What action logics do family livestock farmers have to maintain their activity over the long term?

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Abstract: *This paper sheds light on what livestock farmers do to "last" over the long term, from their own point of view, through explanation and analysis of their action logics. The authors take the examples of four contrasted case studies carried out in France, Uruguay and Argentina, on a total of 45 family livestock systems. Each study of changes in the livestock systems was carried out using cross-disciplinary approaches (livestock sciences, sociology, management sciences) and resulted in descriptions of types of adaptive paths, that are explanations of adaptive paths taken by family livestock systems in relation with farmers' action logics (logics being defined as particular sets of action principles). This diversity of action logics is cross-analysed in order to patterns to test the hypothesis that production context has an effect – or no effect - on action logics. The conceptual framework used in the four case studies recognizes the capacity of systems to absorb internal and external disturbances. Some generic styles of logics and action domains emerge from the comparison and are relevant to build up adaptive patterns, such as: to tend towards technical optimization or to diversify, to enlarge production volumes or farm structure (livestock and land), to search for autonomy, to be innovative, to preserve internal flexibility for the technical system. The combination of such domains determines generic adaptive patterns and paths that are taken by family livestock systems, independently of the context. The authors then discuss the different adaptive patterns and how these patterns provide evolution and resilience perspectives for family livestock systems.*

Keywords: *family livestock systems, action logics, resilience, adaptive patterns, long term, comparative analysis*

Introduction

Of livestock farmers who run their activity within family farms, few become involved in the main development model preached by the agricultural advisory system services. This model puts forward the management of livestock production as a specialised economic activity and the search for an optimum thanks to perfect control of the production process. Instead, many livestock farmers explore other models, searching for compromises in the production process in relation with the resources (natural, human etc.) that are at their disposal (Lemery et *al*., 2005) and developing various adjustment capacities that allow production to cope with situation variations. These models are still largerly unrecognized from the advisory services and little studied from the researchers. Moreover, the economic, environmental and human cost of this control of production process and resources is increasingly debated in a situation that is even more uncertain (Dedieu et *al*., 2008). Searching for an optimum - which presupposes that the environment is defined and stable - becomes of less interest.

It is becoming necessary to think of farming activity development models over the long term, considering a disturbed environment, the occurrence of shocks (Milestad and Darnhofer, 2003) and uncertainty about future conditions. Research and development is thus required to renew its models and forms of support: the aim then becomes to increase the production system's capacity to adapt to ensure the long-term survival of family farms. This supposes, and this is the aim of this paper, a better understanding of the action logics of farmers over the long term through the study of the operation and dynamics of these systems over long periods of time which incorporate uncertainties, shocks and divergences in the paths taken (Grossetti, 2006). We define long term action logics as the set of principles which guides action on technical, economic, financial and human levels (Levrouw *et al,* 2007).

In this way, we use:

1) an analysis framework, which borrows from the adaptive cycle concept (Holling, 2001), associated with the resilience concept. This framework makes it possible to tackle farming system dynamics in relation to a co-evolutionary approach (Darnhofer et *al*., 2010) so that we can describe important phases of internal transformation in relation to shocks or accumulation processes, but also phases during which farming systems gain better control over uncertainties, when their nature and intensity are quite predictable.
2) a comparative analysis of contrasted situations of family livestock production (dairy cows, beef cattle or small ruminants): in Argentina and Uruguay (where agricultural policy is liberal and which have been faced with serious economic and health crises in the past few years) versus two regions in France (where agriculture is supported by the Common Agricultural Policy, via products such as milk, or via environmental compensations).

Each case study resulted in the expression of tipical adaptive paths, which are the practical expression of livestock farmers' action logics to maintain their activity over the long term. The cross-analysis of these four case studies, conducted separately, shows similarities among the action logics whatever the agricultural situation. Their connection leads us to produce the generic analysis framework submitted in this paper as a principal result: some elementary adaptive patterns. Independently or combined, these adaptive patterns highlight all action logics identified in the different cases studied.

