Suitable cows for grass-based systems: what stakeholders do in France?

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Abstract
Breeding suitable dairy cows for a grass-based system is an emerging concern in France to improve farm sustainability. The lack of genetic tools to support farmers in the genetic management of their herd grazing abilities could represent a potential lock-in for the improvement of grass use on farm. This study is based on French dairy-cattle farmers, breeding societies and inseminator viewpoints and practices regarding cow adaptation to grass-based systems. Three technical tools are highlighted as '*locks-in*' to the breeding of adapted dairy cattle to grazing conditions: the ISU (global merit index), the mating plan and milk performance indicators produced by milk recording. Crossbreeding practices are identified as a strategy to step-out the locked systems and quickly improve grazing capacities of cows. These results underline the need for a participative reflection on the breed selection scheme organization.

Keywords: dairy cow, grazing system, genetic selection, socio-technical transition

Introduction
In a context of climate and prices variability, a better use of local forage resources, particularly grass is a lever for dairy cattle farmers to reduce their dependency on inputs while improving farm sustainability. Such a strategy requires farmers to breed suitable cows for grass-based systems capable of efficiently transforming forages into milk and improve reproductive efficiency while facing feed resource variability (Delaby *et al.* 2009). In France, breed genetic orientations do not explicitly refer to these performance traits and a lack of tools to support farmers to select cows which are adapted to grass-based systems was reported (Tixier-Boichard *et al.* 2015). In such a context, the questions are: how do dairy farmers breed suitable cows for grass-based systems? And how do actors involved in dairy cow genetic selection support them effectively to such ends? This paper aims to identify the main locks-in, considered here as widely use and diffused technology or practice detrimental to transition and innovation, to the breeding of suitable dairy cows for grazing by analysing the technical tools designed and used by the main French breeding system actors. This paper also explores if farmers adopted adaptation strategies to step-out of systems locks-ins (Geels 2004): get out of the main regime by innovating and adapting the technology and practice to their own context or objectives.

Materials and methods
Our study is based on qualitative data collected in several studies carried out in different areas within France (Auvergne, Midi-Pyrénées, Bretagne, Normandie, Rhônes-Alpes) between 2014 and 2016. Interviews with 70 dairy farmers were conducted (47 with pure breed herds, 23 who crossbred) regarding different aspects of the breeding process: cow characteristics and breeding practices associated with robustness (Ollion, 2015); the characterization of the transition process from purebred to crossbred herds (Basset *et al.* 2016); and the relationships with inseminators (Daubard *et al.* 2017). Representative from six dairy cattle breeding societies were interviewed to understand the consideration of adaptation capacity traits in the breed selection schemes (Cloet *et al.* 2015). Three inseminators were interviewed to

understand their job evolution (Daubard *et al.* 2017). Data were analysed using the actor network theory (Callon, 1984) focusing on the role of technical tools in order to understand actors' interactions and knowledge articulation (Labatut *et al.* 2009).

Results and discussion

The use of three main technical tools was identified as locks-in to the breeding of dairy cows suitable for grass-based systems. First, the global merit index (ISU) is, for most farmers, the main indicator to select a sire for insemination, despite a lack of understanding of its origin and meaning. In practice, some farmers select bulls with the highest ISU score without looking at its composition and others completely delegate the choice of bulls to inseminators. Such a use of ISU prevents farmers from selecting bulls on specific characteristics regarding their farm context or objectives and requires them to rely on the breed orientations. Conversely, for all breeding societies, the ISU can allow dairy cows adapted to grazing conditions to be selected by virtue of the increased relative emphasis on functional traits (fertility, legs, udder health etc.) within the index. For local breed representatives (Abondance, Brown Swiss), grazing abilities are inherent to the origin and history of the breed: 'the breed was made by the mountain'.

The second breeding tool is the mating plan, i.e. choosing the bulls to reproduce with each individual cow. Some farmers choose a small number of bulls based on 2 or 3 important indexes to mate with all the females of their herd, independently from their individual characteristics. The majority of these farmers completely or partially delegated the mating plans to their cooperative inseminators or breeding societies' advisors because of the large number of bulls available and their rapid turnover. Interviewed inseminators mostly developed mating plans based on the main breeding objective of the breed(s) used, when farmers are not involved in the decision.

