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LIVESTOCK FARMING SYSTEMS RESEARCH IN EUROPE AND ITS POTENTIAL CONTRIBUTION FOR MANAGING FOR SUSTAINABILITY IN LIVESTOCK FARMING

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Abstract

Livestock farming systems in Europe is mainly the fact of "generalist practitioners" researchers all over Western Europe, often involved in regional development projects, locally or again overseas. Within the frame of specific regional research institutes, as for instance Hill Farming Research Organisation in UK) or within Research Ministries impulsed projects as for instance in France and in Italy, they involved in interdisciplinary works with many disciplines (from ecology to sociology) in order to provide improved bases for an integrated development to livestock farming in very constrained environment. For playing their part in these projects without becoming "specialists in all disciplines", they developed concepts, methods and tools for addressing farm management as a whole, remaining animal production researchers. They developed a dual conception of a farm, as a human driven activity, integrating that way farmers objectives and constraints, and linking them as far as possible through systemic modelling with the usual animal science knowledge. The need for such researches in animal production increased more recently in Northern Euerope countries new societal pressures regarding pollution, limitation of production, etc. The LFS EAAP working group meets the need to improve bases in animal production for such types of research, the geographical location becoming a secondary issue when familial farm management as a whole is addressed. We consider that such research can contribute efficiently to improve the addressed. We consider that such research can contribute efficiently to improve the sustainability of livestock systems, on the condition they (i) keep open to other disciplines contributions through interdisciplinarity but also (ii) are deep-rooted in the animal scientists commuinty. The paper develop these different considerations.

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Introduction

A series of symposia was initiated under the auspices of EAAP and of European Union in 1990 to encourage discussions between European animal productions scientists involved in on-farm livestock research in a development scope. Their approaches, though very diversified, had in common to refer to system analysis in order to cope with development issues at the regional scale with respect to Livestock Farming Systems (LFS). The LFS working group developed exchanges on the theoretical and methodological bases of such researches, accounting therefore to the specific traits of the livestock systems in the regions they are undergone. The group gained progressively a common understanding of the general fundaments of their research. This provided LFS researchers with an improved outlook of their potential specific contribution both to livestock development under the new societal current concerns, within which sustainability becomes a major issue, and to animal science.

This paper aims to give an overview of current LFS research activities, and to emphazise how LFS researchers can contribute to the nowadays increasingly shared objective to improve sustainability of livestock systems. Sustainability concerns can provide a fruitful support for a closer cooperation with the other members of Animal production science community, that appears them as essential and of potential mutual benefit.

LFS research: a diversity of backgrounds but increasingly convergent aims

Since its informal emergence in 1990, the LFS group focused its symposia series on exchanges about animal production research run for development purposes. In this movement, emphasis is put on discussing the concepts and methodologies under use in concrete LFS studies that usually address regional development issues or again national ones. At the same time most attention is paid to the conditions of farming and to the major current development issues identified with respect with each local situation.

As the very varied origins of the papers contributed to the symposia illustrates it (Gibon & Matheron, 1992; Gibon & Flamant, 1994; Dent et al., 1996; Sorensen et al., in prep.), LFS research developed in most of the Western Europe countries with regard to local or overseas livestock development issues. Since this research developed parallely and mostly independently among several communities, it is important to get an overview

of this diversity of backgrounds when analysing the analogies and the differences between the set of concepts and tools used by ones or others of the teams (Gibon et al., 1994).

A one week workshop hold in Paris in April 1994 by a small working group allowed to analyse and compare situations within Western Europe, from the examples offered by the countries which involved an important effert in creating the LFS movement. It helped to assess more objectively the point reached into a common understanding of LFS research from the two first symposiums (Gibon et al., 1996). The Paris workshop and further reflection within the working group make us consider as a prerequisite to get an overview of the general evolution in animal research attitude towards development issues within the occidental industrialized countries, that is in fact common to the whole agricultural sciences community.

The general past prevailing view in occidental agricultural research with respect to development issues

During the "Thirty glorious years", the scientific common search for maximizing agriculture productivity found a huge support both in the successful advances gained by the mean of experimental methods since the beginning of the century and in the technological progress allowing to put them into practice on the one hand, and in the need to increase significantly food production after World War II in order to meet increasing population needs for animal products on the other (van der Zijpp, 1993; Huirne et al., 1994; Nardone and Gibon, 1997). Their concern evolved then from maximazing production systems specialised and, for each of them, a unique intensification development model was proposed to farmers. It progressively integrated the tremendous accumulation of new biological and technical knowledge gained during this period.

Given the advantages many occidental farmers gained in adopting the intensification model, either in dairy or meet production, and due to the character of objectivity and generality attributed to scientists advances, development was currently considered as deriving from the application of knowledge and technology of universal value, the intensification model being the unique one to promote (van der Zijpp, 1994). Under that view, development was only a matter of application (or again 'transfer') of technology in various environments by specific institutes of development (or for some peculiar cases by R&D teams). Most of the animal production universities and research institutes in European countries developed their research orientations according to this general 'ethical' framework. The view of scientific advances as a support to improved transfer was a major reason for pursuing a 'self-oriented' research effort. It continued to support most of the specialised research advances till the very recent times.

A progressive change in the concept of development with respect to agricultural systems specificities in developing countries

The many failures experimented in the transfer of the technology founding the intensification model in developing countries led to question the generality of such a development model since yet many years. Despite numerous controversies, the usual answer has long time been to denounce both the lack of education of farmers and the weakness of local development structures, and to propose patterns for organising development actions, for fulfilling the failures in its application (as for instance the 'technological packages' methodology). Such attempts have been more ancient, and, for a long time, more investment was done in the search for more adapted development projects frameworks in crop production rather than in animal production. They led to the development of multidisciplinary approaches for assessing farming systems within participatory research frameworks (Chambers, 1986; Farrington and Martin, 1990). Similar tendencies nevertheless developed with regard to livestock systems, after a first period during which the spreading of occidental technology was limited to farm animals disease control (Rey and Fitzhugh, 1994).

