# CHAPTER 3

# MATERIALS AND METHODS

## 3.1. Study area

The study was conducted within the project "Community-driven breeding and management programmes, building on local resources, local knowledge and organization opportunities at village, regional and national level", a sub-project of the Thai-Vietnamese-German Collaborative Research Programme "Sustainable Land Use and Rural Development in Mountainous Regions of Southeast Asia/ The Uplands Programme", conducted by the University of Hohenheim and partner institutions in Thailand and Vietnam, and funded by German Research Council DFG.


Figure 1: Map of Son La province

Son La is a mountainous province in the Northwest of Vietnam, with a total area of 14,125 $km^2$ (4.27% of Vietnam's total area). Son La has 10 districts and one capital town. The population is 1,007,500 people, including 12 ethnic groups. 89% of the population live in rural areas. The average altitude is 600-700 m a.s.l.

The research site is located in Mai Son and Yen Chau districts in Son La province, Northwest Vietnam. Yen Chau district is 260 km from Hanoi and 60 km from Son La, next to the National Highway 6. Total land area is 857.75 $km^2$, the total population accounts for 64.2 thousand people. Yen Chau has five ethnic groups, including Kinh, Thai, Sinh Mu and Kho Mu people. These groups account for 70% of the total population.

Mai Son is located 30 km from Son La, between the districts of Yen Chau and Son La. Mai Son's infrastructure includes the highways 6 and 4G, the airport Na San and Ta Hoc river port of the Da River.

The major agricultural activities in both districts are crop and livestock production. Rice, maize and cassava are the major cultivated food crops. The planted area and production output of rice, maize, cassava and sugar cane in both districts is shown in figures 2 to 9 below.

