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in

López-Francos A. (ed.), Jouven M. (ed.), Porqueddu C. (ed.), Ben Salem H. (ed.), Keli A. (ed.), Araba A. (ed.), Chentouf M. (ed.).
Efficiency and resilience of forage resources and small ruminant production to cope with global challenges in Mediterranean areas

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 125

2021
pages 309-313

Different forms of Crop-Livestock Integration. Analysis in the South of France

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Abstract. Reconnecting crops and livestock is a way of contributing to agro-ecological transitions in production systems and territories. This is a particularly important challenge in the Mediterranean area because of the marked specialization of territories, with cash crops in lowland areas and on the coast, while livestock farming is concentrated in inland regions, which are often in decline. There are various forms of Crop-Livestock Integration (CLI). Based on a few specific examples, we present various forms of CLI (reconnecting the crop system and the livestock system on the farm; local-level arrangements between neighbours; partnerships between winegrowers or orchard farmers and breeders; cooperation between stakeholders on a regional scale, and so on). We will study the conditions for their implementation, the changes brought in the activities, the potential performance and the prospects offered by these forms of CLI for the development of livestock systems and territories in the Mediterranean area.

Keywords. Mixed farming – Crop – Livestock – Integration – Reconnection – Transition – Cooperation – Arrangements.

Différentes formes d'intégration agriculture-élevage. Analyse dans le Sud de la France

***Résumé**. Reconnecter cultures et élevage est un levier pour favoriser des transitions agro écologiques à l'échelle des systèmes de production et des territoires. En zone méditerranéenne, cet enjeu est particulièrement important du fait de la spécialisation marquée des territoires : cultures de vente en plaine et en littoral, élevage dans les arrières pays, souvent en déprise. L'Intégration Culture-Elevage (ICE) peut prendre différentes formes. A partir d'exemples concrets, nous présenterons diverses formes d'ICE, (remise en connexion du système de culture et du système d'élevage dans l'exploitation ; organisation à l'échelle locale entre voisins ; collaboration entre viticulteurs ou arboriculteurs et éleveurs ; coopération entre acteurs à l'échelle régionale). Nous étudierions les conditions de leur mise en œuvre, les changements induits dans les activités concernées, les performances potentielles et les perspectives offertes par ces formes d'ICE pour le développement de l'élevage et des territoires en zone méditerranéenne.*

***Mots-clés.** Agriculture mixte – Culture – Élevage – Intégration – Reconnexion – Transition – Coopération – Arrangements.*

I – Introduction

The agricultural modernization policies implemented in France since the 1960s have resulted in the specialization or even the disconnection of arable and livestock farming both at production systems and territorial scales. In the French Mediterranean area, the segmentation of space is particularly marked: we find intensive monoculture in lowlands and largely pastoral livestock farming in the foothill areas in decline. In this kind of context, Crop-Livestock Integration (CLI) is one of the key approaches for making the agro-ecological transitions and reinforcing the sustainability of activities in the territories (Mischler *et al*., 2019). However, CLI can prove difficult to implement because the sectors and advisory bodies have become specialized and due to a number of socio-technical barriers (Geels, 2007). Now is a good time to design LCI projects. Society's re-evaluation of intensive agriculture, the evolution of food systems, the increasing focus on environmental issues and the climatic emergency all raise questions about the future direction of arable and livestock farming.

A few pioneering initiatives are gradually emerging. Some involve a single farm and farmer, while others involve several farmers pooling their land. There are also mutually agreed arrangements between, for example, a mountain livestock farmer and a lowland farmer and, more rarely, projects rolled out on a regional scale. In this document, we analyse four situations where arable and livestock farming have been reconnected in the South of France: two at farm level, involving only crop growers and livestock farmers, and two at the scale of a natural park area or a municipality, involving a diversity of stakeholders. We compare these contrasting situations to identify the lessons to be learned about emergence conditions of CLI, to identify limitations to CLI, and to discuss the contribution of CLI to the agro-ecological transitions.

II – Original ways of reconnecting crop and livestock farming

1. A small herd grazing in an orchard

Seeking to reduce chemical treatments in their orchards, some farmers have acquired a small flock to control certain pests and diseases such as voles, codling moth and scab (Dufils, 2017; Rey and Coulombel, 2008). A first management strategy consists in a post-cropping grazing of the orchard to consume and reduce as far as possible fallen fruit and leaves, the latter being potential sources of inoculum. The flock leaves the orchard at the onset of the budding period. In this case, the farmer has at his disposal other foraging areas : grasslands, summer pastures, rangelands to feed the flock during spring and summer. A second management strategy consist in maintaining the flock in the orchard for as long as possible. Grazing can occur all year round, except in periods of fruit harvesting or lambing. Such strategy offers more opportunities and flexibility to synchronize the timing of grazing with pathogens cycles, thus increasing the impact on pests and diseases.

