Production flexibility in extensive beef farming systems in the Limousin region

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Abstract*: The aim of this work is to assess the flexibility of production allowed by the extensive conditions of production faced with variations in the environment (market variations and climate fluctuations) of the Limousine beef systems. The study used a case-based methodology in which seven beef farms with less than 1 LU/ha were chosen. Data collection was based on three interviews using a semi-structured questionnaire and on the analysis of the productive and economic results for a 15-year period (1991-2005). The main evolution of these farms is related to an increase in work productivity associated with an increase in herd size. Herd increase was made possible by enlarging the area, the margin of intensification being limited in these regions. To take advantage of the enlarged land area, females were reared for fattening or for reproduction instead of selling them at weaning. The Limousin female provides a wide product mix because of its plasticity, as has been studied by several researchers. This diversification and capacity for adaptation from one product to another is the mix flexibility. This mix flexibility is achieved by delaying product differentiation; it is a form of production flexibility that can reduce the risk of under-producing or over-producing through varied product configurations. Calves sold to the Italian market after weaning are generic products, associated with a flexible production process to overcome fluctuations in forage availability due to climate variations. The introduction of maize silage for feeding acts as an alternative route (actual and potential) through the system to overcome unexpected forage shortage from natural grasslands as a result of droughts. The study shows that extensive farming systems have developed types of flexibility to match different factors of uncertainty from the environment. An important challenge for further research on flexibility is to develop knowledge regarding the relationship between time and extent of change: a better understanding of when to change is crucial to remain competitive.*

Keywords: *extensive farming system, livestock production system, mix flexibility, process flexibility*

Introduction

During the last 15 years, European agriculture has been confronted with unprecedented change. To remain competitive, farmers have had to deal with increased levels of foreign competition, revised regulations, and rapid market changes (Lherm et al., 2004). Flexibility is often the system's response to deal with uncertainty (Upton, 1994; Volberda, 1996; Gupta and Somers, 1996; Corrêa and Slack, 1996; Scala et al., 2006). The concept of flexibility is frequently used for the analysis of manufacturing companies facing change, but as far as we know, in agricultural research the issue of flexibility has not received much attention as a separate issue. In the research program "Farm flexibility confronted with beef crises" (Ingrand et al., 2007), flexibility is defined as "the capacity of the livestock system to adjust quickly to a wide range of economic, technical, marketing and climatic constraints, whilst allowing the farmer to cope with his production plan in the medium term, or even the long term".

Based on the work by De Leeuw and Volberda (1996), the definition of flexibility can be expanded to include the idea of control applied to the systems theory. According to these authors, flexibility "is the degree to which an organization possesses a variety of actual and potential procedures, and the rapidity by which it can implement these procedures, in order to improve the controllability of the environment". Control is understood here as any manner of directed influence, not defined by its success but by the ascribed intention (this idea must be distinguished from control in the sense of strict determination of processes). This definition adds the concept of a response that is not only reactive, as 'adaptation' would be, but proactive as well. This viewpoint involving control and anticipation processes, makes it possible to distinguish the notion of flexibility from the notion of resilience (Holling, 1973; Gunderson, 2000; Milestad, 2003).

The effectiveness of the flexibility response is determined by the ability of the system to achieve a desired outcome despite variety in disturbances from the environment. Greater flexibility can translate into a market advantage by better absorbing a greater number of disturbances from the environment (like product prices and production conditions) (Scala et al, 2006).

On these bases, it is clear that flexibility is always relative to the goal strived for and the environmental circumstances. Flexibility, therefore, is not a characteristic of an organization itself; it is a characteristic of the relationship between an organization and its environment. So, to assess the flexibility of an organization, we need first of all to determine what the drivers are, i.e. the factors that determine the need for flexibility. Pujawan (2004) considered that different drivers might imply different flexibility requirements.

The research proposition integrates these concepts, applying them to the responsiveness of the extensive production systems: the extensive farming system possesses the capacity to respond effectively to variations in the environment keeping the integrity of the system by changing internally or externally.

Objective

The aim of this work is to study the degree of flexibility allowed by the extensive conditions of production faced with the variations of the environment (market variations and climate fluctuations).

