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### ► To cite this version:

Charles-Henri Moulin, Alexandre Ickowicz. Summary and conclusion. The place of family-run ruminant grazing systems in the Mediterranean and Tropical zones for sustainable development. Ickowicz Alexandre (ed.); Moulin Charles-Henri (ed.). Livestock grazing systems and sustainable development in the Mediterranean and tropical areas. Recent knowledge on their strenghts and weaknesses, Ed. Quae, pp.172-181, 2023, Matière à débattre et décider, 978-2-7592-3710-4. <hal-05180627>

**HAL Id: hal-05180627**

**<https://hal.science/hal-05180627v1>**

Submitted on 23 Jul 2025

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# Livestock grazing systems and sustainable development in the Mediterranean and Tropical areas

Recent knowledge on their strenghts and weaknesses

Alexandre Ickowicz and Charles-Henri Moulin, editors



# 5. Summary and conclusion.

## The place of family-run ruminant grazing systems in the Mediterranean and Tropical zones for sustainable development

Charles-Henri Moulin, Alexandre Ickowicz

The work presented in the previous three chapters has revealed that grazing family systems in the Mediterranean and Tropical areas have numerous functions that relate to the various Sustainable Development Goals (SDGs). They have considerable strengths in terms of their capacity to adapt to change, innovation for agroecological transition in agriculture and their performance in terms of economic, environmental and social efficiency. In this concluding chapter, we will highlight the following three issues that are critical to the contribution of these farms to sustainable development.

- Family-run ruminant grazing system (as defined in Chapter 1) is a diverse and dynamic form of livestock production that can make a strong contribution to sustainable development, complementary to other forms of livestock production. These innovative contributions relate to certain characteristics or properties of these livestock grazing systems (adaptability, mobility, significant use of renewable natural resources and space, significant use of labour and local knowledge).
- However, the developments observed, which are the result of the interaction between the families developing this type of livestock and their biophysical and socio-economic environment, do not always go in the direction given by the SDGs and must therefore be better supported.
- Finally, the scale of the territories in which these livestock activities are carried out emerges as the most relevant level of analysis and intervention to support these changes in a direction that promotes sustainable development.

## **Complex, diversified and dynamic livestock farming requiring improved insight**

The numerous case studies presented above are a good illustration of the diversity of family-run livestock grazing systems, possibly alongside other forms of livestock farming in Mediterranean and Tropical areas. Without being exhaustive and without wishing to propose a classification, this diversity is linked to the complexity of these livestock grazing systems, which use numerous resources and organise their interactions on various spatio-temporal scales, (for example with regard to access to production factors, whether for livestock or the resources necessary for their rearing and mobility, linking resources in areas with often shared uses) and the various stakeholder systems that manage them (Chapters 2 and 3). This complexity and diversity of livestock grazing systems requires analysis and support via interdisciplinary approaches so as to understand the richness of the interactions involved and to respect, in the search for new trajectories, the fragile balances built over time. The past trajectories observed clearly show this need and demonstrate that it is a strong asset for strengthening the capacity to adapt to change.

Even if these grazing systems are highly complex and diverse, they are also evolving. The studies described, either on adaptation processes considered over several decades (Chapter 2), or on supporting ongoing innovation processes (Chapter 4), have clearly demonstrated significant changes, with varying degrees of depth according to the context. The dynamics can be quite powerful and rapid, as shown by the situations in Vietnam or the Brazilian Amazon; they can be slower and more contrasted between areas in the same geographical zone (West Africa, the Mediterranean basin, the Indian Ocean). Global changes, however, such as the increase in population density in some West African regions, are accelerating the evolution of farming systems. Finally, these livestock grazing systems are a world away from the image of immobility that is sometimes attached to them, notably in relation to the limited means available to often poor families to invest in their livestock activities.

The diversity of situations, based on the territories studied, in terms of the types of livestock farming present and the biophysical and socio-economic contexts, as well as the diversity of the dynamics observed or supported, make it necessary to consider the contribution of livestock grazing systems in a nuanced manner: it is not a question of making hasty generalisations based on a given situation. Nor is it a question of generalising a dynamic observed in a given place and at a given historical moment to other situations. However, the work presented in this book, which covers a large part of this diversity of situations through often diachronic studies, makes it possible to draw certain conclusions regarding the contributions of grazing livestock farming to the SDGs presented in Chapter 1.