European animal researchers involved in overseas R&D projects were not the only ones to question the prevailing intensification model in animal husbandry. Even if the general intensification model remained prevalent when addressing European livestock systems development, changes progressively appeared in different countries since the seventies or even earlier.

Changes in animal science with respect to changes in European development issues

Animal science developed principally till the recent years according to the general pattern of running scientific research on experimental farms under a complete control of the scientists, and gained more and more specialised biotechnical advances. However, at the same time, changes in conceiving livestock farming development occurred progressively in both the Northern and Southern European countries. Their bases present important variations amoung countries and teams.

The diversity of backgrounds and working conditions of the LFS researchers.

The main bases for the differences among teams and countries were identified collectively from the 1994 workshop in Paris and from further reflection within the small group involved in it (Gibon et al., 1996). They

came out from a comparative analysis of the evolutions observed in Denmark, France, Italy, Spain and United Kingdon respectively.

The role of the regional disparity in potential for development at national level.

The questioning of the prevalent intensification model, and the search for alternative models raised firstly with respect to the regions lagging development and/or presenting harsh environments. This fact constitutes a common trait among countries. The changes nevertheless follow different patterns.

The search for sounded biological bases for improving livestock systems productivity under harsh environmental considions

Research evolution at MLURI in UK illustrated it well. The organisation of research state funded institutes according to the main geographic areas of the country led the Scottish institute to undergo research about the biological and physical components for livestock systems on the least productive, natural pasture since the end of the 1950's. A classical experimental approach to the development of Scottish LFS was used until the late 1960's. In a first phase, 'reductionism' and 'inductive' science were used to explore the biological potential of these systems. In a second one, new systems were designed via a synthesis of the understanding gained in the previous phase and system experiments were undergone on research farms under scientists' full control. Scientists were trainted both in agricultural science and farm business management. As a consequence emphasis was given to practical, farmer-oriented performance indicators such as seasonal body condition scoring or again sward height for the application of the new systems. Advisory services advocated and demonstrated the value of indicators approach to farmers. Computer modelling of the biotechnical sub-systems of the grazing system was run. At the end of the 1980's, MLURI moved towards a programme of modelling the whole farm (Sibbald and Maxwell, 1992 b; Armstrong and Sibbald, 1992).

Evolution towards an holistic R&D approach to agricultural and/or rural development in regions lagging in development

That can be regarded as a trait common to France, Spain and Italy, despite huge differences in further evolution of LFS research. As in most of the European countries, classical and increasingly 'reductionist' approaches to animal production within the general intensification model scope prevailed at national level since the recent years. Experimental farms under scientists' full

control have been the current basis for running them, despite variations in institutional organisation of both research (National research institutes with regionally spread centres in France and Spain; major role of the Universities in Italy) and development services. Additionally, in Spain, after the creation of the national advisory service at the end of the 1950's and the settlement of research training abroad at the end of the 1960's, research became increasingly directed towards applying new technology from other countries (mainly France and the UK) and studying new potential systems through system experiments on research farms.

Within all the countries of thie group, as well as in other Southern Europe countries, the very first LFS oriented research at the very beginning of the sixties related to genetic improvement schemes, because of the specific needs for selection of dairy sheep and hardy cattle breeds in constrained environment. The AGRIMED group of EEC, toigether with the CIHEAM-FAO network, played a major role in the evolution of the animal production scientists towards better tuned a research to meet specific regional development needs in animal production (Flamant & Morand-Fehr, 1989; Boyazoglu & Flamant, 1990). The development of such research orientations is partly linked to specific cultural traits of Mediterranean livestock farming production and to consumption cultural traits, ...). Some of the research themes derive also from the general constraints to livestock farming under harsh environments (genotype-environment interactions, management of replacement females in restrained feeding conditions, grazing of poorly productive pastures, etc.), therefore contributing to reinforce the links with some research teams from Northern Europe such as MLURI.

Politician-driven impetus to multidisciplinary research with respected to agricultural and rural development in marginalized agricultural systems and regions.

This other trend of importance for LFS research background, is common both to France and Italy. At the beginning of the 1970's in France, and of the 1980's in Italy, research and agricultural ministries iniated incentive programmes aimed at fulfilling regional discrepancies in agricultural development. Their results have been very different in both the countries.

In Italy many animal scientists became convinced at the end of the 1980's that a review of the disciplinary, specialised approach was needed, and developed a 'filière' (production chain) view calling for cross-disciplinary collaboration. Finalised projects led by interdisciplinary work groups or again extension of field activities of single researchers occurred, but it must nevertheless be emphasized that in most cases the system approach remains limited to experimental farms, despite the long time acceptance of the system-approach concept in the national cultural traits of the scientific community.

In France, cross-disciplinary collaborations developed within the successive incentive programmes of the Research ministry resulted in an important spreading of a dual view of farmers practice, as closely associating social and technical dimensions, and in a currently accepted assertion of the necessity to diversity development models (Jollivet, 1988). It also strongly reinforced a conceptual and at the same time very concrete view of the potential links between "Nature"'s sciences and "Society"'s sciences in interdisciplinary projects (Jollivet, 1992).

