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Economic efficiency of ruminant production in Dien Bien district, Dien Bien province

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ABSTRACT

This research aimed to assess the current production and economic efficiency and propose the optimally saleable age for the farmers of extensive, semi-intensive, and intensive groups in three communes: Noong Hẹt, Noong Luong, and Thanh Yen, by using the descriptive investigation and the economic accounting with Tropical Livestock Units TLU indicator to evaluate the cost, the profit, and the efficiency of 3 groups. The results showed that the extensive group have the lowest direct costs of 730.53 thousand VND per individual per year, and intensive farms have the highest with 2724.19 thousand VND per individual per year. However, the family's labor of the extensive group was spent the most time on grazing lands, so they have less free time. But, they still find the job more straightforward than the semi-intensive and intensive farmers. If direct costs were taken into account, the economic efficiency of the intensive group was the highest (For every 1 VND spent VND for the costs then get 0.43 VND in profit, and the extensive group is the lowest (For every 1 VND spent VND for the cost then get 0.34 VND in profit). The more intensive the farming practices applied, the shorter the optimally saleable age of ruminants would be. The conclusion is that intensive group are the most effective in the situation which is gradually shrinking pastoral land.

Keywords: *ruminants, extensive, intensive, semi-intensive, profitable*

Introduction

The world population is projected to reach 9.8 billion in 2050, and 11.2 billion in 2100 (United Nations, 2017), which means the future food demand is increasing and animal-based protein is also included. However, the degradation of agricultural land raises significant concerns about crop and pasture yield (Hossain *et al.*, 2020), which affect to animal husbandry. This shows the need for an effective breeding methods.

Dien Bien district is located in the southwest of Dien Bien province, where there are all favorable factors of hills, forests, and plains. Agriculture is the main development direction in the economic structure (Giang *et al.*, 2022). According to Dien Bien Provincial Statistics Office, the district's natural land area is 1396.26 km2, of which more than 90% is agricultural land. Thus, the availability of abundant source of food by-products along with extensive grazing grounds which is favorable condition for the development of ruminant husbandry. In 2020, the output of live-weight buffalo meat for the slaughter of the district was 466.1 tons, while live-weight beef output for the slaughter was 581.7 tons (Dien Bien statistical Year Book 2020, 2021)

In recent years, Dien Bien district has had policies to develop livestock in the area, husbandry techniques have been transferred. One of them is intensive livestock farming, where animals are confinement at high stocking density and their food is provided directly at the

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barn (Ilea, R. C., 2009). Realizing the effects achieved by this model, many livestock farmers have been changing methods from mainly grazing to semi-grazing, boldly investing in barns, and planting more grass to proactively ensure food sources. Besides, other parts still maintain the conventional practice, that the food for ruminants is mainly based on natural grass sources by grazing or also known for extensive farming. How effective are the farming methods according to the extensive and intensive farming models? Is the level of labor investment in these models different? What is the optimally saleable age in these farming methods? Because of these reasons, we conduct this project, "Economic efficiency of ruminant production in Dien Bien district, Dien Bien province". The objective of this research is to evaluate the current status and economic efficiency of raising cattle and buffalo and propose the optimally saleable age for extensive, semi-intensive, and intensive farms in 3 communes in Dien Bien district, Dien Bien province, Vietnam.

Materials and methods

Materials

Cattle raised according to extensive, semi-intensive, and intensive farming models at households in Dien Bien province.

Locations and duration

Secondary data were collected over the period of 2020 - 2022; primary data were collected from April to May, 2022.

Locations: Research project was carried out in 3 communes: Noong Het, Thanh Yen, and Noong Luong in Dien Bien District, Dien bien Province

Research methods

Survey sampling method

Using stratified random sampling in each commune, based on a list (provided by local officials) of cattle raising households of Dien Bien district representative communes. Three communes were selected for the interview.

The study randomized the cattle-raising households in captivity and grazing, growing grass and no grass, using the concentrate and not the concentrate.

Data collection

Secondary data sources: Data were collected from the Dien-Bien Provincial Department of Agriculture and Rural Development, local research results and reports, and internet

Primary data sources were gathered from interviewing and conducting cattle raising households through designed questionnaires commune veterinary staffs.

