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Solving the "forage dilemma" to increase the resilience of forage systems: the example of cattle farming in the Massif Central

In a context of global change that accentuates short-term risks and makes future production conditions uncertain, the security and resilience of production systems are major issues for the future of agriculture. Grazing livestock systems are particularly sensitive to the effects of climate change (Lemaire et al., 2006). In the Massif Central (France) and other mid-mountain territories, droughts can be combined with outbreaks of a grassland pest, the bank vole (Quéré et al., 1999; Michelin et al., 2014). Many forage systems in the Massif Central are just about self-sufficient in forage under normal climatic conditions, so that the occurrence of several successive or even concomitant disturbances strongly disrupts their functioning (Duru et al., 1988; Komarek et al., 2020). In fact, highly variable forage production is contrasted with the needs of a herd, which are rather fixed in the short term, forcing herders to acquire forages whose price increases when production decreases. Faced with these disruptions, farmers find themselves in a "forage dilemma": the search for the optimum and for security appear to be two contradictory objectives.

How can forage systems resolve this "forage dilemma"?

From a theoretical perspective, we draw on the theories of resilience and adaptation (Darnhofer, 2014; Meuwissen et al., 2019;). The concept of resilience tends to develop strongly to analyze the capacity of agricultural systems to sustain themselves in the face of disturbances and changes affecting their environment. Although it still encounters significant theoretical difficulties, the concept of resilience makes it possible to renew approaches to the sustainability of agricultural systems and to better integrate the dynamic character of these systems, which are by nature unstable. Indeed, resilience corresponds to the buffer (Allen et al., 2018), adaptation and transformation capacities of the system (Tendall et al., 2015; Urruty et al., 2016).

From a methodological point of view, we model the functioning of a suckling and grazing cattle breeding system in Cantal, subject to climatic hazards, ground vole outbreaks and price risk on fodder. Using bioeconomic simulations, we test several management levers of the forage system and highlight the effects of different strategies to secure it and increase its buffer capacity. We model the storage of fodder, the purchase of fodder, the flexibility in the use of the land (mowing/grazing), the acceleration of the culling of suckling cows, the mobilization of the body reserves of the renewal heifers, the increase of the useful agricultural area and the reduction of the productive livestock. Two simulation scenarios are proposed: on the one hand, a simulation based on historical production conditions (allowing to approximate the actual conditions that affected the Cantal systems), and on the other hand, a "crash-test" type simulation.

Our results show that, in the face of past disturbances but also in the perspective of cumulative disturbances, the forage systems must consider transforming their structures (modification of the animal change) in order to secure and stabilize their technical-economic performance. It is noticeable that the most efficient strategy is a decrease of the livestock which, although decreasing the maximum potential cash flow, presents the same average economic performance as the reference strategy (storage/purchase of forage) while stabilizing the system.

Keywords: forage system, hazards, resilience, buffer capacity, livestock

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