One of the results of major interest for French LFS research is the creation at INRA in 1979 of a new and 'atypical' Department, called SAD (Systèmes Agraires et Dévelopement). This evolution boosted LFS research in France since the beginning of the 1980's, whils at the same time it contrubuted to some extent to loosen the links between generalist and specialised livestock research. SAD contracts with the other Departmens at INRA by its wide interdisciplinary composition (from ecologist to geographers and sociologists), and by its research practices, mainly based on field work at micro-regional level in cooperation with local development partners. Since the middle of the 1980's this department involved an important effort in developing a collective theoretical background in system modelling (Brossier et al., 1989) and in decission and management sciences. Since the creation of the department, the animal scientists involved in its various research units run a collective reflection to identify and improve their specific contribution to wide interdisciplinary approach (Gibon et al., 1988; Landais and Balent, 1993). This reflection is run in a close association with the animal scientists of CIRAD, the main French research and development institute for overseas cooperation, especially with scientists of its EMVT department, whose background is in tropical animal health and production.

The many marginal and mountainous areas of Spain also led into the development of multidisciplinary system research (Revilla and Manrique, 1981). Despite such efforts Spanish research is still characterised by a prevalence of works focused on alternative biotechnology with less emphasis on subjects related to the management of resources.

The recent societal awareness of the detrimental effects of intensive livestock system model

Within advanced industrialized countries, the recent societal awareness of the detrimental effects of the massive adoption by the livestock farmers of the countinously intensifying livestock-system model, and the changes in consumers attitudes led animal researchers to change their views about the orientations to pursue with respect to development. Denmark exemplifies well this other form of background to LFS research, common to several the western European countries presenting favoured environments on a significant part of their national territory, such as Germany, France, UK, and the Netherlands.

The obvious complexity of management of biotechnical system at the livestock farm led in a first stage some research teams to identify the necessity of a system research integrating several disciplines, mainly economists and specialists in managerial sciences.

The aim of livestock system research at DIAS (Danish Institute for Animal Science) was to improve production efficiency, for the good of society as well as for the farmer. That led the researchers to develop computer models of livestock sub-systems to provide farmers with management support, at DIAS as well as in other European countries of comparable conditions, specially in the Netherlands (Korver and von Arendonk, 1988).

The view of the society in livestock farming is currently changing, farming been seen nowadays as 'more than food production' (Sørensen et al., 1997). Issues such as effects on landscape, pollution risk, and animal welfare become equally important. This current change in society led DIAS to revise the approach to livestock systems. This institute has carried out holistic research for nearly 30 years using private dairy farms in close co-operation with the local advisory services. In the multidisciplinary reseearch conducted in order to optimise production at farm level, the concept was based on economic theories and strong links with the tradition of experimental animal science (Thysen et al., 1987). Since 1988 the objective of on-farm research at DIAS has moved from increasing productivity to improving sustainability, and a LFS approach with reference to general systems theory has been applied (Sørensen & Kristensen, 1992). Such a change has necessitated the use of a complex model of livestock farm management and also co-operation with new partners such as social scientists and philosophers (Sørensen & Sandoe, 1993).

The main lessons from the analysis of the part diversity of LFS research

It appeared rapidly obvious for the LFS group that the differences in their national environments, with respect both to general societal and agro-ecological conditions, and to the institutional organisation of research and development, played a major role in the orientations and the patterns of evolution of the LFS researches run, together with the differences in the current ways of thinking according to national cultures (Gibon et al., 1994). These observations meet the conclusions drawn by Farrington and Martin (1990) in a very interesting comparative analysis of participatory research in Agriculture (PRA). For these authors, the local agricultural conditions under which R&D projects are run, the institutional organisation and links the research teams have, as well as the culture and ethics of the researchers involved in such projects play an important role in both the attitude towards farmers in the partnership framework, and in the orientations and methodological bases of research with regard to development.

Once overcome the difficulties in understanding each others coming from the diversity of backgrounds, this diversity appears as a richness, given the increasingly convergence in the aims of the resarch. They provide very diverse scientific experience and material that facilitate the identification of the fundamentals in the a research field, and that allow more rapid advances in the design of methologies.

A major interest of the comparative analysis of our different background is that it gave us a better understanding of our identity within the scientific community. We gained an increased consiousness of the fact that, even we are animal scientists of a special kind, since we are at the interface of two recognised scientific communities: the animal science one on the one hand, and the agricultural systems one on the other, we actually are and intend to go on being animal production scientists.

Current advances of European LFS research towards a common understanding

Common interests and goals

The search of an improved cooperation with farmers for developing an holistic approach of their management practice develops increasingly. An additional reason to the ones developed in the previous section of the paper can be found in the PAC incentives to the development of livestock systems able to meet multipurpose objectives and to the 'extensification' of livestock. The resultant emphasis of grazing systems in which there is imcomplete control over the food supply and on a multiplicity of objectives, together with a societal framework demonstrating an increasing confusion about political priorities to follow and uncertainty with respect to its future. The resulting current challenge for livestock farm management can be seen as the replacement of external inputs by 'matière grise' inputs (Béranger comm. Pers., 1993). Land management and production chains ('filières') become two complementary major issues in the new context.

Despite their diversity of backgrounds, two major ideas are shared by the research groups. The first is the acceptance that the complexity of the livestock farming activity forms the background for our research. The second concerns the overall objectives of livestock farming systems research, which are:

- to increase knowledge about livestock farming systems;
- to build management aids for livestock farmers and tools for advisors;
- to build tools to aid negotiation between actors within a given framework at local, regional or national scales for questions dealing with rural development (where actors might be, for example, farmers, other members of a local society and

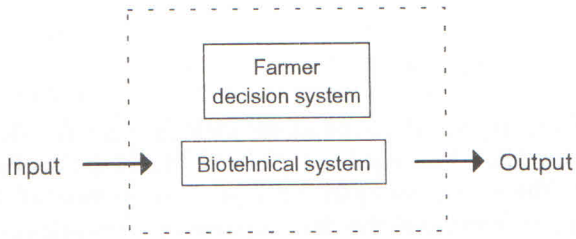
land-use planners for local development planning) and animal industries (where actors might be the different partners in a given animal industry, etc.).

