

## CHARACTERISATION OF LARGE RUMINANT SYSTEMS AND THEIR MULTIPLE CONTRIBUTION IN A HIGHLAND COMMUNE, DIEN BIEN PROVINCE

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### ABSTRACT

Upland regions cope with many difficulties compared to the delta region. Cattle are considered as the most important livestock species. This study uses an ontology to define relevant indicators to evaluate multiple functions of these grassland livestock systems for characterisation of main livestock farm types and their contribution to the sustainable development of farms, and community. The study was implemented in Quai Nua commune, Tuan Giao District, Dien Bien Province North-West Vietnam. 48 smallholders of seven villages were selected for data collection in an in-depth survey. In addition, key person interviews with other stakeholders were also implemented. Four main types of farms are identified including (i) the extensive livestock farms; (ii) the semi-intensive livestock farms; (iii) the crop-oriented farms; and (iv) the farms without ruminants. Livestock contributes multifunction to all kinds of household farms with high contribution from value of ruminants that implicates the role of grazing land in the study region.

**Keywords:** *Livestock system, highlands, livestock contribution, Dien Bien, Vietnam.*

### TÓM TẮT

**Đặc điểm các hệ thống chăn nuôi gia súc nhai lại và đóng góp của chúng ở xã vùng cao, huyện Điện Biên**

Vùng cao gặp nhiều khó khăn so với vùng đồng bằng. Đại gia súc được coi là vật nuôi quan trọng nhất. Nghiên cứu này sử dụng bản thể luận để xác định các chỉ số liên quan nhằm đánh giá đa chức năng của các hệ thống chăn nuôi sử dụng bãi chăn và xác định đặc điểm của các loại hình chăn nuôi chính và đóng góp của chúng vào sự phát triển bền vững của nông hộ và cộng đồng. Nghiên cứu được thực hiện tại xã Quai Nua, huyện Tuần Giáo, tỉnh Điện Biên, Tây Bắc Việt Nam. Tổng số 48 hộ dân được lựa chọn từ bảy bản tham gia vào cuộc điều tra sâu. Ngoài ra các cuộc phỏng vấn với các tác nhân khác cũng được thực hiện để thu thập số liệu. Bốn loại hình chăn nuôi nông hộ chính được xác định bao gồm (i) chăn nuôi quảng canh; (ii) chăn nuôi bán thâm canh; (iii) nông hộ chủ yếu dựa vào trồng trọt; và (iv) nông hộ không có chăn nuôi động vật nhai lại. Chăn nuôi đóng góp đa chức năng cho tất cả các loại hình chăn nuôi hộ gia đình với đóng góp cao từ giá trị đàn gia súc nhai lại, kết quả này đồng thời thể hiện vai trò của đất sử dụng làm bãi chăn trong vùng nghiên cứu.

**Keywords:** *Hệ thống chăn nuôi, vùng cao, đóng góp của chăn nuôi, Điện Biên, Việt Nam.*

### 1. INTRODUCTION

Upland regions cope with many difficulties in terms of steep slope, uneven terrain, accessing difficulties, low soil quality, poor infrastructure, and high poverty rate

(Minot *et al.*, 2003; Tran Duc Vien, 2003). In Northwest Viet Nam, rain-fed crop monoculture is dominated on sloping lands. Cattle are considered as the most important livestock species. Farmers are largely dependent on grazing lands as main feed source for their animals (Huyen *et al.*, 2006; Phung, 2009; Trung, 2011).

On the one hand, the intensification of large ruminant systems (cattle and buffaloes) relies on the establishment of forage crops

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production promoted by research and development projects and agricultural extension services, however, the areas currently available for forage production remain very limited. On the other hand, pastoral or grazing systems are considered archaic, not intensive enough to meet the production challenges and not remunerative enough, therefore, they are little taken into account, studied and supported by extension services and development. It is taken into account that an assessment of the contribution of these grassland livestock systems for the territory development is necessary in order to initiate a dialogue with the local authorities on the basis of scientific data.

