Boost Agricultural Sustainability through Crop-Livestock Integration: Insights from Điện Biên District

Policy Paper

Crop-Livestock Integration (CLI) through biomass exchanges between crop and livestock enhances the sustainability of mixed farming systems, improving production, autonomy, efficiency and recycling. By analysing the diversity and recent changes in mixed farms and modelling potential CLI pratices changes, we assess the effect of these changes on farm performance and sustainability in Điện Biên District, Northwest Vietnam.

CLI enables farms to improve animal feed and environmental performances if pressure on land resources remains minimal. High pressure on pasture land may force pasture-dependent farms to cease animal production despite support for forage development.

Agroforestry (fruits and forage) could enhance animal feed and farm performance with high-value products, though still its innovative stage.

The results show that local authorities must continue to develop innovative models for the production and conservation of forage and crop residues, while also devising additional strategies to support resource-constrained farms. It suggests exploring new forage production systems and biomass management between farms with a broader district-level vision.

KEY TAKEAWAYS

- CLI improves animal feed and environmental performance on farms with ample land
- High resource pressure may force pasture-dependent farms to cease livestock activities, despite forage development support.
- Agroforestry, though still at the innovation stage, offers promising solutions for improving animal feed, farm performance and high-value products.
- There is a need for innovation in forage production, to support resources-strained farms and to explore new models for biomass management between farms.

Elephant Grass (Le Trouher, 2019)

CROP-LIVESTOCK INTEGRATION

Crop-livestock integration (CLI) is based on the organised recycling of biomass on farm, or between farms. The biomass could be crop products (maize, vegetables), by-products (rice bran) and residues (rice straw, maize stems), animal waste, compost and manure.

CLI enhances the economic and environmental sustainability of farming systems and territories and improving ecosystem services [1]. CLI in mixed farming systems boosts efficiency in resource use [2], productivity and the crop resources use for animal feed [3] and helps maintain soil fertility [4].

KEY FIGURES : FORAGE PRODUCTION TO DEVELOP LIVESTOCK

Animal feed remains the main obstacle to animal production and the development of CLI.

In Dien Bien District, the objectives of increasing forage production and covering the animal needs are still far from the current situation (Figure 1).