The search for understanding of the complexity of livestock farming systems by the different groups led to the construction of a number of theoretical frameworks. The major common basis for comparing the frameworks is the individual farm, which represents either the starting point or the final point of the research according to the background of the groups.

A shared conceptual framework of the livestock farm

In any LFS research activity it is important to understand the whole livestock farm as a system. Figure 1 illustrates a conceptual model of a livestock farm which represents a duality between the view of a farm as a human activity system and the view of a farm as a production process.

Figure 1 - COMMON CONCEPTUAL MODEL OF A LIVESTOCK FARM



The view of a farm as a production process focuses on the transformation of physical input to physical output.

In the view of the livestock farm as a human activity system, the farmer (family) is seen as a person (a small social grup) satisfying specific objectives through farming activities, using information from the farm environment to make decisions which adapt farming activities to achieve objectives and to respond to environmental pressures (Osty, 1978; Béranger & Vissac, 1994).

This approach can explain phenomena at the farm level which cannot be understood by a model of a farm as a production process and can add to knowledge bases which may be applied to future development and advisory actions. It generally requires that animal production scientists work with experts from other disciplines, for example, sociology, economics and the more recently developed management sciences.

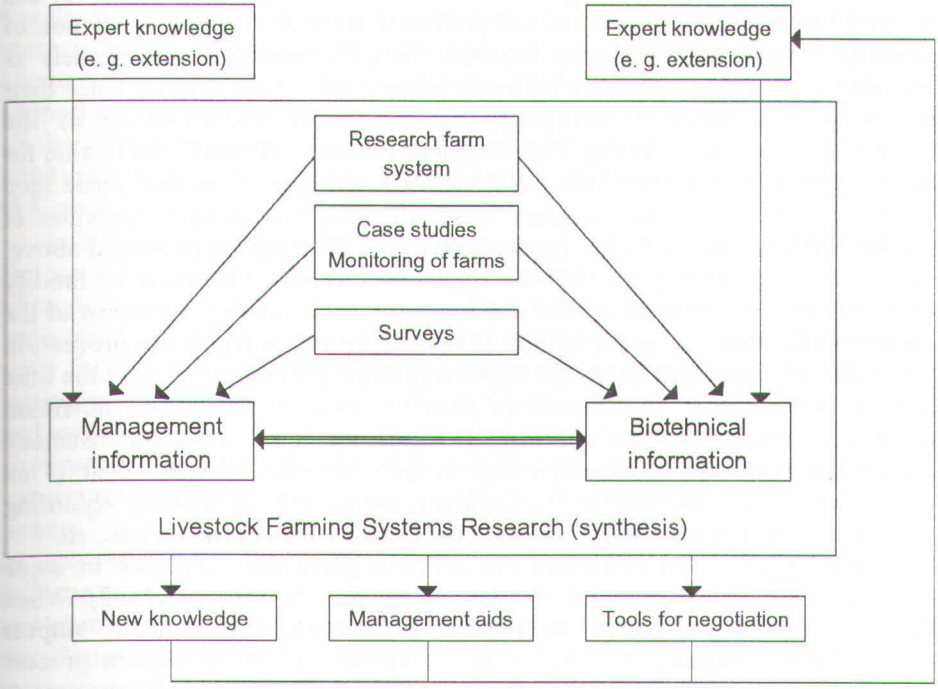
Methodologies

Livestock farming systems research has the main objective of gaining a better understanding of the whole system at the farm scale and is based upon linking technical and biological information with knowledge of farmers'

decisions and practices (Dent et al., 1994; Béranger et Vissac, 1994). To achieve this, 'standard' sources of knowledge about the biology of animal production, derived from 'traditional' animal science (experiments and on-farm recording schemes) on the one hand, and about farm management practices, classically regarded as coming from the extensionists, have to be used concomitantly. The challenge for the LFS researchers is to integrate livestock and socioeconomic systems into complex ones (Dent et al., 1994).

A range of methodologies adapted to the objective has been developed (Figure 2).

Figure 2 - OBJECTIVES AND METHODS OF LIVESTOCK FARMING SYSTEMS RESEARCH AT THE FARM LEVEL



The fundamentals in developing methodology of LFS research is system modelling. System modelling can be seen as the application of the concepts of general system theory to building operational representations which integrate biological processes and decision processes controlling them (or again 'regulation' ones when addressing biological systems as some nutritionists, such as Sauvant (1994) for instance). Such a conceptual model allows to

assess the evolution of any system in time (the operation and dynamics of the system) according to a general strategy of control that in turn defines a set of objectives and correlated actions (Le Moigne, 1990). The main assertion when using this fundamentals for LFS methodology is permits the formulation of an increased understanding.

Computer modelling

The classical concept of the use of simulation models in system approach to animal production is given by Morley (1972). The simulation model is used to relate dynamically inputs and outputs of a defined livestock system through a connecting structure of inter-related processes and products. Data derived form experiments designed to gain understanding of the biological and technical components (processes and products) are used in the construction of simulation models of livestock systems. In LFS research, such models as regarded as of major interest to better understand the whole system, since their processes with time offered progresively a better understanding of the biotechnical system operating. But they are obviously of insufficient value for an integrated assessment of the livestock farm technical operation, since they usually lack the facilities necessary to simulate the management strategies of the farmers. According to the fundamentals of LFS research presented above, to contribute efficiently to such an objective, they should allow to modify some of the parameters under use (for instance for reproduction patterns of the herd) in order to cope the conception of management as a regulation process, in which the farmer makes decisions and acts at some given times during the time horizon addressed by the simulation model to reorient the system operation according to his objectives (Gibon, 1981; Duru et al., 1988 for instance). Under the view currently under use in LFS research, management is an adaptative process, that allows the farmer, more or less successfully according to his capacity to handle it, to deal with uncertainity (of climate, prices, etc.).