This study uses an ontology to define relevant indicators to evaluate multiple functions of grassland livestock systems for characterisation of main livestock farm types and their contribution to the sustainable development of farms, and community. This essential information can help local authorities in their strategic planning of investment and orientation of agricultural and livestock production, resource management and spaces and territories in general. All can help to consider the trade-offs between issues of production, protection of space and resources, economic development.

## 2. MATERIALS AND METHODS

To assess the place and role of grazing livestock in the mountainous areas of North-West Vietnam in terms of the sustainability, an ontology of grazing livestock systems developed by Muller *et al.* (2020) was mobilized to identify the multi-functionality provided by these systems. The indicators used in the ontology included a series of 21 criteria and 129 indicators those cover the four dimensions: Production, Local development, Ecosystem and Social, and the different levels and entities herd, farm, community and landscape, services and value chain. From this list, we have selected 28 indicators that make sense in the local context, in relation to the

challenges of livestock systems, recognized or not by the diversity of the actors involved, and responding to the expectations of the various actors involved in territory and the value chain linked to grazing livestock system.

The study was implemented in Quài Nua commune, Tuần Giáo District, Điện Biên Province North-West Vietnam. Seven villages were selected for data collection in an in-depth survey after a rapid survey on farm typology that was carried out based mainly on scales of livestock production, land areas, land use, and types of grazing systems in 10 high and intermediate highland villages out of total 21 villages of Quài Nua commune (at least 15 households per village were quick accessed).

A series of surveys was carried out afterwards with the diversity of the actors involved: diversity of mixed farms, local authorities, collectors, retailers, butchers and producers of dried meat. An in-depth survey was conducted in 48 farms selected to represent the diversity of farm types: i. Farm without ruminant; ii. Farm with a small herd (<5 cattle) and cultivates large areas (>1.5ha); iii. Farm with a small herd and cultivates small areas (<1.5ha); iv. Farm with an average herd (5-8 cattle) and cultivates large areas (>1.5ha); v. Farm with an average herd (5 to 8 cattle) and cultivating small areas (<1.5ha); v. and Farm with a large herd (>9 cattle). The farms surveyed also represent the diversity of grazing management systems from animals to free grazing with more or less close monitoring to control grazing animals, at certain times of the day, or even completely stabled animals. The farm survey focused on farm structure; the agricultural system with the available and cultivated surfaces on the farm, the production costs, the harvests and their futures, and the income from different crops; the livestock system with the composition of the herd, the costs of production, the herd exploitation (reproduction, donations, purchases, sales), the livestock income, the practices of animals feeding on pasture and barn; family alimentation and other farm income sources.

To build a global image of the farming systems of the town, we relied on a typology of livestock farms. The diversity of livestock farming systems was analysed through a Principal Component Analysis (PCA) on the variables representative of this diversity: family size (number of people), size of the cropping area in low land, highland and forage crop (in m<sup>2</sup>), herd size (in tropical livestock unit (TLU)), feed distributed to animals (in kg DM /TLU / year), part of feeding taken during grazing (%) and off-farm time in the rainy season and in the dry season (%). A Hierarchical Ascending Classification (CAH) was carried out to identify homogeneous farm groups, according to these criteria. Each type of livestock identified by this analysis represented a defined percentage of the commune's farms, which made it possible to go from individual evaluation of certain indicators to an assessment of the value of