Data analyses

The data were processed and analyzed in Excel 2016.

Methods of data analyses

Qualitative analysis: Qualitative data and information were systematically synthesized and summarized.

Descriptive statistical method: Data classified the survey samples according to extensive, semi-intensive, and intensive livestock production

Extensive farms: Households take their livestock to the grazing areas daily for a long time (5 hours or more per day), do not use self-grown grass, and do not use concentrates.

Semi-intensive farms: Households tend to go to grazing areas with their livestock everyday with less time (1-4 hours per day) and near the farm, using self-grown grass as well as using concentrated feed

The farms in Intensive group: Farmer only tend to go for a few days per year near the farm or entirely in captivity, using much concentrates and self-grown grass.

Table 1. Number of survey samples by types of livestock

Groups	Number of farms
Extensive group	9
Semi-intensive group	23
Intensive group	9
Total farms	41

Source: In-depth interview, 2022

Economic accounting method based on TLU indicators

Tropical Livestock Units (TLU) are livestock numbers converted to a common unit for comparability between groups.

Table 2. TLU indicators

Type	TLU
Male buffalo	1.6
Female buffalo	1.4
Male cattle	0.96
Female cattle	0.8
Calf, young buffalo	0.5

(According to Meyer,2018)

The purpose of calculating TLU is to obtain the common indicator of all types of animal on the farm, thus determining the costs for per TLU of each farm.

The results in raising cattle in groups of household: GO, IC, VA, MI, TPr

GO - Gross output

GO = Income from selling cattle + Income from young animals born on the farm per year + Income from manure + Income from draft power

Intermediate costs (IC): Intermediary costs are all costs of materials and services such as buying animals, feed, veterinary medicine, and other material costs, excluding depreciation of fixed assets.

VA-Value add: VA= GO - IC

Total cost (TC) = IC+ A+ (Labour family cost)

A depreciation of fixed assets

Mix Income MI = GO - IC - A

Total profit (TPr): TPr = GO - TC

The economic efficiency: GO/IC, VA/IC, MI/IC, TPr/IC, GO/TC,VA/TC, MI/TC,TPr/TC.

The ruminant productions on the farms are relatively diverse, including young animals, culling cattle and buffaloes, Etc., and have relatively different periods/cycles. In order to calculate the results and efficiency in raising ruminants according to different purposes, we convert and calculate with a one-year farming period, specifically:

For reproductive cattle and buffaloes: The breeding cost to produce young ruminants is the total cost of raising a cow from the the service to calving.

For cattle and buffaloes raised from the young: the breeding cost is the cost of buying calves. If the young are born on the farm, the estimated price of the young is based on the market and converted farming time to 1 year.

Optimal selling age

Determining the optimal selling age of cattle and buffalo is an important factor in livestock management to maximize profits and economic efficiency.

Profit = Expected revenue - accumulate cost

At a certain point, cattle and buffalo may reach a point of diminishing returns. This means that while ruminants grow slowly, the cost of raising them continue to rise. The optimal selling age is right before this point.

Results and discussion

General information from livestock households

Table 3. Statistically compared about three groups of farms

Average	Unit	n (farms)	Extensive	Semi-intensive	Intensive
			Mean ±SD	Mean ±SD	Mean ±SD
Age of holders, owners or ranchers	Year	41	60.11 ±11.37	52.26 ±12.39	50.78 ±12.95
Number of experienced years in raising ruminants	Year	41	27.78 ±16.56	15 ±11.36	9.78 ±11.12
Number of people in holds	Nb	41	4.33 ±1.50	3.52 ±1.24	3.67 ±1.73
Number of people related to animal production	Nb	41	2.56 ±0.73	2 ± 0.85	2.11 ±1.27

Source: In-depth interview, 2022

From Table 3, it had been seen that the average age of extensive farming holders was the oldest (60.11 years old) and then in the semi-intensive farming holds (52.26 years old) and the youngest age had been seen in the intensive farming households (50.78 years old). Similarly, experienced years was also found that the largest of 27.78 years in extensive farms and the lowest was 9.78 years of intensive farms. All of these showed that the extensive livestock farmers were older and have been more familiar with the traditional manner from their previous generations, and it was seamed that they could hardly want to change. The holders in intensive farms were younger and easy to approach with innovative mind and thinking and bolder investment.