Farm management strategies are given a particular emphasis in some simulation models, for example by Sørensen & Kristensen (1992). When the decision rules that control the physical transformation of inputs to outputs are simple and operational, they may be linked with a production process model which quantifies technical aspects of livestock farming (Sørensen & Kristensen, 1994). Artificial intelligence procedures are being tested to model complex farm management decision systems (Châtelin & Havet, 1992; Girard et al., 1994). When usig such management simulation tools in practice, it has been shown for cropping farms that the preliminary joint work between farmer and advisor, in order to clarify his decision rules and to introduce them into the simulation tool, constitutes in itself a powerful decision aid for the farmers (Châtelin et al., 1993). Fruitfull advances in

conceptual and computer modelling have been gained in both the fields of biological processes and management systems. Their concrete connection into integrated simulation tools remains however limited for now. That is not very surprising due to the complexity of the issue, but the exploration of the feasibility of building such a kind of models calls for a deep reflection not only within the LFS group, but also among the whole animal science community. Is it actually possible, through an integration of the knowledge gained till now, to build simulation tools allowing to assess the interest of different management scenarios on any given farm belonging to its validity domain? Should they address the technical operation of the whole farm, or again limit their scope to subsystems of special interest? Wouldn't they be to heavy to run to actually come into current use in advisory practice?

Reviews of the role of the systems approach and of systems models in livestock farming (for example, Bywater, 1990; Maxwell, 1990) provide many examples of modelling on the basis of experimental data. The linkages between component experiments, models, field systems experiments, decision support models and technology transfer, which are discussed in a recent review of the development of intensive grassland systems (McCall and Sheath, 1993) reflect the way in which developments have taken place in LFS research in Europe.

In a recent review of modelling as a tool for grassland science progress, Seligman (1993) states that, in order to ensure the future value and relevance of models in grassland science, "it will be necessary to improve their scientific sophistication and their management relevance. At the scientific end of the scale this could be accomplished by integrating more explicitly with modern ecological theory and system theory. At the management end, both in research and practice, it will be necessary to identify more efficiently those areas of application where the role of models, whether simple or complex, adds up to a net improvement in the decision capability of farmers, scientists and policy makers." The use of experimental data in the provision of biological information to be incorporated through synthesis with management information (see Figure 2) will continue to be an essential contribution to LFS research. This will require continued and improved lunks between LFS scientists and those involved in the "more traditional" livestock production sciences. The view of the respective role of experimentation and on-farm performance recording in LFS research view is not yet sufficiently assessed to presently reach a real common understanding. For some of us, both experimental devices and on-farm works should be used concomitantly in LFS research, the priority being given as far as possible to field work in order to avoid a derive towards biological research disconnected of the concrete local needs for management support, and experimental facilities devoted to limited topics that cannot be informed from an on-farm research (Revilla et Gibon, 1992). Many considerations have to

be taken into account, with respect to the concrete issues under consideration. They range from the actual possibility to run experiments, either because of the nature of the issue (for instance collective grazing of common lands), either because of the lack of experimental farms, to the actual interest of making them.

Case studies, farm monitoring and modelling

A detailed study of a farm system through time (a case study or farm monitoring, accordint to both local practice and terminology under use) makes it possible to understand a farm as a complex system involving management and biological/technical information as illustrated in Figure 2.

Case studies acknowledge the duality between a farm as a production process and the farm as a human activity system. They are the LFS researchers favourite tools for getting a better understanding of farm management (Sørensen & Kristensen, 1992; Béranger & Vissac, 1994). Beyond the production of monographs and the expertise gained by the partners of the case studies networks, it is generally considered fruitful to integrate case studies with modelling, in order to generalise the knowledge gained or to use it directly in management aids for livestock farmers. Modelling has to be understood in the previous sentence as well as computer modelling as well as the elaborating a representation scheme that can help the general understanding of both researchers and farmers and their advisors.

Some approachers aim to directly integrate case studies with information from experimental data in computer simulation models (Sørensen & Kristensen, 1992). The basic idea is that farms and models are developed in an integrated and parallel process. The computer model is then seen as research tool which can be used as a basis for management aids for farmer and advisors (Sørensen and Kristensen, 1992). Recent examples are given by Halberg et al., (1994) for energy utilisation in dairy farms and by Clausen et al. (1994) for herd management.

Other approaches mainly aim at deepening the conceptual understanding of the decision systems of farmers. For example "action models" (Duru et al., 1988) have been developed as a method for assessing farm management strategies. Such "representation models" of farm functioning are often expressed as systemic diagrams relating farmer's decisions over time to the evolution of the states of the operative components of the biotechnical system (Hubert et al., 1993; Halberg et al., 1994). The development of methods for assessing a farmer strategy according to such conceptual models can form the baisis for the provision of advice to farmers (Hubert et al., 1993). As said upper, in some cases, the main result of the use with farmers of a computer model is of similar nature, the farmers finding more interest in the explanations

about the conceptual bases in use in the model than in the results of its running (Chatelin, 199X, op.cit.; Girard et al., 199X).

In many approaches, emphasis is given to elucidating state indicators for the components of the biotechnical system (e.g. the herd, the pasture) which the farmers use when making decisions. Their identification assist researchers to understand farm management practices (Dedieu & Thériez, 1994). Improved knowledge aboug farmers' management systems can in turn help the choice of more judicious bases for modelling the dynamics of the biotechnical systems. Taking into account the farmers indigenous knowledge which unerlines their decisions when developing a model of the operation of a given biotechnical system often leads to re-appraising the existing knowledge derived from experimentation. Experiments specifically designed as a complement to farm monitoring can also be set up in order to contribute local and general information for modelling of the herd performance response to farm management strategies and to provide information to help farmers' decision makins (Revilla & Gibon, 1992, op. cit.).

