Mémoire

présenté par

MANON FUSELIER

Master Agrosciences, Environnement, Territoires, Paysage, Forêt
Parcours « De l'Agronomie à l'Agroécologie »

Studying mixed livestock farming systems in Languedoc Roussillon: connecting innovations, adapting capacities and territory embeddedness.

Pour l'obtention du diplôme de
Master Agrosciences, Environnement, Territoires, Paysage, Forêt

Enseignant responsable du stage: Philippe Lescoat

Maître de stage: Marc Moraine

Soutenu le 30 août 2019

Département SIAFEE

Engagement de non plagiat

❶ Principes

- Le plagiat se définit comme l'action d'un individu qui présente comme sien ce qu'il a pris à autrui.
- Le plagiat de tout ou parties de documents existants constitue une violation des droits d'auteur ainsi qu'une fraude caractérisée
- Le plagiat concerne entre autres : des phrases, une partie d'un document, des données, des tableaux, des graphiques, des images et illustrations.
- Le plagiat se situe plus particulièrement à deux niveaux : Ne pas citer la provenance du texte que l'on utilise, ce qui revient à le faire passer pour sien de manière passive. Recopier quasi intégralement un texte ou une partie de texte, sans véritable contribution personnelle, même si la source est citée.

❷ Consignes

- Il est rappelé que la rédaction fait partie du travail de création d'un rapport ou d'un mémoire, en conséquence lorsque l'auteur s'appuie sur un document existant, il ne doit pas recopier les parties l'intéressant mais il doit les synthétiser, les rédiger à sa façon dans son propre texte.
- Vous devez systématiquement et correctement citer les sources des textes, parties de textes, images et autres informations reprises sur d'autres documents, trouvés sur quelque support que ce soit, papier ou numérique en particulier sur internet.
- Vous êtes autorisés à reprendre d'un autre document de très courts passages in extenso, mais à la stricte condition de les faire figurer entièrement entre guillemets et bien sur d'en citer la source.

❸ Sanction : En cas de manquement à ces consignes, le département SIAFEE se réserve

le droit d'exiger la réécriture du document, dans ce cas la validation de l'Unité d'Enseignement ou du diplôme de fin d'études sera suspendue.

❹ Engagement :

Je soussignée Manon Fuselier
Reconnaît avoir lu et m'engage à respecter les consignes de non plagiat

A Turin le 16 aout 2019.
Signature: Fuselier.

Remerciements

En premier lieu, je remercie tous les agriculteurs et leurs proches pour m'avoir accueillie aussi chaleureusement lors des enquêtes. Le temps que vous m'avez dédié, les informations que vous m'avez fournies ainsi que vos partages d'expérience ont été d'une immense richesse lors de mon stage. Cela m'a apporté énormément, tant humainement qu'agronomiquement!

Ensuite, je souhaite mentionner mon maître de stage Marc Moraine qui m'a fait confiance une seconde fois pour travailler avec lui. Tes précieux conseils, tes réflexions toujours pointues et ton brin d'humour ont rendu ce stage plaisant et stimulant. Je te remercie pour l'accompagnement et le suivi de mon travail durant presque six mois.

J'aimerais aussi remercier Philippe Lescoat pour son suivi à des moments clés du stage et pour ses conseils sur les outils méthodologiques. Sans parler des photographies de cochons en plein air, j'ai compris et partagé ta passion pour l'élevage des monogastriques.

J'adresse mes remerciements aux deux encadrantes du Master AAE, Alexandra Jullien et Safia Mediene, pour nous avoir guidés et supervisés tout au long de l'année. J'aimerais saluer vos efforts afin de rendre notre parcours académique plus fluide et de nous communiquer des stages et offres d'emploi pour le futur.

Je remercie toutes les personnes de l'Unité Mixte de Recherche Innovation qui ont rendu ce stage agréable et festif par moment! Grâce à vous, je me suis sentie intégrée et nous avons pu partager nos connaissances et idées. Un remerciement spécial pour Nicolas et Delphine qui travaillent dur pour rendre la vie des stagiaires plus facile, toujours avec le sourire.

Enfin, j'aimerais remercier les personnes de mon entourage qui m'ont soutenue dans cette exercice qu'est une première longue expérience dans la recherche. Vous m'avez permis de rester motivée dans des moments de doute. Merci à mes grands parents, mes parents et Valerio pour tout le soutien moral.

Merci à tous ceux qui ont contribué de près ou de loin à ce stage!

Table of contents

I. Introduction

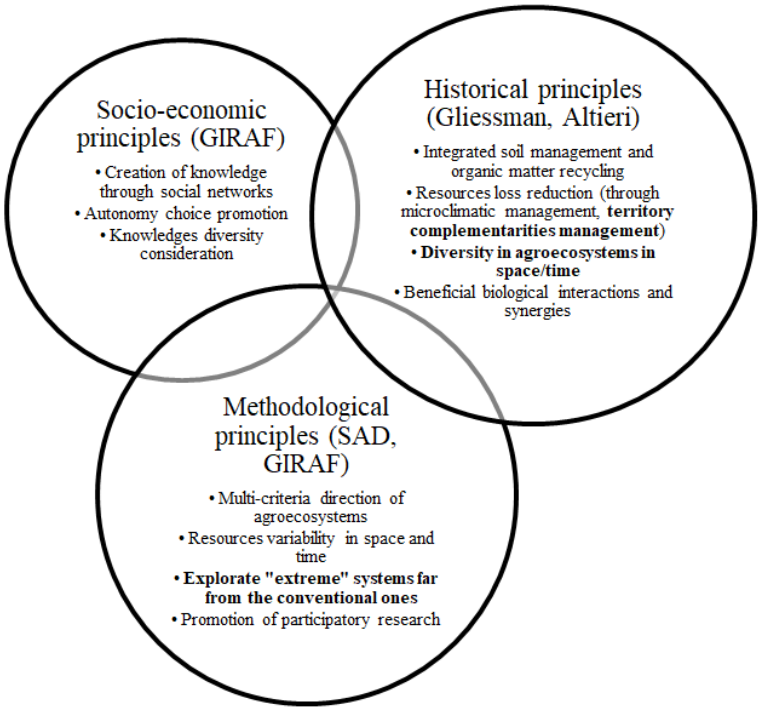
A. Context of the agricultural system: issues, transition and innovation.

After the Second World War, the fundamental principles of agriculture in Europe has drastically changed. Since then, food production systems became more and more dependent on chemical inputs and on highly productive crops and animal breeds. In the same time, those systems has been highly simplified and intensified; practices and products became more standardized. In a context of environmental crisis, this way of producing food is widely contested. The water pollution, the excessive Greenhouse gas emission, the loss of biodiversity… Modern industrial agriculture is identified as one of the main responsible for many environmental issues. (Steffen et al, 2015)

At a worldwide level, agriculture follows three distinct development trajectories according to Van der Ploeg (2008): a strong industrialization, a process of repeasantization and a process of deactivation. The process of industrialization remains the main pathway followed by agriculture although it is widely contested for their negative social, environmental and economic impacts. Van der Ploeg (2008) and others scientists claim the interest for agriculture to become again an agriculture of peasantry, based on ecological process in order to gain autonomy.

Along with this progressive awareness, many actors (scientist, politics and farmers) and institutions took into account environmental and social issues in their discourses and practices. Two transition pathways for agriculture emerged in response. Horlings et al (2011) distinguished the "weak ecological modernisation" and the "strong ecological modernisation" of agriculture. The first transition pathway is the logical continuation of the green revolution with a better environmental efficiency, still causing negative effects. In opposite, the second transition pathway requires a deep paradigm change by considering the ecological interactions at different levels and the social issues linked to agricultural production.

The "strong ecological modernisation" described by many authors is one proposed way to continue to feed the world in an unstable context. This transition belongs to the agroecological movement. The concept of agroecology emerged during the nineties in opposition to the green revolution. The first aim of agroecology was to apply the ecological principles to agriculture (Altieri, 2018). Then, this concept was extend to food systems and became an interdisciplinary practice between agronomy, ecology and social sciences. Now, agroecology is at the crossroad between the scientific field, several social movements and a set of practices (Wezel et al., 2009). One way to define the polysemic nature of agroecology is to define it by principles (Fig. 1).



SAD: development and action sciences, France; GIRAF: interdisciplinary research group in agroecology, Belgium.

Figure 1: The main agroecological principles (adapted from Stassart et al., 2012)

The concept of agroecological transition is deeply linked with the notion of innovation. Innovation is considered as a multi-level process driven by multiple actors in order to change "the design, production or recycling of goods and services". (HLPE, 2019) In the first transition pathway, innovations are mostly technological and are a substitute implemented with a "top down" approach. In the second transition pathway, innovations are in the hand of a wide range of actors and emerge from niches in the dominant regime (Geels, 2004). In our research, we considered the innovation as distributed between many actors of the agri-food system. To understand those innovation processes, we adopt a "bottom up" approach by considering actors' trajectories and choices, the strategies and monitoring of farming systems in their complexity. The complexity behind this approach is challenging, but also crucial to study, redesign and assess sustainable agricultural systems.

B. Why are we interested in mixed livestock systems?

Livestock systems were not spared by the industrialization of agriculture and are often criticized for their detrimental effects on the environment, the human health and the animal well-being. In the same time, extensive livestock systems in specific regions are considered beneficial for landscape opening, the biodiversity management and for providing quality goods and services (Dumont et al., 2017). By definition, livestock farms are at the crossroad between ecological systems (natural resources), technical and social systems. They are all more or less linked with the territory and they can offer many different services. Duru et al proposed to assess these territorial services and impacts with a visual framework called "La Grange". (Duru et al, 2017)

According to Soussana et al. (2014), the eco-efficiency paradigm is not sufficient to redesign the livestock farming systems and to prevent them from the negative externalities. In this context, a new strategy for animal production has to be widely supported, studied and promoted. (Thompson and Nardone, 1999). The agroecological principles have been extended to animal production in order to analyse and to redesign sustainable livestock systems. Those principles are the following (Fig. 2).

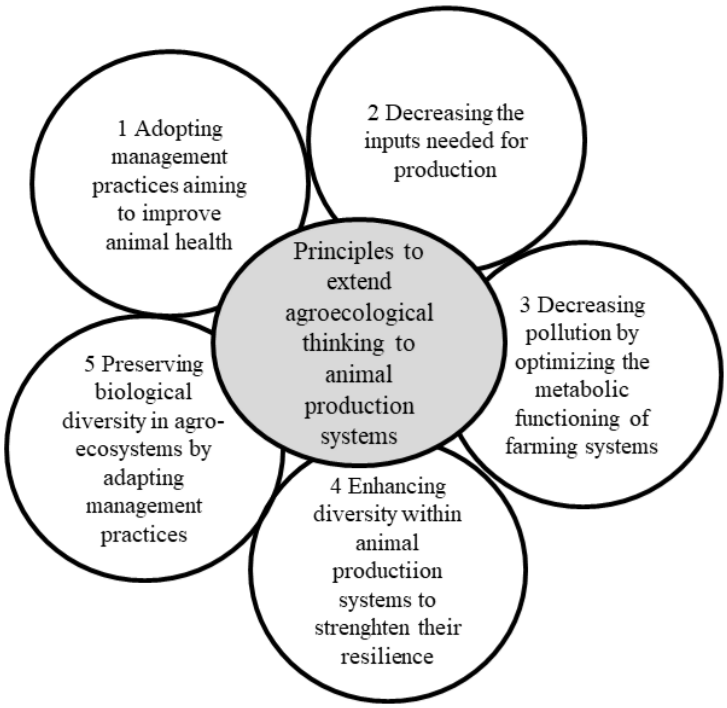


Figure 2: The agroecological principles adapted to animal production (Soussana et al., 2014)

As stated above, diversity is a key aspect in agroecology and is an important element to redesign more sustainable systems. This aspect has been widely studied concerning crop diversity offering a better management of weeds and pests and soil fertility in farming systems. However, the studies about diversity in livestock farming systems are almost non-existent. Most of the work about this diversity concern some specific aspects such as the benefits of mixed grazing or the animal behaviour in mixed herd (Anderson et al., 2012). A global and systemic approach about mixed livestock farms has never been truly made to study those systems. Mixed livestock systems are defined as farming systems with at least two animal species raised for their products (meat, milk, others). They address many technical issues and question the dominant agricultural model by adopting some innovative practices. The inherent complexity of these systems explains this lack of knowledge (Bell and Moore, 2012).

C. Context of the research

To address this gap, the project "Mix Enable" is being led since 2018 and subsidised by the Core Organic Co-fund call (2017). This project aims to characterize mixed livestock systems in order to assess their sustainability and resilience. It takes place in several rural regions in Europe and the UMR Innovation unit of the National Institute of Agronomy in France (INRA) lead the research in the Languedoc Roussillon area. The unit mandate is to spread and develop knowledge about innovative agriculture and food systems by studying actors' schemes of action (practices, strategies). Their studies are brought at different scales: from the farm to the territory, from markets to policies. The final purpose is to support and assess innovative process for a sustainable development in agriculture.

D. A strategic approach for understanding complex systems

Many researchers highlight the concept of "locks-in" in a socio-technical system to explain the difficulty to change the actual agricultural-food system. In fact, those locks-in prevent major changes at many levels and it explains why we still have difficulties to move towards a real ecological and fair agri-

food system. (Bui et al., 2016) The studying of innovations hold by the farmers is an interesting approach to understand how the niches are built and contribute to the dominant regime disruption. We propose to study mixed livestock systems with the conceptual framework of the agroecological transition and it numerous principles. In our case, mixed livestock farms appear as an alternative to specialized ones and are an interesting case study in order to find and describe innovation in animal production. We want to see if a link exists between the diversification of livestock and agroecological principles. Mixed livestock systems (MLS) consist of integrating two or more animal species with crop or agroforestry in the same farm. MLS can be way more complex than specialized ones, even if crop-livestock systems can show low levels of integration (Moraine et al., 2017). We need to develop our own method to understand their functioning and to characterize them, considering it has never been made.

We focused on farms trajectories and evolution for understanding the functioning of mixed livestock systems. We adopted a systemic and a territory approach to consider all the flows and components inside and outside the farms. The systemic approach for studying livestock systems described by Dedieu et al. (2010) allows considering the farmers operating logic in an unstable context. Studying those logics is useful to approach farms resilience and flexibility. Dedieu et al. (2010) describes general operating logics found in different context: intensification, diversification, development and extension of the livestock activity are common to livestock farms trajectories. The logic behind the diversification has been developed by Lamine et al. (2014) who describe three trajectories followed by small-diversified farm in France:

Maintaining in a context of sector crisis, when the diversification allows traditional farms to stay viable.

Rationalisation after an hyper diversification, when farmers try to rationalise their production in order to become more viable.

Optimisation on a constraining structure, when the production is highly valued as an answer to the environment and the structure.