We discuss this result to illustrate how concepts of adaptive cycle and resilience can contribute to improving the understanding of family farming systems over the long term.

Cross-analysis of the action logics of farmers and the adaptive paths of livestock systems

Conceptual framework: co - evolutionary approach to farmers' action logics

The farming systems we are studying are specific at two levels: firstly, the family dimension of the livestock production involves situating the management of this activity in the family's system of activities and life projects (Paul et al. 1994). Secondly, the study regions do not benefit from comparative economic advantages because they are situated in the mountains (Ségala and Bauges in France). When they do have economic advantages (Tacuarembo, Paysandu in Argentina and Cuenca del Salado in Uruguay), the development of industrial agriculture comes into asymmetrical competition with family agriculture and can place small farms in peril. So our research is principally interested in the destiny of this type of family agriculture, and above all, in its sustainability in its economic and social dimensions. So we analyze the livestock systems over pluriannual time steps and describe the paths of family farm systems to identify their different forms of evolution according to internal and external events (Moulin et *al*. 2008).

In this context, the definition of the adaptive cycle established by Holling (2001) is an interpretation tool for the adaptive path of farming systems. The concept sheds light on the direction lines underlying the sequence and dynamics of different phases (release, reorganisation, accumulation-exploitation, conservation) that we can identify from the concrete ways in which farmers run and adapt their production system over time. So it is a relevant concept for studying crisis effects (e.g. CAP reforms) or environment transformation effects (e.g. new orders for landscape maintenance) on livestock production practices.

A joint methodology to analyse action logics

With the aim of carrying out qualitative studies, this approach leads us to choose small samples of livestock farms presenting local diversity in terms of structure and present functioning (table 1). A series of interviews was carried out with each farmer – or member of the family involved in the livestock activity – to collect qualitative and quantitative information about the present functioning of

the livestock systems and about the farms' evolution paths (Moulin et al., 2008), i.e. the changes which have led to the present production model.

We carried out a multidisciplinary approach, involving animal scientists, management scientists and sociologists, or agronomists who have knowledge of social science concepts. Each discipline contributes to a global understanding of farming system functioning and dynamics, in order to explain the sense of livestock practices and their evolution. This approach allows us to express the strategic patterns carried out by livestock farmers, according to Minzberg and Waters (1985). From these strategic patterns, we extract paths, action logics and registers (technical, financial or other) - main principles upon which the farmers rely to act and change their practices. Thus, our analysis deals with six domains enquired through the interviews, that are common to each case study: i) family configuration; ii) combination of the family's activities; iii) herd configuration and livestock system operation (feed, exploitation, replacement...); iv) buildings and equipment; v) workforce composition, delegated and shared tasks; vi) finances or investment financing sources. These domains gather several specific variables which are analysed thanks to methods dealing with conceptual grids (Gaines and Shaw, 1993) or Bertins' graphs (1977). The analisis results in the expression of tipical adaptive paths presented in boxes 1 to 4. Our approach consists in creating knowledge from the reality of livestock farmers, and leads us to adopt certain specificities concerning the analysis factors and variables within each case study.

Diversity of action logics

In the region of the Ségala (Centre of France), where the dairy industry is very much present, successive CAP reforms, fluctuating prices and health crises affecting cattle have shaken all dairy farms. The variables and analysis factors therefore centred on the concerns of farmers faced with the survival of the dairy activity, over a period of time of about fifteen years corresponding to the latest major CAP reforms (1992) (box 1). The study region situated to the south of the mountains of the Bauges (North Alps) is subject to a serious reduction in the farming population (more than three quarters of farms between 1955 and 2000) in parallel with an increase in the urban population close by. The farmers, in a minority on the territory, are subject to strong pressure on land and on their production patterns, which must respect the environment and maintain landscapes that are attractive from a touristic viewpoint. The factors linked to modifications of land use by livestock farmers were therefore studied over a period of about fifty years. This period corresponds to the start of the agricultural modernisation process and the disappearance of farms (box 2). In Argentina, the liberal context of agriculture, causing serious price fluctuations, recurrent financial crises, droughts and the increase in large scale soy bean crops (*pool de siembra*) are sources of disturbances for small traditional beef cattle farms on the Pampa to the South of Buenos Aires (Cuenca del Salado). The specific variables in this case centred on the technical and economic dimensions–, such as the search for autonomy, the degree production intensification; the strategies of farmers confronted by droughts, their relation to risk and the commercial management of their system (box 3). In Uruguay (regions of Paysandu and Tacuarembo), the context is similar to that of Argentina; the presence of full-time paid workers in farms has led to the integration of variables relative to the forms of salaried staff and the remuneration of employees. We shall see that these specific features make it possible to complete the framework of generic analysis.

