SUSTAINABILITY OF FRENCH RABBIT BREEDING SYSTEMS

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ABSTRACT

This work aimed at evaluating the sustainability of performance of French rabbit breeding systems using the DIAMOND method. Seventy-six rabbit farms in 12 French regions, chosen to be representative of French production units, were surveyed to obtain 111 measured indicators as related to economic, environmental, and social issues. The farms were specialised (level of economic specialisation = 76%) and were of variable size (210 – 2,100 females). The responses obtained were transformed into scores (or sustainability units) and then pooled by objectives or sustainability goals. Analysis of the data showed that economic, environmental, and social performances were highly variable among farms (means: 45, 44, and 37 points on a scale of 0-100, and CV: 27, 14 and 16%, respectively). In conclusion, results revealed that technical choices or structural characteristics of the farm influence the sustainability scores and categorises rabbit farms according to their sustainability profile.

Key words: Sustainability, economy, environment, social, rabbit.

INTRODUCTION

In the last decade, consumers and citizens have become increasingly critical about livestock production. People are expressing concerns over issues such as farm animal welfare, product quality, and land use. Additionally, some reports show that "the livestock sector emerges as one of the top two or three most significant contributors to the most serious environmental problems" (Steinfeld et al., 2006), such as water and air quality, biodiversity or climate change. Several attempts have been made to develop quantitative measures of sustainability (Vavra, 1996; Becker, 1997) in order to set the framework for the priorities and actions to be implemented (Hubert, 2002) and help the system to change. Applied to agriculture, sustainability may be assessed in its three dimensions (social, economy, and environment) at different levels: the breeding unit (Gueneuc *et al*., 2010), the farm as a whole (Vilain *et al*., 2003), and the sector in its region (Pottiez *et al.*, 2011).

We have developed a method to assess the sustainability of animal breeding units relevant for rabbit production using a participatory approach to define sustainability objectives and indicators (Fortun-Lamothe *et al*., 2012a). To validate indicators and their transformation into scores, the method has been applied within the French network of rabbit reference farms. The aim of the paper is to present the sustainability performance results of a sample of French rabbit farms.

MATERIALS AND METHODS

The livestock units

The data was obtained from 76 rabbit farms belonging to the French reference farm network (the Cunimieux network). This network was set up to characterise the farming systems regarded as representative of national rabbit production units (Jentzer *et al.*, 2009). The units were spread over 12

French regions. Rabbit production had to represent a significant component of each farm's economic activities. The data were taken from a survey carried out in 2010-2011, which applied economic data from March 2009 to June 2010.

The evaluation of sustainability

To evaluate sustainability we used the DIAMOND method (Fortun-Lamothe et al., 2012a) and measured 111 indicators – quantitative, qualitative or subjective – to evaluate the response of rabbit units to each of 30 sustainability criteria (18, 45, and 48 indicators in the economic, environmental, and social categories) of the method. The responses obtained were then converted into scores (or sustainability units) and aggregated by criteria (10 points per criteria), by objective (50 points for each of the 6 objectives), and by sustainability scales (100 points for each 3 scales: economy, environment, and social as a sum of the scores for each of two objectives by scales). The final sustainability score was the lowest of the three sustainability scale scores.

Statistical analysis

The analysis was done using the R statistical program. Analysis of variance was applied to the scores obtained for the three sustainability goals. Model fixed effects for final sustainability as factors included: usable agriculture area (3 levels : <1-1/50->50 ha); specialisation level (2 classes < or ≥ 80%) ; size of unit (3 classes : <400-400/700-≥700 females) ; the legal status of the farm (individual or company); and start-up year (< or ≥ 1995). A classification of units was made using a hierarchical classification algorithm (the Manhattan distance and Ward method) on the six sustainability scores.

RESULTS AND DISCUSSION

Sampling

The characteristics of the surveyed rabbit farms are presented in Table 1. The units are quite specialised as rabbit production represents, on average, 76% of the total income of the farm (including other production enterprises). The creation date of the units (1974-2008) and their size (210-2100 reproductive females) were variable. Most of the units (95%) used a batch system with artificial insemination every 42 days.

Table 1: Characteristics of farms.

