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### ► To cite this version:

Marc Moraine, Guillemette Boiron, Xavier Arnaud de Sartre, Pierre Gasselin. Optimizing territorial resources to support agroecological transitions: which levers to adapt to climate change in livestock systems in South of France?. 15. IFSA Conference, Systemic Change For Sustainable Future, International Farming Systems Association, Jun 2024, Trapani, Italy. hal-04644933

**HAL Id: hal-04644933**

**<https://hal.science/hal-04644933v1>**

Submitted on 15 Jul 2024

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## **Optimizing territorial resources to support agroecological transitions: which levers to adapt to climate change in livestock systems in South of France?**

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Abstract: Agroecological transitions require to foster frameworks and strategies to optimize the identification, access to and activation of territorial resources. Climate change threatens the durability of natural resources and the stability of favorable socioeconomic conditions for transitions. In this paper, we propose a framework to analyze the degree of agroecological transition in farming systems and the sets of territorial resources already available or required to support this transition. We implement this framework on a case study in South Western France, in the Basque region where PDO cheese are produced. After describing ten types of farming systems, we characterize their proximity to agroecology and their potential resilience and adaptation to climate change. The analysis of territorial resources shows that agroecological transition in this territory is possible and would enhance adaptation to climate change, but require further development of territorial resources which depends on economic and political dynamics at local level. This work contributes to the understanding of agroecological transition at territory level, and proposes a framework to bridge existing methods for their analysis.

**Keywords:** Agroecological transition; Territorial resources; Adaptation; Typology; Coexistence.

### **Purpose**

Agroecological transitions are more and more studied and conceptualized at the territorial level, to deal with the deep embeddedness of technical practices and farmers' strategies in ecological, social, cognitive and economic dynamics which operate beyond farm level. The territory level is also where the combination of natural, cognitive, technical and socioeconomic resources allows or limits the implementation of agroecology (Bergez et al., 2019). Supporting agroecological transitions requires to optimize the identification, access to and activation of territorial resources (Thenard et al., 2021). However, in a context of climate

change, the durability of natural resources and the stability of favorable socioeconomic conditions are highly threatened. More probably, tensions, concurrence, conflicts for resources, resulting in affirmations of competing development models for agriculture, could be horizons of future of agriculture of the Anthropocene.

To avoid this and support agroecological transitions on the long run, we analyzed the conditions of agroecological transitions at two levels. At farming systems level, we observe how farmers mobilize territorial resources to engage in agroecology. At territory level, we observe how territorial resources can be managed to facilitate the agroecological transitions of diverse forms of agriculture and their positive coexistence. This article presents this analysis in a case study in South Western France, in the Basque region, where climate change threatens the sustainability of livestock farming systems.

### **Methodology and analytical framework**

This article is based on the historical, technical and economic analysis of the territory of Hasparren, in Pays Basque, South-West of France, following the method of agrarian diagnosis (Boiron, 2017). Hasparren is a mountain area under oceanic climate with mild winters and warm and humid summers, adapted to the growth of crops including maize and grasslands. The topography (mountains, hills, valleys) determines the type of use of the soils: step and rocky slopes are left as moors and ferns lands, hills and slopes with shallow soils are used as permanent grasslands, flatlands with deeper soils are cultivated as temporary grasslands and maize mainly.

Ten types of identified farming systems have been described and analyzed after an historical investigation in local archives, interviews with experts of the territory and a set of around 50 interviews of farmers. Technical and economic data have been collected on farms, as well as the farmers' strategies described by themselves. These actual data on farm illustrate and inform the farming systems described in the typology. On this basis we propose three complementary ways to analyze the farming systems: their dynamics of adaptation to climate change, their proximity to agroecology, and the type and importance of territorial resources that they mobilize. How farming systems implement adaptation measures to climate change has been described using data from a prospective survey conducted in the Pyrenees (OPCC, 2018). Proximity to agroecology has been defined using the historical principles proposed by Altieri (2002).

P1- Reducing external inputs by optimizing the use of natural resources and inputs-services. This principle includes integrated health management for animals.

P2- Favouring biodiversity at agroecosystem level to enhance regulation services.

P3- Optimizing the functioning of production systems to reduce pollutions and environmental impact.

P4- Favouring the diversity and complementarity of resources used in the production system to increase its resilience.

P5- Increasing autonomy and capacity of adaptation through adequate configuration of actors and supply chains.