Table1. Contrasts within the study cases.

Site of research	Context	Livestock (type)	Sample (nb EA)	Animals (nb/type)	AA (ha)	Work Force (nb)
Segala (France)	agricultural area (professional field ; industrial supply chain) ; CAP reform context	Dairy cows	12	17-55 Dairy cows (DC)	17-90	1 - 3
Bauges (France)	urban area (land pressure ; short distribution networks) ; CAP reform context	from dairy cows to small ruminants	14	2-126 Small ruminants 25 horses 8-45 DC 3-33 Suckler cows	1-103	1- 3 (part-time employees)
Paysandu & Tacuarembo (Uruguay)	frequent economic crisis & droughts ; expansion of soy bean crops (land pressure) ; liberal policy context	Dairy cows and beef cattle	10	77-4289	119-7100	1- 4 (0-3 employees)
Cuenca del salado (Argentina)	frequent economic crises & droughts ; liberal policy context	Beef cattle	9	79-247	108-523	1-3 + piecework employees

Considering the contrast between each case study (type of livestock production, farm size, agricultural context, cf. table 1), the comparative analysis asks for a new perspective on the results produced separately (Cialdella et al., 2010). So, we do not compare the adaptive paths as they are expressed in each case study, but their meaning in relation with the action logics and domains which explain the adaptive paths. These logics and domains refer to a differentiation axis, constructed with the grouping of factors and variables identified as relevant (table 2).

Table 2: Differentiation axis for each case study.

Site of research	Differentiation axis 1	Differentiation axis 2	Differentiation axis 3	Differentiation axis 4
Ségala (France)	Livestock specialisation vs production diversification	Enlargement vs staying small	The farm's management efficiency indicators: technical, or global (economic, fiscal, workload)	Optmization vs flexibility
Bauges (France)	Livestock specialisation vs production diversification	Enlargement vs reduction	The farm's investments practices : financial debt, savings or no investments	Land management and configuration
Paysandu and Tacuarembo (Uruguay)	Livestock specialisation vs production diversification	Enlargement vs staying small	The farm's investments practices : financial debt vs savings	Livestock management : innovative vs traditional
Chascomus (Argentina)	Livestock specialisation vs production diversification	Risk management : seeking autonomy vs taking technical and financial risks	Livestock management : innovative vs traditional	

Box 1. The action logics – Dairy farming systems in Ségala (Begon et al. 2009).

- path 1 "Staying small, being technically efficient": Fast specialisation to reach large productivity in milk per dairy cow ; no enlargement of land nor investments. Farm management is economically inefficient, but pluriactivity helps.
- path 2 "Staying small, managing the whole farm resources": Relative specialisation, no enlargement, global farm management is efficient: technically, economically and fiscally.
- path 3 "Becoming "big" in milk": Tendency to specialisation, considerable enlargement of land and livestock, technically efficient, but not economically. Workload is a limiting factor.
- path 4 "Having a large dairy herd and another herbivore activity as a buffer solution in case of shock": Diversification with milk as the main production, relative enlargement through joint farming arrangements (GAEC, EARL), global farm management is efficient.
- path 5 "Being a diversified "businessman": Diversification of farming activities with a high technical level; enlargement of land and all the activities equally; global farm management is efficient.
- path 6 "Being diversified on local opportunities": Farming diversification (sometimes off farm jobs) thanks to local resources, autonomous milk production, no enlargement, seeking for flexibility in farm management

Box 2. The action logics – Livestock farming systems in Bauges (Cialdella et al., 2009).