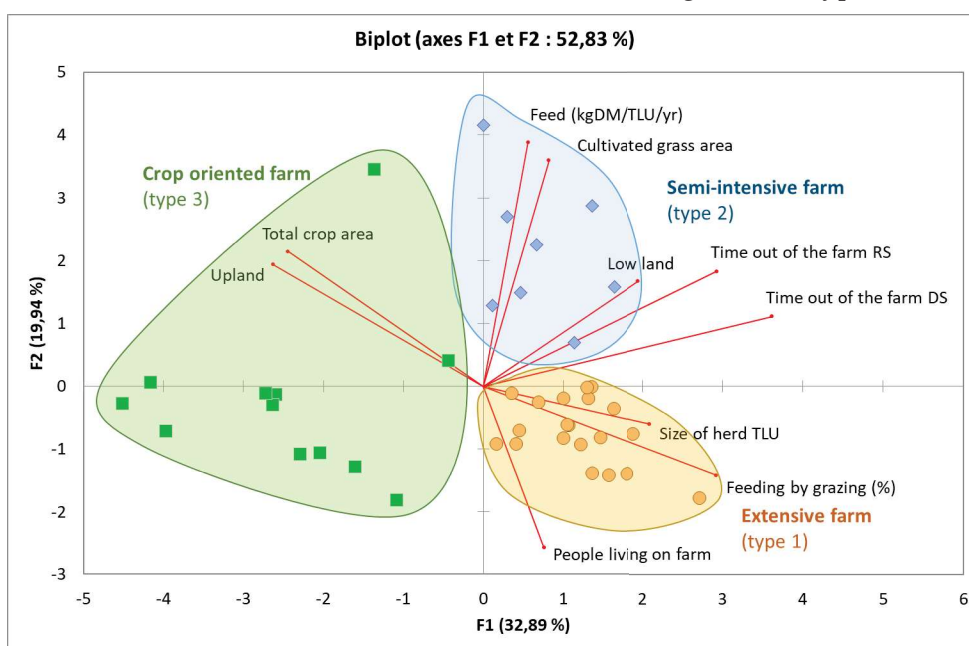
indicators at the commune level.

### 3. RESULTS AND DISCUSSION

#### 3.1. Diversity of livestock farming systems in Quài Nưa commune

The three farm types with ruminants are represented according to the main CPA plan in figure 1. The non-ruminant farm is an added type of farm (type 0) is no represented in the figure.

On the first axis of the PCA, the variables illustrate the size of the herd, part of feeding taken during grazing and the off-farm time to the right and the size of the cropping area in the uplands on the left. The second axis differentiates farms with larger forage areas and those with feed distributed to animals upwards. The size of the family is not discriminating for farm types.



**Figure 1. First plan of the main component analysis with projection of 3 types of farm**

The analysis makes it possible to distinguish 4 types of exploitation.

The extensive livestock farms (type 1): They have average cultivated area of 6,235m<sup>2</sup>, composed mainly of upland field, and with

a medium area of the lowland field. They have no or little forage crop. The herd of ruminant is large (>6 TLU) whose feeding is largely ensured by grazing (60%) with a little supplementation to the trough. The animals

spend a lot of time in whole year around grazing outside the farm.

The semi-intensive livestock farms (type 2): They cultivate in intermediate surfaces (11,870m<sup>2</sup>), with the highest area of lowland surfaces (2,070m<sup>2</sup>) compared to other types of farm, intermediate highland areas, and an average of 825m<sup>2</sup> that is the largest area for forage among all surveyed farm types. They also own a large herd (>6 TLU) that are grazed in all seasons but remain largely fed to the trough (2,330kg DM/TLU/year).

The crop-oriented farms (type 3): They have the largest cultivated areas (20,160m<sup>2</sup>) compared to other farm types. The land

area mainly contains of high land field, but without forage crop area. They have a smaller herd (>3 TLU) that are kept under a barn. The contribution from pastures outside to this farm type was smallest compared to the others. The animals are mainly draft animals.

In addition, the farms without ruminants (type 0): This type of farm shares about 30% of the total farms in the commune according to the local authority's data. These farms have small cultivated areas (2,240m<sup>2</sup>) distributed between the lowlands and the highlands. They rear pig and poultry and practice agriculture with rice and some maize production. The detailed characteristics of these four types of farms are presented in Table 1.