Figure 3: the farm trajectories described by Lamine et al. (2014)

We chose to consider the farm as a **driven system** controlled by the farmer and influenced by its external environment, which can offer threats and opportunities. The practices analysis method allows us to access to the decision-making process of the farmer and the reasons behind these choices. Actual farmer choices are in line with the farm history, his past success and failures but also with his strategic objectives and his values (Laurent et al., 2003; Capitaine et al., 2013). As illustrated below, the farmer's strategy is influenced by several factors. Understanding those factors from the history of the farm to the actual farm situation will give us relevant tools to understand farmers' strategies behind animal diversification and its impacts on the resources and the territory. Considering the strong relationship between livestock system and it territory, we enlarge our approach to the flows between the farm and the territory, their impacts on the farm performance and functioning.

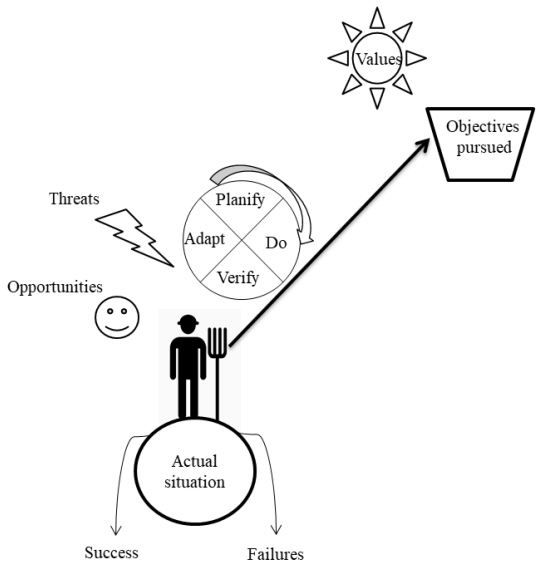


Figure 4: the farmer strategic management (Capitaine et al, 2013)

E. Our research questions

The agricultural context is unstable and uncertain. Livestock systems are not spared by these uncertainties. Studying mixed livestock systems is an entry point for studying alternative livestock systems and their potential generalization. Considering MLS as complex systems, we decided to focus on the **farmers' strategies and trajectories** to understand the **functioning and the management** behind this choice. Farmers' strategies and trajectories analysis will give useful tools to consider resilience and flexibility of these farms. Understanding their functioning and management enables to approach their potential generalization in the socio-technical system. Hence, our approach has a multi-level spectrum: from farmer's strategic logic to their local and territorial embeddedness; from economic, social and environmental considerations to their position in the agroecological transition. This results in a complex and a unique framework combining different scientific approach and existing frameworks.

Thus, the research questions are as follow:

1) Which strategies are developed by farmers in mixed livestock farms in order to adapt their practices to the resources available in the territory?

2) Which performances, sustainability and potential resilience?

3) Which agricultural models are followed by MLS and how they contribute to the agroecological transition of their territory?

The first research question focus on farmers' practices, which highlight their strategies and logics of action. The second research question makes a link between these strategies and sustainability and resilience performances. The third one is a wider question about the position of these systems as models in the agroecological transition.

II. Materials and methods

In this section, we will describe each step of our research method, which allows us to answer our research questions and to characterize mixed livestock systems.

A. Description of the methodology

This section describes the methodological sequences from literature review to the analysis of farm profiles using on farm interviews to understand the functioning and evaluate the contributions of MLS to their territory, using quanti-qualitative data. We describe the different steps of our research method in the diagram below (Fig.5):

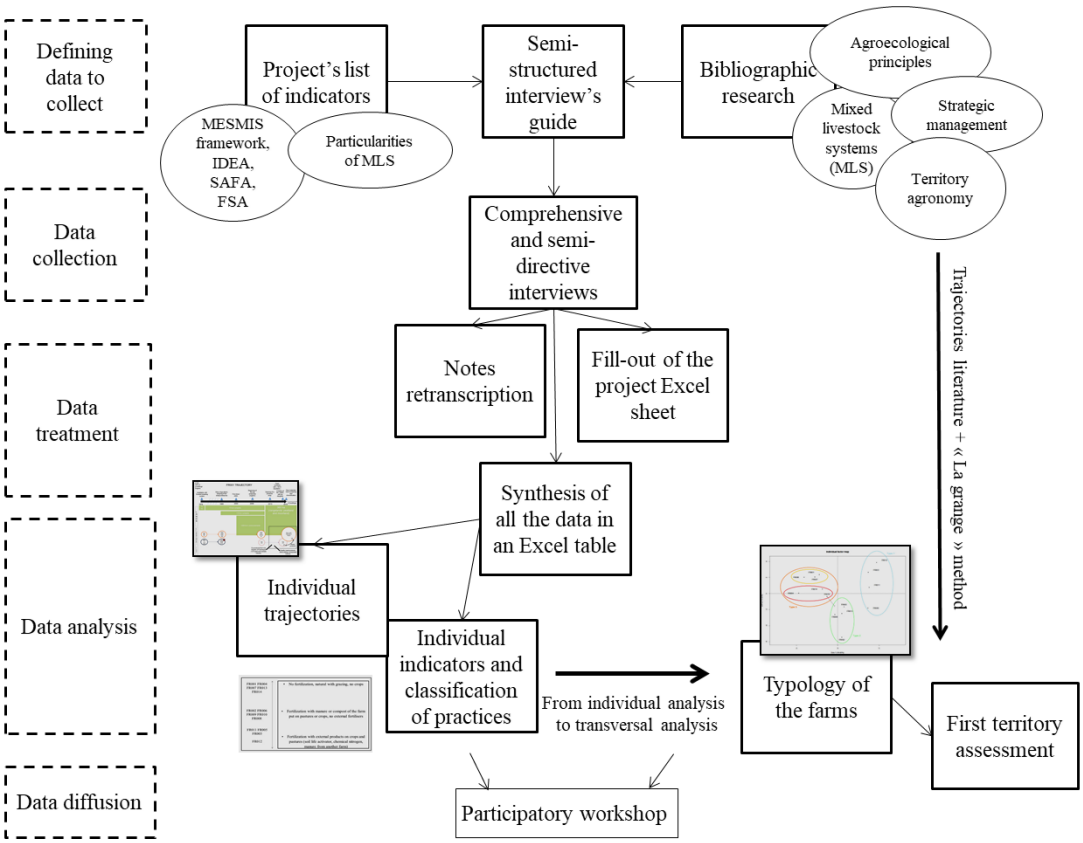


Figure 5: diagram of the general methodological approach

. *Bibliographic research*

The first step in the method is the literature review about mixed farming systems and for the analysis framework construction. The main topics covered by this research are: the agroecological principles linked with livestock systems; the specificities of mixed livestock systems; the agropastoralism in our case study area; the sustainability of livestock systems… We also built our conceptual framework at this point and decided to consider the farm as a piloted system. We linked our bibliographic research with the project guidelines in order to create our own semi-structured interview guide (in appendix).

. *The project guidelines*

The project approach is also based on considering the farm as a piloted system. This piloted system is composed by several subsystems, which interact between them and with the environment. Those subsystems can be more or less integrated between them. The project framework is based on the concept of integration between those subsystems also called "enterprises". The project Mix ENABLE takes into account all the interactions between the enterprises from the point of view of production, work and sales. Farms show different integration level regarding those points of views; one farm can have integrated farming practices and be specialized in terms of work organization. To understand and

characterize those interactions, the project dressed up a list of indicators. Indicators are applied at the farm scale or at lower levels sometimes (herd, field). It allows us to understand how the mixed farms are managed and how the farmer integrates crops, pastures and livestock.

In order to assess the sustainability of the farms, the MESMIS framework inspired the project: the Framework for assessing natural resource management systems incorporating sustainability indicators (Lopez Ridaura et al., 2012) which proposes five attributes associated to sustainability. They made a mix between this method and the particularities of mixed livestock farms and developed seven issues linked with the farms sustainability: resource use efficiency; resource conservation; self-reliance; productivity; profitability; liveability; resilience. The indicators have been attributed to each category and have been picked up from different assessment methods (IDEA "Indicateurs de durabilité des exploitations agricoles" in french, SAFA “Sustainability Assessment of Food and Agriculture systems”). We built our indicators corresponding to these ones but we also adapt it regarding the specificities of the case study. For example, the social networks indicator is built regarding farmers discourses: their different implication in time, the network nature and the follow-up.

. *Surveys modalities*

To answer to the project’s objectives, we had to find and contact farms corresponding to different criteria. For the project, the farms had to be organic, to have two (or more) species bred in the farm and to be located in our study area. With these criteria, we prospected different websites and established a list of potential contacts. After this first step, we phoned each farm and tried to make an appointment for a survey. At this point, many farms were not in line with our criteria or were not available for a survey. We succeed to survey 8 farms with these criteria and we expand our prospection with more conventional farms, which were at least mixed and extensive. In total, we surveyed 14 farms.

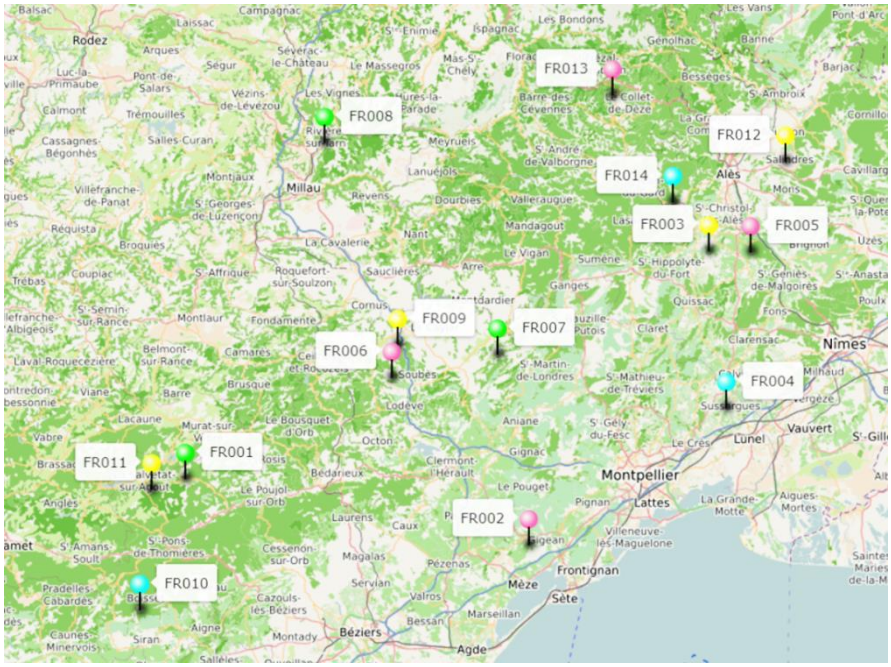


Figure 6: farms surveyed location (maps of Occitanie, France, Framacarte, 2019)

During the surveys, we used a recorder and a notebook to save the discussion with the farmer and to note the most important information. To ease the interview, we used a semi-structured guide with different parts inspired by the project indicators mentioned before. The different aspects covered by this guide concerned the global farm functioning, the history of the farm, the farm structure, the workload, the economy and many others components concerning the farm. We can find this guide in appendix.

. *Data transcription*

After this, we transcribed the survey in a synthetic text with the most important information about each farm. Then, we filled out the Excel table given by the project for the comparative analysis between countries. Finally, we synthesized the interviews in a table and we classified the data in different explanatory section such as “materials”, “resources”, “economy”. This allowed us to have all the farms components in one sheet and to work with it later. With those information, we were able to start the individual analysis.

. *Individual trajectories*

With the historical data and the farm components, we were able to draw the trajectories of the farm. We used the “PowerPoint” software to draw the trajectories. In those graphs, we represented the history of the farm with an historical arrow beginning with the farm creation until the actual situation. In this arrow, we described each important time and elements of the farm history described by the farmer during the interview. Under this arrow, we represented the agricultural areas, the livestock enterprises and their evolutions over time. We used the project’s graphic code for the dimensions of lands and livestock (squares and circles formula, in appendix). At last, we drew the graph of the farm flows (internal and external). This graph is inspired by the flows graph of Bonaudo et al. (2014) which allows to visually representing the inputs, the outputs and the internal exchanges in the farm.

. *Individual classification*

The next step was to calculate and to select the indicators for the transversal analysis. We had to calculate the stocking rate, the lands repartition, the farm seniority and many other relevant indicators to describe the farms. Most of the quantitative data had been given by the farmers during the interviews or found somewhere else in articles or diagnosis document. This allows us to describe the farm structure, context, the lands repartition and the farm functioning for each farmer interviewed.

We also highlighted some practices such as the fertilization management and classify the farms regarding their own practices in a table. In each table of practices (fertilization, animal management or integration), we classified the farms regarding several criteria. Most of the practices chosen were selected with the idea of the autonomy quest. We built these categories of practices regarding the mechanisms for gaining autonomy described by Ploeg (Ploeg, 2008). Ploeg described the six following mechanisms: diversification of the products and the mode of marketing; decreasing external inputs; enhancing ecological functionalities; pluriactivity; cooperation and collective action; improving technical efficiency and skills. We described practices and classified the farms using those mechanisms as reference and we linked it with the agroecological principles.

We converted the practices observed and discussed in the farm in several variables. At the end, we obtained 24 variables (Table 1).

Table 1: Criteria and indicators for the classification of farms

Category	Criteria	Indicators	Unit	Type
Structure	Farm size	Utilized Agricultural Area (UAA)	Hectare (ha)	Quantitative
		Number of species		Quantitative
		Working unit		Quantitative
		Livestock Unit/Working unit		Quantitative
	Farm specialization	Specialization rate	%	Quantitative
Farm context		Climate		Qualitative

		Environment		Qualitative
	Integration in a network	Technical network		Qualitative
		Label		Qualitative
Farm history	Farm background	Creation or takeover		Binary
	Stability of the practices	Evolution of the farm		Qualitative
	Seniority	Years since the farmer got installed		Quantitative
Lands repartition	Land use	Crops	%	Quantitative
		Pastures	%	Quantitative
		Rangelands	%	Quantitative
Farm functioning	Added value construction	Processing on the farm or not		Binary
		Diversification with another activity		Binary
	Extensive farming	Stocking rate (UAA/Livestock Unit)	LU/ha	Quantitative
	Subsidies contribution	% of subsidies related to the sales revenue	%	Quantitative
Practices	Breeding practices	Animal feed management		Qualitative
		Animal health management		Qualitative
		Animal selection		Qualitative
	Complementarity between enterprises	Fertilization management		Qualitative
		Integration between enterprises		Qualitative

. *Farm typology*

With those indicators, we were able to convert them in variable in a statistical tool called R (R Development Core Team, 2005). We obtained 24 qualitative and quantitative variables. In order to find similarities between the farms thanks to these variables, we used a FAMD (Factor Analysis of Mixed Data) method, which can take into account mixed data in the analysis (Kassambara, 2017). This analysis method combines the PCA (Principal Component Analysis) and the MCA (Multiple Correspondence Analysis) method in order to consider the quantitative and the qualitative variable at the same level. Variables have been normalized during the analysis. With this statistical tool, we obtained a spatial repartition of the farms and we grouped them in types. We gathered the closest farm together while considering the different dimensions explained by the analysis and put it in circles. This allowed us to establish a typology of the mixed livestock farms surveyed. We gathered the farms with more similarities represented in the graph and made a link with the farmers' strategies and trajectories.