	Mean	Std.	Min.	Max.
Start-up year of unit	1994	-	1974	2008
Usable agricultural area (ha)	37	66	0	504
Number of females	584	312	215	2100
Mortality rate of females per batch (%)	3,4	2,4	0	15,8
Mortality rate of young rabbits (%)	6,4	3,3	0,3	15,8
Age of rabbit at sale (d)	73	1	70	77
IC	3,5	0,4	2,9	5,8
Specialisation rate (%)	75	27	16	100
Net profit (€/female/yr)	27,9	35,0	-131,8	98,2
Number of animals produced/full-time worker/yr	29 820	11 215	5 388	58 843
Total rabbit sale (€/female/yr)	221	39	125	343
Other production than rabbit in the farm (no.)	0,7	1	0	3
Fuel cost (€/female/yr)	0,79	1,07	0	5,18
Energy cost (€/female/yr)	5,51	2,68	0,74	12,42
Water cost (€/female/yr)	1,27	1,19	0	6,07
Distance breeding / feed industry (km)	66	41	3	180
Distance breeding / semen center (km)	143	140	0	575
Distance breeding / slaughter house (km)	76	54	6	300
Holidays (weeks /yr)	0,8	0,8	0	2,5

Sustainability performance

Table 2 shows the sustainability scores obtained for the 76 rabbit farms studied and their scores for the six objectives. The mean scores are 44.6±12, 43.5±6 and 37.3±6 sustainability units in the economic, environmental, and social scales, respectively (on a scale of 100 units maximum). The economic performance exhibited greater variability than the environmental or social performance (CV= 27% vs 14% and 16%). Indeed, the results for economic viability were highly variable: 30±35 € net profit/female/year (varying from -132 to +98 €/female/year). The scores of each of the three scales were moderately (r=0.4 between economy and social) or not correlated (r<0.2 between economy and environment or environment and social). Indeed, we deliberately avoided using linked or similar indicators in the different scales to limit the co-linearity phenomena. Therefore, there is no antagonism between the economic, environmental, and social objectives. The final score, as the lowest score of the three sustainability goals, encountered a regrettable loss of data, but it clearly indicates the dimensions on which efforts need to be focused to improve the system (Vilain et al., 2003) : economic (n=16), environmental (n=12) or social (n=48).

Several structural characteristics of the breeding unit significantly influenced sustainability performance (Table 3). For example, specialised units (part of rabbit production in the total turnover > 80%) had an economic performance score that was 28% higher than in the less specialised units (P<0.001). The large units (>700 females) had a social performance score that was +18% higher than in smaller units (<400 females; P<0.01), because of a greater socio-economic viability and a lower « hardness of work » (P<0.01). Rabbit breeding units which were companies had economic performance scores that were +27% higher than for individual farms (P<0.01). On the other hand, the start-up year has no significant influence on the score of the three sustainability scales.

Table 2: Sustainability scores of French rabbit farms (n=76 from the national network of reference farms) for three goals and six objectives.

Items	Mean	Std.	Min.	Max.
Sustainability final score* (score maximum = 100)	34.8	6.0	19.0	50.0
Sustainability objective (score maximum = 50)				
Is profitable	18.8	7.2	3.0	33.0
Is flexible and adaptable	25.8	8.9	9.0	43.0
Use in a thrifty way the non-renewable resources and produce renewable resources	21.3	4.9	12.0	32.0
Protect and manage ecosystems	22.2	3.8	10.5	30.0
Preserve the quality of life and the working conditions of the producer	23.0	5.3	11.0	37.0
Respond to the demands of the citizens and consumers	14.3	2.9	7.5	22.0

*The final score is the lowest of the score between the three goals for each farm.

A hierarchical classification can allow one to form four groups (G1, n=21; G2, n= 17; G3, n=11; G4, n=27) whose rabbit units have similar sustainability profiles (P<0.01 for five objectives except for the objective « to respond to the requirements of the citizen-consumer » : NS; Figure 1). In the first group (G1), scores are high for the sustainability objectives, followed by the G3 group which received the highest scores for the flexibility objective. G2 and G4 generally performed less well on the six objectives, but G2 was the best for the objective of protection of ecosystems (Figure 1).

CONCLUSIONS

This work is the first attempt to a quantitative evaluation of rabbit production on the basis of sustainability. Results showed that the breeding farm is an adequate unit to assess sustainability that reflects measures of breeding practices and sustainability performance. The use of a French network of reference rabbit farms represented a major resource that provided useful data on a large number of farms, though it is regrettable that they were all fairly specialized. The great variability among farms for performance allowed us to identify ways to aim for real progress towards higher sustainability.