- path 1 "continuing to exist as a livestock farmer": Shift from dairy cows to beef cattle or small ruminants and off farm activities; reduction in livestock and areas; no investments; use of only small plots of land near the farm
- path 2: "staying autonomous": Diversification of agricultural and off farm activities; little enlargement of livestock and land; investments when savings are available; land configuration and land development in order to reduce workload
- path 3 "taking the path of "Modernity: Fast and continuous specialisation; considerable enlargement of land and livestock; financial debt to invest; land extension anywhere it is possible
- path 4 "continuing to exist as a livestock farmer then staying autonomous": Shift from dairy cows to beef cattle or small ruminants and off farm activities; reduction in livestock and areas then new relative enlargement; investments when savings are available; use of only small plots of land near the farm

Box 3. The action logics – Beef cattle systems in Argentina (Sirben 2009).

- path 1 "muddling through": Diversification of farming activities; flexibility in livestock management with no investments to avoid risk and to survive whatever the year conditions
- path 2 "staying good in the technical domain and staying autonomous": Diversification of farming activities; investments in technology if there is no risk; relative innovative and adaptive livestock management with the year conditions
- path 3 "Going ahead on the technical domain": Specialisation in beef cattle; investments in technology and innovative livestock management

Box 4. The action logics – Beef cattle and Dairy farming systems in Uruguay (Levrouw et al., 2007).

- path 1 "Muddling through " : Diversification of farming activities; staying small in land and livestock; no investments; continuous readjustments within traditional livestock management.
- path 2 "becoming big": Specialisation in beef cattle; considerable enlargement of land and livestock; investments when savings are available; conservative and traditional livestock management
- path 3 "Optimizing the technical domain: Specialisation in beef cattle with high productivity; enlargement is not a goal ; financial debts to invest in high technology; innovative livestock management
- path 4 "Maximizing control": Specialisation in livestock production with high productivity; considerable enlargement of land and livestock; investments when savings are available; innovative livestock management

Results: elementary and generic adaptive patterns for family livestock farmers

Despite the specific features of the contexts, reading the paths shows that the farmers' action logics to 'last' often present similarities and what they do not always depend on transformations in the context. The paths are in fact adapted using internal levers and brakes, very much associated with the resources available in the farm (workforce, forage resources and therefore land, skills..), which will be in tune with opportunities and disturbances external to the system (opportunities for outside work, state of the markets...). Moreover the registers are not always technical; it is also often a question of

choices concerning the financial management of all the activities on the farm (and off the farm), choices of saving or their patterns for investment, as well as the farmers' projects for their social life. Here we present the elementary patterns for action logics from the cross analysis of the systems studied. These patterns are sufficient or must be combined to qualify as a specific action logic of a given area of study.

The "diversified" pattern

This centres on the diversification of activities within the family farm system and is very frequently found in the case studies (100% in Bauges, 60% in Segala). Diversification then fulfils two types of function. The first aims ar securing the whole system, according to the adage « don't put all your eggs in one basket" and which is therefore the opposite of specialisation. This function favours spreading the risk when one of the activities is faced with a difficult situation. The complementarity of the activities and their interdependence is another manifestation of this adage. In fact, during the paths the activities can be reorganised or regraded so that some of them play a buffer role to stabilise others (Box 1 path 4). The second centres on the emancipation of family members and the realisation of their life projects. For example, in the Ségala (Box 1 path 5), the creation of a new activity on the farm is often justified by the need to occupy a young person who wants to stay on the farm. It is therefore a way of keeping a work collective on site and preserving the professional identity of each one in the collective by means of a pluriactive system (for example agro-tourism or outside work by the partner).

In this case, the dynamic of activities over the long term shows a development and a direction independent one from the other, according to what it represents for the person or persons responsible for it. Thus the choice of diversity of activities does not in itself prejudge the way in which these activities will evolve over the long term and therefore does not in itself characterise one single action logic (e.g. Box 2 path 4).