Dedieu et al. (2010) emphasize the studying of farmer's trajectories in order to understand their operating logics. The understanding of farmer's operating logic helps to reach their adaptation capacity (resilience, flexibility and vulnerability). The farms trajectories analysis of Lamine et al. (2014) inspired our typology. Her analysis was made with very diversified and small farms in France and Italy. It allows us to understand the rationale of action behind the farms trajectories and to link it with farmer's adaptation capacity.

. *Territory services assessment*

In order to characterize the farm contribution to the territory, we made a first territory services assessment based on the "La grange" method proposed (Duru et al., 2017; Ryschawy et al., 2019). This method provides a synthetic representation of the services and impacts of livestock systems in a territory. We created our own table with the same indicators given by the authors (in appendix). We used a rating

system starting from -1 to 1 to attribute a note for each indicator. Negative score corresponds to a negative impact and a positive score corresponds to a positive impact. We rated each type with this method. We used this method to describe the services and impacts provided by each type of MLS to their territory. With this first assessment, we want to see how our models contribute to the territorial dynamics.

. *Participatory workshop*

We organized a participatory workshop in order to present and discuss our first results with farmers interviewed and farmers' associations' facilitators (CIVAM, "Centres d'Initiatives pour Valoriser l'Agriculture et le Milieu rural"). The participatory workshop was divided in two sections: the project and results presentation; the discussion around the table with the participants. This workshop has been organized in order to discuss the prospection and the future of MLS, to discover the actors' point of views and their opinion about MLS development potential. This participatory workshop allowed us to take a step back from all our research and to connect it with prospective and interrogation about MLS. We can find the final workshop report in appendix.

B. Description of the case study area

The area where the research took place shows particularities and it description is important for a better understanding of the systems studied. The case study is located in the Languedoc-Roussillon area. This old regional division was divided in 5 departments: Aude, Gard, Hérault, Lozère and Pyrénées Orientales. The farms surveyed are located in the departments of Gard, Hérault, Lozère and Aveyron.

The Languedoc Roussillon area is characterized by a strong wine industry mainly located in lowlands and by specialized livestock farms in mountainous regions. The Utilized Agricultural Area is composed by pastures (40%), arable lands and vineyards. The following map shows the repartition of the different form of agriculture in our study area:

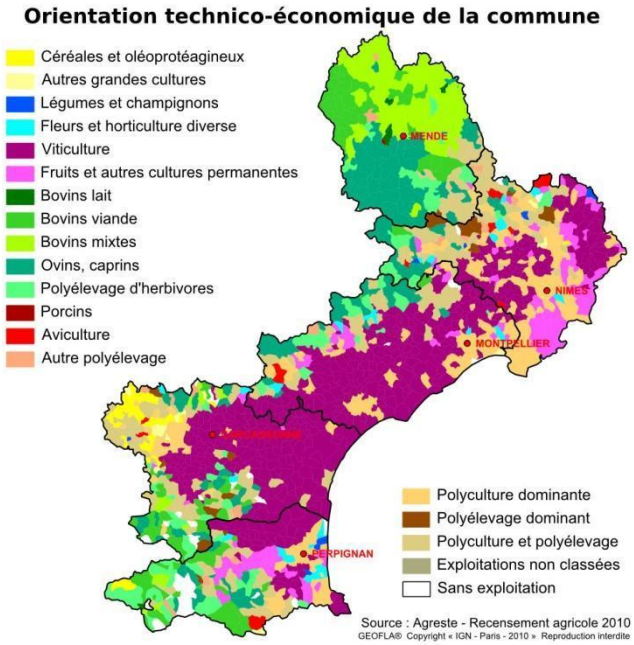


Figure 7: maps of the different lands orientations (Agreste, 2010)

In Languedoc-Roussillon, farms are globally small : 29 hectares of UAA in average. This small farm size is explained by the strong presence of small and diversified winegrower's house. Farm number is decreasing since 2000, leading to wider and more capitalistic farm structure. In fact, the number of farmers and the number of small farms is decreasing continually. Small farms still represent 48% of the

total farms in the territory. More than 80% of the farms have an individual status even if the number of farms with societal status (GAEC, EARL…) is increasing.

Animal breeding represents 12% of the total local production value. The main practice of breeding in the region is agropastoralism, which have an impact on the landscape management and maintenance. (Dreal Occitanie, 2016) 50% of the lands in the area are exploited by livestock systems, mostly located in Lozère. The region is a rare case where livestock systems are not decreasing. The majority of them are extensive and are based on the grazing of garrigues, steppes and moors. This way of farming consists of valuing low productivity lands with low livestock rate. (Agreste, 2015)

This territory specificity raises several issues linked with the sustainability of these systems; their resilience and flexibility to address climate change. In fact, those systems are mainly based on natural and territorial resources. With the recent environmental variations, we saw that those resources tend to drastically change and it has a strong impact on farmers and their systems. The climate variability induces farmers to adapt their practices and to find quick solutions to address this instability.

III. Results

The results are divided in two section: the individual analysis and the transversal analysis. We start with the individual analysis, which help to characterize the farms surveyed. The following results present the characterization of the surveyed farms with structural indicators (age, localisation, livestock unit). Then, we dress a list of several farming practices and we explain some specific practices linked with agroecological principles and the autonomy quest. In the last part of the individual analysis, we analyse farmer's trajectories and choices behind the diversification.

A. Individual analysis

a. General structure of the farms

. Localisation and environment

We surveyed 14 farms distributed in all the Languedoc Roussillon area in southern France. They are located in four departments: Lozère, Gard, Hérault and one farm is on the border of Aveyron. Regarding this wide geographical scope, each farm environment shows their specificities. We defined five different environmental zones: « Mountain », « Garrigue », « Forest », « Arable » and « Littoral ». Almost half of the farms are located in mountainous and hilly zones and the other half is located in lowland areas (Garrigues mostly).

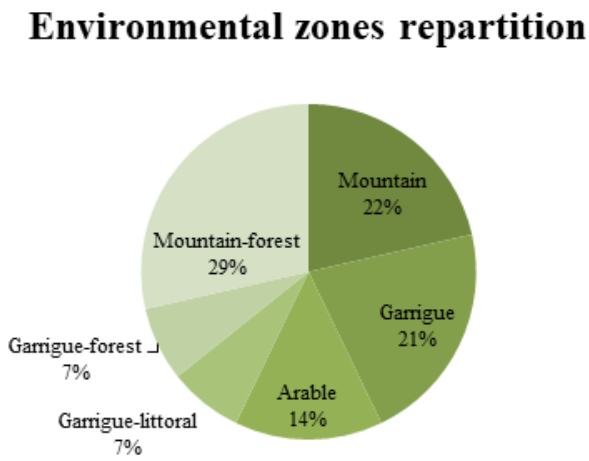


Figure 8: diagram of the environmental zones repartition

The three main mountainous areas are the « Haut Languedoc » regional park, the « Cévennes » national park and the « Grands causses » regional park. Their zones are characterized by a low agronomic potential and consequently they have been abandoned by the traditional agriculture. The climate is variable and can be very cold during winter due to the altitude and very hot and dry during summer. These areas are very touristic region during summer but can be quite isolated from cities and main selling points. As regional parks, many environmental agencies controls and follows the activities linked to the natural resources for example. All these aspects drive the farmers to adapt their practices.

The lowland areas are composed by a typical Mediterranean climate and vegetation: the Garrigue landscape. The climate is often dry and hot, especially during summer, which prevents high yields crops. Most of the lands are cultivated with vineyards. They are more reachable than the mountainous region but there is more competition regarding land acquisition and production sales. Even if the native vegetation is adapted to dry condition, the climate variability of these last years has a strong impact on agriculture. Also in this case, farmers have to change and adapt their practices in order to ensure their viability.

We observed that more than three quarters of the farms are located in dry land and are susceptible to drought. In extensive systems, drought is a threat for grass productivity and it has a direct impact of animal production. Some farmers adapt their practices by moving their animals in less susceptible areas (mountain) or by planting trees in their lands to mitigate this issue.

. *Type of installation and legal status*

We distinguished two ways of installation: « creation » and « takeover ». More than 60% of the farmers created their own farm and the others took-over the parents farms.

Most of the farms are installed with a GAEC status (8/14 farms). A GAEC structure allows two or more associates to work together with a company which pays its employees. Recently, two married people had been authorized to create a GAEC together, which induced an increase of this societal status. This status offers many advantages for the farmers. The others farms have an individual status.

. *Age*

The farms surveyed have been created in different times. The farms age starts from the year the main farmer (declared as the owner) was installed. The youngest is 4 years old and the oldest is 41 years old. The average age is 15 years old but there is a wide variability. Five of the farms are settled since more than 20 years and five others are installed since less than 10 years.

. *Size*

We noticed a wide diversity of UAA (Utilized Agricultural Area) in terms of size. It starts from 29 hectares to 1000 hectares. The average is 306 hectares but the standard deviation is 276 hectares, which means there is a lot of variability (Fig. 10). In comparison with regional data, the surveyed farms are two times larger in average. It is explained by their wide presence of rangelands and their extensive management.

. *Working unit*

In average, the farms have two workers in full time and it is close to the national mean value. Six of them have more than two workers. For four farms, the holder works alone. Some farms only employ family members meanwhile some others employ farm workers. The large majority are built with a family nucleus.

. *Animal production*

There is also variability around livestock units. Four of the farms have low livestock units (between 15 and 25); five of them have medium livestock units (between 25 and 50) and five of them have high livestock units (between 50 and 150).

We calculated the stocking rate with the livestock unit divided by the UAA and obtained very low stocking rate (always under 0.76 LU/ha). 10 farms have a stocking rate under 0.5 LU/ha and 4 of them have a stocking rate higher than 0.5 LU/ha.

. *Lands surfaces*

The next graph allows us to see how diverse the utilized surfaces are in terms of size and content (Fig.9). There are three types of utilized areas: crops which are minor in most of the farms, pastures which are mainly permanent and rangelands. We chose to include rangelands because some farms have only this type of surfaces in their UAA and we considered it as “utilized” in that case. In average, the farms have more than 70% of their UAA in rangelands. Rangelands types are: woods, garrigues, scrublands and moorlands. There are different types of rangelands regarding the environmental zones and it has an impact on grazing practices and feeding management.

The farms with almost 100% of rangelands in their UAA practiced extensive grazing in protected areas, followed by environmental agencies. They are recognized by these institutions for their services for the biodiversity and the landscape management.

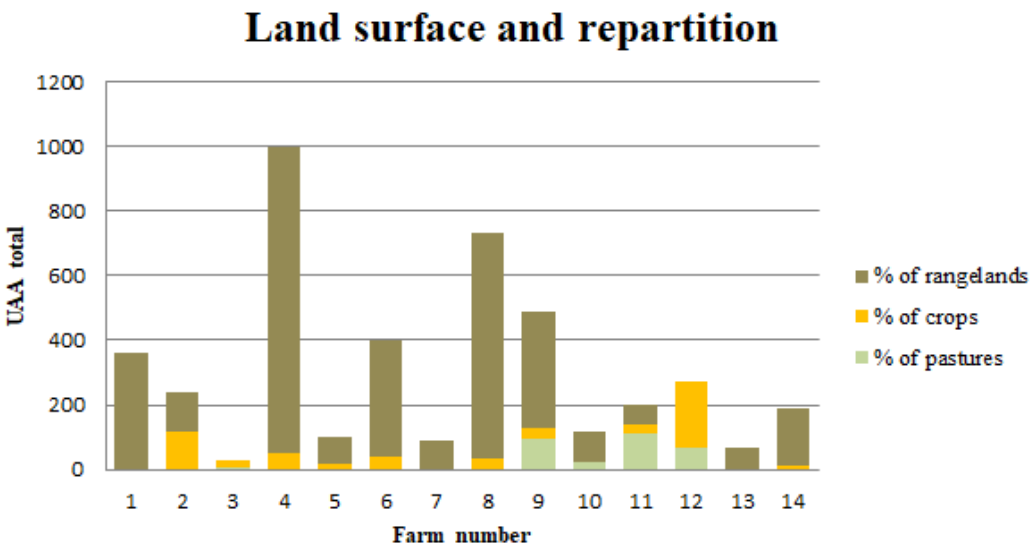


Figure 9: land surface and repartition for each farm surveyed

. *Livestock combinations*

We determined six different livestock combinations. The combinations are well distributed and there is no prevalence. We can observe ruminants mixed with monogastrics as well as big ruminants mixed with small ruminants. We did not take into account the destination of production (milk or meat) and small livestock enterprises (poultry, few monogastrics and few ruminants) in order to simplify the analysis. We did not notice a dominant logic behind these combinations and decided to create an indicator of specialization and an indicator of animal diversity instead.

The specialization indicator revealed that the farms have mainly one biggest enterprise and a smaller one (70% of them). Some farms combinations are well distributed, for example when they only have small ruminants grazing together or when each enterprise is managed by one holder. The animal diversity indicator is the number of species raised in the farms; it starts from two species to four. Most of the farms have only two species.

. *Labels*

The majority of the farms (8) are organic. Three are organic and conventional in the same time. In that case, we observed one enterprise with the organic label and the other one in conventional (often the pig enterprise). Farmers explained this choice with the high organic feed cost in comparison with the conventional feed cost. Two farms have protected appellation (AOC Pélardon and AOP Roquefort). One farm is conventional.

With those structural aspects, we can draw some first conclusions about the farms. Most of them are diversified and constructed around a particular environment, full of constraints, which can be turn for an advantage. We noticed a large diversity of structures. There are many differences between the land areas, the age of installation, the labels, the combinations and the environment around the farm. MLS tends to be extensive (high presence of rangelands), to have low stocking rate and to have labels even if there is variability. Those systems are built with a family nucleus. All those variables have an impact on the farm management and we will develop it with the practices classification.

b. Classification of practices and farms functioning

In this part, we show the diversity of practices we observed and discussed during the interviews. We made a range for each type because we observed variability between the farms regarding some practices. We linked those practices with the concept of autonomy and the agroecological principles to approach their sustainability and resilience.

. *Fertilization autonomy*

During the interviews, all the farmers pointed out the importance to be self-sufficient in fertilisers and animal feed. We observed a variability of strategies around this quest of autonomy. We divided those strategies in three categories:

- **No use of fertiliser**: farms of this category mentioned the natural fertilization of the pastures with grazing and the animal presence on the lands. The farms in this category have large surfaces and are not threatened by the lack of organic matter.

- **Animal-based fertilization of crops**: the second category of farms have crops and use manure or compost from animal enterprises in order to fertilize them. They do not buy anything from outside to fertilize crops, as often observed in organic crop-livestock systems.

- **Purchased fertilization**: The last category concerns farms with crops in their UAA which aren't sufficient and have to buy external fertilisers such as soil life activator or manure. Only two farms in our sample use chemical nitrogen (the conventional ones).