Table 3: Effects of structural characteristics of the rabbit farms on sustainability scores (n=76 from the national network of reference farms).

Items	Economic score	Environmental score	Social score	Final score*
Usable agricultural area (ha)	P<0.01	NS	P<0.05	NS
<1 ha (n=23)	39.3 b	42.7	37.7 ab	34.0
[1-50] ha (n=31)	42.6 b	43.1	35.5 b	33.5
>50 ha (n=22)	53.0 a	44.7	39.5 a	37.4
Number of reproductive females	NS	NS	P<0.05	NS
<400 (n=18)	46.2	42.9	34.2 b	33.2
[400-700] ha (n=16)	43.9	43.6	37.5 ab	35.0
>700 (n=42)	44.6	43.7	40.4 a	36.0
Legal status	P<0.001	NS	NS	P<0.05
Individual (n=41)	39.6	42.9	36.2	33.2
Company (n=35)	50.4	44.1	38.6	36.7
Part of rabbit production in total turnover (%)	P<0.05	NS	NS	NS
<50 % (n=19)	54.0 a	43.8	38.8	36.8
[50-80] % (n=18)	46.2 b	45.0	35.6	34.8
>80 % (n=39)	39.3 b	42.6	37.4	33.8
Date of creation of the rabbit farm	**NS**	**NS**	**NS**	**NS**
>1995 (n=41)	46.5	43.6	43.6	35.2
>1995 (n=35)	42.4	42.4	43.4	34.4

*For each farm, the final score was the lowest of the score in the three sustainability scales.

[a,b]Means in columns within each item bearing different letters are significant as noted in the body of the table.

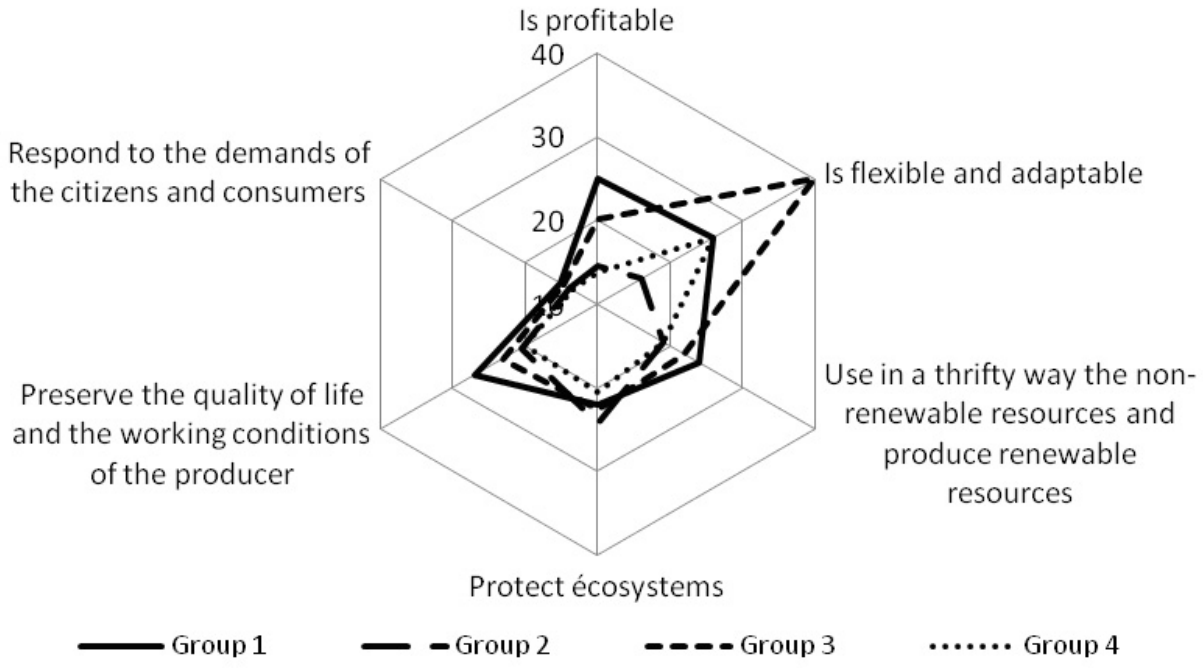

Figure 1 : Typology of rabbit farms according to their sustainability profile

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