## **Contributions to the sustainable development goals that require support**

In relation to all 8 SDGs that directly concern livestock (chapter 1), the work carried out was essentially focused on 5 SDGs that we can divide into three groups:

- the promotion of livestock for sustainable food security (SDG2),
- the participation of livestock in sustained and shared economic growth (SDG8) and in poverty eradication (SDG1),
- finally, the adaptation of livestock to climate change (SDG13) and the preservation of terrestrial ecosystems (SDG15).

### **Family-run livestock grazing systems as a sustainable contribution to food security**

Livestock grazing can make a sustainable and significant contribution to the supply of animal-based food. This contribution to the sustainability of food systems is linked to the capacity of these systems to use local resources (both plant and animal), by ensuring biomass transfers and recycling, through a variety of practices that organise the mobilisation of these resources (Chapter 2). This allows these systems, which are not particularly developed (few buildings and equipment), to consume few inputs and to achieve interesting levels of efficiency (Chapter 3). This type of livestock farming can then be implemented with relatively few resources (possibly only livestock as in the case of landless farmers in India) and contributes to the food security of these poor families. Research that improves the use of biomass (feed, excreta) through technical and organisational innovations that improve recycling in crop-livestock systems, at the farm and territorial levels (Chapter 4), illustrates the ability of livestock grazing to contribute to sustainable food systems, as well as the scope for further improving their efficiency.

However, the challenges to food security raise the question of the capacity of these systems to feed farming families, but also to provide animal-based foodstuffs to other parts of the population, in particular urban populations, which are expanding significantly around the world. While grazing family systems can be very efficient in terms of nitrogen use, they can also be unproductive (see Chapter 3, comparing Caribbean and Amazonian farms), calculated on a per head or per hectare basis. In situations where population density continues to increase and where land use dynamics are dominated by cultivated land on the one hand and protected vegetation areas (e.g. forests) on the other, from which livestock are excluded, the levers of transferring and recycling local biomass may no longer be sufficient to effectively support a level of production compatible with the challenges of food security and the agroecological transition. External inputs, in particular fertilisers, may then be necessary (see Chapter 3). Complementarity between different types of livestock systems, if they can co-exist, can also be a way to ensure food security, both for livestock families and the rest of the population.

However, these livestock systems can be of interest due to their efficiency, for example by making use of marginal land and transforming low-value biomass into high-quality protein. Their efficiencies make them partly sustainable in terms of sparing resource consumption. On the other hand, since they are not very artificial, they are highly exposed to climatic shocks. Implemented by families with few resources, in contexts where protection systems are poorly developed beyond family solidarity, they are also highly exposed to economic shocks and the vagaries of life (illness or death of a family member). Strengthening the resilience of these systems is therefore an imperative, and there are many ways of improving their capacity to adapt, as Chapter 2 has demonstrated. Their implementation in an integrated manner, at different levels of organisation, is an important issue. However, the ability of livestock grazing to cope with all shocks alone is an illusion. Working on the socio-economic and political conditions that provide and ensure a protection system to which livestock farmers are entitled and must have access is also a major challenge.

### **Family-run livestock grazing systems contributing to sustained and shared economic growth and poverty eradication**

In some contexts, family-run grazing systems contribute significantly to agricultural GDP and, more globally, to a country's GDP, as illustrated by the study on internationalized beef market value chains in Southern Africa. On this national scale, this example also highlighted the fragilities of a sector exporting to a demanding market and importing such a large number of low-quality products (Chapter 3), with a negative trade balance. However, it has been shown that family-run livestock farming on grazing land contributes significantly to the economic efficiency of activity systems and therefore contributes to the economic viability of these systems, in particular in areas or regions where few alternatives exist (Chapter 3, study in Egypt for example).