**Table 1. Characteristics of the diversity of livestock farm types in Quài Nua Commune**

	Type 1	Type 2	Type 3	Type 0	Significance
Number of surveyed	20	8	12	8	
%	41.7	16.7	25.0	16.7	
People living on farm (person)	5.7 <sup>a</sup>	3.8 <sup>a</sup>	5.3 <sup>a</sup>	3.9 <sup>a</sup>	ns
Total crop area (m <sup>2</sup> )	6 235 <sup>bc</sup>	11 870 <sup>b</sup>	20 163 <sup>a</sup>	2 238 <sup>c</sup>	***
Low land crop area (m <sup>2</sup> )	1 605 <sup>ab</sup>	2 070 <sup>a</sup>	1 079 <sup>b</sup>	900 <sup>b</sup>	*
Upland crop area (m <sup>2</sup> )	4 630 <sup>bc</sup>	9 800 <sup>b</sup>	19 083 <sup>a</sup>	1 338 <sup>c</sup>	***
Cultivated grass area (m <sup>2</sup> )	10 <sup>b</sup>	825 <sup>a</sup>	0 <sup>b</sup>	0 <sup>b</sup>	***
Size of herd (TLU)	6.1 <sup>a</sup>	6.1 <sup>a</sup>	3.6 <sup>a</sup>	0.0 <sup>b</sup>	***
Feed (kg DM/ TLU/year)	432 <sup>b</sup>	2 330 <sup>a</sup>	303 <sup>b</sup>	0 <sup>b</sup>	***
Feeding by grazing (%)	59.4 <sup>a</sup>	29.0 <sup>b</sup>	16.8 <sup>b</sup>	0.0 <sup>c</sup>	***
Time of cattle grazing in the rainy season (%)	61.8 <sup>a</sup>	66.1 <sup>a</sup>	28.0 <sup>b</sup>	0.0 <sup>c</sup>	***
Time of cattle grazing in the dry season (%)	65.0 <sup>a</sup>	62.0 <sup>a</sup>	12.2 <sup>b</sup>	9.6 <sup>b</sup>	***

ns : non significance ; \* : P-value<0,05 ; \*\* : P-value<0,01 ; \*\*\* : P-value<0,001

Huyen *et al.* (2011) also describe similar main types of household farms in Son La province, however, without quantified value of different production practices. In addition, the specialized beef farm type is not existed in the current study area.

### 3.2. Contribution of grazing livestock systems to the production, local development, ecosystem and social aspects

The total contribution from crops and livestock production to the whole commune is estimated about 152.712 billion VND/year, in which, 40.6% from crops, and the rest of

59.4% from livestock production. Ruminants contribute 41.097 billion VND out of 90.766 billion VND of total animal production value in the commune (45.3%), in which pastoral based ruminant shares of 16.3%. Nevertheless, roles of different production segments are not the same on different farm types. The proportion of contribution value from pastoral ruminants in the total income of extensive livestock farms (type 1) is higher than on other farm types. While the share of non-pastoral ruminant in the income of semi-intensive farms (type 2) is larger than of other farm types; and not much different between

## ANIMAL PRODUCTION

extensive and crop-oriented farms (type 3). Even though, on ruminant keeping farms (at farm level), the contribution from ruminants is quite high, especially on type 1 and 2, however, the proportion of these farms is lower

than cropping farm and mono-gastric animal keeping farms in the commune. This results in lower contribution value of ruminants to the whole commune compared to crops and mono-gastric livestock (at communal level).