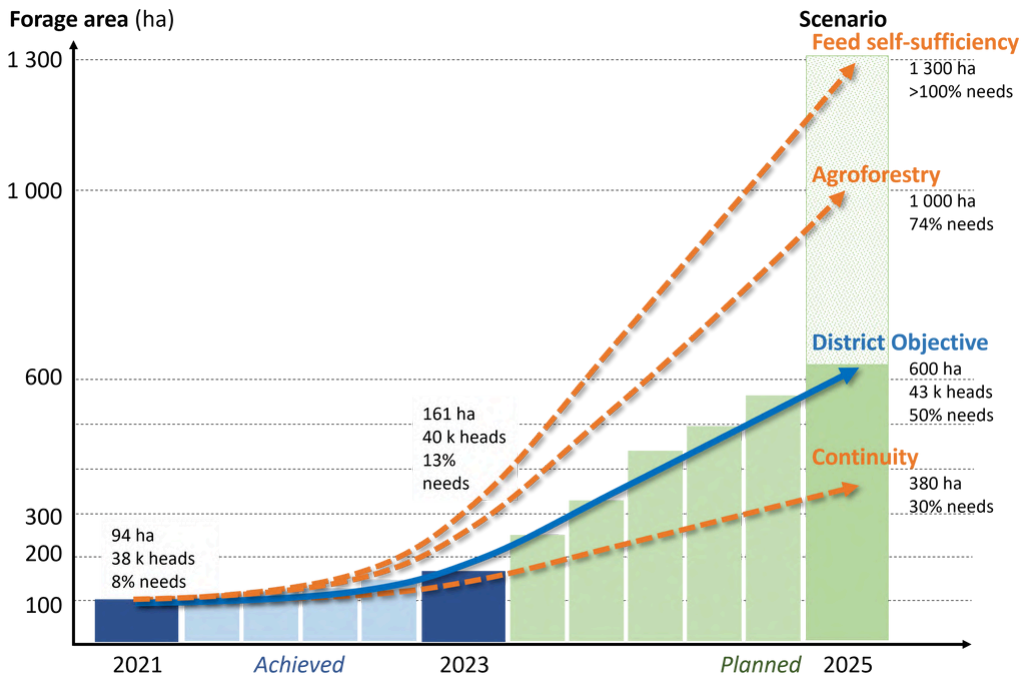

Figure 1. Trends in forage production and coverage of animal needs in Điện Biên District, current situation and future prospects (Blanchard, 2024)

The targeted production by 2025 would require a 4-fold increase in the area currently under forage, and land available for forage production does not easily allow this. Measures to improve not only production but also the quality and types of forage grown are still needed.

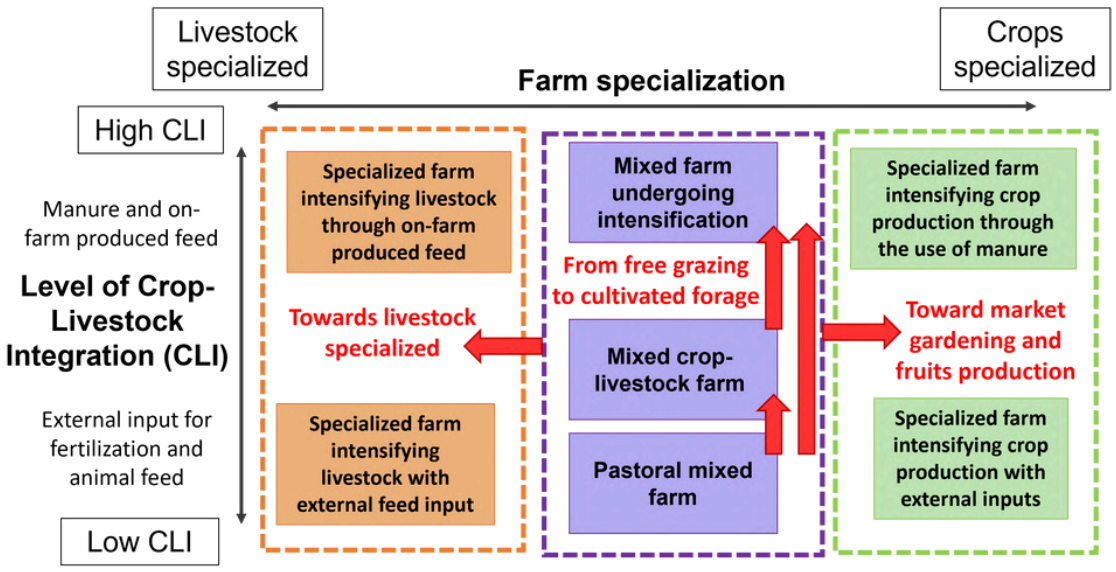

Figure 2. Types of farms and their past trajectories (Le Trouher et al., 2024)

ASSESSING CLI CONTRIBUTIONS TO FARM PERFORMANCE

A review of the diversity of farms and CLI practices in Điện Biên District was carried out, followed by an analysis of past trajectories over the last 30 years to understand current practices [6].

Possible future scenarios for farming systems and CLI practices were designed in collaboration with stakeholders, in order to model the economic and environmental impacts of changing CLI practices.

CLI: A STRATEGIC RESPONSE TO AGRICULTURE CHALLENGES

Traditional mixed crop-livestock systems in Vietnam face challenges from policies favoring specialized farms, market access issues, health crises, and rising input costs.
CLI is crucial for sustainable agricultural production, addressing environmental, economic and climatic challenges, aiding in resource conservation, poverty reduction, environmental sustainability and creating social links. Integrated systems can meet the rising demand for meat and support the poverty eradication, ensuring food security, providing clean water and adapting to climate change (SDGs).