⇒ Fertilization autonomy mainly belongs to the following agroecological principle: decreasing pollution by optimizing the metabolic functioning of farming systems. Indeed, manure improves crop production and income for the cropping system according to Soussana et al. (2014). This principle is linked with the integration within crops and animals in mixed systems. It has been proven for regulating biogeochemical cycles and environmental fluxes. The two first categories are the closest to fertilization autonomy.

. *Feed autonomy*

Once more, regarding feeds autonomy, we observed different strategies and practices. The quest for feed self-sufficiency has been observed in all categories but there are several ways to try to get closer to it. Two farms are 100% self-sufficient for animal feed and many of them are close to it. We classified those practices in three categories:

- **By-products supplements purchased:** The first category presents farms without crops practicing extensive grazing to feed animals and completing with sub-products from cereals industry or waste from organic wholesalers for specific animal categories (such as young being fattened or young mothers). They cannot be 100% self-sufficient because of the lack of crops but have found another strategy to balance it. Those sub-products are less expensive than industrial feed and are interesting in terms of nutritional aspects. They are not competing with human consumption.

- **Additional crop-supplements purchased:** The second category represents farms with crops only used as feed for animals. They buy cereals or fodder locally when it is needed but it is only a supplement to extensive grazing during winter for example. They are very close to self-sufficiency but the yield capacity of the environment and the lack of equipment is an obstacle.

- **Full crop-supplements purchased:** The third category is more dependent to external purchases. Their strategies are not based on extensive grazing and they buy cereals and fodder without particularly taking into account the local origin.

⇒ Feed autonomy mainly belongs to one agroecological principle: the reduced use of external inputs for feed production. The aim behind this principle is to reduce human food and animal feed competition for lands and to reduce environmental impacts. There is a huge need to improve feed utilization efficiency and it can be allowed by different feeding practices. Farmers develop feeding strategies based on natural resources from pastures and rangelands and/or agricultural by-products. The two first categories are the closest to this principle.

. *Livestock genetic management*

Autonomy quest strategies are intrinsically linked with livestock management. We chose two categories of practices around it: the genetic selection and the health management.

We observed three different types of selection strategies depending on the breed choice and how it is conducted and selected. We made a difference between rustic (selected for their robustness) and "industrial' breeds (selected for their productivity) (Couix et al., 2016). Behind the breed choice, we are interested in the way farmers decide to conduct and to select these animals. We distinguished two different strategies around it: some farmers conduct and select "industrial" breeds such as rustic ones; they have in mind to give them rustic and robust traits with selection. Their criteria are also the animal adaptations to their environment and the resources. The other strategy is considered as more traditional because they keep selecting "industrial" breeds for their production traits mostly. This classification is illustrated below (Fig.10). The two first categories appear to be well adapted to their territory regarding their selection strategies.

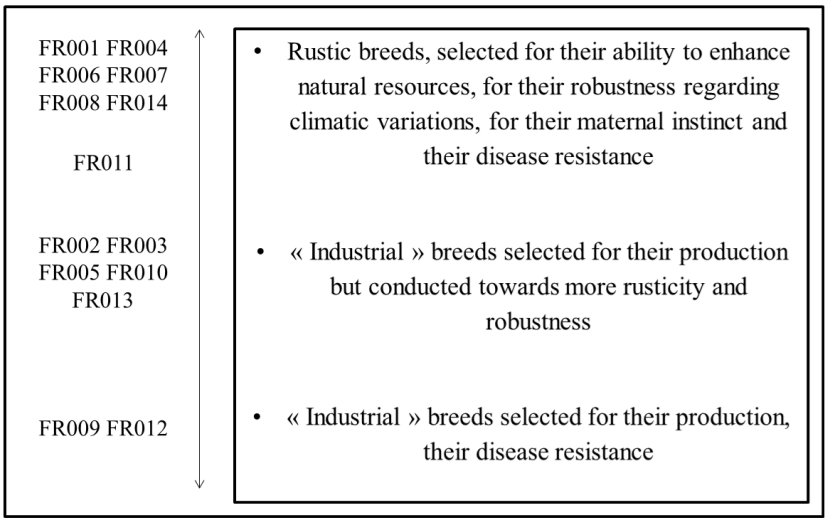


Figure 10: livestock management classification

. *Livestock health management*

There is also variability regarding how to take care of animals and to consider their global health. In the first category, farmers consider the animal health globally: with their selection work and grazing management, animals are not supposed to get sick. If so, they treat them with natural medications such as garlic. Only the obligatory veterinary interventions are made. In the second category, the animal's health is controlled with natural treatments and prophylaxis such as homeopathy and garlic. There are

more veterinary interventions than in the first category. In the third category, animal's health is controlled in a more "conventional" way with antibiotics and conventional medications.

Most of the farms are located in the two firsts categories. Only farm 9 and 12 which are the conventional farms manage their animals in a more "conventional" way. The others at least use natural treatments and are concerned about the robustness and the flexibility of their animals. Integrated health management is a major concern for the majority of the farmers interviewed.

⇒ This practice belong to the principle "integrated health management". The aim behind this principle is to reduce disease occurrence by adapting animal to their environment. Management practices have been developed by farmers to strengthen animal's health: rotational grazing, mixing species, legumes and tannin plant based feed for example. The two first categories seem to belong to this principle.

. *Integration within livestock enterprises*

Mixing species can take part of an integrated health management as mentioned before but it also shows other advantages in terms of integration. In this section, we got interested in the flows between the animal enterprises. We noticed three levels of integration: high, light and none.

- **A high level of integration** implies at least two types of exchanges between animal enterprises. Those exchanges can be the following: co-products exchanges, mixed final products, mixed grazing or same living area. 6 farms show a high level of integration between animal enterprises.

- **A light level of integration** implies at least one type of exchange between animal enterprises. 5 farms have a light level of integration and most of the time those exchanges are the whey recycling from milk transformation for pigs or the development of mixed products.

- **No integration** is when exchanges are almost non-existent. 3 farms have no integration between their animal enterprises. Animals do not live in the same building and there is no contact between them.

. *Integration in social networks*

We analysed farmers' social networks through different aspects: the implication in time, their function in the network and the type of networks (institutional; farmers; union). We distinguished three types of implication in a social network.

- **Active participation in alternative farming networks**: First, some of the farmers are very implicated in farmers' networks: they participate to trainings, they organize visits on their farms and they meet each other many times a year. Those networks are composed by multiple actors, mainly farmers and facilitators but also some institutions. Their aim is to promote alternative and sustainable farming practices and to share and create knowledge about it.

- **Follows-up with institutional actors**: they are part of a farmer network but they are not fully implicated in it. Sometimes they are followed by institutional actors such as the Coastal Conservatory or the National Forestry Office. Institutions are interested to follow up the biodiversity evolution in the exploited lands but they do not organize collective meetings or trainings.

- **Implication in a professional network:** the third type concerns farmers implicated in more traditional farmers union and they meet two or three times a year. They can do trainings and Agricultural Chamber are often implicated.

⇒ The creation of social networks belongs to the socio-economic principle raised by the research unit GIRAF in Belgium. They highlight the necessity to create networks of heterogeneous actors concerned by same local issues. Many authors raise the necessity for farmers to take part in a network in order to exchange services, materials and knowledge (Duru et al., 2014). All the farmers are implicated in at least one network even if there is variation.

. *Sales and transformation*

Sales management in the farms are key aspect and reveal a part of their economic strategy. First, all the farms surveyed practice direct selling. There is variability regarding how much production is sold directly but they all do it at some point.

- **High rate of direct selling:** most of the farms (8) sell 100% of their production through very short channels such as producer shops, markets or even directly on their farms.

- **Medium rate of direct selling**: some farms use an intermediate to sell some of their products but maintain direct selling in majority.

- **Low rate of direct selling:** only one farm still sells a part of it production through long channel and it is a result from its history.

Half of the farms are processing their raw product meanwhile the other half does not. There is a link between milk production (goat and sheep) and it processing on the farm. All the farms producing milk are processing it in cheese or yogurt on the spot.

Another indicator is the diversification of the farm with other activities more or less linked with farming practices. 5 farms have another activity than farming: it goes from wood production to wool transformation, from brushwood exploitation to horse riding activities.

⇒ This category is linked with the quest for economic autonomy, farmers control their sells and incomes with direct selling. The variation is explained by the different farms opportunities and structures: networks implication, number of workers, farm history influence the capacity to sell the production through short channels.

. *Subsidies dependency*

Farms economy shows different levels of subsidies dependency:

Strong dependency: 4 farms are strongly dependent to subsidies; they build their income with it and could not be viable without it. There are different explanations about this dependency. Some farms are newly created; they depend on subsidies to build their treasury before getting stable economically. Other farms are located in ICHN help area, which is an allowance for having difficult farming environment.

Medium dependency: 6 farms. The majority of the farms have a medium dependency to subsidies: it represents half of their total sales revenue.

Low dependency: 4 of the farms have a lighter subsidies dependency, they produce more than the others with a traditional model, they are well settled, stable, it's often a takeover of the family company.

After a first characterization with farms structure, we described farms practices and functioning and linked them with agroecological principles. We observed a wide range of diversity regarding farms practices and functioning. We can notice that the majority of the farms practices are closed to agroecological principles even if there is variability. Most of them have in mind to gain autonomy and they develop mechanisms to do it. Most of the farm are close to an integrated health management and have in mind to become self-sufficient for feed and fertilization. Not all the farms succeed to reach this goal; it can be explained by the farm history or structure.

c. Trajectories and motivations behind the diversification

In this section, we analysed farmers' trajectories and choices behind the diversification. We began to identify the stability of their practices and then we described the reasons underlying the diversification.

. *Stability of the practices and dynamic*

We identify through the trajectories' drawings different types of dynamic regarding the practices and farm history.

- Stable trajectories:

Most of the farms have stable practices, they are settled since more than 10 years and they did not experience big shocks that might have destabilized their practices. One animal enterprise can be added without disturbing the dynamic. 8 farms are considered as stable. We can illustrate this stability with the farm trajectory FR010 (Fig. 11).

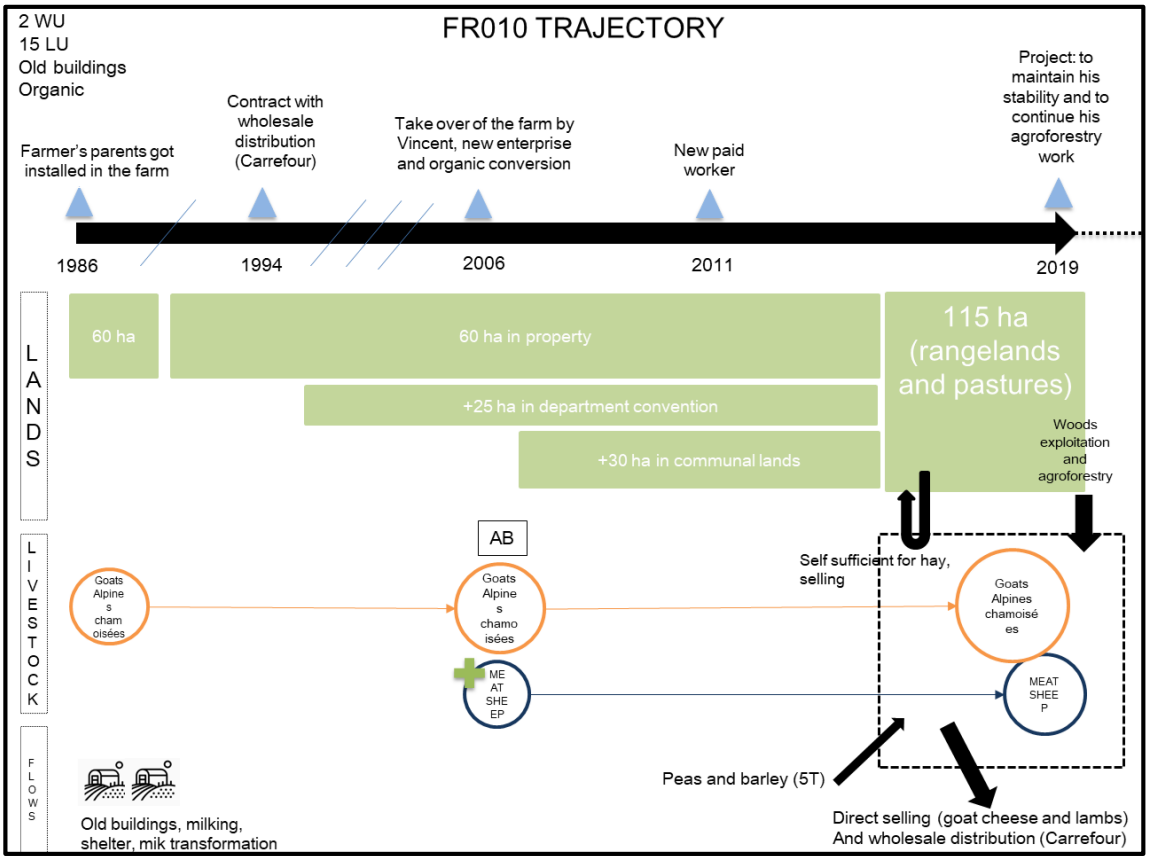


Figure 11: farm 10 trajectory

In that case, the farm exists since 1986. The farmer took over the farm in 2006 but he has not made big changes. He added a meat sheep enterprise and he hired a worker to develop his activity. He sells his production to the same customer since the beginning. His projects are: keeping this stability and to keep developing his agroforestry work.

- Slowdown trajectories:

Two farms show the same dynamic but with a slowdown in terms of production or projects, revealing the future stopping of the activity planned by the farmer. This slowdown can appears after a high diversification in the farm, which led to a high workload for the farmers in consequence. This slowdown can also consist of a homogenization and a simplification of the practices.