When regrouping farms by types of livestock farming according to other criteria, there had been the differences among these three types in terms of grazing criteria.

Table 4. Average criteria for livestock grazing in each type of farming

Criteria	Extensive	Semi-intensive	Intensive
Time for daily cattle grazing (hours)	7.00 ±2.50	4.02 ±2.27	1.89 ±3.10
Number of grazing days per year (days)	365.00±0.00	313.30±101.93	33.33±50.74
Distance from the households to the grazing areas (km)	2.73 ±1.85	0.64±0.70	0.28 ±0.44
Time from the households to the grazing area (minutes)	42.22±14.81	10.35 ±9.82	4.44±10.14

Source: In-depth interview, 2022

Table 4 shows that the average criteria of cattle grazing for the extensive group are the highest, and for the intensive group are the lowest. Specifically, for extensive group, the average daily time for cattle grazing, number of annual grazing days, distance from family to grazing areas and time from family to grazing land are 7.00 hours, 365.00 day, 2.73 km and 42.22 minutes. Whereas, for intensive group, these criteria are 1.89 hours, 33.33 days, 0.28 km and 4.44 minutes respectively in the average daily time for cattle grazing, number of annual grazing days, distance from family to grazing areas and time from family to grazing land.

The annually average cost for three farming groups

Annually average direct cost to raise an buffalo and cow individual in the studied households (Calculated by TLU indicators)

Table 5. Annually average direct cost in to raise a ruminant individual in farming groups (based on TLU indicators)

Unit: 1,000 VND

Criteria	Extensive	Semi-intensive	Intensive
A-Feed	578.94	962.59	2307.49
Rice Straw	515.09	455.69	798.26
Forage	1.21	0	8.22
Concentrate	0	428.98	1414.42
Mixture of minerals	62.64	77.92	86.59
B. Veterinary cost	105.39	21.10	161.24
C. Labour cost	0	63.07	0
D. Depreciation of fix assets (A)	46.20	59.23	255.46
Total cost	730.53	1105.99	2724.19

Source: In-depth interview, 2022

Table 5 shows that the average annual direct cost per head of animals in the extensive group is the lowest with only 730.53 thousand VND, and the intensive group has the highest cost with 2724.19 thousand VND. This difference derived from many different sources of costs. In the meanwhile, ruminants in the extensive group were not invested any costs for concentrated feed, or the other feed sources. The intensive group spent the most with 1414.42 thousand VND per year. The annual depreciation of fixed assets and veterinary expenses also clearly show that the expenditure of the intensive group is higher than those of the other groups. In summary, the direct costs increased tending from extensive to semi-intensive and intensive farming groups.

The annually average cost to raise an individual buffalo and cow in each group (including labor cost - According to TLU indicators)

When the family's labor works were included in the costs, the price at the time of the survey was 200,000 VND for a day of 8 hour working, so the costs vary substantially.

Table 6. The annually average cost to raise individual livestock in each group (including labor cost- According to TLU indicators)

Unit: 1000VND

Criteria	Extensive farm	Semi intensive farm	Intensive farm
A-Feed	1344.18	2201.04	5152.69
Rice Straw	578.85	566.47	872.40
Forage	695.44	977.96	2519.9
Concentrate	7.25	578.69	1673.8
Mixture of minerals	62.64	77.92	86.59
B. Veterinary cost	105.39	21.10	161.24
C. Labour cost	0	63.07	0
D. Depreciation of fix assets (A)	99.54	129.26	393.13
E. Labour family cost	9126.22	6083.23	1095.04
Total cost	10675.33	8497.7	6802.10

Family's labor costs are mainly allocated to activities such as gathering and harvesting forage and labor works in leading ruminants in pasturelands and taking care of them. The group of extensive farms was basically on grazing, so its cost is the highest with 9,126.22 thousand VND/year, and the labor cost for self-growing the grass is the lowest among the three groups. In contrary, labour family cost in the group of intensive farms was found the lowest. Because of depending on elephant grass, so, the labor cost for self-growing grass is the largest, and they spend little time with grazing ruminants or even completely captive confinement, so the labour cost was the lowest for this group, 1095.04 thousand VND/year. for semi-intensive farms, their ruminants used both grown and natural grass, so the cost was in the middle of the three groups of households. In general, if the cost includes family labor, the extensive group was found the highest, and then comes the semi-intensive and intensive group.