Method

The study used a case-based method in which seven beef farms were analysed in depth. The farms were located in the Limousin region (Corrèze and Haute-Vienne Departments), which is quite an important area of beef production in France (Limousin breed). The choice of the farms was not random, since these farms were studied 15 years ago (Josien et al., 1994), because of their extensive conditions of production (< 1 LU (Livestock Unit) / ha).

Data collection was based on three interviews using semi-structured questionnaires according to the approach of Das and Patel (2002). The first questionnaire inquired about the main evolution of the farms during the last 15 years, and attempted to identify the most significant changes that have affected the overall performance. The second questionnaire aimed at explaining what attempts, if any, have been made to counter the detrimental effects of the identified changes. The third questionnaire analyzed the productive and economical results for the 15 year period to estimate the impact each change has had on the global performance of the farms.

Results and Discussion

Main evolution of the farms studied

The main evolution of these farms in the last 15 years is related to an increase in work productivity associated with an increase in herd size (Table 1).

Table 1. Structural characteristics of the seven farms studied and changes between 1991 and 2005

Farms	1		2		3		4		5		6		7	
Year	1991	2005	1991	2005	1991	2005	1991	2005	1991	2005	1991	2005	1991	2005
total area (ha)	73	80	181	243	125	255	71	71	119	165	178	305	179	245
% grazing area	100%	100%	96%	100%	92%	76%	94%	100%	92%	95%	96%	100%	96%	92%
beef cows	45	45	126	191	75	89	42	42	92	96	82	128	75	114
stocking rate (LU/ha grazing area)	0.89	0.89	1.03	1.02	0.70	0.89	0.89	1.00	1.00	0.82	1.00	1.20	0.83	0.90
workforce	1.7	1.7	3	3	1.5	2.5	1.2	1.2	2	2	2	2.5	2.5	2.5
LU/workforce	38	38	60	83	54	69	50	59	55	64	56	90	57	81

In order to maintain their income in spite of the continuous price decrease of cattle, farmers had to increase the productivity of their work (+ 20%) by significantly increasing the size of their herds (+ 45%). These results agree with those reported by Lherm et al., (2004) for beef cattle farms in France (Figure 1).

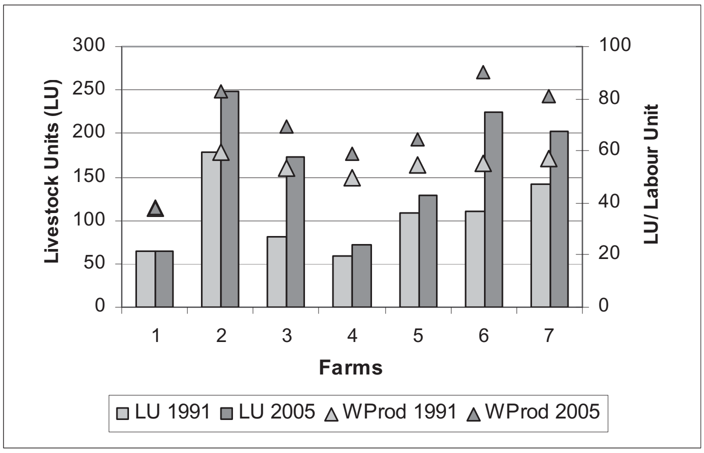


Figure 1. Evolution of herd size and work productivity (Wprod)

Herd size increase was made possible by increasing the area, the margin of intensification being limited in the Limousin region (+ 30% area and + 5% LU / ha on average). The increase in area was achieved by the retirement of farmers without expected succession (Figure 2).