The presence of the herd is an additional factor to be considered in terms of type of work to be done in the orchard. The additional work introduced by livestock farming includes managing grass resources, developing mobile pens for rotational grazing under the trees, observing animals and sward to see when grass resources become insufficient and a change of paddock is required, and protecting tree bark from damage. Livestock farming also implies more time constraints, a different health management and different regulations. It also calls on different networks (e.g. veterinarians, sheep shearers, slaughterhouses, etc.) to be added to the farmer's usual set of contacts. The integration of livestock in the orchard will largely depend on what services the farmer expects and on his interest in livestock farming. It will also be closely linked to his ability to develop an integrated production system and acquire new skills.

2. Reverse transhumance based on mutual agreement between a winegrower and a livestock farmer

The agricultural systems involved – viticulture on large estates in the *Var*, and sheep farming for meat in the southern Alps – have undergone significant changes in recent decades (Garde *et al.,* 2014, Dupré *et al*., 2017). In viticulture, there is a renewed interest in winter grazing of sheep in vineyards, prompted by the growth of certified organic wine markets and a marketing approach aiming to promote winegrowing as integrated with other activities in rural areas. The aim of CLI here is to minimize weed growth between vine rows using grazing rather than herbicides, while giving wine a pastoral image associated with 'natural values'.

In sheep farming, there has been a sharp increase in herd sizes in the mountain areas of the Southern Alps, caused by economies of scale and public incentives since the 1990s. However, on some farms, this has been limited by the capacity to build up sufficient forage stocks for winter feeding. To overcome this, livestock farmers in the mountains bring their flocks down to the lowland coastal areas in winter, to graze shrubland and forest areas. They often work hand-in-hand with public authorities to reduce fire risk.

This context favours the reactivation of a traditional winter transhumance almost abandoned during the second part of the 20 th century. In fact, the lowland areas grazed by livestock are close to the wine estates, which has led to the development of winter grazing among the vines, on the basis of mutual agreements between the two types of farmer. These agreements require (i) the provision of large areas of pastureland, adapted to the size of the flocks; (ii) grazing in small paddocks, developed using mobile pens which can be easily removed in case agricultural operations are carried out in the vineyard. Such CLO involves just two parties: the manager of the vineyard estate and the livestock farmer, in a relationship of subordination. In fact, the constraints of livestock farming must not hinder the flexibility required for the management of the vineyard. Large flocks with limited production objectives are the best type of partner for this kind of CLI.

3. Synergies between arable farming and livestock breeding at the level of a regional natural park

Animals and crops have been farmed together in various ways throughout agricultural history. Today, as agriculture evolves towards more sustainable production systems, orchard farmers are choosing to let ewes graze among their fruit trees. As in our first example, their main aim is to manage grass cover and to improve the control of certain pests and diseases while reducing chemical inputs such as plant protection products or fertilizers. In the *Alpilles* Massif, some farmers joined up with '*herbassier*'[1] shepherds, in order to graze the large sheep flocks in dense fruit-farming areas, from the end of the harvest until bud emergence the following spring. This informal arrangement benefits both parties, providing access to grass resources for the herd and maintenance of the grass cover in the orchard (Ducourtieux *et al*., 2012).

With its role in territorial management, the *Alpilles* Regional Natural Park is trying to capitalize on this practice to encourage new connections between crop farmers and livestock breeders as part of a multi-partnership project, with the aim of reducing agricultural inputs to protect the area's rich avifauna. This initiative has a clear sociological objective: to bring together stakeholders from different sectors who rarely mix otherwise. However, one of the challenges will be to coordinate CLI with other activities and stakeholders (elected officials, hunters, walkers, etc.) over the long term, while maximizing synergies with livestock breeders already present in the territory, in forest areas or in annual crop-growing areas.

4. Synergies between mountain areas and low-lying plains on a regional scale

In the framework of a development project (financed by a program launched by the Ministry of Agriculture in 2012 to support collective actions encouraging agro-ecological transitions), local officials from a coastal town in the South of France (*Claira*) and livestock farmers from the *Pyrenees* foothills (*Canigou*) worked together to convert peri-urban agricultural wastelands into forage crops. Together, they pursued two objectives : promote a diversified land use in the coastal area and increase feed self-sufficiency of livestock farms by producing hay and cereals, which is not possible in mountain areas (Napoleone *et al.,* 2019; pleinchamp.com, 2017).