The third breeding tool is milk performance indicators produced by milk recording organisations, to which the majority of the interviewed farmers are members. An annual milk recording summary is sent to each farmer (containing indicators on milk volume, composition, reproductive performance). All farmers considered such indicators as useful tools for their herd management notably for breeding practices. Nevertheless, farmers looking for cows adapted to local grazing conditions explained that individual performance should be assessed only over the long run, notably over several reproduction cycles.

To step-out these previously identified locks-ins in pure breed selection schemes, 15 farmers started implementing strategic and long term crossbreeding (Figure 1). They aimed to achieve rapid progress regarding several characteristics considered as essential for the balance between cow and grass use: fertility, health and grazing behaviour. This system transition can be implemented in complete disruption to the main system, with farmers withdrawing from cooperative or advisory services and giving up on the main technical tools (ISU, milk records). These farmers re-appropriate genetic management on farms, building their own mating plan and even their own selection indexes. Some farmers still rely on breeding societies and selection companies, buying French bull semen, but some also started importing semen from other countries (Ireland, New-Zealand) to get more adapted genetics for their grazing systems.

Conclusion

Currently three main paths are evocated by different actors to improve the grazing capability of dairy cows: 1) allowing more weight to existing functional traits in the ISU, 2) using local breeds relying on their natural ability to adapt to local grazing systems, and 3) experimenting

with a new breeding system using crossbreeding leading to the re-appropriation of on-farm genetic management by farmers. The transition from the main genetic regime to crossbreeding indicates that a better support system is needed to transition toward grass based systems. This support should lead to the development of technical tools helping the on-farm management of genetic selection considering specificities of the local context and of farmers' objectives. Participative reflection including all actors of the dairy cow genetic selection process should be implemented in order to redefine collectively selection scheme organisation to reconsider technical tools. Our results also suggest that within-breed reflection could lead to the exclusion of farmers using who are crossbreeding.

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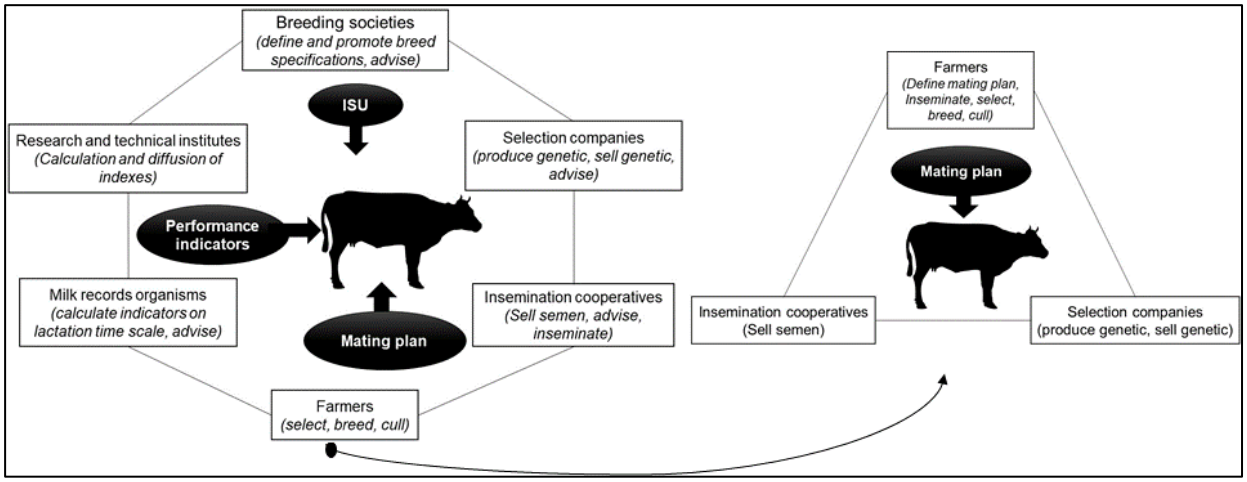

Figure 1: Representation of the strategy implemented by farmers to step-out from the locked sociotechnical systems of dairy cow genetic (left) to the unlocked system (right) through crossbreeding of dairy cow. Actors of the system are represented in the white boxes and technical tools in the black circles.

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