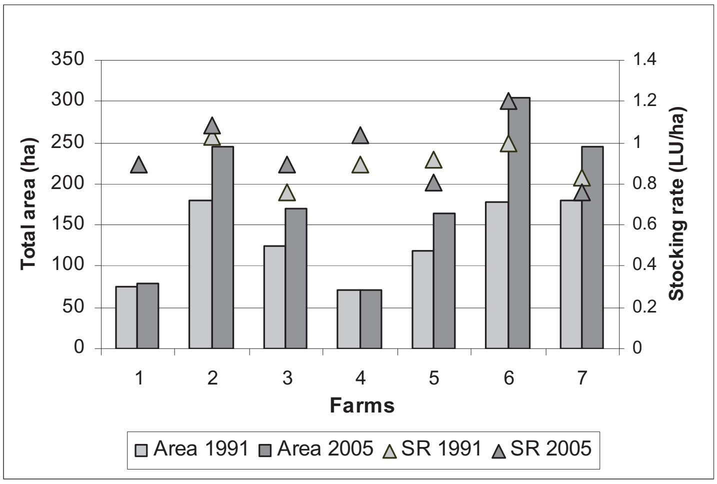
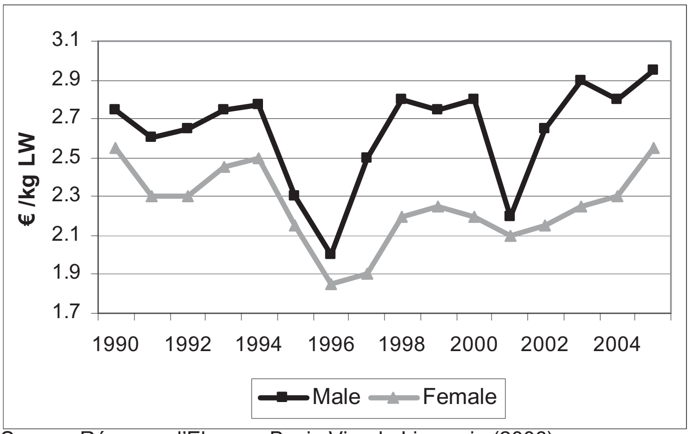


Figure 2. Evolution of total area and stocking rate (SR)

The additional area allowed for an enlarged product mix.

Wider product line (mix flexibility)

The generic product produced by these extensive farms is the calf sold just after weaning as “Broutard d’Italie”, which does not need a high level of energy in the diet, as for fattening bulls after weaning for example. This is why these systems can be 100% based on grass. But whilst the value of the male is considerably enhanced, the female is penalised. The heifer has a dual handicap in relation to the male: a lower weight and a lower price /kg LW (Live Weight) (Figure 3).



Source: Réseaux d'Elevage Bovin Viande Limousin (2006)

Figure 3. Evolution of the average price of the "Broutard d'Italie" for the period 1990 – 2005 (euros 2005)

As a result of public politics of subsidies (the suckler cow premium is limited per farm), advantage was taken of the increase in land area by rearing the females for fattening or for reproduction.

The uncertainty in the farm income (in the medium and long term) and the need to make the best profit from the females, acted as a driver to increase production mix flexibility. The female in the Limousine system allows a wide product mix because of its plasticity as has been studied by several researchers (Geay and Micol, 1982; Dauplais 1996) (Table 2).

Table 2. Product mix of the Limousin beef system

Beef categories		**Beef products**
Females (F) 0 - 3 years	F 0-1 →	"Broutarde d'Italie" (animal sold just after weaning)
	F 1-2 →	"Génisse de Saint Etienne" (12 to 15 months old)
	F 1-2 →	"Génisse de Lyon" (15 to 24 months old)
	F 1-2 →	For reproduction for "Le veau sous la mère" system (18 to 24 months old)
	F 2-3 →	Pregnant for herd replacement
Males 0 -1 year		"Broutard d'Italie" (animal sold just after weaning)

So, as the male is predominantly sold after weaning for the Italian market, the female will be sold as different beef products: for fattening (Broutarde d'Italie) or fattened (Génisse de Saint Etienne and Génisse de Lyon) or as a heifer for reproduction (for the "Le veau sous la mère" system), or as pregnant heifer for herd replacement.

The female Limousine sold for reproduction or fattened (for slaughtering), improves the gross margin/female in comparison with the female sold for the Italian market. In particular, females sold for reproduction (F1-2 or F2-3), which are reared in the same way as the females for replacement, allow an enhanced value of the grazing area, without increasing operating expenses like extra feed, or specific equipment.

This diversification into several products and capacity for switching from one product to another is the mix flexibility. According to Suarez et al. (1996), a wider product line tends to be associated with larger market share and profitability, and it does not seem to be associated with higher costs. Furthermore, firms with high (or higher) mix flexibility are best at avoiding volume fluctuations and may enjoy the benefits of a more stable production flow. This is mainly the result of the "cushion" effect provided by a broader mix: firms that can switch among products for many categories of final products, will not be so adversely affected if the demand for one product line shrinks unexpectedly.