- Progression trajectories :

Others (3) are showing a progression in their practices: they are mostly new settled and they keep evolving and developing projects. They are planning to get bigger or to keep diversifying by adding a new animal enterprise, buying new lands and selling more products. It is illustrated below (Fig.12):

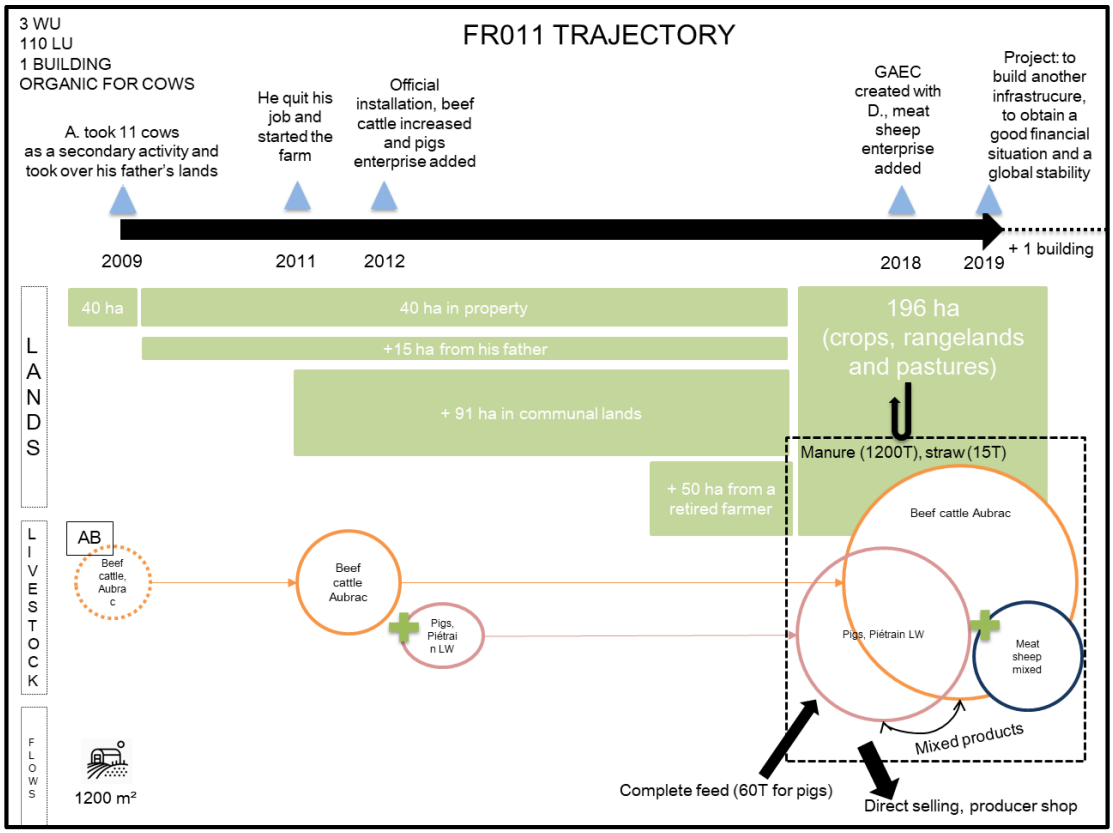


Figure 12: farm 11 trajectory

This farm is quite recent, it is settled since 2009. Since then, they added two more species in the farm and they have several projects of buildings. They bought new lands and they are increasing their number of customers. They do not consider themselves as stable and they want to obtain this stability soon.

One farm is in high economic difficulties and still tries to rebuild it activity, it strategy is to increase it production by focusing on the pig enterprise. Another one is in construction because the project has started in 2015 but it follows the progression trajectory, they want to progress through the diversification of their animal enterprises.

Each farm have unique history and trajectory. Thus, we can observe common points between some trajectories. Eight of the farms show stability in their practices meanwhile others are in progression or in decline. It has an influence on the farm management and future. This trajectories analysis did not allow us to consider the farmers choices behind the diversification and we will develop this aspect in the next section.

. *Reasons underlying diversification*

We identified several reasons explaining the farmers' choice to have mixed species in their farm. Those reasons concern different aspects linked to the farmer motivations and strategy.

Mixity as an ideal: The animal diversification can take part of a more global logic belonging to activism, life philosophy or ethic. Indeed, farmers often pointed out their belonging to social/peasant/ecologic movements and their practices are in reflection. Mixing animal species in their farm is part of this movement and it allows them to develop other practices linked with the diversification (complementarity, activity diversification).

Mixity as a strategy: Other farmers stated a more practical and technical speech relied to economic aspects or grazing practices aspects. In fact, for them, the diversification offers an interesting economic advantage for direct selling. It allows them to build their treasury more quickly and to keep their customers. The benefits of mixed grazing have also been highlighted but not as the first reason behind this choice.

Mixity as an alea: A third reason is the family farm legacy: originally, the farm had two animal species and they just keep it.

During the interviews, farmers quoted one principal reason to explain their diversification choice and a secondary one (for example, one farmer chose the mixity for it ideal and as a consequence it helped him with the commercialisation).

With the individual analysis, we are able to describe several aspects of mixed livestock farms. We noticed most of them are extensive, based on natural resources and they aim to gain autonomy. There is variability regarding each practice and trajectories. Some farms are very close to agroecological principles by being self-sufficient in feed or by selling all their production through short channels. However, if a farm is close to one agroecological principle, it does not mean that it is the same for all its practices. The logic behind the diversification has an influence on the farmer's strategy and on his practices in consequence. The farms trajectories show the stability of the practices, the breaks and it gives us an idea of their adaptation capacities.

B. Transversal analysis

The transversal analysis was achieved thanks to the individual analysis, which structured and determined the appropriate indicators to describe the farms surveyed. The aim behind a transversal analysis is to understand if there is a common logic or strategy for MLS. Understanding MLS and modelling them can give useful tools to approach those systems' future and expansion. We linked the strategic models with the services and impacts of these models on the territory.

a. Typology of the farms

With the FAMD method on R, we obtained the following graph with each farm located and oriented regarding their similarities for each indicator (Fig.13). This graph allowed us to distinguish three distinctive groups of farms quite far from each other.

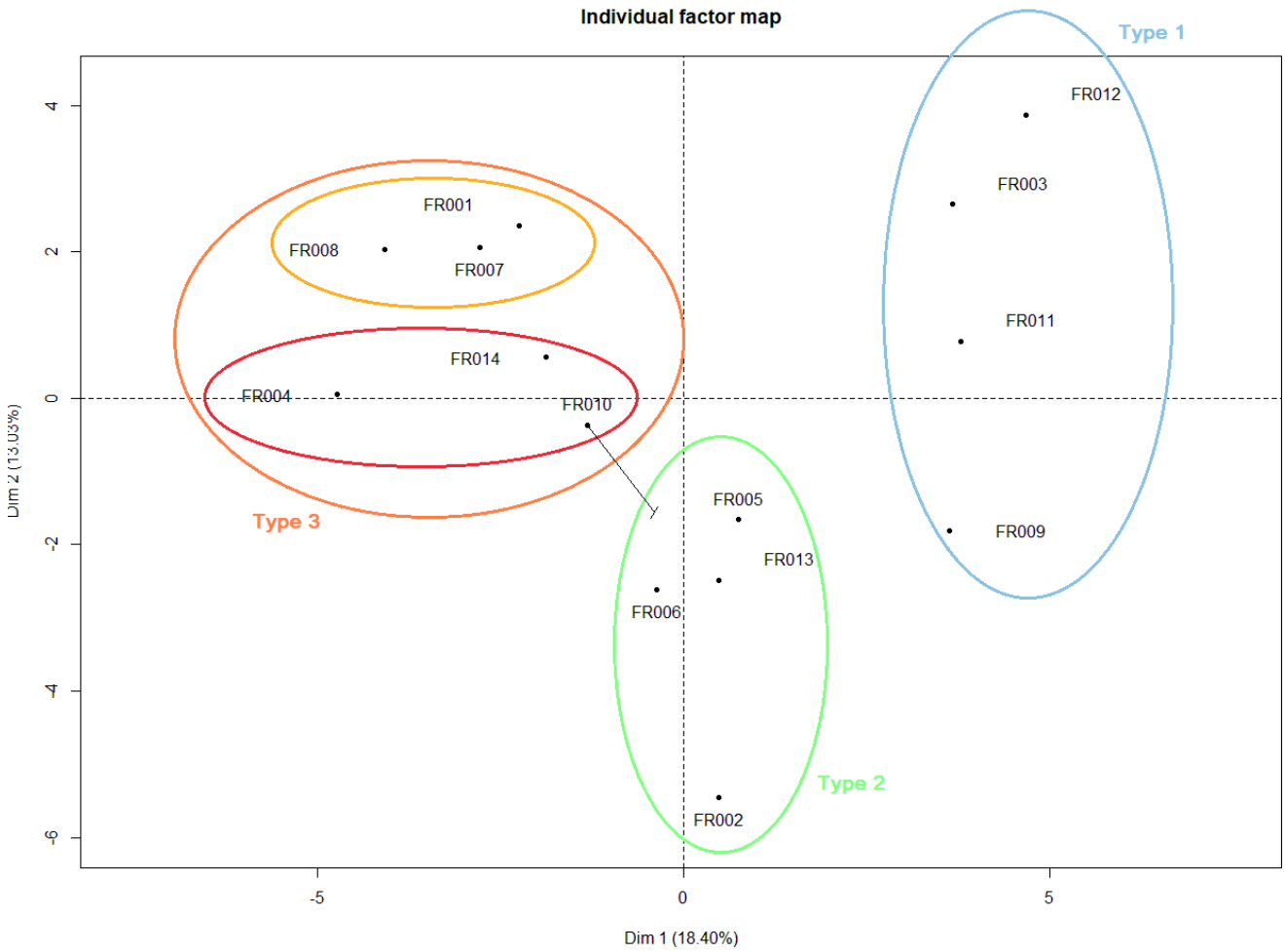


Figure 13: farms repartition with the FAMD method (R)

After gathering the farms in three groups, we described their specificities and common points with the trajectory analysis proposed by Lamine et al. (2014). We attributed each group to each trajectory model regarding the different dimensions explained and farms specificities. There is variation in each group and the types are not fixed but it gives interesting dynamics to discuss later on.

The three models are the following:

- **Type 1:** this type corresponds to the most "intensive" one. In fact, the farms in this type have the highest stocking rates and still aim to increase their production. Farms in this group are the most dependent on fertilisers' inputs and chemical inputs. Thus, some of them are close to feed sufficiency. They are based on crops and temporary pastures to feed their animals. Two of the farms still sell it production through long channels but they develop direct selling in parallel. Only one farm is fully organic in this group. They mainly produce meat and processed meat products. These farms are diversifying their production and their selling practices to survive in a difficult context. Lamine describe this strategy as the "**maintaining of the structure in a sector crisis context**". In that case, the diversification is a constraint and an answer to the economic and sector crisis. Addition of a new enterprises, an organic conversion or a new mode of commercialisation are the adaptations observed in this type and allow the farmers to keep producing and staying economically stable. Farmers often put forward the diversification as an economic advantage.

- **Type 2:** this type gathers the dairy producers, even if the type of production does not belong to indicators. Those farms are in between the most "intensive" and the most "extensive" ones. They have medium stocking rate and want to increase their production without increasing the herd. This volume increase in permitted by an improvement of the feed quality for animals and the milk transformation process. A high level of diversification and a high level of integration between the enterprises illustrate this type. Most of the farmers in this type raise ethical and activism motivation behind their practices. Regarding Lamine farmers' trajectories, this type belong to the strategy of "**rationalisation after a hyper diversification**". The rationalisation of the production corresponds to the improvement of the practices. This rationalisation occurs after a hyper diversification (many of them have more than 2 animal species in the farm) in order to organize the activity in the farm and to obtain a better stability. Farms in this group are the less stable ones: their trajectories are punctuated with several events (addition or removal of an animal enterprise, new workers, new economic strategies). They try to obtain a stability by streamlining the production.

- **Type 3:** the last type is the most extensive one. Indeed, those systems are based on rangelands to feed animals. Stocking rates are very low and it can be explained by the wide quarried surface (up to 1000 hectares). They mostly produce meat except for one farm which produces meat and milk. Those systems are diversified and based on non-competitive feed for human consumption. Farms are located in very rough environments, mostly mountainous and they had to find adaptations for their production. In answer to those difficulties to product, they are selling high quality products with a high added value. This strategy is the "**optimisation on a constrained structure**" type. We distinguished two groups: the young farms adopting this strategy (red circle) and the oldest well settled farms (orange circle). They are not the most diversified farms; most of them have only two species on their farms. They show a good stability in their practices and economic choices.

b. Territorial assessment

In this part, we represented the three farms types with the "La Grange" method. This is a first territory assessment to understand the contribution of each model to the territory in terms of services provided and impacts.

. Type 1

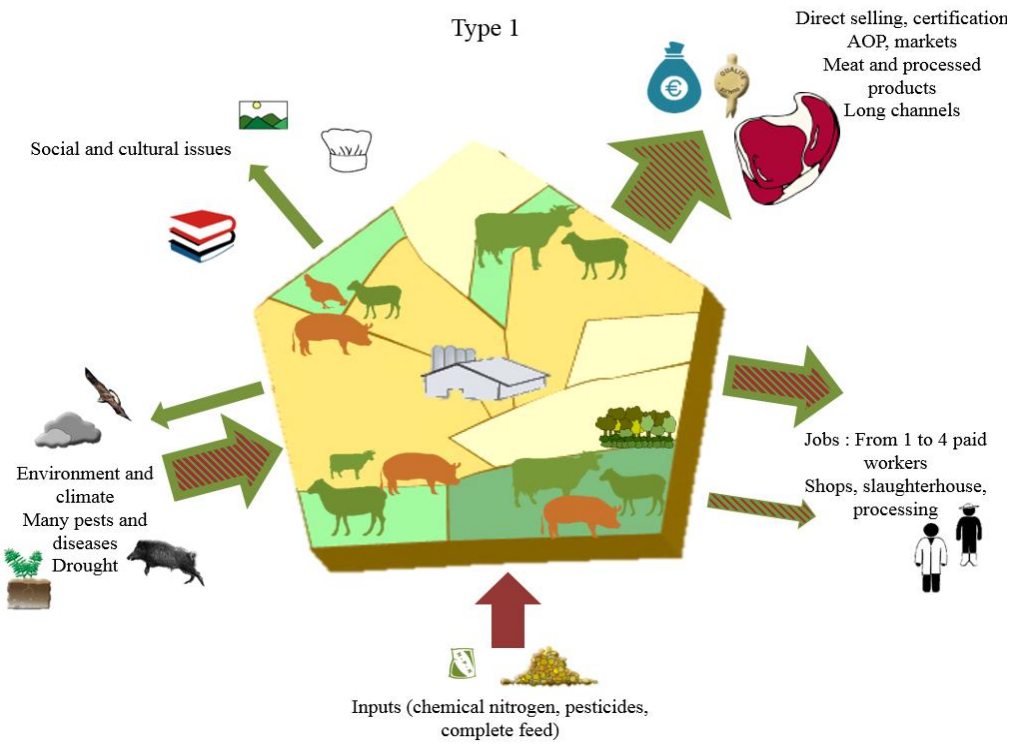


Figure 14 : “Grange” of the first MLS type

Farms in this group are mostly located in dry areas such as garrigues (one is located in a mountainous area). They are based on cultivated crops such as wheat, barley, alfalfa and sainfoin. Their systems are quite inputs dependent. Two of them used chemical fertilisers. They also buy complete feed to cooperatives even if they try to reach autonomy with their crops. This farm model tends to employ many workers (up to 4 and 5 during high workload period). They only produce meat with conventional prices, controlled by the farmer himself for direct selling. This model is confronted with pest, diseases and drought.

This model seems to have an important and positive impact on the employment and the supply of the territory meanwhile it has a lesser impact on the cultural and environmental issues.