Economic efficiency

Table 7. Results of raising ruminants in 3 types of farms on average per year according to direct costs and direct income

Unit: 1000VND

	Criteria	Extensive	Semi-intensive	Intensive
Gross output				
	GO	21020.89	63763.57	59531.99
	Live ruminant sale	4294.44	55439.13	53133.33
	Calves	16337.56	7580.96	5176.44
	Manure (raw)	388.89	743.48	1222.22
Expenditure				
	IC	15411.8	45525.72	40480.2
1	Purchase animals	10888.89	26706.52	11888.39
2	Feed costs	3734.58	14351.6	27881.81
2.1	Rice Straw	3245.47	2416.46	3497.92
2.2	Forage	11.11	2608.7	77.78
2.3	Concentrate	0	8847.83	24006.67
2.4	Mixture of minerals	478	478.61	299.44
3	Veterinary cost	788.33	104	710
4	Labour rent	0	4363.6	0
B	A	271.33	330.33	1008.52
Results	TC	15683.13	45856.05	41488.72
	VA	5609.09	18237.85	19051.79
	TPr	5337.76	17907.52	18043.27
Economic efficiency	VA/IC	0.36	0.40	0.47
	TPr/IC	0.35	0.39	0.45
	VA/TC	0.36	0.40	0.46
	Tpr/TC	0.34	0.39	0.43

In the extensive group, the income from selling live ruminants is the lowest (4294.44) thousand VND a year, in the mean while the income from cows and calves born on the farm is the biggest (16337.56 thousand VND) among three groups. It showed that they tended to want increasing the herd and selling their young ruminants. In intensive and semi-intensive groups, the major source of annual income was from selling fattening ruminants. The value added divided by intermediate costs in the extensive group is the lowest (0.36), followed by the semi-intensive group with 0.40 and the intensive group with the highest 0.47 (1.31 times as high as extensive group). The profit divided by the intermediate costs of the extensive group equals 0.35, which means that spending one VND of the intermediate cost will earn 0.35 VND of profit. The group of intensive group is still the most effective with 0.45 VND profit when investing 1 VND of intermediate cost. In summary, the intensive group is the most economically efficient, and then to the semi-intensive group, and the lowest was found in the extensive group.

When the family's labor cost was included in husbandry activities (at the survey time was 200,000 VND per person working 8 hours a day), the cost and the profit significantly changed.

Table 8. Results of raising ruminants in 3 types of farms on average per year including family's labour cost