This mix flexibility is achieved by delaying product differentiation, which is a form of production flexibility that can reduce the risk of under-producing or over-producing varied product configurations (Cattani et al., 2003). Limousin females sold for reproduction or fattened make “delayed differentiation” possible: following the demand and prices, the one-year-old females are differentiated as fattened products or heifers for reproduction. For the same product mix offer to the market, “delaying product differentiation” is a strategy that allows high variety and quick response time (Gupta and Benjaafar, 2004), changing the competitive strategy of the firm from economies of scale to economies of scope.

In particular, as the genetic qualities of the herd progressed, the possibility of selling heifers for reproduction has become an important competitive advantage for these farms. The sale of heifers for reproduction is a segment with more added value than the fattened heifer (Table 3).

Table 3. Average prices of the Limousine females sold for reproduction or for fattening

	F 2-3 (pregnant)	F 1-2 (for reproduction)	F 1-2 (fattened)	F 0 -1 (for fattening)
Average price (euros 2005)	1811	1522	1470	767

There are many advantages in the sale of females for reproduction:

- The advantages of registration and qualification in the herd book, in a competitive environment, represent barriers to the admission of potential new entrants onto the market.
- The added value of the "brand image" specific to livestock in an extensive system with permanent natural grasslands, is transformed into a competitive advantage, and takes on a value for the enterprise.
- Direct sale to other livestock farmers, means that it is the farmer who fixes the sale price. Furthermore, direct contact with the demand side also improves forecasting systems: for instance, a firm can reduce the level of uncertainty under which it works but, at the same time, it can prepare itself to respond faster to future customers’ orders (Corrêa and Slack, 1996) from having better demand information before committing generic semi-finished products to unique products (Gupta and Benjaafar, 2004).

The way to cope with uncertainty and variability of outputs is the flexibility of individual resources (in this case, the Limousine female), as the ability of the system as a whole to reschedule production. This type of flexibility (mix flexibility) is appropriate with regard to demand side requirements, but it does not adequately treat severe uncertainties within the process characteristics.

Land-use changes (process flexibility)

In recent years, farmers have had to confront two serious droughts, those of 2003 and 2005, which placed great stress on their forage system. The drought in 1976 had been experienced as an exceptional event. The more recent droughts, in the early 1990s and especially those of 2003 and 2005, were seen more as one of the possible manifestations of "climate change" announcing a more frequent return of these "anomalies" which, from the status of exceptional catastrophe, could move to the status of recurrent phenomenon (Amigues et al., 2006). The risk feared by the livestock farmer is not the drought in itself, but more its random nature: what season will the drought be in? And how serious will it be?

As the taxonomy proposed by Corrêa and Slack (1996) for disturbances from the environment, the drought appears to farmers to be a change that risks becoming ‘frequent’, ‘unpredictable’ and ‘drastic’ (the rate of unplanned change).

In ruminant farming systems, forage and grasslands are intermediate products, transformed into animal products. The function of the forage system is to provide continuous feed in spite of fluctuations in the supply of forage associated with fluctuations in the climate, whilst the demand for feed remains relatively stable for a constant animal population (Duru et al., 1988).

This aspect could become a weakness for systems that have to assure a stable production flow. So, another type of flexibility at overall system level is required to maintain output in spite of unplanned changes with the process itself. The uncertainty of forage production (from native grasslands) as a result of climate fluctuations, acted as a driver for process flexibility, as we are going to discuss.

The studied cases can be grouped according to the stocking rate in three categories: low stocking rate, medium stocking rate, and higher stocking rate (but always below 1.1 LU/ha) (Table 4)

Table 4. Main changes in farm system to cope with droughts

	Stocking rate (LU/ha)		
	Low	medium	high
Stocking rate (LU/ha)	Less than 0.90	0.90 to 1.00	More than 1.00
Changes to cope with drought	No changes	Decreasing stocking rate by reducing or eliminating areas under crops	Increasing forage production by including (or increasing) area for maize silage
Farms (1)	1 and 4	5	2 and 7

(1) Farms 3 and 6 already had an area for maize silage before the 2003 and 2005 droughts (approx. 5% of total grazing area)

The systems with the lower stocking rates, based on permanent pasture, show some leeway that allows them to 'tolerate' drought better, due to the lower stocking rate used in the system. Regarding the droughts of 2003 and 2005 these farms were in a steady state, but in the case of a more severe drought this situation might change.