In Northwest Vietnam, agricultural development goals align with supporting the local economy and reducing poverty, particularly among ethnic minorities. Điện Biên Province approved a project for the sustainable development of grass-fed livestock (buffaloes, cows, goats) to enhance incomes and create a stable and competitive market [5].

A DIVERSITY OF MIXED CROP-LIVESTOCK FARMING SYSTEMS

The diversity of today's farms, as seen through the prism of CLI and diversification of agricultural activities, reveals 7 types of farm grouped into 3 groups (Figure 2). The **mixed crop-livestock farms** remains predominant (around 60% of the District farms), while the **specialized farms in livestock production** and the one **specialized in crop production** are secondary (both account for around 20% of the District farms). Farms are differentiated according to their level of CLI, reflected by their practices (use of feed and manure produced on the farm) and according to their level of specialisation, reflected by the share of sales from livestock, crop and off-farm activities.

RECENT TRENDS OF EVOLUTION OF FARMING SYSTEMS

Three main mixed farm trajectories have been identified, highlighting changes and their effects [6].

The "***From free grazing to cultivated forage***" trajectory reflects the change in rearing methods on highland farms. These changes result from reduced grazing areas and natural grasses due to expanded cropping on slopes and forest protection policies. As a result, traditional grazing practices are being gradually phased out, herds are shrinking, forage crops are expanding, and crop residues are being used more efficiently.

The "***Towards market gardening and fruit production***" trajectory reveals a crop specialisation of mixed farms, driven by land and water availability, market development, private investment and agricultural policies promoting high-value crops like fruit trees [7]. This has led to increase hugely use of mineral fertilisers, partly balance with organic fertilizer. Large areas devoted to vegetable and fruit crops create significant amounts of crop residues and fertilizer needs, presenting an opportunity for developing CLI practices between farms.

Photo 1. Cows fed a mixture of forage and silage (Blanchard, Le Trouher, 2024)

The "***Towards livestock specialised***" trajectory shows mixed farms focusing more on livestock due to limited land for crops, meat market trends, reduced grazing areas, and local authority incentives. This involves on-farm feed production, cultivated forage, recycled crop residues, or external feed inputs, resulting in more manure available for exchange or sale.

These trajectories highlight the crucial role of government policies, the geographical location of farms, access to land and resources, as well as farmer individual motivations and cultural factors. They show while forage production remains small, it is increasing, suggesting new dynamics at the District level.

AN INCREASE IN LIVESTOCK NUMBERS IN FARMS WITH MORE CLI

We compare the effects of 3 scenarios for the future of farming systems [8] : the continuity scenario is based on the objectives set by the Province and District of Điện Biên, the agroforestry scenario involves systems intercropping high-value fruit trees with forage, and the feed self-sufficiency scenario focuses on increasing on-farm feed production (Figure 1).

These scenarios set forage self-sufficiency on farms at 20%, 50% and 70% of livestock feed needs respectively covered by the farm. It is assumed that the rest of the livestock needs are covered by external forage resources. These resources come from cultivated areas after harvest, or from natural grasses, and are decreasing due to the expansion of forests and crops. Cattle and buffalo are considered.

The continuity scenario results show that the herds of the most integrated farms grow when forage autonomy faces few constraints, regardless of their orientation (mixed, livestock specialised or crop specialised). This scenario also raises concerns for mixed farms heavily dependent on external natural resources for feed, putting their livestock activities at risk. These farms account for an estimated 20-30% of the farms in Điện Biên district.

BENEFITS OF FEED SELF-SUFFICIENCY vs AGROFORESTRY SCENARIOS

Simulation results for these scenarios show a smaller reduction in livestock numbers for the agroforestry scenario compared to feed self-sufficiency scenario, due to less pressure on external forage resources. Farm specialized in crop production may diversify into livestock, having land to produce forage or supply other farms in deficit in the District. Feed availability per cattle is greater in the feed self-sufficiency scenario because more land is converted to forage (Figure 1).

On-farm feed production through CLI improves livestock production and environmental performance, with stronger nitrogen recycling in the feed self-sufficiency scenario and greater nitrogen autonomy in agroforestry.