This economic efficiency is based on technical efficiencies, related to biomass recovery, transfer and recycling, as mentioned in the previous section. However, the implementation of practices favouring recycling and the rational use of local resources (notably on rangelands) is labour intensive. Their implementation may also be limited in situations where labour is a limiting factor compared to other production factors. The search for high labour productivity is a powerful driver for the evolution of these systems. This is the case, for example, in the context of French Mediterranean areas. Technical inventions and innovations that make it possible to reduce the work time required to implement more agroecological practices, by automating certain tasks or by facilitating decision-making (see Chapter 4), are a promising way of promoting useful practices in these situations, for example from the point of view of the environmental impacts of livestock farming. But they are labour-intensive.

Even if livestock grazing often makes a significant contribution to family income, some of the developments observed have indicated that the processes of change do not

always lead to equitable development among families (see Chapter 2). The exclusion of some families from development processes is typically observed in a number of economic sectors. The exit of some families or family members from livestock production has also been observed. Livestock rearing cannot absorb population growth, given the low population density allowed by this extensive and not very productive livestock rearing, which is the only agricultural activity possible in arid zones in the absence of water development. As long as other sectors of economic activity, possibly in other regions, can provide jobs or income for these dropouts, this does not represent an issue of sustainable development. However, these exclusions become a serious issue when these opportunities do not exist or when the families of impoverished livestock farmers have no access to them. The analysis of the consequences of innovation processes for the inclusion of livestock families, whether technical or organisational innovations, especially within livestock production chains, is imperative in many situations where livestock families are already marginalised in a poor socio-economic context.

### **Family-run livestock grazing systems contribute to climate change mitigation and the preservation of terrestrial ecosystems in a fragile balance**

The relationship between livestock farming and climate change should be considered in terms of both adaptation and mitigation. Family-run livestock systems in the Mediterranean and Tropical zones are highly exposed to climate change, with an exacerbation of extreme phenomena, such as the succession of several years of drought, and long-term trends such as the decrease in primary biomass production following the rise in temperature or the increase in heat stress in animals that have to travel long distances to build up their rations in sparsely vegetated areas. Many of the adaptation levers presented in Chapter 2 refer to the need to strengthen the robustness of these systems in the face of climate change.

Family-run grazing systems also contribute to climate change, due to GHG emissions, in particular enteric methane produced by ruminants. Specifying the emission factors of animals in tropical zones continues to be a major objective for refining the carbon balance at the farm and territorial levels. The work described in Chapter 3 has revealed the potential for mitigating emissions, but also that carbon balances can be neutral or even negative (net carbon storage) at the farm level, but even more so at the territorial level, depending on the balance of land use and the carbon sequestration capacity of grasslands and various types of rangelands, which are more or less forested. The energy efficiency of livestock grazing is also demonstrated, with less consumption of non-renewable energy. This makes livestock grazing a credible system not only in the face of the climate emergency, but also so that livestock farming can fulfil its function of ensuring the income and food security of farming families, while at the same time participating in a territorial operation that is at least carbon neutral.

However, if livestock grazing can provide diversified foodstuffs (plant and animal products) and other services, while presenting a neutral carbon balance, the balance is unstable and any change in management and land use can call into question the neutrality of the balance. The ex-ante assessment and modelling of the impacts of innovations (see Chapter 4) both in terms of livestock adaptation and mitigation capacity is therefore a major challenge.

In terms of preserving terrestrial ecosystems, livestock grazing, which uses vast areas of spontaneous vegetation, contributes, if it is well managed, to maintaining open environments and associated ecosystem services (habitats and biodiversity, maintenance of landscape mosaics, water and nutrient cycles, prevention of forest fires, etc.). This is a significant issue in territories with a grazing vocation, but where agricultural expansion has led to abandonment and a decline in the use of spontaneous vegetation areas (as in the French Mediterranean areas). In other contexts, the question arises as to the intensification of the use of certain areas, either causing the disappearance of former rangelands, or to ensure the preservation or restoration of terrestrial ecosystems (notably forestry). The example of the development of a new forest network in an area of the Brazilian Amazon is a good example of an environmentally favourable development as a result of the intensification of the use of grasslands on the most favourable soils. On the other hand, the retreat to mechanised cultivated areas to produce fodder for grazing or conservation in French Mediterranean areas is an unfavourable development, leading to the abandonment of rangeland areas where livestock farming is expected to maintain open environments. Depending on the context and the methods used to intensify grasslands, a similar process can therefore be more or less favourable to the sustainable development issues of each territory.