. Type 2

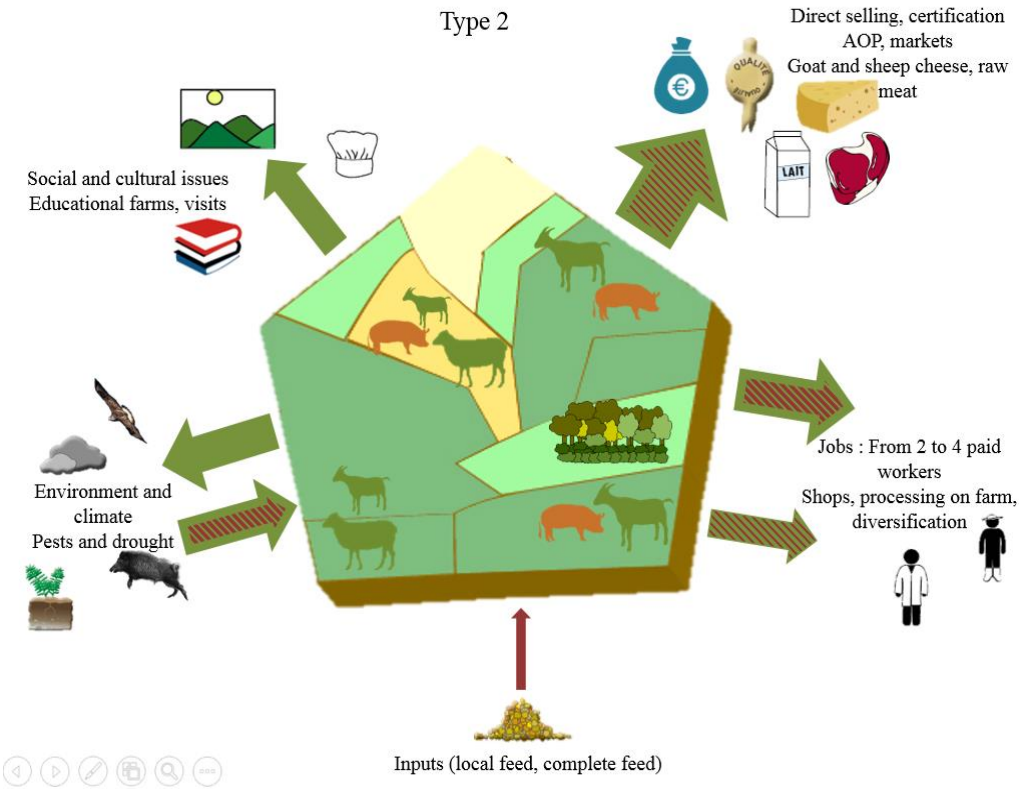


Figure 15: “Grange” of the second MLS type

This group gathered farms located in mountainous and woody areas (expect one located in Garrigues). All the farms are composed by dairy goats or sheep, they are all milk and cheese producers. Their feeding systems are based on grazing, few crops and on local feed purchased. These farms are self-sufficient for fertilization and they only buy feed to a local cooperative (cereals and oil cakes cultivated and processed in the territory). They mainly produce milk and cheese but they complete their production with pigs meat or delicatessen. The pig’s enterprise addition allow them to recycle whey and refusals from the dairy animal’s enterprise. The milk enterprise requires employing workers (at least one) because it represents a huge workload. They added value to their production with quality labels such as the AOP Pélardon.

This model seems to contribute to the social and cultural dynamic of the territory with their networks implication and their educational aspects. They have a moderate impact on the environment because they manage landscape with grazing but they cannot be fully extensive because of milking. This model seems balanced between the different positive and negative impacts on the territory.

. *Type 3*

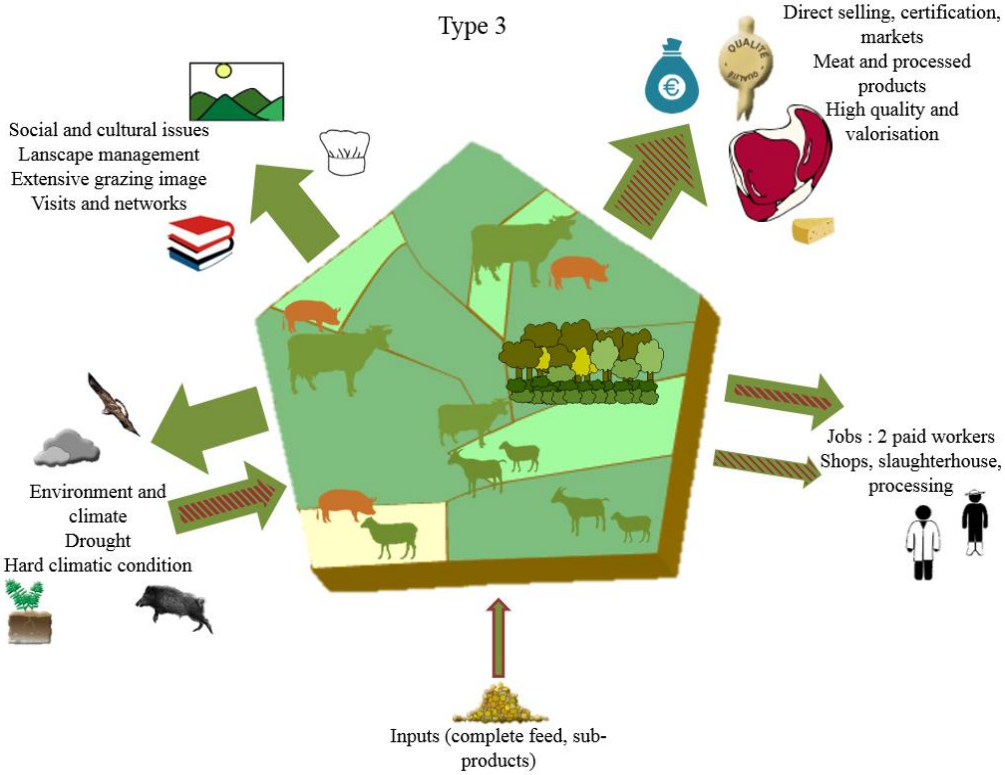


Figure 16: "Grange" of the third MLS type

Farms in the third group are located in mountainous and constrained areas (high altitude, hard climate). Their feeding systems are based on rangelands and they have the longest grazing duration. They all produce meat and processed products except for one farm which produce cheese. Rangelands are under institutional management (conservatories, national offices) for their management and protection. These natural environments are sensitive and the grazing of animals is a form of management against the progression of brushwood and forest fires.

Those systems have many beneficial impacts on the environment and on the social and cultural dynamics. They have a reduced impact on the employment because they mostly work alone or with one worker.

In this section, we described the different territory contribution for each mixed farm model. We can notice that each farm model have a balanced contribution between the different components. The first model contribute to the employment and the supply of the territory. The second model have the most balanced contribution between the three models. The third one offers services to the environment and the social-cultural issues but it has lesser impact on employment and supply than the first one. The coexistence between those three models in the same territory brings interesting information to be developed in the next part.

IV. Discussion

A. Back on the research question

Our first research question was about the strategies developed by farmers linked with their environment and on how they organize their management around the diversification of the animal enterprises. After analysing farms structures and environment, we were able to describe each farm with their own specificities. Those specificities are useful to explain the context in where farm strategies are tested and developed. Indeed, the farm structure, which can be more or less constraining, revealed farmer's strategic adaptations to make his system viable. Then, we analysed farmer's practices which helped us to understand farmers choices and strategies behind these practices. Farmers practices have been classified regarding if they follow agroecological principles or not. It helped us to determine if the farmers tend to "green up" their practices or if they follow other principles/goals. We found that a large majority of the farms adopted practices deeply linked to their resources and environment. We observed different strategies in order to adapt farming practices with their social, economic and ecological environment. Each practice is a result of a specific farming strategy.

For a better comprehension of farms history and it adaptation capacity, we drew and analysed farms trajectories. With those three individual analytic element, we are able to establish farms profiles described by their structural characteristic, their practices and their evolution in time. The individual analysis allows us to approach strategies and management modalities for each farm, but it is not enough to understand if there is a common model or strategy regarding animal diversity. The transversal analysis seems relevant to draw functioning models linked with the animal mixing, corresponding to the third question. Each farm shares the fact of having two or more animal species and we wanted to understand if common strategies does exist. The typology allows us to distinguish three different strategies. This typology seems useful to determine mixed farms models. The next step was to assess these models with the "La Grange" method. This final step in the analysis allows to link farmers strategies with their contribution to the territory dynamic. The final assessment reveals that each model contribute to the agroecological development of its territory but with different levels and scales. Each model have a unique contribution to its environment and the three models can coexist in the same territory. The transversal analysis allows us to answer to the third question about MLS models and their contribution to the territory.

The second research question "which performances, sustainability and resilience?" is the less addressed question. We did not make a sustainability and performances assessment such as IDEA because of the disparities in the data. Yet, we were able to approach it with the agroecological principles, the concept of autonomy and some relevant indicators (social networks, subsidies dependencies). The concept of resilience is wide and hard to assess regarding our farms. The study of farmer's operating logics is useful to approach farms adaptations capacity according to Dedieu et al. (2010). We determined three different operating logics, which follows diverse trajectories and motivations. With the study of long term operating logics inspired by Rigollot et al. (2019) and the study of farms trajectories inspired by Lamine et al. (2014), we are able to distinguish the three types' adaptation capacities. The logic of "producing more with more standardized products" corresponding to the first type appears to be less resilient and flexible than the logic of "producing in adequacy with the available resources" corresponding to the third type. The second type seems to be located in between those two profiles and is focused on the diversification of the production and animal breeds, which brings adaptation capacities to their systems.

B. Advantages and limits of the method

With this research, we tried to characterize farmer's strategies by considering the more elements as possible. Our survey method was partial and considering the short interviews, we were not able to

understand all the components and flows of the farms. Yet, we were able to develop some important aspects to understand diversification strategies and farmers operating logics. We did not assess farms performances because of their inherent complexity and diversity. It does not seem relevant for us to use classical tools of assessment regarding the idiosyncrasy of these farms. Instead, we used a combination of different existent method and approach to create our framework. This framework allows us to make a first characterization of MLS in Languedoc and to build MLS models. Those models can be useful to understand the evolution and the possible expansion of this type of system. Creating an analysis framework is challenging regarding the multiple components and scales we considered around the farm: from the farm enterprises to the global management; from the territory embeddedness to sustainability aspects. This framework does not consider specific characteristic for each farm but aim to be transversal to understand dynamics that are more global.

Individual analysis formed the basis of the transversal analysis. With this first characterization, we were able to determine farms characteristics and to select the most relevant indicators. We did not take into account some indicators such as animal combination, animal products, crops rotation and renewal rate. Those information were too variable regarding the farms and some farmers didn't have those type of information. We chose not considering those indicators to focus on others more selective and appropriate ones.

The transversal analysis allows us to establish a typology of three MLS models regarding their history, structure, practices and trajectories. This typology is a useful tool to understand the possible evolution and perspectives for MLS. The first limits of this typology is the small size of our sample. In fact, mixed livestock farms are quite unusual and rare in Languedoc Roussillon, especially in organic agriculture. It would be interesting to test this typology with others farms from other territories. This typology is a first tool in order to characterize mixed livestock farms and their perspectives, which have to be develop with other surveys.

Another aspect of our method is the large presence of qualitative indicators and the mix between quantitative and qualitative indicators. Our research method is based on semi-directed interviews, this allows the farmer to talk about topics and issues he is interested in. It gives crucial information for understanding the logic, the determinants and the choices of the farmers. In the same time, we wanted to have a minimum of quantitative dates to characterize the structure and the functioning of the farms. As a result, we obtained many quantitative and qualitative data and we selected the most relevant ones for our analysis and treated them with a mixed data statistical method.

The graphic representation with the "Grange" shows advantages and limits. This representation is useful to show the main advantages and issues of a territory shared by different actors and systems. It allows highlighting the diversity of services and impacts of a territory and confirming that one territory can be geared towards supply meanwhile another one is geared towards environmental and cultural issues. This graphic tool illustrate also more balanced systems. However, this tool has a limited heuristic scope according to the authors (Duru et al., 2017). The assessment method to determine the arrows size is quite subjective because we determined it by ourselves. Even if we created a table with a notation system, it is not a real sustainability assessment method. Once the "Grange" is created, it is interesting to confront it with the concerned actors. In our case, we discuss with three farmers during the workshop and they were in accordance with our conclusion about their systems. It would have be interesting to show them those "Grange" but they were not created yet.

We organized the participative framework during a high peak workload for the farmers and it prevented us to present results here. It was an interesting exercise but it does not give sufficient information to discuss about it. Still, the farmers present during the framework approved our models and conclusions.

C. Discussion of the results

All our results are based on farmer's discourses during the interviews. The information given by the farmers were sometimes approximate and sometimes based on declarations documents. It brings few uncertainties to the results but it is the more efficient way to obtain a large amount of information about the farms and the practices. The individual indicators and the trajectories have been built regarding those discourses. We obtained 24 indicators and one trajectory per farm. With those results, we are able to understand the farm history, structure and functioning. The trajectories are very useful to understand the key elements of the farms with a qualitative approach. With those graphic representations, we have the main components and history for each farm. It helped us to determine the models by analysing each farm trajectory.

The three models obtained through the FAMD method can be discussed. The statistical analysis method is relevant regarding our mixed data. Thus, considering the large amount of indicators and their differences (from the lands repartition to the enterprises complementarities) the real statistical value can be contested. We decided to keep this method because we use it as a tool for discussion. The types are an illustration of farmer's strategies and trajectories and they are flexible. For example, one farm can below to the third type but be close to the second type. It means it strategy tends to look like the second type even if it belongs mainly to the third type strategy. Each farm shows specific trajectories and strategies even in each model. The models are useful to draw general tendencies followed by the mixed livestock farms, not to describe each farm perfectly. We found that the models follow three different economic and development strategies. One model is more focused on the high valorisation of their products; another one on the rationalization of it production and the last one is focused on the diversification in order to stay viable. Those three strategies results from the farms history, structure, and environment and from the farmer personality.

The "Grange" allows us to illustrate the three strategic types with their services and impacts for the territory. It gives us interesting information about their contribution to the territory dynamic. For example, the second type has a balanced contribution between the main services and impacts meanwhile the two others are less balanced. The two other types do not contribute at the same level for their territory. We can imagine that these three models are coexisting in the same territory without too much competition regarding this high contrast. With the actual agricultural situation, we can make supposition about the future of these models and their contribution to the agroecological transition.

D. Perspective for MLS

We built three different MLS models with their own operating logics, trajectories and adaptations capacities. This modelling allows to distinguish different form of farm management with more generic and precise indicators than usual ones (organic/non organic for example). This distinction is outside the traditional agronomic method, the same way MLS are outside the traditional farming models. The characterization of MLS has been forgot by traditional methods because they tend to identify the most dominant systems at a territory scale (Dumont et al., 2017). Characterizing MLS means characterizing innovative systems in their relation with the territory, their mode of production and their practices. Therond et al. (2017) built a conceptual framework allowing representing different agricultural models regarding the inputs' nature and source and their globalized or territory embeddedness.

