Matière
à débattre & décider

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

Recent knowledge on their strenghts and weaknesses

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This research work highlights the originality and specificities of inventions to contribute to the agroecological transition in livestock farming to:
• manage livestock systems with fewer synthetic inputs;
• obtain regular and rapid information required for the complex management of Mediterranean and Tropical agropastoral livestock systems;
• better use and manage available forage resources and grass cover.

These inventions contribute to the emergence of more efficient farming systems by promoting co-creation and knowledge sharing.

The technical innovations that we describe in the rest of this chapter focus more on the recycling of biomass and the diversification of forage resources in production processes, which are at the heart of research on the agroecological transition.

Technical innovations to improve recycling and diversification of resources in livestock grazing systems

Mélanie Blanchard, Ollo Sib

Improving the closing of biomass and nutrient cycles and diversifying resources from agroecosystems are two pillars of agro-ecology, in which ruminant farming can play a key role. This is because, through their ability to consume fibrous feeds (e.g. grass and straw) and by-products and wastes (e.g. swill), ruminants use biomass that humans cannot eat, thereby increasing the efficiency of natural resource use. However, although numerous studies conducted in research stations have shown how agroecology allows for greater production while minimising negative externalities (environmental, social, economic), the adoption rates of these practices often remain limited and underline the relevance of better supporting stakeholders in adapting their practices to this new paradigm according to the local characteristics of their livestock system. This section of the chapter illustrates this through the presentation of two case studies, from tracking down innovative practices to measuring the first impacts using participatory co-design mechanisms.

Shrub fodder banks, a promising innovation for agro-pastoral dairy systems in West Africa

In West African agropastoral systems, the milk productivity of cows remains low and irregular, partly due to the low coverage of their nutritional needs during the year. Cow feeding is essentially based on a combination of:
• natural grazing land with low and seasonal quality biomass productivity,
• and crop residue, grazed in the field or stored on the farm, mostly composed of straw with low nutritional value.

In order to intensify milk production to meet the demands of dairies and consumers, some farmers have adopted fodder crops (grasses) to complement these resources.

Others have resorted to expensive and unaffordable concentrate feeds, the heavy use of which poses potential health risks for the animals. The search for alternative options to fill the existing gaps in feed and productivity is a priority for farmers, dairy value chain stakeholders and research and development. The alternatives to be promoted must be productive, sustainable and affordable for low-income farmers in order to enhance their farm autonomy.

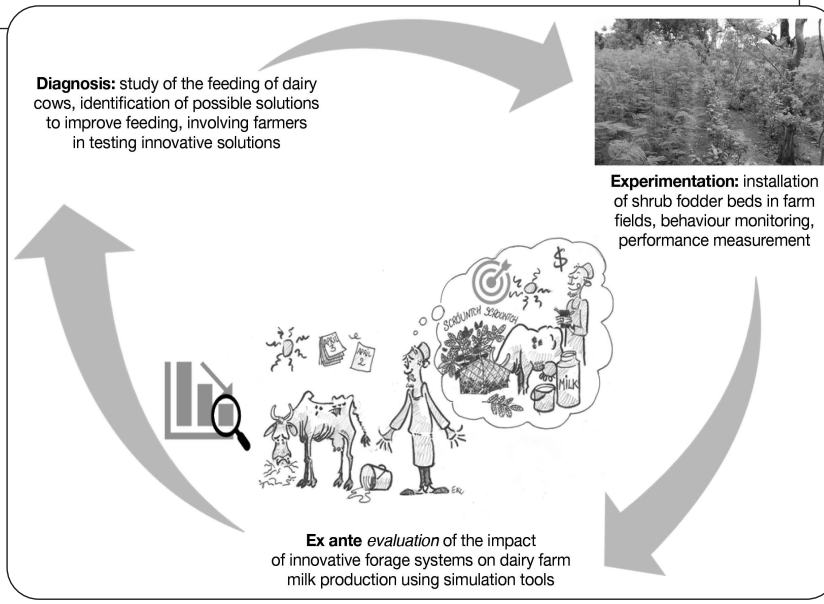
A promising alternative, tested in several humid tropical regions (Latin America, Oceania, the Caribbean, Asia, etc.) is based on agroforestry-livestock integration. It consists of introducing various strata and species of multipurpose trees and shrubs at different densities into livestock farms for livestock feed.

In the context of the West African savannahs, the role of spontaneous fodder trees and shrubs in feeding livestock in the dry season is well documented. In the natural environment, the sometimes over-intensive use of branches and twigs of fodder trees and shrubs (Kaya senegalensis, Pterocarpus erinaceus, etc.) to feed livestock leads to a decrease in the resource. Agroforestry, through the technique known as high-density shrub fodder banks, is an interesting solution. It makes it possible to intensify quality fodder production in order to improve fodder autonomy, reduce the dependence of farms on concentrated feed, increase the production and income of farmers and improve plant and wildlife biodiversity on farms. In addition, due to the richness of woody fodder in proteins and tannins, the shrub fodder reserve is an option to ensure a protein supply to animals, limit greenhouse gas emissions and strengthen the resilience of livestock systems to climate change.