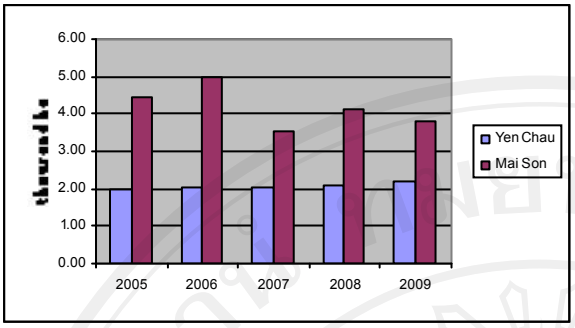


Figure 2: Planted area of rice

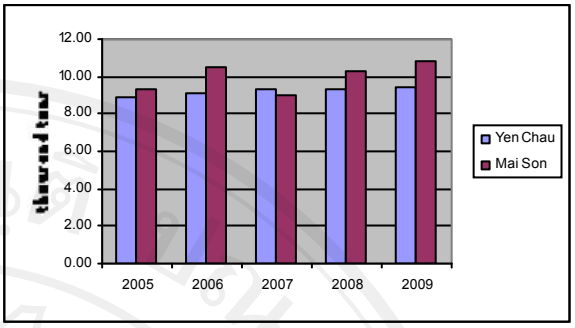


Figure 3: Production of rice

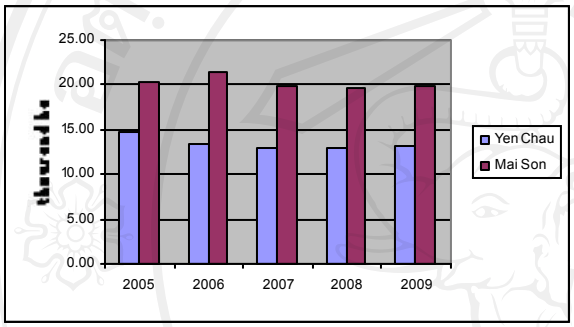


Figure 4: Planted area of maize

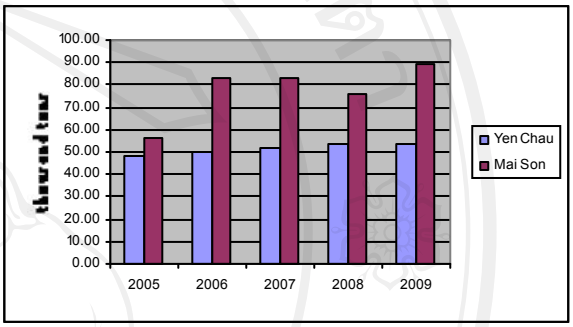


Figure 5: Production of maize

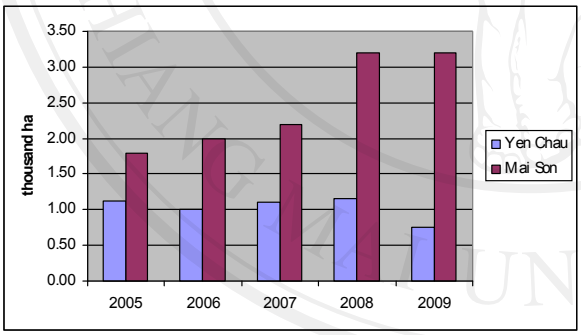


Figure 6: Planted area of cassava

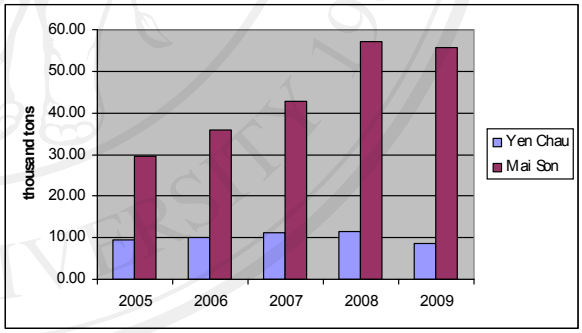


Figure 7: Production of cassava

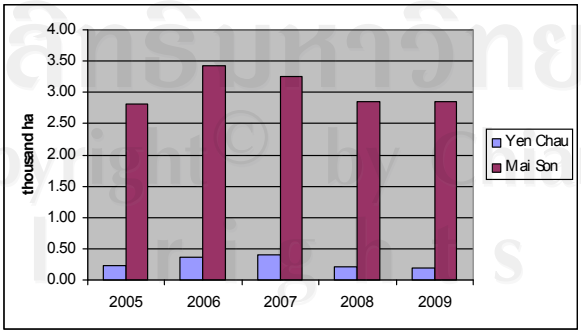


Figure 8: Planted area of sugar cane

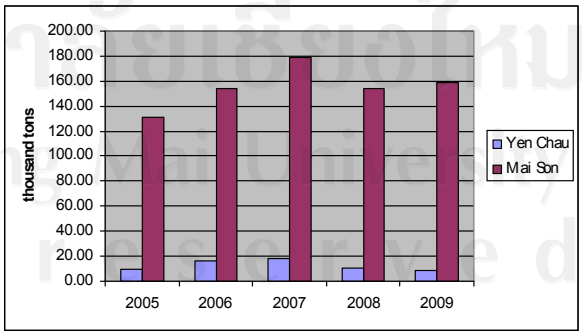


Figure 9: Production of sugar cane

The figures show that the cultivated area of rice, maize, cassava and sugar cane of Mai Son are larger than in Yen Chau. The yield of rice in Yen Chau is higher than in Mai Son. The differences in planted area of cassava and sugar cane can be explained by a cassava mill and a sugar factory that were established in Mai Son district. In both districts, maize is the most important crop, indicated by the size of planted area for maize.

The livestock species in both districts include buffaloes, cattle, pigs, horses, goats, and poultry. The livestock population in the two districts is summarized in Table 1.

Table 1: Livestock population in Yen Chau and Mai Son in 2009 (in thousand heads)

| Species | Yen Chau | Mai Son | Son La |
|---|---|---|---|
| Buffaloes | 14.51 | 14.39 | 162.46 |
| Cattle | 11.86 | 19.84 | 176.48 |
| Goat | 9.97 | 18.86 | 136.25 |
| Horse | 0.48 | 1.13 | 18.51 |
| Pig | 24.21 | 81.99 | 481.81 |
| Chicken | 244.02 | 721.15 | 3797.35 |

(Son La Statistics office, 2010)



In general, livestock population in Mai Son was larger than in Yen Chau except for buffaloes. The differences can be seen on the populations of pigs, poultry, horses and

goats. The total cattle population in Yen Chau and Mai Son district in 2009 was 11,860 and 19,840 heads, respectively.

### 3.2. Villages

The villages in this study were chosen based on the results from the study of Setianingrum (2010) on the smallholder cattle farms in northern Vietnam with access to communal pastures, applied feeding practices and underutilised locally available feed resources. The communes chosen were Tu Nang, Chieng Dong (Yen Chau) and Chieng Chung (Mai Son). One village in each commune was chosen. They are located in the remote mountainous areas and had access to natural pastures. These villages were investigated about feed and feeding system by Setianingrum (2010) and have enough crop by-products for the feeding trial. Other criteria for choosing villages are with regard to the large cattle population and the availability of different size framed cattle. All of the three villages are Thai villages. Chieng Ban and Na Pan village are located 3 km far from highway 6, Nam village is located 19 km far from highway 6. In Chieng Ban and Na Pan, maize croping is the main production activity and the main income generation source. In Nam village the most important crop is coffee.