Unit:kVND

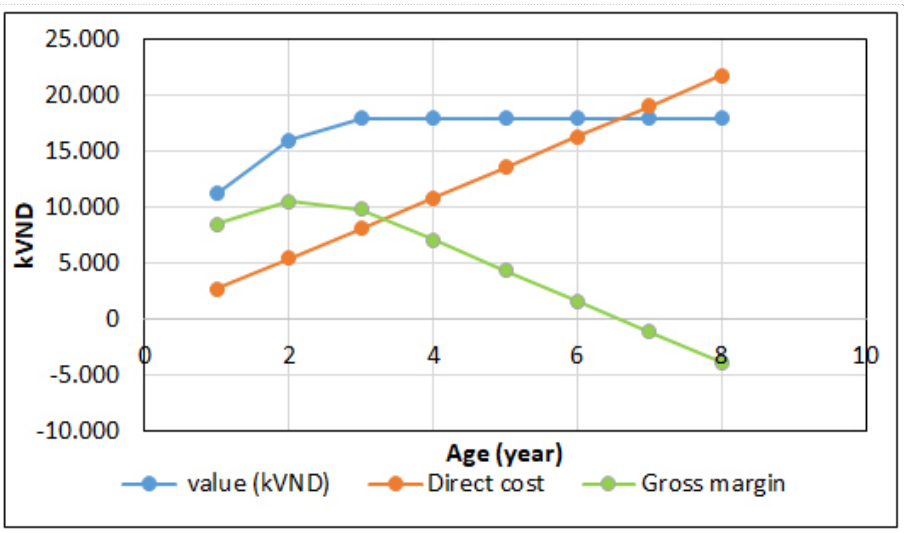
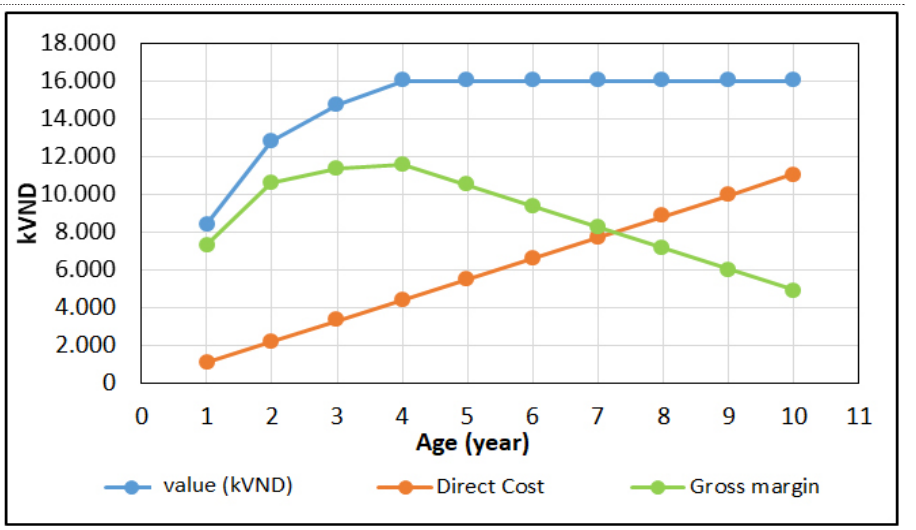
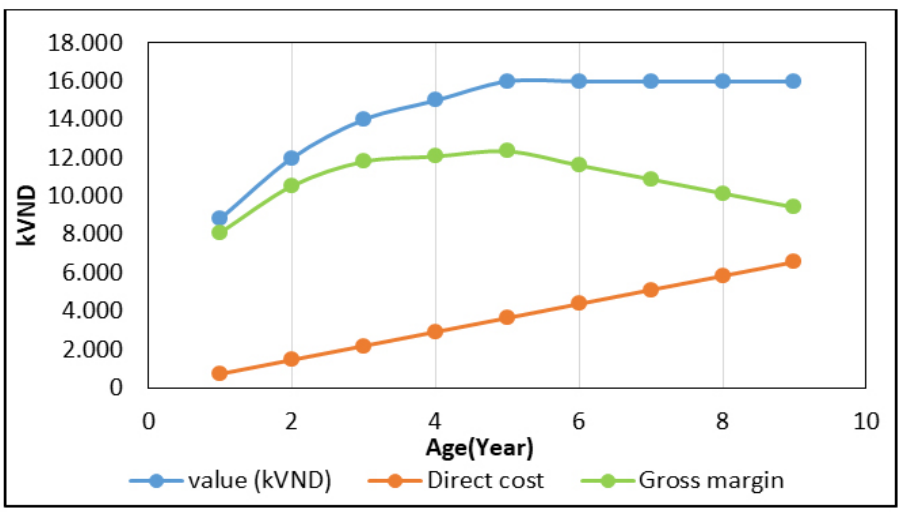
	Criteria	Extensive	Semi intensive	Intensive
Gross output				
	GO	26754.22	68676.83	63626.44
1	Live ruminants sale	4294.44	55439.13	53133.33
2	Calves	16337.56	7580.96	5176.44
3	Manure (Raw)	5388.89	4839.35	5316.67
4	Draft power	733.33	817.39	0
Expenditure				
A	Intermediate consumption (IC)	20978.93	51367.6	52189.69
1	Purchase animals	10888.89	26706.52	11888.39
2	Feed cost	9301.71	20193.48	39591.3
2.1	Rice Straw	3594.04	2938.48	3797.52
2.2	Forage	5163	7415.96	11072.67
2.3	Concentrate	66.67	9360.43	24421.67
2.4	Mixture of minerals	478	478.61	299.44
3	Veterinary cost	788.33	104	710
4	Labour cost	0	4363.6	0
B	B. Depreciation of fix assets (A)	737.26	617.54	1450.07
C	C. family's labour cost	63875	23915.22	4750
Results	TC	85591.19	75900.36	58389.76
	VA	5775.29	17309.23	11436.75
	MI	5038.03	16691.69	9986.68
	TPr	-58836.97	-7223.53	5236.68
Economic efficiency	VA/IC	0.275	0.337	0.219
	MI/IC	0.240	0.325	0.191
	TPr/IC	-2.805	-0.141	0.100
	VA/TC	0.067	0.228	0.196
	MI/TC	0.059	0.220	0.171
	Tpr/TC	-0.687	-0.095	0.090