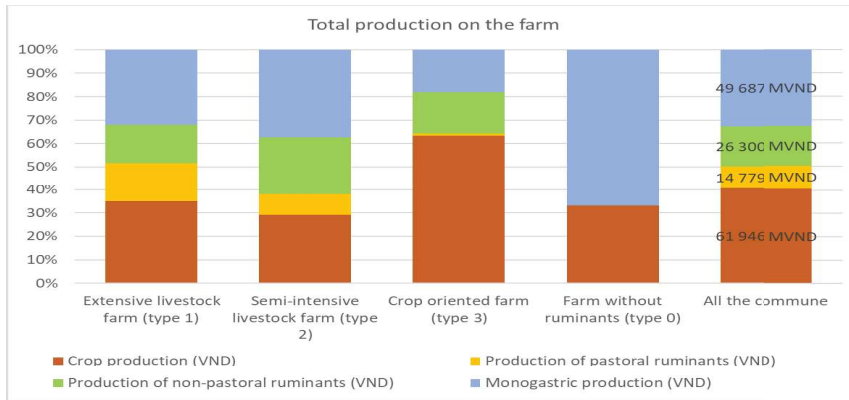


Figure 2. Total values of crop and animal production at farm and communal levels

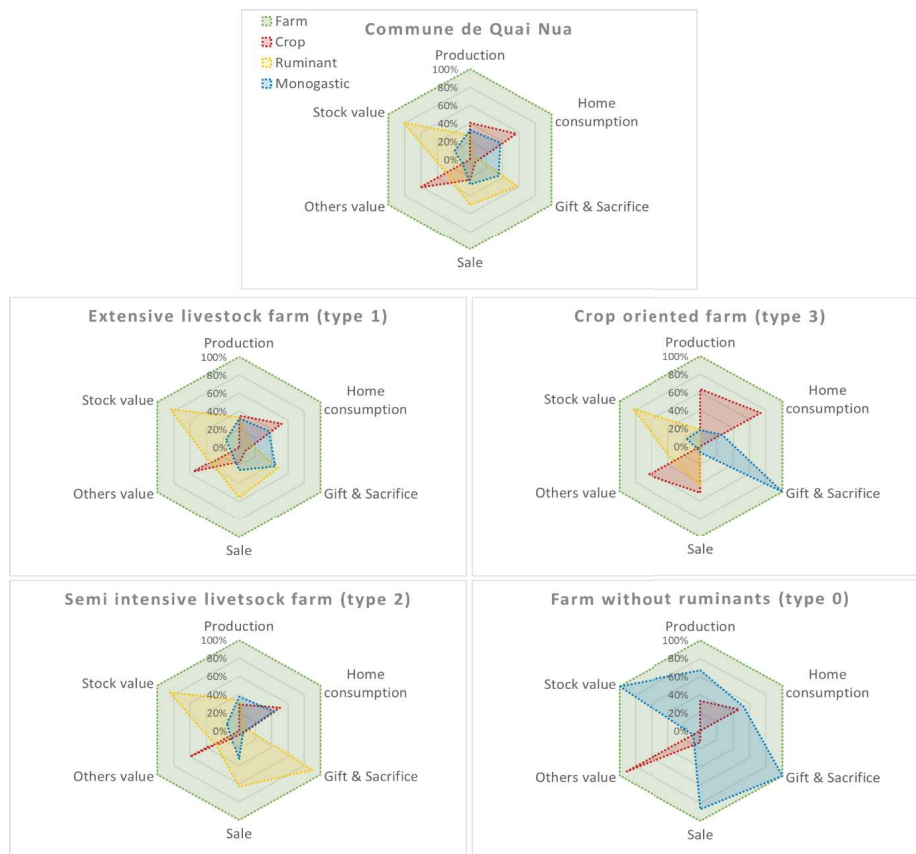


Figure 3. Multifunction roles of livestock in the commune and different farm types

Figure 3 also illustrates multifunction of livestock in the whole commune as well as at different farm types. Livestock production systems are not just noble animal products for sale. Particularly in extensive and semi-intensive livestock farm those are strongly dependent on pastures, the ruminants play multiple roles on the farms and community, such as meat for home self-consumption (protein source of the farm), sacrifices and donations (cultural and social roles), traction force (important for slope land), and the production of manures (necessary for maintenance of organic soil fertility and increase crop productivity). Stock value of ruminants plays an important role as bank saving for all farmers.

Results of the current study found that livestock contributed multifunction to all kinds of household farms, inclusive of non-ruminant keeping farms, crop-orientation farm, extensive ruminant farms, and semi-intensive ruminant farms. In which, cattle and buffaloes brought high contribution to the two latter farm types from different values of meat for home consumption, sacrifices and donations, traction force, production of manures for cropping and stock value of ruminants as bank saving for families. High contribution of non-cash value from cattle and buffaloes is also identified in Son La province by Huyen *et al.* (2010). A number of authors (eg.: Choocharoen *et al.*, 2014; Huyen *et al.*, 2018) state that pastoral systems are characterized by multi-functions of livestock with strong linkages of livestock, grassland, forest and cropping. The grazing areas were identified as in the review of Huyen *et al.* (2018) those are composed of uncovered grasslands, but also of forest lands, fallows and interstitial areas (border of fields, roads, etc.).

#### 4. CONCLUSIONS AND RECOMMENDATIONS

In a highland commune, livestock production systems (cattle and buffaloes) are diversified and tend to be sustainable adapted to the local conditions. In each system,

livestock plays multiple contribution to the farm and the development of the community. The contribution of large ruminant implicates the role of grazing land that is need to be improved and more concerned by the local authority and farmers.

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