The "controlled and autonomous" pattern

This pattern marks the systems at several levels: technical improvement and growth when it is sought. Technical improvement is based on what makes it possible to manage farm resources effectively (forage areas etc…) more than the expression of a productive optimum requiring considerable recourse to inputs (supplementation) (Cournut and Dedieu 2005). Growth is controlled, in the sense that the farmers' main principle for action is not to run any risk of getting into debt by preferring to invest from savings and beeing financialy autonomous (e.g. box 1 path 5). If there is disturbance (internal such as reduction in the workforce, or external, such as modifications to health standards), the reorganisation of the system can be slight and regular or sudden. In the first case, it affects the technical aspects of the farm which must remain autonomous. In the second case, disturbances can trigger a thorough reorganisation of management; for example a change in the species reared, in type of land use and the operation of the budget, which express the aim of ceasing one type of production (milk) and moving over to another (meat) that is even more autonomous (box 2 path 2). Thus shocks are absorbed in reorganisation phases that can be relatively long (sometimes more than 15 years in the case of Bauges).

The "system innovation" pattern

This pattern consists of regular adjustments aimed at maintaining an efficient livestock activity at overall level, i.e. which is based on the implementation of planning, integrating technical, economic and fiscal dimensions as well as work efficiency. (box 1 path 2). The reorganisations then affect aspects of the technical management of the livestock farm as well as work organisation in the farm when it is specialised or when planning the whole combination of activities and if relevant, their complementarities. These reorganisations consist essentially of trying out new ideas to improve the

overall management of the farm: keeping maximum control of the whole of production (box 4 path 3), securing income and freeing up some leisure time (box 1 path2). Unlike the "controlled and autonomous" pattern, the farmers accept taking risks, innovating on livestock techniques and sometimes taking on debts to invest in new technologies.

The “growth” pattern

The main action principle of the « growth » pattern is to increase the volumes produced, by playing on an enlargement of the land areas used and of livestock,. Shocks and disturbances to the system are quickly absorbed: the phases reorganising the activities are barely perceptible in the paths. And yet, these evolutions engender internal and technical disturbances, in particular on herd management and work organisation (box 1 path 3, box 2 path 3, box 4 path 2). This « Growth » pattern can be associated with powerful technical ambitions (following pattern). Logic then leads to considerable mechanisation and increase in the quantity of work. On the other hand, the "Growth" pattern can be combined with the will to preserve flexibility in the technical system (pattern 2.5) to plan and implement.

These systems seem proactive faced with all the crisis situations: the farmers respond to new product quality and health standards by investments in infrastructures, they access new milk quotas by negotiating with cooperatives... Livestock is often the main activity on the farm and the family members who have employment outside the farm do not participate in work on the farm. On the other hand, if this outside income exists, sometimes temporarily on the paths, it safeguards the domestic budget, enabling farmers to progress further in the "race to becoming big " without necessarily seeing the risks. This pattern is expressed in France, by a considerable increase in work on the farm. Today, farmers seem to be at the maximum of their work capacity and still do not make enough money to have recourse to paid labour (box 1 path 3). Following the path on the same pattern seems in fact compromised and questions their long term resilience.

The “technical optimisation” pattern

This pattern is centred on the search for technical optimisation of the farm (box 3 path 3, box 4 path 4). The systems are highly specialised and constantly integrate innovations aimed at increasing farm productivity (per animal and per hectare of land). This pattern is also proactive as regards outside disturbances but generates tensions by its internal dynamic (very dependent on inputs, balances difficult to achieve in an uncertain situation whether climatic or market). This pattern is not reserved for small farms: it is certainly developed in reference to the model that justified intensification at the start of the path of small farms, with land as a limiting factor (box 1, Path 1), but equally in reference to the model of the large farm, the « mega farm », tending towards industrial production (box 1, path 3; box 4, path 4).