Family's labors allocated to activities such as leading their ruminants to grazing lands, harvesting, and caltivating elephant grass, gathering rice straw, and so on, resulted in increasing the total cost, and decreasing in profit or evenly financial deficit. The extensive group lost 58836.97 thousand VND, while the semi-intensive group lost 7223.53 thousand VND. The group of intensive farming households still has a profit of 5236.68 thousand VND. It was proven that the higher intensive, the more reduced family labor costs are.

Optimall saleable age

For cattle (Not include farmers' labor)

Table 9. Evolution of the gross margin of the sale of cattle according to age of 3 types of farm

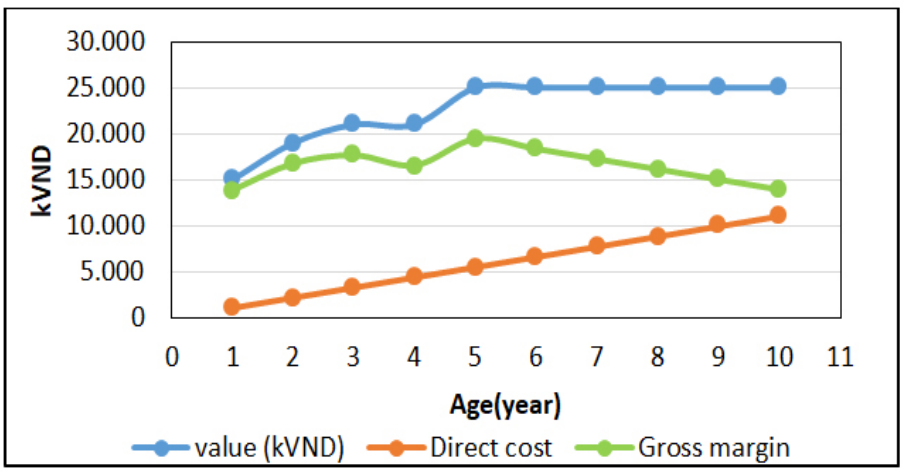
Intensive farms	
For the simulation, this group should be sold at 2 years old. The value will peak in the 3rd year, but the profit in the 3rd year is reduced due to the high annual costs.	
Semi-intensive farms	
According to the simulation, the optimally saleable age is 4 years old, with the most profitable of slightly over 11 million VND/head.	
Extensive farms	
According to the simulation, the optimally saleable age is 5 years oldto get the most profitable of about 12 million VND/head.	