Livestock grazing can contribute to the preservation of terrestrial ecosystems due to their efficiency and their capacity to use a range of natural resources (spontaneous vegetation in grasslands and rangelands) and resources that cannot be used for human consumption (crop residue, agro-industrial co-products). However, in line with the political and socio-economic contexts the changes observed do not always point in this direction. This is demonstrated by the study on crop-livestock integration in Gujarat, India. Here, integration is limited by easy access to nitrogen fertilisers and by an unequal socio-economic structure (see Chapter 3), which demonstrates the need for policies resolutely geared towards the agroecological transition of agriculture.

### **Taking into account the multifunctionality of livestock grazing systems in the territories over the long term**

The formulation of 17 distinct SDGs enables the identification of priorities for sustainable development agreed upon by the UN member states. But it is by moving forward on these different SDGs in a well balanced manner that the concept of sustainable

development takes on its full meaning. Similarly, in this precarious balance described above, considering the contribution of livestock grazing to sustainable development requires taking into account the various relevant SDGs simultaneously. This is all the truer for family-run pasture-based livestock farming which, due to its characteristics (diversity of products and services produced, ability to use local resources in their territory, use of vast areas with the mobilisation of significant human resources) is highly multifunctional and therefore participates in a number of SDGs, unlike livestock farming that specialises in one product and is disconnected from the use of local resources.

Beyond its multifunctionality, livestock grazing also has other significant characteristics to be taken into account when considering how to strengthen its contribution to sustainable development. Like all systems, livestock grazing which is largely on a family-run scale, but also collectively within territories, must be thought of in terms of an interlocking of levels of organisation, from sub-levels, such as the physiological functions of the animals, to levels corresponding to the entities managed by the family (the herd, all the livestock owned by the family, the grazing paddocks, the custody circuits) and up to encompassing levels (the animal population within which the reproductive process takes place, the agrarian system in which the various agricultural production systems that develop and renew the resources of the environment are structured). These encompassing levels are crucial to bear in mind: an approach centred on the farm level, even when considered in the context of its environment (access to the market, for example), is not sufficient. By virtue of its spatial footprint, livestock grazing is often part of a multi-use system, made possible by animal mobility and the various mechanisms that allow the rightful owners to use the same area for different purposes. In addition to the relevant levels of organisation for considering livestock grazing, it is also essential to take into account various temporal scales. In fact, these farms integrate multi-annual processes, such as the dynamics of spontaneous vegetation, which are partly determined by grazing methods, or the evolution of animal populations, which are subject to both natural selection pressure and the selection practices of livestock farmers and their organisations.

As with all agricultural systems, work on the contribution of livestock grazing to sustainable development requires a systemic approach, articulating analyses at various spatio-temporal scales and multidisciplinary analyses, making it possible to cross-reference the points of view of a range of disciplines relevant to addressing the various dimensions of the SDGs. This approach is also essential for designing relevant inventions and innovations, including in a participatory manner as presented in some of the case studies in Chapter 4. To strengthen the resilience of livestock grazing systems and the territories in which they are deployed, there are many ways to adapt and increase efficiency. The challenge is not just to produce information on each of the levers, but also to combine them at different levels of organisation and in different timeframes. Work on efficiency has demonstrated the interest of the concept, due to its adaptability (multiple dimensions taken into account) and its ability to reflect a systemic approach to the processes at work in the construction of these efficiencies.

The studies described in this book have also demonstrated that the contribution of livestock grazing systems cannot be considered in absolute terms, but rather in terms of the context, the situation of a territory in which livestock activities are carried out, in synergy or competition with other activities, whether agricultural or others. This refers, for example, to the links between these livestock systems and other agricultural systems (including other forms of livestock production). These exchanges can take different forms, whether it be biomass, to reason out the integration of crops and livestock on a territorial scale, or work or cooperation based on shared resources (land, food products, etc.). They also involve relations with other economic activities in the area within the framework of a circular economy. In these situations, the range of functions or services expected and attainable by livestock grazing differs from one area to another, depending on the characteristics of the areas and activities involved and the system of stakeholders who manage the activities in the area. This reinforces the need to reason out the contributions of livestock grazing in relation to the issues at stake in the territories, in particular how national and global issues (such as climate change) are reflected locally in political choices.

