefore an understanding of multifunctional agriculture as the attribute of (the degree of) how different important local purposes of ecological, economic, and societal character are beeing included in the actual farming management practices. The multifunctionality in that sense is then a matter of the relation between the farm (farmer family) and other interest groups and stakeholders in the local environment.

The integrated model of the livestock farm in use in LFS research supports an understanding of development orientations at real-life farms as a specific response to a variety of purposes and pressures from the environment.

Investigating this issue under a variety of site-specific rural development contexts can guide the assessment of purpose and values according to farmers, farm structures and rural contexts.
However, based on our experience a number of challenges still remain. First of all, the issues that need to be addressed in such a context include a wide variety of research disciplines. Secondly, the indicators that are relevant in a local context are probably of a less universal character, why it may be difficult to communicate and transfer research results. In order to determine relevant research methods for such complex aspects and also create knowledge about the potential of different farming practices for rural development, we suggest that research and development initiatives should include:

(i) The establishment of local platforms for dialogue and development of relevant indicators of multifunctional performance adapted to the local environment. The expectations of and opportunities for farming to contribute to local development are defined among a range of stakeholders (regional policy makers and authorities, professional associations and councils, farmers, agricultural advisors, grassroots movements and researchers of different backgrounds). Through dialogue, the most promising areas are identified and research staff proposes relevant indicators for farm performance.

(ii) Documentation of results obtained from a number of farms. The indicators of farm "performance" will be evaluated at farm meetings to examine the farmer's affiliation to the indicators and the farmer's views on possibilities and constraints to improve farm performance. These analyses will form new inputs to the platform for dialogue.

(iii) Analysis of development possibilities in the light of changes "requested'. Using agricultural advisors and researchers, a range of options can be considered for use on-farm and for policy-making at regional or central level.

A transnational effort as described above can support the understanding of the value of the multifunctionality concept and the building of indicators of multifunctionality for guiding constructive change in regional LFS development.

5 - Conclusions

Sustainability appears as a general invitation to animal scientists for revisiting their contribution to animal production development. The sustainability debate has shown that economic, social and environmental concerns need to be viewed and solved in the context of each other (*e.g.* Bosshard 2000; Haberl *et al*. 2004). The in depth analysis of the processes and consequences of development of animal science during the 1945-1990s carried out by Hodges (2003) stresses out lost credibility of animal scientists for society and the negative impacts if animal science would take food production farther and farther along the road that priviledged economics. For this author, a general change in the culture and professional practice of animal scientists is requested: "(…) *animal scientists now face the task of formulating new beliefs about the role of science in food production. We must not only listen to the new agenda of society—we must seek to interpret and fulfill it in creative ways*." It is a very requirement for animal science to search for an ethical foundation supporting a renewal in its contribution to society. Hodges considers therefore as new agenda for animal scientists:

"*1) Regaining and maintaining scientific objectivity, not only in the learned journals, but in the eyes of the consumer.*
2) Positioning themselves as objective, thoughtful servants of the whole of society.
3) Listening to what the public as consumers and as citizens are saying about food related to quality of life.
4) Ensuring science is independent of self-serving interests.
5) Rethinking the nature of risk in the context of radical biotechnologies. This means evaluating risk in terms of the consequences flowing from one failure rather than from small probabilities of failure.
6) Designing and researching new hypotheses and questions that will enrich life quality.
7) Engaging in dialogue with other components in the food chain community, including business, to ensure that information flows in both directions with the aim of improving transparency and accountability."

LFS research can be considered as having a special focus on the last point in this agenda.

Methodological frameworks in the LFS research area were developed initially with the view to consider not only the efficiency of the production process in managing LFS to but the whole-system efficiency understood as sustainability. The area built first from the idea to account for the real-life farm conditions, objectives and values of farmers and also their indegeneous knowledge when designing advice to farmers using scientific advances. The purposes and values of scientists were varied but the general idea was to avoid failures of the past due to lack of awareness that the systems animal scientists were trying to improve where included in wider systems (van der Zjipp, 1993).

The adoption of system thinking for an integrated approach of livestock farming activities and of an evolutionary framework to sustainability inscreasingly pushed LFS scientists into a changed view of their ethical responsibility in society. Their role would not lie into the use of scientific knowledge for designing themselves constructive directions for societal change. What appears us to form the ethical background of LFS scientists is rather a view of scientists as members like others in society, with knowledge and skills of a particular type. These later would only give them a special responsibility in enlightening on on-going change and their likely consequences as well as in helping in the prospective assessment the options designed for sustainable change. Such a view support the importance they attach to participation, their main belief being that for development to be sustainable, study of development options and design of development policies should follow from in-depth communication between all stakeholders in society.

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