Surveys and typologies

Another important aspect of livestock farming systems research is the creation of knowledge bases for the assessment of farm diversity at local, regional and national scales to satisfy specific development questions (Gibon, 1984). The main objective is to gather information about the diversity of farmers' situations, practices and objectives. Typologies are then constructed for different purposes (a) in order to assess trends of change in livestock farming, (b) in order to identify the main constraints to productivity (for example health problems; Bernués et al., 1994) or the main priorities for a specific development policy (Rey, 1981; Landais, 1986), (c) to be used as a basis for identifying "target groups" in development projects (Tripp, 1991), or again (d) as a tool for advisors in their work with individual farmers, allowing them to assess each situation in reference to known functional types (Perrot, 1992).

The methodologies used for structuring the surveys and for developing the typologies are based upon the main assumption that conventionally gathered information about the structure of livestock farms and usual tedhnico-economic indicators do not provide sufficient information for development purposes. LFS Researchers usually look for a characterisation of the diversity of the organisation of farming systems, by identifying objectives and practices in family farms. The methods used directly refer to the conceptual models derived from on-farm research (Cervantes et al., 1992; Theau & Gibon, 1993) or rely upon the expertise of advisors (Perrot, 1992). Diversity of land use patterns resulting from individual's objectives and herd management practices is one of the important focuses of these typologies (Rubino, 1992, Gibon & Theau, 1994; Manrique et al., 1994).

Other tropics of importance are under progress in European LFS research within the aim to provide holistic frameworks to support livestock development at local or regional scale.

The system modelling approach is also used to address livestock farming organisation and operation at upper levels than the livestock farm, such as production chains (Vallerand, 1992; Gherardy, 1996), or again land use concerns (Dent et al., 1996).

The dual view of livestock farm still constitutes an important basis in the approaches, but not any longer the prevalent one. In the researches at that upper level try gain an holistic assessment by a concomitant assessment of the two main dimensions of any human practice: the social one as well as the biotechnical one. When addressing land use, there is less general evidence about the operators to take into account and their overall organisation than in animal production chains. The objective of gaining an holistic understanding lead the LFS to undergo concomitant cooperation with disciplines dealing not only with the biotechnical component (mainly landscape ecology or animal products technology) but also with the social organisation of the operators (mainly anthropology and sociology). Special emphasis is given to the assessment the aims and the role of each type of operator in the overall operation of the system considered, in order to identify their respective needs for both technological information and management support, and to point out to which extent their respective practice and objectives complete or compete with respect to the overall operation of such complex systems. Such approaches proved yet in concrete projects their efficiency in providing support for negotiation between operators of varied nature, in order to define collectively acceptable trade-offs. We nevertheless are far from now to be able to propose more than a range of concrete examples of application of such approaches, since these researches have less a long past that the livestock farm level ones, and also the more complex a system is, the longest is the time needed to attain a common understanding.

Current LFS advances call for reinforcing the implication of LFS researchers within the animal science community

We colectively consider necessary nowadays to reinforce our links with the whole animal production scientific community. That doesn't mean at all that we intend to drift from our present condition, one foot in multidisciplinary agricultural system, the other in animal science to only concentrate on animal science. But after a period in which many of us focused on the links with disciplines far from animal science in order to contribute to a better approach of development issues, after the settlement of the first bases of a common understanding of LFS research as the scientific tools and orientations for an

integrated animal science of value for 'generalist' in animal science, times are coming for us to invest in improving in our animal science background.

For many reasons that can be found easily from the above exposition, our current concern with respect to the reinforcement of these links, deals with the modelling of the biological operation of LFS at farm level.

New concerns in animal of potential interest for facilitating exchanges between LFS and 'classical' animal scientists

The sustainability concept and its potential value for animal production research

Controversies about the interest of using or not the term are not only the fact of animal scientists, whose positions range from making an extensive use of the term to totally ignoring it because of it very weak scientific value. The work of the scientists involved in fundamental research about this concept (in philosophy, ethics,...), makes easier to understand the debates the term impulses within the animal production science community, as the paper given by Thompson & Nardone demonstrates it.

The term is "fraught with ambiguity and uncertainity" Jeager (1995). People use the term in so many ways that it is easy to despair of ever reaching a systematic, defensible analysis of its meaning (Thompson,, 1995; 1996). For this last author, "using the term of sustainability for raising some livestock production issues is obscurantism and does nothing to advance ethics or sustainability". The term "sustainable development" as defined for instance by FAO (1992) does not escape to similar critics. Nevertheless, many authors, including the ones just cited, acknowledge that the current usage of both these terms also helped to clarify some important aspects for Agricultural scientists. Since the factual question "is it sustainable" help to precise the way of conceptualizing human values, responsibilities and goals, it is of relevance for addressing long term dynamics of practices and systems, and beneficial for clarifying the ethical aspects involved in any human activity, especially animal production research (Thompson, 1996). Sustainability then be seen "as a goal, like liberty or equality, not to be reached, but a direction that leads constructive change" (Lee, 1993). In such a scope, "we must abandon the idea that sustainable use is an endpoint" (Vavra, 1996). We should rather define it as "a trajectory with certain bounds, rather than a peculiar state", and "scientists could help in envisioning the maximum stresses that various sub-systems can tolerate at various moments and still maintain future options." (Fuentes, 1993). As a consequences, the sustainability concept may help to address long term management including uncertainity and risk into a process of adaptative management (Varvra, op cit.).