Each type of farming system is positioned on the two axis of Therond et al. (2017): biodiversity/inputs and territory/globalized, based on the description of farming systems made in Boiron (2017). Mobilization of biodiversity in production systems is assessed through four criteria: 1-Diversity of land types; 2-Diversity of animal species; 3-Management of genetic resources (breed and mode of selection); 4- Contribution to the management of natural areas. Territorial embeddedness of production systems is assessed through four criteria: 1-Diversification of activities: number and nature of enterprises, existence of pluri-activity; 2-Process and commercialization: frequency of direct sales on farm or local supply chains; 3-Local purchase of inputs; 4-Collective dynamics at local level, governance and shared values.

Finally, we assessed qualitatively the type and relative importance of resources available for farmers for their agroecological transitions and adaptation to climate change. For this we used the definition of natural, technical, cognitive, economic and social resources by Thenard et al. (2021).

## **Findings**

The ten types of farming systems in Hasparren present different levels of mobilization of biodiversity and territorial embeddedness (Fig. 1), and of implementation of agroecological principles (Fig. 2). Four farming systems are close to agroecological principles: Dairy Ewes Process. (DEP), Mixed Cows Process. (MCP), and to a smaller extend Dairy Ewes spe. 2 (DE2) and Mixed dairy Ewes and Suckler cows 2 (MES2). The most intensive systems do not mobilize any – or very few – agroecological practices: Dairy Ewes spe. 1 (DE1), Dairy Cows spe. (DC), Mixed dairy Ewes Suckler cows 1 (MES1), and Suckler Cows spe. (SC1).

The mobilization of agroecological principles seems to depend highly on the commercialization channels: high added-value channels such as direct sales or short supply chains favor the development of agroecological practices. Indeed, the two types of farms that process their production (dairy ewes and mixed cows) present more diversified systems, limit their use of inputs using local feed resources from a diversity of areas (schrublands, permanent grasslands, crops). Specialized farming systems selling in globalized markets, in particular DC, are constrained by the necessity to intensify the production per working unit, thus making high use of inputs, especially for maize production.

### ***Coexistence of economic structures and strategies on the territory***

Three groups of farming systems can be identified comparing their economic strategies and the resulting income level (Figure 3). Systems processing their products into food products with direct sales or short supply chains obtain high levels of added value per work unit thanks to the commercialization in niche markets: PDO farm cheese, local calf meat, fruit jam, etc., often sold on local markets or through CSA networks.

Figure 1: Biodiversity mobilization and territorial embeddedness in farming systems.

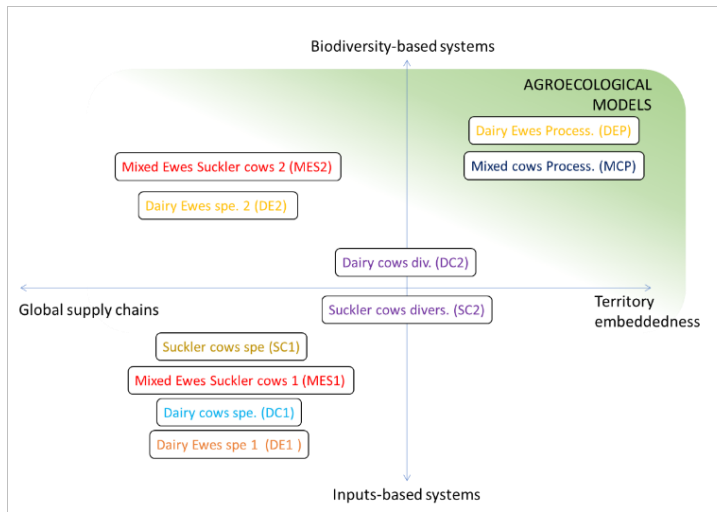


Figure 2: Practices of the farming systems and their proximity to agroecological principles