For buffalo (direct cost, not include labor's cost)

Table 10. Evolution of the gross margin of sale of buffalo according to age of 2 types of farm

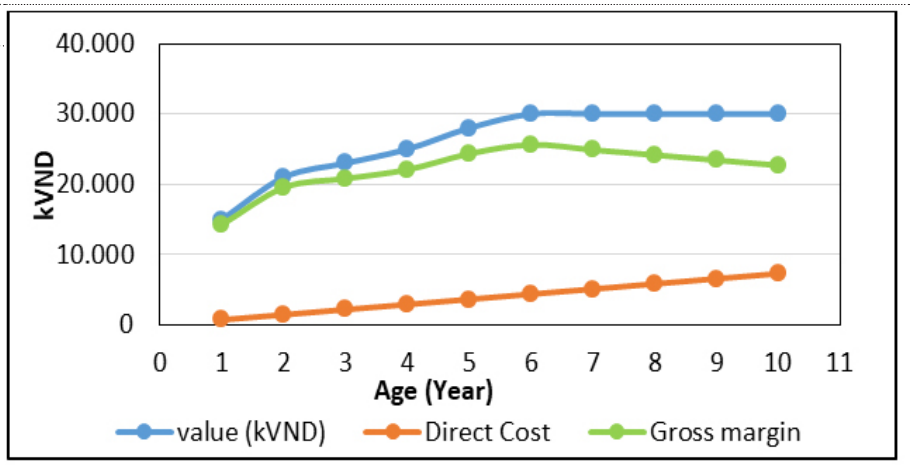
Semi-intensive farms

According to the simulation, in the 5th year, the selling age is optimum, with a profit of about 16 million VND.



Extensive farms

According to the simulation, the optimal selling age is in the 6th year, with the highest profit of about 25 million VND.



The results showed that the more intensive farming is applied, the shorter the optimal selling time would be. Although the cost for husbandry was high, the rapid capital turnover time can still be observed.

The perception of work

Table 11. Assessment of the perception of the work invested in livestock activities.

How do you feel about?	Extensive		Semi-intensive		Intensive	
	MEAN	SD	MEAN	SD	MEAN	SD
The workload	3.33	0.5	3.61	0.66	3.56	0.53
The arduousness of livestock activities	3.22	0.5	3.57	0.51	3.44	0.53
The organization of work	3.22	0.44	2.87	0.46	3.22	0.44
The required level of technique	2.56	0.88	2.96	0.93	3.00	0.71
The required level of capital investment	3.00	0.71	3.13	0.63	2.89	0.33

1-Very low, 2- A small, 3- A medium, 4-High, 5- Very high

In terms of workload, the extensive group was assessed that they were on average (3.33± 0.5) lower than the other two groups. The main daily work of the extensive farms was to lead the herds back and forth to the pasturelands, which was easy work (not too hard and tired). After taking the herds to the grazing area, they often underwent gossipping, and some people evenly might perform other activities. Although semi-intensive and intensive groups did not spend much time for grazing every day likely extensive group, they have much work to do. For instance, cultivating and processing forage, feeding the ruminants and cleaning up the barn, and so on, and will take more effort.

Regarding the arduous work, the farmers in the extensive group also rated the lowest among the three groups (3.22±0.5). The reason is that the extensive group had the highest average husbandry experience of 27.78 years, so they were more adaptive with the job characteristics than the others.

In the relation to the technically required level, farmers in extensive group felt that there was little technique for raising their ruminats, in the meantime farmers in intensive group felt that they need to have more knowledge of disease diagnoses like hematoma, foot and mouth disease, or fattening techniques.

Conclusion

Ruminant production in Dien Bien district has progressive potentials for development.

The direct cost in a year of the extensive group was the lowest, and the intensive group was the highest. However, when labor included, on the contrary, extensive group was the most, and intensive farming was the lowest. The more intensive the farmers applied, the more economic efficiency the farmers would get. The annually economic efficiency including labor cost, was very low, evenly negative, and the higher the level of intensive farming, the lower labor cost was.

The optimal selling age of cattle in the intensive group was two years old due to faster weight gain and high direct costs, four years old in the semi-intensive group, and five years old in the extensive group. For buffalo, the optimal selling age in the extensive group was the 6th year, while the semi-intensive group was the 5 years old. If labor cost was included, the optimal selling age of the groups was under one year to achieve the highest profit.

The daily working time was longer than in semi-intensive and intensive groups, but the farmers in extensive group felt idler than the semi-intensive and intensive ones. Also they were more familiar with grazing work than the others.

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