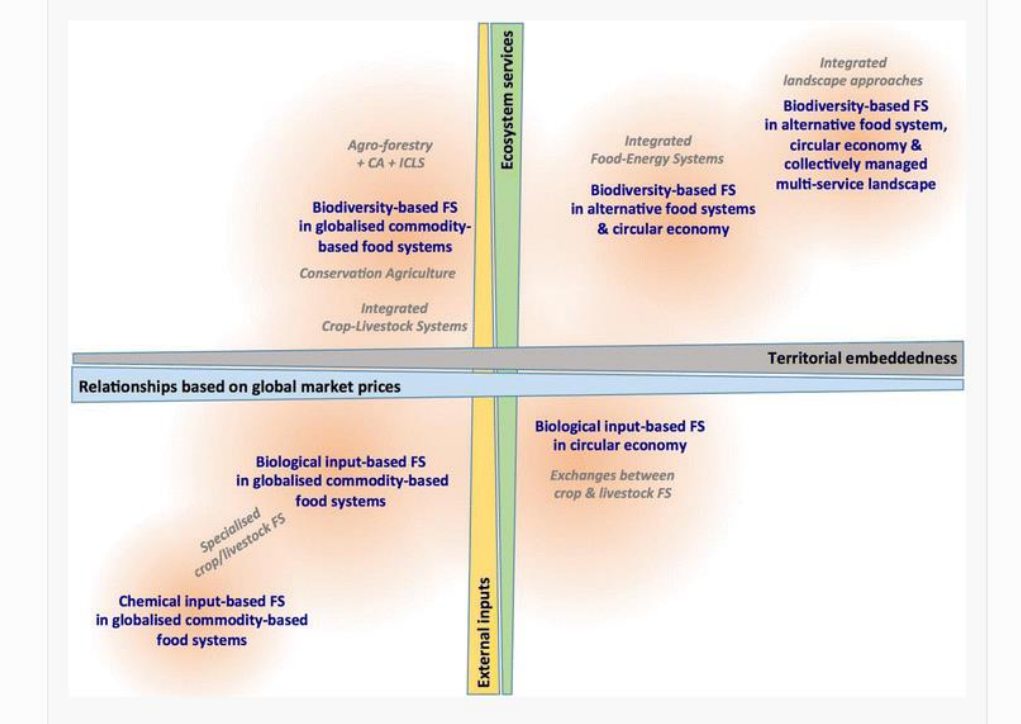


Figure 17: conceptual framework representing six agricultural models according to Therond et al. (2017)

With this framework, we are able to situate our own models. The third type seems to correspond to the "integrated food-energy systems" meanwhile the second one seems to correspond to the "biological input-based food system in circular economy". The first type is more widespread, it starts from "chemical inputs based food system in globalised commodity-based food systems" to "biodiversity based FS in globalised commodity based food systems". This graphic representation is useful to represent the coexistence between agriculture models and their possible evolution.

With this framework, we are able to represent the coexistence between our three MLS models and to imagine their possible transition from a model to another one. Regarding its own context, each model is able to move towards another one by mobilising levers such as circular economy, the autonomy quest, alternative mode of commercialisation or labels. The wide majority of the mixed livestock farms seems to mobilise those levers because of the high environmental and economic pressure on their systems. This specific context explains why those systems have developed innovative and agroecological practices. We can consider MLS as "niches", they do not correspond to the main socio-technical regime. The multi-levels perspective proposed by Geels et al. (2004) consider the "niches" as incubators for a new way of producing. The "niches" studying, promotion and diffusion is useful to facilitate the dominant regime transition. As niches, MLS question the dominant livestock system which tend to be standardized and specialised. In the same time, those models seem difficult to generalize considering their specificities and the work hardness. To some extent, we can consider that MLS contribute to the agroecological transition by adopting innovative practices (from the production to the sales management), by contributing to the territory dynamic and by developing adaptation capacities linked with their environment.

E. Conclusion

First, we characterize mixed livestock farms through their structures, environment and functioning. It reveals that the surveyed farms were unique and have different constraints and advantages. The context of installation, the age, the environment, the animals combinations and many others indicators helped us to build a set of 24 descriptive indicators. We completed this table with the classification of the practices and the trajectories analysis. We can notice the strong link between the farmer's motivation, his practices and his global functioning. The classification of practices revealed that there is a lot of variability regarding those practices and that mixed livestock farms tend to adopt agroecological or autonomous practices. The trajectories analysis shows the stability and the logic of action of each farmer. It helped us to make a link with adaptation capacities and to draw first conclusion about farms resilience, flexibility and vulnerability. For example, the farms with unstable practices and breaks in their trajectories seem more vulnerable than farms well settled with stable practices. This first step represents the individual analysis and it helped us for the transversal analysis.

With the transversal analysis, we were able to distinguish three models corresponding to: "maintaining in a sector crisis structure", "optimisation after a hyper diversification" and "high valorisation in a constrained structure". Those three models correspond to three different operating logics induced by their specific environment, structure and history. We assessed those three types with the "La Grange" method, which allows us to distinguish their territorial contribution. We found that each model contribute to the territory dynamic at different levels and scales. For example, the first type contribute more to the supply than the two others meanwhile the third one contribute more to the environmental issues than the two others. This territory assessment linked with our typology highlight the coexistence of different mixed livestock models in the Languedoc Roussillon territory.

If we compare our three models with the six agricultural models described by Therond et al. (2017), we found that each model is located at different position in the graphic representation. This confirm the coexistence between our models but it also stresses out the different form of transition each model can follow.

This research gives interesting tools to characterize and to model mixed livestock systems. We can make assumption about the MLS contribution for the agroecological transition considering them as niches in the dominant system. However, their high level of specificities and the work hardness described by the farmers can prevent those types of systems generalization. Considering the many issues linked to livestock systems, we suggest enhancing studies and researches about those systems and about others innovative systems. There is a need for innovation in agriculture according to Meynard et al. (2016) and it is possible through an innovative design process for radical innovations; the development of innovation "niches"; the sharing of expectations and knowledge to design together innovations. This research is a first step in the characterization and the redesign of livestock systems innovations and need to be deepened.

V. List of references

- Agreste, 2015. Mémento de la statistique agricole. Agreste Languedoc Roussillon, 32.
- Altieri, M. A. (2018). *Agroecology: the science of sustainable agriculture*. CRC Press.
- Anderson, D. M., Fredrickson, E. L., & Estell, R. E. (2012). Managing livestock using animal behavior: mixed-species stocking and flerds. *Animal*, *6*(8), 1339-1349.
- Bonaudo, T., Bendahan, A. B., Sabatier, R., Ryschawy, J., Bellon, S., Leger, F., ... & Tichit, M. (2014). Agroecological principles for the redesign of integrated crop–livestock systems. *European Journal of Agronomy*, *57*, 43-51.
- Bui, S., Cardona, A., Lamine, C., & Cerf, M. (2016). Sustainability transitions: Insights on processes of niche-regime interaction and regime reconfiguration in agri-food systems. *Journal of Rural Studies*, *48*, 92-103.
- Capitaine, M., Garnier, A., Jeanneaux, P., Pervanchon, F., Chabin, Y., Bletterie, N., ... & Framond, H. D. (2013). Accompagner la démarche de management stratégique de l'exploitation agricole. *Économie rurale. Agricultures, alimentations, territoires*, (337), 75-90.
- Couix, N., Gaillard, C., Lauvie, A., Mugnier, S., & Verrier, É. (2016). Des races localement adaptées et adoptées, une condition de la durabilité des activités d'élevage. Cahiers Agricultures, 25(6), 650009.
- Dedieu, B., & Ingrand, S. (2010). Incertitude et adaptation: cadres théoriques et application à l'analyse de la dynamique des systèmes d'élevage. *INRA Productions animales*, *23*(1), 81-90.
- Dedieu, B., Faverdin, P., Dourmad, J. Y., & Gibon, A. (2008). Système d'élevage, un concept pour raisonner les transformations de l'élevage. *INRA productions animales*, *21*(1), 45-58.

- Dedieu, B., Faverdin, P., Dourmad, J. Y., & Gibon, A. (2008). Système d'élevage, un concept pour raisonner les transformations de l'élevage. *INRA productions animales*, *21*(1), 45-58.

- DREAL (Direction Régionale de de l'Environnement, de l'Aménagement et du Logement), 2016
- Dumont, B., Dupraz, P., Aubin, J., Benoit, M., Chatellier, V., Bouamra-Mechemache, Z., ... & Frappier, L. (2016). Rôles, impacts et services issus des élevages en Europe. Synthèse de l'expertise scientifique collective.
- Dumont, B., Ryschawy, J., Duru, M., Benoit, M., Delaby, M., Dourmad, J. Y., ... & Sabatier, R. (2017). Les bouquets de services, un concept clé pour raisonner l'avenir des territoires d'élevage.
- Duru, M., Donnars, C., Ryschawy, J., Therond, O., & Dumont, B. (2017). La «grange»: un cadre conceptuel pour appréhender les bouquets de services rendus par l'élevage dans les territoires.
- Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research policy*, *33*(6-7), 897-920.

- HLPE. 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.
- Horlings, L. G., & Marsden, T. K. (2011). Towards the real green revolution? Exploring the conceptual dimensions of a new ecological modernisation of agriculture that could 'feed the world'. *Global environmental change*, *21*(2), 441-452.
- Kassambara, A. (2017). *Practical Guide To Principal Component Methods in R: PCA, M (CA), FAMD, MFA, HCPC, factoextra*(Vol. 2). STHDA.
- Lamine, C., Garçon, L., Dupre, L., & Navarrete, M. (2014, November). Trajectoires de petites exploitations en France et en Italie: des facteurs de résilience multiples mais souvent fragiles.
- Laurent, C., Maxime, F., Mazé, A., & Tichit, M. (2003). Multifonctionnalité de l'agriculture et modèles de l'exploitation agricole. *Economie rurale*, *273*(1), 134-152.
- Lemery, B., Ingrand, S., Dedieu, B., & Dégrange, B. (2005). Agir en situation d'incertitude: le cas des éleveurs de bovins allaitants. *Économie rurale. Agricultures, alimentations, territoires*, (288), 57-69.
- López-Ridaura, S., Masera, O., & Astier, M. (2002). Evaluating the sustainability of complex socio-environmental systems. The MESMIS framework. *Ecological indicators*, *2*(1-2), 135-148.
- Meynard, J. M., Jeuffroy, M. H., Le Bail, M., Lefèvre, A., Magrini, M. B., & Michon, C. (2017). Designing coupled innovations for the sustainability transition of agrifood systems. Agricultural Systems, 157, 330-339.
- Moraine, M., Duru, M., & Therond, O. (2017). A social-ecological framework for analyzing and designing integrated crop–livestock systems from farm to territory levels. Renewable agriculture and food systems, 32(1), 43-56.
- Soussana, J. F., Tichit, M., Lecomte, P., & Dumont, B. (2015). Agroecology: integration with livestock. FAO.
- Stassart, P. M., Baret, P., Grégoire, J. C., Hance, T., Mormont, M., Reheul, D., ... & Vissser, M. (2012). L'agroécologie: trajectoire et potentiel pour une transition vers des systèmes alimentaires durables. *Agroéocologie, entre pratiques et sciences sociales*, 25-51.
- Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the Anthropocene: the great acceleration. *The Anthropocene Review*, *2*(1), 81-98.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... & Folke, C. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, *347*(6223), 1259855.
- Thomas, M., Fortun-Lamothe, L., Jouven, M., Tichit, M., Gonzalez-Garcia, E., Dourmad, J. Y., & Dumont, B. (2014). Agro-écologie et écologie industrielle: deux alternatives

complémentaires pour les systèmes d'élevage de demain. *Numéro spécial, Quelles innovations pour quels systèmes d'élevage*, 89-100.

- Thomas, M., Fortun-Lamothe, L., Jouven, M., Tichit, M., Gonzalez-Garcia, E., Dourmad, J. Y., & Dumont, B. (2014). Agro-écologie et écologie industrielle: deux alternatives complémentaires pour les systèmes d'élevage de demain. *Numéro spécial, Quelles innovations pour quels systèmes d'élevage*, 89-100.
- Thompson, P. B., & Nardone, A. (1999). Sustainable livestock production: methodological and ethical challenges. *Livestock production science*, *61*(2-3), 111-119.
- Van der Ploeg, J. D. (2012). *The new peasantries: struggles for autonomy and sustainability in an era of empire and globalization*. Routledge.
- Venables, W. N., & Smith, D. M. (2003). The R development core team. *An Introduction to R, Version*, *1*(0).
- Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D., & David, C. (2009). Agroecology as a science, a movement and a practice. A review. *Agronomy for sustainable development*, *29*(4), 503-515.

VI. Appendix

A. Interview guide

GUIDE ENTRETIEN PROJET MIX ENABLE INRA UMR INNOVATION

Question d'ouverture : « Vous êtes aujourd'hui éleveur mixte en agriculture biologique, pouvez-vous nous dire comment vous en êtes arrivés là ? »

I.Présentation générale

a) Histoire de la ferme [*héritage, reprise, extension, succession, statut légal, nom, année de conversion en bio*]

b) Profil de l'exploitant [*nom, formation, âge, choix du métier, début dans la ferme, racines agricoles, expérience agricole, travail en dehors de la ferme, perception bien être de ses animaux*]

c) Relations sociales [*agriculteurs, réseaux professionnels, réseau social non agricole, source d'informations et satisfaction*]

d) Motivations et difficultés par rapport au métier [*aspirations, idéologie, évènements marquants]*

. Forces (global et lié à diversité)
. Faiblesses (global et lié à diversité)
. Opportunités (global et lié à diversité)
. Risques (global et lié à diversité)

II. Structure de la ferme

a) Contraintes [*pédologiques, climatiques, géographiques*]

. Qualité du sol, labour, zones environnementales, MAE
. Précipitations, évapotranspiration, durée saison croissance
. Accessibilité, points de vente [*point de vente le plus proche*]

b) Utilisation des surfaces [*superficie totale, SAU, assolement, espaces boisés/haies, parcours, longueur forêt entourant champs, surface irriguée, surface labourée, surface pâturée, distance entre champs les plus éloignés*]

c) Sol [*état, nombre parcelles, distances, cultures/prairies, fauche/pâturage*]

d) Travailleurs [*nombre temps plein, salaires, non-salariés, UTH*]

e) Infrastructures [*bâtiments, enclos, autres, utilisation, temps d'occupation bâtiments*]

f) Cheptels [*nombre d'espèces, nombre de têtes*]

g) Spécialisation [*autres activités, différents ateliers, salariés spécialisés*]

III.Caractéristiques techniques

a) Production végétale [*type production, superficie, espèces, assolement*] :

. Rendement moyen [*T /ha, prix en €/tonnes*]
. Couverture du sol [*engrais vert, hiver*]
. Rotations [*cinq dernières années, calendrier des semences*]
. Fertilisation [*fertilisants extérieurs, azote épandu, fumier, lisier, association graminées/légumineuses*]
. Protection ravageurs

b) Production animale [*type production, espèces, races, nombre, début atelier, attente vis à vis atelier, troupeau, poids moyen, nombre têtes achetées par an, temps passé au soin pour chaque type*] :