The idea of introducing high-density shrub fodder banks (20,000 plants/ha) into agro-pastoral systems in western Burkina Faso was born out of partnership projects between UMR Selmet and the professional organisations with which it has been working for years on crop-livestock integration issues. This initiative aimed to meet the demand of livestock farmers in western Burkina Faso for sustainable and low-cost intensification of local milk production.

The introduction of shrub fodder banks was based on an iterative co-design process in order to adapt them to the multiple technical and socio-economic constraints and to the local knowledge of the farmers (Sib *et al.*, 2020; figure 4.7). Farmers and stakeholders in the sector took part in the initial diagnosis of livestock systems by means of individual surveys and group feedback to identify animal feeding practices on the grazing land, according to the seasons, and to analyse possible solutions for improvement. The shrub fodder reserve was presented as a potentially interesting solution, and volunteer farmers agreed to try it out on their farms. To support these farmers in learning this new technique, a consultation framework was set up at each site and led by the research team, the farmers, the decentralised technical services, the local communities, the customary authorities and the dairies. The participatory workshops gradually provided an opportunity to acquire the theoretical principles of shrub fodder reserves and to adapt the innovation to the local context and the farmers constraints.

Figure 4.7. Co-design process of an innovation consisting in the introduction of shrub fodder banks in dairy agro-pastoral systems in western Burkina Faso (source: Ollo Sib).



The shrub fodder bank contributes to the diversification of the fodder system of dairy farms and to the improvement of their fodder autonomy, with over 10 tons DM/ha/year of quality fodder (gross protein › 20% DM). It contributes to their resilience in the face of constraints on access to natural grazing land, better nutritional quality of dairy cow rations, with dry matter and organic matter digestibility between 65 and 81% and increased cow productivity (+ 1 or 2 litres per cow per day) while potentially reducing enteric methane emissions.

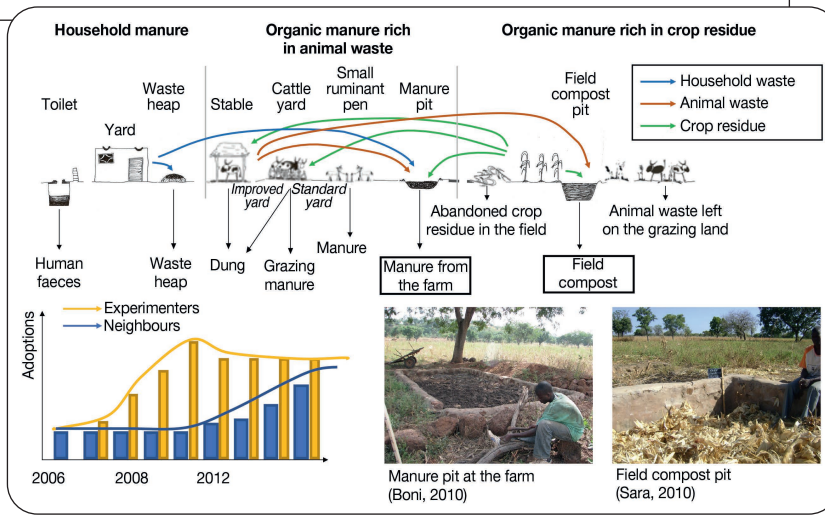
"From tracking to impact" of innovative organic manure management practices in agro-pastoral systems in western Burkina Faso

The decline in soil fertility in the West African savannahs jeopardises the sustainability of production systems in a context of increasing population, cultivated areas, livestock farming and pressure on natural resources. In western Burkina Faso organic manure production techniques have not been widely adopted due to transport and labour constraints and subsidies for mineral fertilisers. A small proportion of agricultural and livestock co-products were valorised and the manure produced remained of poor quality.

The co-design of innovative practices (Vall *et al.*, 2016a) was initiated to quantitatively and qualitatively improve the organic manure produced in this area. The approach began with a problem-solving phase involving the study of soil fertility management issues with the stakeholders involved in order to identify the desire for change on the part of the stakeholders and the intention to research innovative practices.