When increasing the stocking rate, some changes are made to cope with drought. By reducing or eliminating the production of crops, the area can be increased, principally for forage conservation (such as hay). Generally this area recovered for this purpose, is intensively worked, with short rotation of quite productive grasses (such as annual ryegrasses). At an early stage, these are operational changes, and represent an operational flexibility (routine capabilities that are based on present structures). This is the most common flexibility and relates to volume activities rather than the kinds of activities undertaken within the farm.

For farms with the higher stocking rates, major changes are needed to deal with drought. Not only the technology of forage production changes, but also the feeding system. It represents a change in the actual capabilities and the system structure. These changes represent a strategic flexibility, more qualitative, necessary when changes have far-reaching consequences and speedy response is needed.

In these latter cases, the introduction of maize silage for feed and the forage stocks that it allows, acts as a preventive method and as an alternative route (actual and potential) through the system to overcome unexpected forage shortage from natural grasslands as a result of droughts.

This process flexibility has been frequently studied and appears in both dimensions such as process routing (routing is often defined in terms of the ability to use alternative routes through the system in case of a malfunction) and sequencing (Gupta and Somers, 1996). Miltenburg (2003) proposes the following definition of process flexibility: the number of products that have alternative processing plans and the variety of processing operations used without incurring negative effects (e.g. changes in performance outcomes) when fluctuations arise.

This process flexibility is related to the "slack" in land production capacity normally exploited compared to intensive land-use conditions: a relatively small area of maize (as a percentage of total land-use) enables the constitution of enough forage stocks to avoid / minimize the deleterious effects of unexpected droughts. In these systems, to become intensive in a very little part of the farm makes it possible to stay extensive at system (whole farm) scale. But achieving process flexibility may result in additional costs to the farm, so the sufficiency of the system flexibility developed must match the degree of the environmental turbulence (Volberda, 1996).

The use of this type of system flexibility to cope with uncertainty and variability of outputs appeared to be highly contingent on the individual manager's view and experience. Facing the same stimuli, the system response may vary according to a certain threshold level (as perceived by the manager) (De Leeuw and Volberda, 1996):

- if this threshold level is not reached, the management acts prudently instead of decisively and prefers to implement change slowly and steadily;
- if this threshold level is reached, the management seeks to limit the variability from the environment by developing preventive methods and therefore reducing uncertainty as opposed to investing in quick corrective methods.

We can distinguish different levels of change in the system, based on the perception of the farmer as to how severe and frequent the changes in the environment might be. The capacity to respond by deliberate postponement of decisions could result in a lack of decisiveness, progressively increasing costs, and a continuous revision of plans. On the other hand, too great a reaction capacity or too short a reaction time may lead to overreaction and wasted resources. According to Volberda (1996) flexibility is the middle course between rigidity and overreaction.

Concluding remarks

This paper attempts to contribute to the study of farm system flexibility and to understand the drivers of flexibility, and their effect on farm systems design. The concept of flexibility captures many of the temporal considerations which influence farmer decision-making: the system flexibility which exists at any time results from decisions taken at earlier points in time.

The study shows that extensive farming systems have developed types of flexibility to match different factors of uncertainty from the environment. From the cases studied, Limousin extensive farming systems seem to have actual and potential procedures to allocate to flexibility-need allowed by individual resources:

- a wider product line and a capacity to switch from one product to another, acting as a “cushion” effect if the demand for one product line shrinks unexpectedly.
- an area that acts as a buffer system and allows alternative routes (actual and potential) through the system to overcome unexpected forage shortage as a result of droughts.

For the system this implies a higher level of security with respect to environmental fluctuations. However, these levels of security vary between farms (human perception of risk threshold) and are related to aspects of management and organisation of the system.

An important challenge for further research on flexibility is to develop knowledge regarding the relationship between time and extent of change: a better understanding of when to change is crucial to remain competitive. Including the time factor, however, requires not only longitudinal and detailed information at both farm environment and farm system levels, but also a design that includes both the successful and the unsuccessful timing of changes.

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