In thet view, some within the present older senior scientists in animal production can be seen as addressing sustainability since a long time without knowing it, in the same way that Mr Jourdain was making prose in Molière theatre: they always have been awarded of the long term possible side-effects of by-effects of the progressive scientific advances in their discipline, and their background allow them to have an overview of the question since (1) they most of the time began research in Animal production before the paramount progresses of this biotechnico-economical science that led to divide it in many diverse disciplines, (2) they often contributed to the definition of the agricultural policies at a national or at the European level.

For younger scientists lacking their general culture, it becomes increasingly difficult to get a general frame allowing an overview of all the advances in the different branches of animal production science, as well for generalists as LFS researchers, as well for specialists in one of the numerous branches of this composite discipline. Since the sustainability concept put emphasis on human and ethical values of importance, it appears us of interest for both these types of animal scientists.

For the specialists, it can act as a spur for undergoing exchanges with the generalists and the specialists in the other branches of the discipline.

For the LFS researchers, it helps to tune the objectives of the system research they run for development purposes. Considering the concept as of an ethical rather than scientific value, the main merits we attach to the use of this terminology are:

1) to focus on the main topics not to forget when addressing a local or even national livestock development issues

2) to provide some general support to develop the integrative concepts and tools necessary for addressing development, by providing an outlook on the overall and the long term operation of livestock production systems. It could have been maybe more opportune for us to refer to the Agro-Ecology background (Altieri, 1983; 1989). The ethical background of agro-ecology is more or less the same that the sustainability one, but it provides additionally a lot of conceptual and methodological bases (Sauget, 1993), that can be of very scientific relevance for us.

General evolution trends in animal science with respect to LFS research concerns

The reorientation of research priorities

Sustainability concerns acted during the last decade as a support for more and more animal scientists, as well in developed countries, as in developing ones, to encourage the thinking scientists, as well in developed countries, as in developing ones, to encourage the thinking about change in research priorities

with regard to the societal pressure. In the first, scientists who contributed to the general intensification model of livestock systems that prevailed till very recent times, based on intensification from ever more specialised research results, realist now that this system is part of a larger system including the total production chain and now that this system is part of a larger system including the total production chain and society (van der Zijpp, 1993; Huirne et al., 1994). In the latter countries, many past R&D projects based on the simple idea of transferring the technology tuned for the intensification model met very disparate and generally poor success. Their evaluation led to the reorient regularly research priorities in animal production, especially within international institutes such as ILCA (Rey & Fitzhug, 1994) towards LFS research.

In any environment, a more or less wide part of animal scientists become interested in positioning their work into more integrative frameworks, and are realy to wider their concerns, or again their cooperation bases.

A new area in modelling bases under use in 'classical' animal science

Being or not in direct connectin with the above mentioned trend, animal scientists came since a few years ago into integrative research from the numerous advances their community accumulated over time. The system approach is of continously increasing use in varied branches of animal science, as for instance in nutrition or again in grazing behaviour to develop new models of a new type. Thanks to the specialised advances gained and to the accmulation of experimental data over time that facilitate the test of their generality, they are evolving from empirical models based on statistical evaluation of their parameters from experimental results towards more biologically sounded ones bases on conceptual patterns of general value (cf. for example Tamminga or Sauvant works in nutrition).

This trend is considered by the LFS scientists as a positive evolution with respect to their own concerns. Even if, for now, this new type models address what we consider as very 'small' subsystems, since they do not even deal with the whole animal but with subsystems of it, they appear us of closer potential direct interest for LFS purposes.

The progressive identification by LFS research of knowledge fields asking for improved cooperation

LFS research aims to define an integrated approach of livestock production systems adapted to development purposes. The organisation of the symposiums for exploring a diversity of themes, the contributions and discussions along the first 4 symposiums (table 1), helped the establishment of a common understanding. Despite very diverse backgrounds and additionally

the many varied forms of livestock systems they address, from conventional intensive one, to very extensive or again 'traditional' ones, the symposiums series progressively pushed the LFS researchers into the idea that it was possible and interesting to think in term of general rather that local models, even for helping local development ("Think globally, act locally" as said in agro-ecology or sustainability research)

The increasing discrepancy between technical advances and the new development objectives under all types of environments calls for a new investment in system modelling in order to better meet the current necessity to actually rely divergent concerns (Dent et al., 1994). Within the LFS group, emphasis was till now put in developing the main basis for integrative models linking management and biotechnical systems, that called an important effort for getting a current understanding of the whole system, an of the management system. As well in the field of conceptual modelling as of computer modelling, we consider nowadays necessary to incorporate new advances into our views about the biotechnical subsystems, by enhancing cooperation among the animal science community. Since the livestock farm is the more advanced LFS model for now, and since its constitutes the 'basic unit' of many livestock production systems, it appears as the very first topic to address.

Some suggestions for potential reinforced cooperations

From the previous exposition, our main interest is in getting a better integrated view of the herd operation at farm level, in order to better assess the actual interest of alternatives in management, from the results that can be expected. We not only search for general models, but also for models of potentially easy adaptation in order to meet the variety of local conditions and breeds. That the reason why we are very interested in the new forms of modelling: they appear as put an huge interest into the idea "law of production", that can help to better assess the herd or flock operation and then to propose decision support, with respect to a wide range management styles.