A step-by-step design of innovations was initiated (Figure 4.8). Studies of local knowledge on soil fertility management in southern Mali (Blanchard *et al.*, 2013) and atypical practices in Burkina Faso (Blanchard *et al.*, 2017) have made it possible to identify a body of original and local technical knowledge on soil fertility management and the recycling of agricultural and livestock co-products requiring little investment. These studies made it possible to identify possible solutions for improving soil fertility management. The innovation proposed to Burkinabè farmers aimed to increase the production of organic manure by distributing it across the farm using a manure pit and a compost pit at the edges of the fields. The most popular options were tested on the station and with volunteer farmers. The technical procedures for ensuring compost quality while minimising labour investment (chopping cotton stalks, watering, and turning) were defined at the site. More than 1,200 experiments at and by farmers have made it possible to evaluate the quality and performance of manure pits and compost pits in real-life situations. Finally, trials on the rational application of manure in the field have made it possible to quantify the impact of different application methods on yields

Figure 4.8. The diversity of organic manure management practices on farms and two innovative models available for adoption: the manure pit and the field-side compost pit.



and economic performance. After each experimental cycle, the results obtained were discussed in order to decide on readjustments, the organisation of new experiments or, on the contrary, the closure of the design process if the objectives were achieved.

To implement this approach, specific partnerships were formalised. Farmers wishing to change their practices, agricultural advisors in charge of farm supervision and researchers formed village committees, these were in charge of leading the process and implementing the activities. A steering committee made up of representatives of research and development institutions and producers decided on strategic orientations, validated programming and managed any arbitration. An ethical framework and governance bodies defined the roles and responsibilities of everyone in this co-design phase (Vall *et al.*, 2016a).

Multi-pit organic manure production improves the recycling of farming by-products by dividing production between the yard and the field. It ensures the quality of the manure and compost produced, without significant investment in equipment, transport and labour. It does not involve watering, chopping of cotton stalks or turning, if decomposition starts in the rainy season and if the pits are covered, for a 12-month production cycle.

Manure is produced from stabled animal manure, mixed with fodder rejects and household waste. The compost is produced by decomposing cotton stalks, otherwise burnt, and a little animal dung to start the decomposition. Recommendations were made for manure production to ensure good quality (minimum dung content, pit coverage) as well as for its application in the field depending on the quality of the manure (compost versus manure). Monitoring the implementation of this process on the farms and an ex post impact study (Vall *et al.*, 2016b) provided insight into the adoption of the innovation and its impacts. The innovation had a positive effect on the farm economy (gain between 21.2 and 51.3 €/ha), soil fertility maintenance (11 tDM/ha compared to 5 previously), animal stabling, but also an increase in labour (installation, production, emptying, transport) and pressure on co-products with the creation of manure markets.

During this adoption process, farmers adapted the proposed practices to their own production capacities, notably by adjusting the size of the pits to the quantity of available co-products, by backing it up with a cattle pen or a bio-digester. Adoption has been sustained and even increased after the project was interrupted, (Vall *et al.*, 2016b) with neighbouring farmers of those who had participated in the project also adopting it. The sharing of know-how was based on village committee networks, highlighting the importance of formalising the partnership in innovation design processes.

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These case studies illustrate various ways of enhancing the local know-how of livestock farmers in the management of their agrosystem resources, noting their contribution to the closing of cycles for the maintenance of soil fertility while limiting the mobilisation of capital, and strengthening the place of trees in fodder systems through the application

of agroforestry principles in family-run farms. While this research makes it possible to produce information on the local skills of farmers, their habits and their determinants fairly quickly, it generally takes longer to contribute to changes in practices, as was shown in the work on organic fertiliser.

While the technical nature of the innovation generally signals a change in the mode of production, this change is always associated with the organisational (and sometimes institutional) changes necessary for the distribution and appropriation of the innovation by its users.

Organisational innovations to support the agroecological transition in territories and animal product value chains

M'Hand Fares, René Poccard-Chapuis, Éric Vall

The creation of a favourable economic and political environment is a necessary condition for the implementation of an agroecological transition in livestock systems. At the level of animal product sectors and value chains, this implies a shift towards economic systems that take greater account of the values of the circular economy in exchanges and solidarity between stakeholders. At the territorial level, this implies the implementation of a more sustainable governance of the management of agro-sylvo-pastoral resources. These changes are based on organisational innovations that mobilise stakeholders in the livestock sector and related sectors. This section of the chapter will present some supporting work:

- European livestock owners and farmers wishing to enter into contracts on new forms of crop and livestock interaction in a given territory;
- stakeholders in the dairy sector in West Africa;
- stakeholders in a West African territory who are committed to formulating a local land charter for resource management;
- and stakeholders in the livestock sector in the Paragominas region of Brazil committed to collective action to restore grazing resources.

Organisational innovations to improve stakeholder cooperation in livestock product value chains

Co-design of formal contracts for grazing in cultivated fields

Grazing cereals intended for grain harvesting or vegetation cover as in viticulture at the end of winter is an ancient technique practised in several regions around the world (Canada, Brazil, Australia, the Mediterranean basin, etc.). Abandoned in Europe in the middle of the 20th century as a result of the massive introduction of synthetic input into agriculture, it has been the subject of renewed interest in recent years on the part of certain farmers and livestock farmers faced with climate change and the need to