The “ensuring flexibility” pattern

The main principle of action is to be able to adapt to disturbances thanks to buffer properties internal to the system, to develop the farm without going into a tense situation. Two ways coexist: in the case of a specialised livestock farm, the extensive character of the production procures certain overcapacities that are useful but not optimal at the economic level, or allows for temporary decapitalisation to get through difficult periods. In fact, when the farm is composed of several species or types of production, some can play a buffer role in the event of a severe blow. They are the special targets of decapitalisation and adjustments (type of product, animal numbers, work load). Consequently, the buffer livestock benefits from low investments in technology, for they will even go so far as to have less productivity per animal or productivity that fluctuates from one year to another (box 1 path 4). In this method, the farmers will therefore play on buffer activities to cope with disturbances before going over to a phase reorganising activities and new controlled growths.

The "muddling through" pattern

In this pattern, the farmers have great difficulty in keeping a livestock farming activity or a stable production plan and the farm is often inefficient at technical level (box 2 path 1, box 4 path 1). The farmers will in fact play on adjustments of production objectives to get through difficult periods (box 3 path 1) even resorting to uncontrolled decapitalisation on the livestock or the land, which every time makes the survival of the activity even more fragile. It is difficult to express an action principle for these farmers, except for the size and amount of elements in the system that can be adjusted. Being more in a position to undergo strong production constraints from the start of the path (land, workforce) (box 2 path 1), the adjustments can go right to the complete cessation of farm activity, temporary or not. But it neither provides an income, nor ensures stability for the activity or for the household, which survives thanks to other types of income.

This pattern, like that of technical optimisation, characterises the start of the paths of a certain number of farms whose action principles have evolved later. In the study carried out in Bauges, paths were described (box 2 path 4) showing a very chaotic start, typical of the "Muddling through" pattern, then a redeployment of the livestock activity on an "autonomous and controlled" pattern. The change in direction of this type of path is achieved by the installation of a young member of the family who has accumulated some capital via a salaried or commercial activity outside the farm. In the Ségala study, the "technical optimisation" pattern was only temporary in some farms, which preferred a more « system innovation» approach later on when a certain control was acquired (Box 1 path 2). These examples clearly show that the increase in the intrinsic potential for development of livestock systems depends on the means available to invest just as much as on the life plans of the farmers.

In the end, these elementary patterns are therefore to be taken as elements constituting action logics. All those presented in boxes 1 to 4 can be expressed as a combination of one or more of the patterns above.

Discussion: methodological and practical lessons from cross-analysing local studies

Crossing local studies enhances the analysis of farmers' action logics

Our approach consists of an iterative implementation of a global method adaptable to each local situation: it is more about methodological principles than about a package applicable anywhere. The adaptive patterns presented here are the result of a collective reading and are not supposed to be exhaustive, nor to be established. But they are useful to derive lessons for improving future case studies, especially concerning the following domains: financial, land use and nature and functioning of the family activity system (agricultural diversification and off farm jobs).

Indeed, we showed that farm management choices often reveal farmers' attitudes to risk and innovation (Ségala, Uruguay, Argentina). This dimension has not as such been taken into account in Bauges and is missing for the description of action logics, in relation with patterns which deal with farmers' receptivity for novelty or change (cf «system innovation ", "ensuring flexibility"). On the other hand, the farmers' relations with the territory has not really been analysed in the Ségala, Argentina and Uruguay study cases, whereas the land enlargement process and the location of the family activities - in relation with the neighbourhood or with the remoteness of suppliers and markets - are important issues in possible divergences within the paths.

Finally, the diversification of activities was seen from a dual focus: that of farming activities, which then is placed against the process of specialisation towards just one type of animal production, and that of the family including non-farming activities sometimes involving temporary migrations of some members of the family. This last form of diversification, although cross-disciplinary in all the areas, was only analysed in detail in the case of the Bauges because of the location of the land in a peri-urban area and the traditional migration phenomena. And yet, results show that the capacity of systems to come out of a muddling through pattern and improve their resilience (Box 2 path 4) or to adopt an adaptive "autonomous and controlled" pattern depends on the complementarity of the

economic activities of the family at a given moment of the path or in terms of levers or future changes of direction.