Economically, agroforestry systems enhance or stabilize the efficiency of crop-specialized farms. Both scenarios boost forage production, alongside high-value tree crops in agroforestry, but face challenges like land constraints, limited organic fertilizers, and farmer reluctance to adopt new practices.

Limited land threatens forage self-sufficiency and livestock farming future. While expanding forage areas, especially through agroforestry on unproductive or fallow land, is vital, it should be complemented by innovations in forage quality, storage, and varieties.

Photo 2. Manure collected and stored in the barn (Tuan, 2022)

TECHNICAL AND POLITICAL IMPLICATIONS

This study aims to provide insights into the potential consequences for farms, herds and the environmental and socio-economic dimensions in the Điện Biên district, rather than giving a prospective analysis of agricultural futures.

A significant risk of reduction cattle numbers or ending cattle production was highlighted for the mixed farms dependent on external forage resources. This risk, affecting many farms, necessitates technical and financial solutions (training, access to forage seeds, small equipment).

These may not suffice, farming systems need rethinking. Shifting away from cattle farming could affect the local economy and food sovereignty, leading family members to seek alternative income sources and impacting social stability.

Photo 3. Stocked rice straws in piles on a mixed farm (Blanchard, 2024)

Livestock numbers could rise for farms with higher CLI, whether mixed or livestock-specialized, as well as for crop-specialized farms with fewer external resource constraints. However, this potential increase in livestock numbers challenges the District feed self-sufficiency targets and raises doubts about whether they can be effectively achieved (Figure 1).

Crop-specialised farms have potential to produce more forage than their need, develop forage markets, or diversify into livestock farming.

Innovative forage systems like agroforestry could benefit farms with fruit trees, aligning with local fruit production goals and converting low-value annual crops to high-value perennial crops, aiding soil health and carbon sequestration. These systems would combine multiple crops on limited land, offering economic and environmental advantages if implemented with sustainable practices (limited use of pesticides, organic fertilisation preferred etc.).

Innovation forage varieties with legumes could improve forage quality. Legumes fix nitrogen, benefit other crops and reduce greenhouse gas emissions from livestock by improving the animal diets. New forage systems and varieties are being tested to meet production and quality expectations.

The systematic use of by-products and crop residues and improving forage storage and quality are relevant with limited land resources. Support for small equipment and input (EM, choppers) and the storage capacity (roof, canvas, bags) remain essential.

It may be beneficial to emphasise on productivity rather than herd size, meat per area or income per animal. Some farms may focus on improving feed quality to increase livestock productivity.

The Province and District aim to boost livestock production through forage crop development and resource optimization. Given land limits and forage self-sufficiency, the District ability to meet feed needs was simulated. Farms changes depend on practices from other farms (e.g. reduced pastoral areas, crop shifts, biomass collection), requiring a District-level approach to address interconnected factors.

DIVERSIFYING FORAGE RESOURCES AND RECONSIDERING LIVESTOCK DEVELOPMENT

To meet livestock development goals in Điện Biên District, expanding forage areas requires new land and preserving external forage resources for farm feed self-sufficiency.

Additional measures include adopting higher-quality forage innovations, efficiently using crop biomass, and integrating high-value crops and agroforestry systems to meet economic needs.

Improving farm productivity is essential to stabilize vulnerable farms and reduce the risk of them ceasing livestock production. However, it is important to anticipate the effects of halting livestock production on these farms and the district.

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Find out more :
[1] Martin et al., 2020
[2] van Keulen and Schiere, 2004
[3] Stark et al., 2017
[4] Bonaudo et al., 2014
[5] Decision No. 3413/QD-UBND. 2021
[7] Decision 610/QD-UBND. 2019.

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[6] Le Trouher A., Moulin C.-H., Huyen L.T.T., Blanchard M. 2023. Trajectories of crop–livestock integration in the context of specialization in Northwest Vietnam. The Journal of Agricultural Science, 161 (4) : 488-501. doi: 10.1017/S0021859623000412.
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