From a more important list of topics we consider of main interest for us, we will just give some significant examples, about which the need for such cooperations appears us very obvious:

- the appraisal of the lifetime biological operation of the reproductive females, in a way that lifetime performance; Special emphasis could be given to nutrition for instance, in trying to get an integrated assessment of the effects of the nutritional status and management rules at any stage of the animal life.
- the linking of veterinary knowledge with biological classical knowledge: it would be beneficial for us animal scientists could find some ways to integrate health management aspects and production aspects into operative models of herd operation that allow to asses productive results according to the herd environment conditions and management rules:

Table 1 - LIVESTOCK FARMING SYSTEMS INTERNATIONAL SYMPOSIUMS SERIES

Title	Organisers et venue	Main Themes	Invited Papers	Contributed Papers	Posters
Global appraisal of Livestock Farming Systems and study of their organisational levels	INRA/SAD, CIRAD/EMVT Toulouse, France July 1990 (1 day)	* Evaluation of herd production on farm * How to organise observation and experimentation * Land management and livestock farming * Research, training and extension	6	-	42
The study of Livestock Farming Systems in a research and development framework	IAMZ. INRA/SAD, CIRAD/EMVT Zaragoza, Spain September 1992 (2 days)	* Livestock Farming studies with regard to economic and social change * Livestock Farming studies with regard to the management of the environment and the landscape * Organisation of R & D projects in livestock farming	7	13	52
Livestock Farming Systems: Research, Development, Socio-economics and the Land Manager	MLURI, IERM. SAC, INRA/SAD Aberdeen, UK, September 1994 (2 days)	* Modelling livestock farming systems and decision support systems * Concrete examples of regional issues and correlative research approaches * Environmental aspects of Livestock farming systems	6	16	35
Livestock Farming Systems: More than food production	DIAS, LFS WORKING LFS Working Group of EAAP Foulum, Denmark August 1996 (2 days)	* A concept of sustainability in relation to the livestock farm * Food quality products and livestock farming systems * A system approach for assesing animal welfare at the farm level	6	(14)	(53)

- the appraisal, with respect to management rules, of the consequences of the within-herd animal diversity (gehotypical and phenotypical diferences among animals, reproduction patterns, batching practices, ...), and the assessment of the potential interest in management practice alternatives.

Conclusions

Occidental societies are nowadays experimenting problems resulting from the prevalent intensification model they promoted. That leads them to become more suspicious with regard to the universal value of development patterns uniquely based on the scientific and technological advances they gained. They now assess that the model they promoted was not enough generally sounded, since they are currently facing the consequences of neglecting of some other esseintial dimentions of livestock farming, when focusing on economical and short term efficiency. The assessment of the livestock farming, when focusing on economical and short term efficiency. The assessment of the very complex character of livestock farming leads scientists to become more currently interested in analysing current knowledge interest limitations according to the variability in local conditions of livestock farming, in order to elaborate knowledge of more general value.

Research privileged for a long time progress in basic biological and technical knowledge about animal production processes, in order to maximise animal yield. We are now entering a time where the knowledge gained, and the changes in socio-economic objectives bearing on production bring not only a reorientation for research priorities but also in methods of research approach in animal production (Milligan et al., 1995). Growing efforts are currently put into theoretical and simulation modelling in order to provide integrated models of biological systems, for example on the regulation of nutritional function (Danfaer, 1990; Sauvant, 1992), or again on the plant-animal interaction and intake at grazing (Demment & Greenwood, 1988; Hyer et al., 1991: The basic knowledge necessary to rear the single animal and to manage the herd and the livestock farm is more and more evolving towards the prediction of the consequences of management alternatives.

Although the European working in LFS research have used varied approaches, the LFS working group led them to come into a 'common understanding' of what are the specificities of such a research. The general aim of the research is to build decision support tools to help farmers, advisors and policy makers in the increasingly complex process of adapting livesotck farming systems to the future needs of society. Improved understanding of livestock farm management is at the heart of the research. Since the beginning of its life, the LFS group put a big emphasis on the presentation of concrete works and results together with their theoretical backgrounds. That helped to progressively identify shared concepts and methodologies. Main of the theoretical and methodological advances gained focus on linking farmers' objectives and practices with biotechnical processes through the application of systems theory.

The ethical aspect of the sustainability concept, that can be regarded as of important value, despite controversies about its scientific value, can help to facilitate a cooperation between LFS researchers and the other branches in animal science, for the search of a better common understanding. This appears of potential mutual benefit. Both adapted tools for development support, and a sounded help to the reorientation of the research priorities can come from such a cooperation.

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ISTRAŽIVANJE SISTEMA UZGOJA STOKE U EUROPI I NJEGOV MOGUĆI PRILOG PODUPIRANJU ODRŽIVOSTI UZGOJA STOKE

Sažetak

Sistemi uzgoja stoke u Europi uglavnom su predmet istraživača "opće prakse" po čitavom svijetu, često uključenih u razvojne projekte, lokalno ili u inozemstvu. U okviru specifičnih regionalnih istraživačkih instituta, kao npr. Hill Farming Research Organisation u Vel. Britaniji ili u okviru projekata što ih pokreću ministarstva kao npr. u Francuskoj i Italiji, oni obuhvaćaju interdiciplinarne radove mnogih disciplina (od ekologije do sociologije), da se dobiju bolje osnove za integrirani razvoj uzgoja stoke u vrlo različitim sredinama. Kako bi odigrali svoju ulogu u tim projektima a da ne postanu "stručnjaci u svim disciplinama" razvili su koncepcije, metode i sredstva usmjerena upravljanju farmom kao cjelinom, ostajući istraživači proizvodnje životinja. Razvili su dvostruku koncepciju farme, kao aktivnost što je pokreće čovjek integrirajući na taj način ciljeve i ograničenja farmera, povezujući ih, koliko je moguće, putem sistemskog organiziranja s uobičajenim poznavanjem znanosti o životinjama. Potreba za takvim istraživanjima u životinjskoj proizvodnji povećala je u zadnje vrijeme u zemljama Sjeverne Europe nove društvene potrebe u vezi sa zagađenjem, ograničenjem proizvodnje itd. Radna skupina LFS EAAP zadovoljava potrebu poboljšanja osnova u životinjskoj proizvodnji za takvom vrstom istraživanja, a geogarfska lokacija postaje drugorazredan problem kada se govori o