The town recruited a land coordinator to convince landowners to lease out their fallow land free-of-charge (one or five-year lease). Five livestock farmers set up a business together (with SARL limited liability status) and worked together to cultivate the land. The land coordinator oversaw the initiative to ensure consistency between the actions carried out by the various parties. Other stake-

1. A 'herbassier' is a sheep farmer with no land of their own, who moves their herd from the coast to the mountains following the various levels of vegetation.

holders (hunters, other farmers, residents, etc.) were involved in the project in a formal or informal way. Over five years, the five farmers cultivated a total 100 ha and are now fully self-sufficient. The spatial distribution of cultivated land within the municipality is discussed and agreed on by the various stakeholders. It includes cultivated areas designed to conserve biodiversity (10% of the surface area, i.e. 10 ha, distributed across the territory), which location is discussed with hunters and hunting and wildlife associations. The scheme has built real social dynamics in the municipality, where people are happy with the project. It has reshaped the urban fringes and represents a support for small-scale mountain livestock farmers.

This system involves various parties. Starting with private property (the fallow land), a resource that benefits the community on the territorial scale is gradually developed, enabling (i) agro-ecological dynamics in the lowland area (e.g. cultivating legume crops), and (ii) support for livestock farming activity in the foothills.

III – Discussion

1. A traditional practice that is being revisited

Farming practices connecting crop and livestock farming are developing in southern France. There is a wide potential of expansion of CLI in the future. As an example, in the *Var* department, 35000 hectares of vineyards and olive orchards are potentially available for grazing, that is to say 7 millions of grazing days for ewes (estimation from the Vitipasto project). In the *Pyrenées Orientales* department, the Chamber of Agriculture estimate that 10 000 hectares of abandoned farmland are available and that cropping one tenth of them could restore the feed self-sufficiency of all the pastoral systems in the area.

2. Conditions for emergence

Many farmers start to question their production methods and seek new ways of reducing inputs, which is in line with consumer expectations about farming practices and the quality of agricultural products. These situations arise from a sense of dissatisfaction or a need to shift towards a more ecological approach. They also occur when stakeholders involved in different activities come together. Even though they may have different concerns, they are all interested in the benefits of CLI and in the synergies which may be activated by their cooperation.

3. Considering a CLI situation over the long term

Livestock is sometimes seen by farmers or other stakeholders in the lowland areas as the key to a reduction in the number of chemical treatments or machine operations. They can therefore focus on the constraints and objectives specific to their farm or territory. However, letting a herd graze on a particular type of plot at a particular time, or growing legume crops in lowland areas must also be compatible with the work involved in livestock farming and the organization of the livestock system. If the transitions are to be sustainable and viable in the long term, grazing must not be reduced to the provision of an 'environmental service'. CLI, which reconnects two specific functions – crop and livestock production – must be considered as a complex system, with its own rules and constraints. In any case, knowledge must be acquired and operations (livestock farming and cultivation) need to be coordinated on the basis of mutual understanding between stakeholders.

4. Private property and common interest

When the debate occurs at a territorial level (e.g. regional natural park, municipality), besides economic aspects (such as reducing inputs or increasing the value of market goods) and private property, CLI raises the question of incorporating livestock through a mechanism that generates a common good. We can certainly consider territory, landscape and environment as common goods. Livestock farmers manage a set of paddocks (usually private) scattered within a territory, thus making a beneficial contribution to the community at an intermediate stage between private and public goods (Ostrom, 2010). In this context of a declared common good, governance issues arise, involving a diversity of stakeholders, and the implementation of multi-level coordination.

5. Livestock farming generates agro-ecological dynamics in areas of intensive cultivation

Regardless of the scale considered, livestock farming helps to set the agro-ecological transition into motion. At farm level, grazing reduces chemical treatments and other operations in orchards and vineyards. At a large territory scale, it enables crop diversification, for example with the introduction of legumes or permanent grasslands, improving the fertility of soils degraded by decades of intensive monoculture (e. g. vines).

IV – Conclusion

We can imagine a variety of ways of reconnecting crop and livestock farming. CLI is clearly of interest in the Mediterranean area. Despite the specialization of territories and activities, it offers some valuable opportunities to increase feed self-sufficiency for herds, reduce chemical inputs such as plant protection products or herbicides for crops, and trigger agro-ecological dynamics within territories. However, there is no turnkey model. Although certain CLI (e.g. winter transhumance) are based on traditional methods, all these systems are somehow pioneer. The various parties involved therefore need to embark on a step-by-step learning process to secure the sustainability of these new forms of arable and livestock farming.

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