. Rendement moyen [*kg protein/UGB*]
. Alimentation [*concentrés, fourrages, provenance et quantité achetée, morcellement prairies, variations au cours de l'année*]
. Vétérinaire [*coûts, nombre d'interventions, urgence, maladies récurrentes; nombre traitements et vaccins, par catégories et maladies, nom et code vaccin*]
. Relations entre les animaux [*sur champ, en bâtiment, autre*]
. Bâtiments [*taux de saturation, nombre de jours passés à l'intérieur*]
. Dynamique du troupeau [*naissance, décès, taux de remplacement, taux de réforme, mortalité des jeunes, mortalité adultes, période naissance, jeunes pour remplacement ou engraissement, nombre mères*]

c) Intégration des productions :

. Echange des sous-produits [*type, provenance, quantité, destination, quantité consommée*]
. Produits transformés/crus [*nombre, type, clientèle, valeur ajoutée, sur la ferme, TVA*]

. Débouchés [*filières courtes / longues, vente directe, quantité vendue, nombre de clients, type d'emballage*]
. Avantages et inconvénients de la mixité [*enjeux techniques, apports, problèmes éventuels*]

d) Autres :

. Mécanisation [*tracteurs, matériel fixe, mobile*]
. Energie [*production, consommation, gaz, gasoil, électricité, utilisation voiture, tracteur*]
. Prestation de services

IV. Charge de travail

a) Journée et année type [*répartition tâches selon profil, pics de travail, calendrier agricole*]
b) Temps libre [*vacances, jours de congé, temps en famille*]
c) Difficulté et complexité du travail [*physique, mental, perception de l'intensité, période plus chargée*]
d) Salariés [*nombre temps plein, origine, formation, versatilité*]

V. Situation économique (demander comptabilité si possible)

a) Investissements [*passés, en cours ou prévus*]
b) Capital total, satisfaction des revenus
c) Coûts [*variables ; fixes, subsides*]
d) Revenus supplémentaires [*vente directe, agrotourisme, autres*]

VI. Recul et perspectives

a) Avenir de la ferme, agrandissement, reprise, développement d'autres secteurs
b) Perceptions par rapport à autonomie et résilience de son système
c) Dimension éducative, visites, études déjà réalisées, autres activités de diversification

B. Project graphic code

Règles des Carrés (ateliers cultures et prairies) :

Taille
Côté du carré = en cm
Exemple Porcs/bovins viande :
pour un atelier prairies de 91ha, le côté du carré =
Positionnement :

Si les carrés se chevauchent, cela veut dire qu'il y a une interaction.
Exemple Porcs/bovins viande :
Les prairies sont en rotation avec les cultures (intégration spatiale et temporelle(+)) sur 6 ha (la moitié de la surface en cultures recouvre les prairies).

Couleurs :
Vert : Prairies
Jaune : Cultures

Règles des cercles des ateliers animaux :

Taille :
Diamètre du cercle = cm

Exemple Porcs/bovins viande :
Il y a 105,9 UGB pour l'atelier porcs donc diamètre du cercle des porcs = 8,21 cm
Positionnement :

Si les carrés se chevauchent, cela veut dire qu'il y a une interaction.
Exemple Porcs/bovins viande :
Les 2 ateliers animaux pâturent sur les mêmes parcelles (intégration spatiale et temporelle (+))

C. Territory assessment indicators

			type1	type2	type 3	total 1	total 2	total 3
Inputs	+	**Natural fertilization**	0,5	0,75	1	0	2	2,25
		Extensive grazing	0,5	0,75	1			
		Close to feed self sufficiency (75%)	0,5	0,75	0,5			
	-	**Nitrogen fertilization**	-0,5	0	0			
		Pesticides	-0,5	0	0			
Work	+	**Concentrates**	-0,5	-0,25	-0,25			
		Paid workers	1	1	0,5	0,5	1	1,5
		Tourism and diversification	0,25	0,75	0,75			
		Jobs out of the farm	0,5	0,75	0,75			
		Social fabric (strong network)	0,5	0,75	0,75			
		Channels management	0,5	0,75	0,75			
	-	**Low incomes**	-0,25	-0,75	-0,5			
		High workpeaks	-0,75	-0,75	-0,5			
		High workload	-0,75	-1	-0,5			

		Poor satisfaction regarding the salary	-0,5	-0,5	-0,5			
Supply	+	**Short channels**	0,5	1	1	1,25	2,5	2,25
		High added value	0,5	0,75	0,75			
		Strong customers demand	0,75	0,75	0,75			
	-	**Long channels**	-0,5	0	-0,25			
		Poor demand	0	0	0			
		Good image	0,25	0,75	1	0,75	2	2,5
Sociocultural	+	**High quality products**	0,25	0,75	0,75			
		Rustic breeds	0,25	0,5	0,75			
Environment	+	**Biodiversity management**	0,25	0,5	0,75	-0,25	0,75	2,75
		Carbon fixation with pastures	0,25	0,5	1			
		Environmental contracts	0	0,5	0,75			
		Climate variations management	0,25	0,25	0,5			
	-	**High energy dependency**	-0,5	-0,5	-0,25			
		Impacts on soil (ploughing, erosion)	-0,5	-0,5	0			

D. Workshop report

Compte rendu

Atelier de restitution du 18 juin 2019 à Grabels

Organisateurs : Marc Moraine, ingénieur de recherche ; Manon Fuselier, stagiaire de Master Recherche - UMR Innovation – INRA Montpellier.

Animateurs : Aurélie Gibert, animatrice FD CIVAM du Gard ; Didier Gomes, animateur CIVAM Empreintes.

Participants : Charlotte Svahn, stagiaire de recherche UMR Innovation Montpellier ; Fabien Robert, fils d'un éleveur intégrant l'ENSAT en septembre ; Bruno Robert, exploitant de la ferme des Pélissiers ; François Crémier, exploitant de la Bergerie de l'Espiguette ; Charles Compan, exploitant du GAEC du Serrelis.

Déroulé de la journée :

- Matinée dédiée à la présentation du projet et à la restitution des résultats, questions et avis des participants ;
- Après-midi dédiée discussions et échanges sur la gestion de l'exploitation au moment présent et à l'avenir, en lien avec les dynamiques des pratiques et la place de la mixité.

Présentation détaillée des systèmes d'élevage des éleveurs présents :

- Ferme Les Pélissiers : bovins viande en vente directe dans le Causse Noir, pâturage très extensif, porcins plein air en complément, certifié biologique
- Bergerie de l'Espiguette : ovins viande, caprins viande, bovins viande en conduite extensive et vente directe, transhumance sur des terres louées aux conservatoires (littoral, garrigues), certifié biologique

- GAEC du Serrelis : brebis lait en vente à Roquefort, bovins viande, porcins plein air, vente directe, découpe et transformation sur la ferme, conduite plus conventionnelle

Points abordés lors des discussions :

- **Autonomie alimentaire, autonomie en énergie** : les éleveurs sont d'accord sur l'importance de se rapprocher de l'autonomie alimentaire mais évoquent plusieurs difficultés reliées à cela. La première difficulté repose les **conditions pédoclimatiques du territoire**, peu avantageuses en termes de productivité, elles ne permettent pas de produire en suffisance pour nourrir les animaux. La deuxième difficulté repose sur **les aléas climatiques** notamment les sécheresses ou **les problèmes de ravageurs** qui poussent parfois les éleveurs à devoir acheter des fourrages et des céréales. Cependant, la forte hausse du coût des aliments et la part importante des **coûts des aliments biologiques** dans les coûts de production ne favorise pas les performances économiques des éleveurs. Une solution pour compenser cela est d'augmenter le prix des produits.

- **Embroussaillement et fermeture des milieux** : il a été évoqué que les animaux seuls ne peuvent résoudre ces problèmes même avec une **pression forte de pâturage**, ils peuvent cependant favoriser le **maintien d'espèces endémiques** dans certaines zones. Plusieurs éleveurs utilisent des moyens mécaniques pour empêcher les buissons d'envahir leurs prairies permanentes, cela demande un travail supplémentaire et difficile mais nécessaire. Les surfaces agricoles se sont agrandies suite aux remembrements et il devient plus difficile de faire pâturer toutes les surfaces avec un chargement animal nécessaire au maintien des milieux ouverts. La présence d'animaux d'élevage en plein air peut, en parallèle, favoriser la présence **d'espèces sauvages**, comme les lièvres ou les perdrix, qui bénéficient de la diversité des milieux.

- **La vente directe et la construction du revenu** : la vente directe est évoquée comme presque indispensable dans leurs systèmes et très bénéfiques économiquement, cependant elle demande beaucoup d'effort en termes **d'organisation et de temps de travail**. Une alternative énoncée est celle du regroupement de producteurs pour alléger la charge de travail, **l'organisation collective** pour la vente est une piste. L'embauche de salariés ou de stagiaires, lorsque la capacité financière de l'exploitation le permet, procure aussi une aide précieuse aux exploitants. Les revenus sont meilleurs en vente directe mais sont malgré tout largement dépendants **des subventions** (primes PAC DPB, ICHN, AB…). Les aides sont une composante importante dans le revenu des éleveurs. Un avantage cité est la quasi absence de concurrence et la forte demande pour leurs produits qui permet un écoulement des productions assuré et rapide.

- **Choix derrière la mixité** : les éleveurs ont construit ou hérité de la mixité des espèces sur la ferme, et justifient cette stratégie selon deux logiques : **économique** d'une part, **éthique ou militante** d'autre part.

La logique économique consiste à créer un nouvel atelier avec des bénéfices : fonctionnels (valoriser certains sous-produits par exemple), financiers (renouveler la trésorerie plus rapidement dans le cas d'animaux à croissance plus rapide), commerciaux (l'offre diversifiée de produits permet de fidéliser la clientèle).
La logique militante se rapproche d'un idéal de fermes paysannes composées de plusieurs espèces d'animaux.

Les aspects techniques sont communs à ces deux logiques : le pâturage mixte par exemple avec plusieurs espèces de ruminants permet une valorisation optimale des ressources.

- **Le métier d'agriculteur** : le métier d'agriculteur est vécu par les éleveurs comme un métier d'expérimentation constante, d'essais et d'erreurs au quotidien, avec une dimension stimulante mais aussi une dimension de contraintes importantes.

La difficulté du travail en termes de charge mais aussi de pénibilité physique a été abordée. Par exemple, la conduite des brebis se révèle très difficile physiquement pour certains et les poussent à réduire leurs effectifs ou à supprimer cet atelier, pour préférer les bovins qui se révèlent plus facile à conduire (moins de manipulation directe).

Une autre difficulté est l'isolement géographique et l'isolement social que le métier peut provoquer. Trouver des employés agricoles ou des collaborateurs fiables se révèle difficile, en grande partie pour les raisons évoquées.

- **Anticipation des aléas climatiques** : le changement climatique est reconnu et observé par les participants, avec notamment des sécheresses longues, plus tardives dans l'année, et des redémarrages plus difficiles de végétation sur certains espaces. Des formes d'adaptation sont envisagées, à court terme : assurance sécheresse contractée par l'un des éleveurs pour compenser les achats nécessaires de fourrages, constitution de plus de stocks ou achat préventif, déplacement des animaux vers des zones moins touchées, estives plus hautes, etc. A long terme, l'agroforesterie et la mise en place de haies brise-vent semblent des options prometteuses.

En conclusion, les participants de l'atelier ont témoigné d'une diversité dans les systèmes mixtes, mais aussi dans les contraintes rencontrées. Certaines convergences apparaissent néanmoins autour d'un modèle d'élevage mixte valorisant fortement les ressources locales, qui construit la performance économique sur la transformation et vente directe, mais dépend en grande partie des aides PAC pour le revenu. La gestion technique apparait bien maitrisée par les éleveurs, tant pour les ressources fourragères que pour la conduite des animaux, mais l'exposition à certains facteurs de risque (perte de valeur de certains milieux, équilibre à trouver entre gestion des milieux et agrandissement, changement climatique) reste forte. L'enjeu social et professionnel est majeur, avec des contraintes (attractivité du métier, charge de travail) mais aussi des points forts (liens aux consommateurs, fierté vis-à-vis des pratiques d'élevage). Les éleveurs s'inscrivent dans une logique d'amélioration continue de leurs pratiques et des systèmes, avec des choix déterminants sur les stratégies à adopter, notamment les effets de taille des ateliers et de l'exploitation.

VII. Abstract

Résumé

Considérant les nombreuses controverses autour de l'élevage, une nouvelle manière d'étudier, de concevoir et d'accompagner les exploitations agricoles est devenue nécessaire. Les systèmes d'élevage mixte biologiques/extensifs apparaissent comme des modèles diversifiés, innovants et adaptatifs dans un contexte de spécialisation et d'agrandissement des fermes. Or, la diversité est souvent mise en avant comme une composante essentielle pour des pratiques plus durables, se basant sur l'agrobiodiversité fonctionnelle. Etudier des systèmes d'élevage mixte de façon systémique relève d'une inhérente complexité et cela n'a jamais été réalisé avant le début du projet européen Mix ENABLE. Nous avons réalisé 14 enquêtes sur le territoire du Languedoc Roussillon et ces fermes se sont révélées très diverses en termes de structure, d'environnement et de pratiques. Nous avons combiné plusieurs approches afin de créer un cadre d'analyse à plusieurs niveaux permettant d'englober les composantes principales autour des fermes enquêtées. Ce cadre part du niveau le plus petit (détails de la structure de chaque ferme) au niveau le plus grand (représentation graphique des interactions avec le territoire). Nous avons modélisé les systèmes retrouvés et nous les avons classé en trois types. Les modèles d'élevage mixte suivent ainsi trois stratégies économiques et de fonctionnement différentes. La typologie couplée à la réalisation de "granges" territoriales permet ainsi de mettre en évidence la coexistence de plusieurs stratégies d'exploitations sur un même territoire et leurs contributions diverses et potentiellement complémentaires à la transition agroécologique.

Summary

Considering the several controversies surrounding animal farming, a new way for studying, designing and supporting agricultural holdings becomes necessary. Organic/extensive mixed livestock systems appear as diversified, innovative and adaptive models in a context of farms specialization and expansion. Yet, diversity is often put forward as an essential component for more sustainable practices, based on the functional agrobiodiversity. Studying MLS with a systemic approach has never been done before the start of the European project Mix Enable, because of the inherent complexity of these systems. We realized 14 surveys on the Languedoc Roussillon territory and those farms appear to be diverse in terms of structure, environment and practices. We combine several approach in order to create a multi-level analysis framework allowing considering the principal components around the surveyed farms. This framework start from the smallest level (the farm structure) to the biggest one (graphic representation of territory interactions). We made a modelling of the systems and classified them in three types. MLS follow three different economic and functioning strategies. The typology coupled with the creation of the territory "granges" allow to highlight the coexistence between different farming strategies in the same territory and their diverse contributions potentially complementary to the agroecological transition.