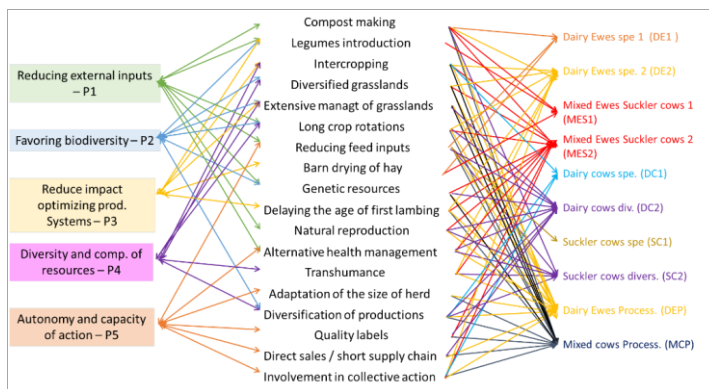
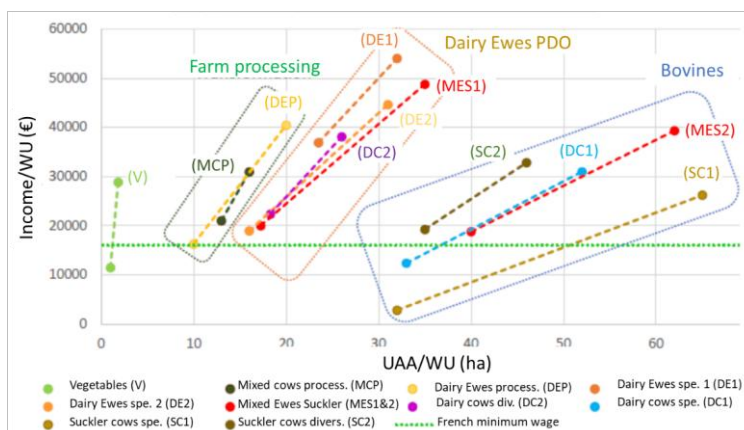


Figure 3: Economic results from land and work for the different farming systems.



Livestock farmers producing ewes' milk for large dairy companies are numerous, and their proximity to agroecology is generally low. Dairy and beef cattle producing generic and standardized food exhibit the lower rate of economic return and need to get larger to reach a satisfying income level.

In these three groups of farming systems, the set of available resources are quite high. Natural resources are high due to the diversity and complementarity of types of lands: croplands for cereal production, high productivity grasslands, valley and mountain pastures, which are spatially distributed and accessible to most of the farming systems. Technical resources such as locally-adapted animal breed, technical advisors (Chamber of Agriculture, farmers' associations), inputs supply companies, are highly present in the territory. The historical structuration of networks for the recognition of the quality of Basque country's products (PDO cheese, vegetables) gives access to economic and social resources. New brands, marketing identities, are developed by alternative farmers (belonging to the DEP and MCP farming systems), to differentiate their products and reinforce their collective identity.

At the territory level, the coexistence of a diversity of farming systems appears to be possible and does not generate strong inequalities, thanks to adequate governance of resources and collective actions for the support and defense of production models in professional institutions (farmer unions, cooperatives, syndicates of products). This coexistence is however challenged by climate change perspectives, which could worsen the competition between farms.

### *Climate change perspectives and resilience of farming systems*

The consequences of climate change will not impact the different farming systems to the same extent. Modification of productivity of mountain pastures will impact farming systems making summer transhumance: DE2, MES2, DEP, MCP. These farming systems will need to adapt their grazing strategies, complete the feed ration with hay and ultimately reduce the number of animals. For the farms having less economic resources, such adaptations could be highly damageable and threaten their survival, especially in MES2 type. Reduction of agricultural productivity, and changes in climate suitable distribution areas for some crops will impact almost every farming system, with a stronger impact on the most intensive, less diversified, using more inputs, cropping systems: DC1, DE1, SC1, MES1. The possible adaptation is to purchase more cereals and protein crops, but this would strongly impact the production costs and profitability of farms.

### **Practical Implications**

Due to climate change, yields and quality of products are more versatile the last years. Agroecological farming systems, more diversified and adapted to local conditions, could represent an alternative for the territory. The agroecological practices already existing could generate technical and cognitive resources for the transition of other farms to agroecology, but other types of resources remain to be developed: valorization of agroecological products on a large scale, in opposition to current niche markets, possibility for young farmers to start their activity on small pieces of land, political and professional support of alternative practices, new productions, evolution of standards and labels. These evolutions are desirable to unlock agroecological transition on a wide scale but they are not the most probable without specific animation structures and supporting communities of citizen.

## Theoretical Implications

This study is a methodological attempt to characterize the territorial resources supporting agroecological transitions and their possible evolution in a future shaped by climate change. In the future, climate change could reshuffle the decks of territorial resources, increasing the pressure on feed resources, grasslands and most productive arable lands. The transition to agroecological models, entailing a reduction of animal density and diversification of crops and practices, is jeopardized by the sociotechnical lock-ins that maintain the most intensive farming systems in their path of dependency. If cognitive, technical and socioeconomic resources developed today by agroecological farming systems could be sufficient to trigger largely implemented transitions is difficult to evaluate, as it depends also from factors occurring at the level of sociotechnical landscapes (public policies, global markets, regulations, etc.). The diversity of existing agroecological farming systems and their adaptation to the ecological context of the Hasparren territory could luckily act as “bright spots” to facilitate adaptation to climate change, but only under the condition of adequate social and political dynamics of transition.

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