The target farms are medium mixed farms promising profitable beef production in the study region (Huyen et al, 2010). The selection criteria were that the households kept more than 5 cattle, practise a mixed livestock-crop production system and were willing to participate in the study. Ten households in each village were chosen for the interview with the assistance from the village headers. Later, eleven were chosen for feeding trials

according to the willingness to participate in the feeding trial and the suitable of their cattle for the experiment criteria (frame size, age and weight of cattle)

### 3.3. Secondary data collection

Secondary data, such as demographic and geographic information, agricultural activities, institutional policy and social structure, were collected from village heads, commune officers, extension service stations, veterinary stations, statistical offices, and a literature review. The header of three village (key persons) were interviewed about the general and social-economic information, production activities and price of feed, labour cost, price of cattle and the way farmers sell their cattle in their villages. The information about health and disease was collected from farmers, village heads and local veterinarians.

### 3.4. Farmer interviews

Key person interviews and farmer interviews with structured questionnaires were carried out to gather the following data and information: General household data and socio-economic parameters (household size, proportion of different age groups, illiteracy rate, land ownership), crop production (plot size and yield of main crops, amount of selling crops, price, amount of crop kept for animal, feeding) and utilization of crop by-products for cattle (kind of crop by-products and amount, current situation of using these by-products, methods applied to preserve and improve the quality of by-crop products), cattle production system (cattle breed, purposes to keep cattle, feed supply, alternative feed supply), management (feeding regimen, breeding methods, herd management, pasture management, cattle housing, cattle marketing, health, disease and animal

performances) and the constraints of cattle production.

Three group discussions were held with farmers and village heads in Chieng Ban, Na Pan and Nam villages. The discussion provided information about the difficulties and the potentials for developing beef cattle production in each of the villages. Possible solutions for overcoming constraints were discussed.

### 3.5. Feeding trial

Eleven farms were chosen for the feeding trial. They had at least three cattle and access to communal pastures. The Yellow cattle were chosen for the feeding trial due to the absence of other breeds in the study region. The selected calves were from 12-15 months of age at the beginning of the feeding trial. The cattle were categorised into two types: a large frame size (LFS) and a smaller framed size (SFS) cattle type. The SFS group was smaller in size, but lead a higher reproductive performance than the LFS group. The SFS cattle gave birth annually, whereas LFS cattle had a longer calving interval of 1.5 to two years. The LFS group was preferred because of higher grow rate. They were more popular in Chieng Ban village while in Na Pan and Nam village, no cattle of LFS group was reported. The initial weight of SFS cattle ranged from 90-132 kg while LFS cattle ranged from 132-153 kg. Before the adaptation period, all animals were treated against intestinal parasites. The Veterinary Departments in the study regions vaccinated the animals against Foot-and-Mouth disease and Pasteurellosis twice a year.



For the feeding trial, SFS and LFS cattle were randomly allocated into 2x3 factorial design experiment. With SFS cattle, there were 12 cattle allocated to the control group

while the control group of LFS cattle had 8 animals (table 2). The experimental period lasted for 67 days including 7 days of adaptation. The animals were weighed after the adaptation period, when feed intake was stable.

In the experiment, four treatments were included for both frame sizes of cattle:

+ Treatment 1: cattle were kept in barns and were fed a fixed ration with five kg natural grass, one kilogram of maize meal + urea-treated rice straw (fed ad libitum, amount of UTRS supply was calculated to achieve 15% surplus feed as previous day's intake);
+ Treatment 2: grazing + urea-molasses multinutrient block (UMMB) (0.5 kg/ head/ day);
+ Treatment 3: grazing + urea-treated rice straw (ad libitum, amount of UTRS supply was calculated to achieve 15% surplus feed as previous day's intake);
+ Treatment 4 (control group): fed according to the farmer's regimen (only grazing on pasture and no supplementary feed supply except salt).

Table 2: Experimental design

| Frame size of cattle | Treatment | | | |
|---|---|---|---|---|
| | Fixed ration + UTRS | Grazing + UMMB | Grazing + UTRS | Control group |
| SFS | 4 | 4 | 4 | 12 |
| LFS | 4* | 4 | 4 | 8 |

*Due to unexpected reasons, data of 3 cattle was not available in the first month of experiment.