How can characterization of adaptive patterns improve knowledge of resilience in family farm systems?

Interest in the diversity of action logics over the long term does not involve considering all the patterns as likely to confront challenges in the future. Firstly it is a question of qualifying the diversity of paths taken by farmers and not limiting the prospective vision of a farm which only survives through a few dominant patterns. (Dedieu 2009).

Two patterns are today implicitly the subject of support from the essential of research and development. The "technical optimisation" pattern of a specialised farm (as driving force of the long term survival of this farm) does exist, but it relies on 1) a capacity for technical refinement, which seems about to concern fewer and fewer farmers. In fact, the constant renewal of techniques,to integrate environmental aspects, animal well-being, product quality, has a more and more selective effect on farmers capable of following…. 2) unfailing support from public development policies in the event of strong tension... This support has been available in France since the 1950s, because of the co-management of agricultural policies. It is far from being guaranteed in the medium term because of CAP reforms and the globalisation of markets and does not exist in the developing countries we studied. This pattern now coexists with another, based on enlargement. It now gives rise to specific innovations (milking robot, precision livestock farming, rationalisation of work etc.) and finds its expression in the "mega farms" model of Northern Europe and the United States, which is becoming increasingly meaningful if only in discussions between farmers (Begon et al. 2009). This pattern, which at first sight shows a certain resilience when confronted by external disturbances (such as milk price variations) thanks to a production overcapacity and a pro-active attitude faced with change, leads however to strong internal economic tensions and tensions at work. The farmers are often in debt and bear witness to heavy work loads. Must support continue to centre on technical aspects and economy of scale, or help to create or reinforce areas of flexibility avoiding break-down?

At the same time, the persistence of other still misunderstood patterns calls for new forms of support for development. This involves all the patterns that give importance to the internal flexibility of the system, to economic prudence in choices (Uruguay). These patterns can be combined with that of enlargement (Bauges), but the chief characteristic resides in a capacity for reorganising the livestock system and the economic activities of the family and the regulatory properties of internal origin when faced with uncertainties. In the more autonomous formula, resilience is sought via the search for an optimum allocation of available resources over the activities according to the opportunities offered by the farm environment. In these different situations, must research develop new ways of looking and new system evaluation elements: what are the foundations and margins for progress in systems that want to preserve flexibility, given the economic costs engendered by such flexibility (Chia and Marchenay 2008)? What are the relevant efficiency criteria for systems of activities with low production but which base their autonomy on being anchored in the territory as well as on maintaining the workforce on the farm? What place can be given to the recognition of a diversity of core activities based on livestock production?

Finally, the "muddling through" pattern remains the most disconcerting for the technical analysis and support because it is not very standardised, but it shows a very flexible "border or transitory" pattern, between systems which have properties of resilience of the autonomous and diversified type, and livestock systems that are vulnerable and condemned to disappear.

Conclusion

The compared analysis of action logics over the long term of family livestock farming systems in contrasting situations provides two types of results which make it possible to go further in research work on the resilience and sustainable development of these systems. The first are methodological

and confirm the necessity of tackling the action logics of livestock farmers over pluriannual time steps to reveal a diversity of farmer behaviour in the face of uncertainty. The relevant analysis inputs are certainly the technical operation of the livestock system – its degree of optimisation or its contribution to flexibility- , but also that of the system of economic activities of the family, the financial management of these activities, the relation with land and the risk-taking of the farmers.

This makes it possible to identify, for each type of adaptive path of the family livestock systems, the domains on which livestock farmers rely to maintain their livestock production system over time: to control production growth and be autonomous, to stay small and innovative, to stay small and diversify activities with local resources, to keep on growing whatever the environment... These domains are often sources of the resilience of family farming systems; they shed light on resilience patterns that are far from the technical optimisation which is still nowadays the main principle used by extension services. Moreover, connections between different phases of farming system paths do exist: farmer choices for change depend on their past experience as much as on their present means and capacities. So research has to improve the assessment of other livestock production efficiency patterns in order to provide farmers with relevant advice and support.

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