However, in order for livestock grazing to fulfil the functions that they can potentially provide and contribute to the development of territories, recognition of their multifunctionality by the system of stakeholders involved in the management of the territory is an essential prerequisite. Participatory modelling tools on multifunctionality can contribute to this recognition (Box 3.7). Getting the multifunctionality of livestock grazing acknowledged by the stakeholders in a given area is a first step. Working on tools such as green finance or the development of efficiency evaluation criteria to clarify collective decisions is another avenue to explore.

## **General conclusion**

We have demonstrated how family-run ruminant grazing systems can directly contribute to three groups of SDGs: eradicating poverty, ensuring food security and promoting sustainable agriculture; promoting sustained and shared economic growth; combating climate change and its impacts, and preserving and restoring terrestrial ecosystems.

Some SDGs have not been addressed in this book, even if livestock farming is involved, notably family-run livestock grazing systems. This is the case for the SDG on gender equality and women's autonomy, for which family farming can be a relevant lever, albeit with the risk of men taking control of the activity when it grows and when the economic stakes increase. This is also the case of the SDG on health and well-being for all, with significant animal health and public health issues, especially in relation to the biosecurity of livestock when animals are out in the open (contact between wildlife and livestock or control of animal movements to limit the spread of epizootics). These are all aspects that can undermine livestock grazing. This health and well-being SDG also

raises the question of animal well-being, which is an increasing controversial issue and a driving force for changes in animal husbandry practices. From this point of view, family-run livestock grazing system has major advantages to highlight thanks to free-range livestock management. Future work must take into account these other dimensions of sustainable development, in particular in a context where sustainable food systems are becoming central to international agricultural policy strategies. This work must always be conceived in a multidisciplinary framework, seeking alliances between the various livestock research skills at both the French and international levels.

Livestock grazing evolve under the effect of a set of interdependent factors, some of which are not related to the livestock sector, but which apply to the same resources and spaces. Their contribution to sustainable development is not definitive. While some of their characteristics provide them with undeniable assets to play a major role, numerous examples drawn from the case studies presented in this book have clearly shown that developments linked to powerful economic drivers and sectoral public policies (whether agricultural, customs or environmental) can lead to unfavourable developments in terms of sustainable development. This means continuing to inform and communicate about these changes as closely as possible to what is happening in the territories and continuing to produce information and tools to support the processes underway, whether they are thought of in terms of adaptation, efficiency or innovation. These changes are complex and some aspects have not been sufficiently addressed in the work presented in this book, in particular with regard to gender and the future of young people. In the transitions to which global food systems must commit in order to meet current challenges, family-run ruminant grazing systems provide numerous levers and powerful incentives. However, the expression of these assets depends on the mobilisation of all livestock stakeholders - women, men, young people - but also on the changing context in which these stakeholders act, with appropriate policies or the development of inclusive commodity chains.

The aim is to enlighten stakeholders on the transformations of livestock farming, first and foremost livestock farmers and their organisations, as well as the various institutions that work to develop livestock farming activities. It is particularly important to continue work on the compromise between the dimensions of sustainable development (social, economic, environmental, governance) and the resilience of farms and territories, in order to inform stakeholders about the compromises to be managed and implemented in the future.

The aim is also to provide political players with insights to inform public decisions at the various levels of governance (from the commune to the sub-regional level), promoting breakthroughs and the definition of new agricultural trajectories. The continuous adaptation of family-run ruminant grazing systems will not be enough to meet the urgent challenges of eradicating hunger and poverty, while preserving the planet's resources.

These systems have a role to play, as part of a localised food system, for example, using animal based foodstuffs, but certainly in addition to other agricultural production systems, using other production methods, other animal species than ruminants, and other forms of organisation of work and capital. This requires informed public policies to enable an equitable coexistence of these different agricultural models for a diversified and sustainable global food system.