In the group receiving the fixed ration with UTRS, maize meal and grass were fed twice per day, at 7am and 5pm; UTRS was only given in the afternoon. The remaining feed was weighted and recorded in the morning of the following day. The intake of UTRS was calculated based on the amount of feed offered and refused.

In the feeding trial, the initial weight of 31 cattle (24 of SFS group and 17 of LFS group) and the monthly weight of twenty cattle used as control (8 of small frame size group and 12 of large frame size group) were recorded to calculate the differences in weight gain between the two frame size groups (table 15).

At the beginning and the end of the feeding trial, all animals were weighed individually for two consecutive days in the morning before feeding, and the mean value determined the respective initial and final weight of the two distinct groups of cattle. Body weight was measured using an electronic scale. During the feeding study, the live weight of the animals was recorded on the $30^{th}$ day by applying the same procedure. Monthly average daily gain (ADG) of each animal was calculated from the individual measurements. Average daily gain (g/ day) was calculated from initial, intermediate and final live weights over the experimental feeding period:

$$ADG1 = \frac{(30^{th} \text{ day live weight (kg)} - \text{initial weight (kg)})}{30 \text{ (days)}} \times 1000 \quad \text{(g/day)}$$

$$ADG2 = \frac{(\text{finishing weight (kg)} - 30^{th} \text{ day live weight (kg)})}{30 \text{ (days)}} \times 1000 \quad \text{(g/day)}$$

$$ADG3 = \frac{(\text{finishing weight (kg)} - \text{initial weight (kg)})}{60 \text{ (days)}} \times 1000 \quad \text{(g/day)}$$

The price of feed ingredients, materials, labour costs for UTRS, UMMB and fixed ration, as well as the price of cattle were collected by interviews with the village heads, farmers and the traders. This information was used to evaluate the economic feasibility of this experiment by using the partial budgets analysis. Grazing costs were not considered and all other variable costs (e.g. medicaments, labour) were the same for both experimental groups. The total cost of production (feed, urea, molasses, and material including plastic sheets used for ensiling the rice straw and urea-molasses multinutrient blocks) entered in the partial budget analysis. The daily net benefit (NB) and the overall change of net benefit over the control group was calculated as follows

NB (VND/cattle/day) = (ADG (kg) x price of meat (VND/kg)) – (cost of treatment (VND/kg) x feed intake (kg))

Overall change of net benefit (VND/cattle/day) = NB of treatment (VND/cattle/day) – NB of control group (VND/cattle/day)

### 3.6. Treatment of crop by-products

#### *3.6.1. Urea-treated rice straw (UTRS)*

For the preparation of UTRS, urea solution (4 kg urea plus 0.5 kg of salt dissolved in 80-100 l of water) was sprinkled onto 100 kg of dried rice straw, spread out on a plastic sheet placed on the ground. The UTRS was then stored in an airtight plastic bag for two to three weeks before feeding.

### *3.6.2. Urea-molasses-multi-nutrient block (UMMB)*

The UMMB contained 37% molasses, 8% urea, 43% rice bran, 5% cement, 5% lime, 1% salt and 1% vitamin mineral premix. This formula is based on research of Vu et al. (2006). The ingredients were purchased on the local markets. At first molasses is weighed and put in a large bowl. Then salt and urea is added and admixture well manually. Then rice bran, cement, lime and vitamin mineral premix which were previously kept into separate bowls, are added with this mixture and also mixed well. This mixture is placed in wooden forme, and then pressure is applied to give it block shape, block so prepared usually weighs 2.5 kg. The block is now displaced from the forme and kept for 1 day under the shade for hardening and ready for animal consumption. Besides the above procedures, the mixture can be pressed in others forme. The purpose of block shape is easier for transportation. The mixture can be directly without block shape. In this case, cement is not necessary to be applied.

## 3.7. Data analysis

Data was analyzed using SAS, version 9.2 (SAS Institute Inc., Cary, NC, USA) Descriptive statistics were used to present general information of the cattle keepers and the cattle production system. The Fisher's exact test was used to investigate the differences between villages.

For the feeding trial, the following statistical model was applied:

$$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

With $y_{ijk}$ - the average daily gain of animal of frame size i and treatment j; $\mu$ - overall mean; $\alpha_i$ - effect of frame size I; $\beta_j$ = effect of treatment j; $(\alpha\beta)_{ij}$ - effect of the interaction frame*treatment; and $\varepsilon_{ijk}$ = random error