Cattle Fattening Opportunities on the Plain of Jars, Xieng Khouang Province, Laos

Pascal Lienhard[12], Florent Tivet[12], Anoudeth Phommachan[32], and Thammakham Sosomphou[42]

1. CIRAD-CA, PO Box 2991, Vientiane, Lao PDR, Email: pascal.lienhard@cirad.fr
2. PRONAE-PCADR, PO Box 10990, Vientiane, Lao PDR. Email: pronae.pcadr@nafri.org.la
3. Provincial Agriculture and Forestry Office Xieng Khouang Province
4. NAFRI, PO Box 7170, Vientiane, Lao PDR. Email: contact@nafri.org.la

Abstract

In the vicinity of Phonsavanh (provincial capital of Xieng Khouang, on the Plain of Jars) as in many other areas of Laos, livestock production remains one of the main components of farming systems. In Pek district of Xieng Khouang, it accounts for more than 50% of household income. Cattle raising remains traditional, based on free grazing on clear forest, savannah grassland, and crop residues after harvesting. Poor soil conditions, and lack of both fodder resources and economic incentives are the main constraints limiting extension of livestock production. The savannah grassland here is characterised by acidic soils, high aluminium saturation, and local weed species that produce low amounts of biomass and have low palatability; the main species are *Themeda triandra*, *Hypparhenia* and *Cymbopogon nardus*. More than 60,000 ha of savannah grasslands is present in Xieng Khouang province, mainly located in the districts of Pek, Phoukhouth and Paxay. Since 2004 the Lao National Agro-Ecology Programme (PRONAE) has been introducing innovative cropping systems based on direct-seeding to regenerate lands and diversify farming production. These systems integrate crops and livestock through the use of forage species and cover crops. At the same time thematic adjustment are carried-out, testing simple technologies such as forage species. Promising fodder productivity results were obtained on the Plain of Jars and it was then decided to test these forage species under grazing conditions. The present study seeks to evaluate the agronomic and economic components of cattle fattening in the vicinity of Phonsavanh using improved forages and other inputs. Cattle fattening appeared to be very efficient during the rainy season with a mean growth rate of 364 $g.day^{-1}$ recorded. The local cattle seem well adapted for fattening and showed a good response to improved fodder. The technical and economical results are clearly positive. However, economic incentives and technical and political support must be better defined if efficient and productive livestock systems are to be developed in such an environment. Forage seed production has to be promoted to improve pasture management, to avoid high stocking rates and to generate new income that could be invested in fertilisers and animal care.

Keywords: Cattle fattening, forage species, daily growth rate, Xieng Khouang province, Lao PDR, direct-seeding systems, economic incentives.

1. Introduction

The Lao Government considers development of livestock production to be a priority, since cattle are an important export and the main source of monetary income for most farmers. In the vicinity of the provincial capital of Xieng Khouang, Phonsavanh, it is estimated that more than 60,000 ha of acid, infertile savannah grasslands are under-utilised by smallholders. On these high plains (altitude 800-1100 m above sea level) farming systems are mainly based on lowland rice and extensive livestock production. As reported by Gibson et al. (1999) this agro-ecological zone is well-known for native cattle and buffalo production. An initial assessment conducted by Lienhard et al. (2004) showed that livestock is a major component of farming systems and income generation. Depending on household strategy, land access and financial backing, livestock production accounts for 52%-87% of family income generation.

Xieng Khouang is the third biggest cattle producing province (Committee for Planning and Investment, 2005) but the lack of feeding resources (Hacker et al. 1998) and economic incentives, combine with health problems (Gibson et al. 1999) to limit the development of the livestock sector. Previous attempts to improve pastureland have been hampered by unavailability of fodder seed, limited fodder growth related to poor soil and free grazing, and lack of labour. Hacker et al. (1998) and Gibson et al. (1999) reported that chemical soil characteristics are seriously unfavourable with a pH (1:5 H_2O) of about 5.0, along with deficiencies in nitrogen, phosphorus, potassium, calcium and magnesium. Moreover, these authors also reported that high levels of aluminium saturation are likely negatively affect the growth of many pasture species and that severe phosphorus deficiency generates animal health problems. The vegetation described by Hacker et al. (1998) is dominated by *Themeda triandra*, *Cymbopogon nardus* and *Hyparrhenia newtonii*.

Since 2004, a large range of forage species (*Brachiaria* sp., *Stylosanthes*) tolerant to drought, aluminium saturation and soil acidity, have been used by the Lao National Agro-Ecology Programme to regenerate savannah grasslands and to diversify farming production. Strategies include: i) testing rotational sequences between improved pasture and edible/cash crops (rice, maize, and soybean) direct-seeded onto forage mulch; and ii) improvement of fodder resources during both rainy and dry seasons to increase the productivity of cattle production. In different locations, experimental units representative of the diverse bio-physical conditions (soil, slope and climate) and farming systems were set up in order to test a large range of systems and technologies for forage species. Soil, species, fertiliser and natural conditions were cross-linked to obtain a set of highly varied conditions.

Specific trials have been carried-out to evaluate adaptability and the seed production of various forage species in the ecology of altitude plains. Promising results have been obtained for fodder production and a specific experiment for cattle fattening designed. The present study seeks to evaluate the agronomic and economic components of cattle fattening around Phonsavanh using improved forage species (*Brachiaria ruziziensis*) and thermophosphate inputs.

2. Material and methods

2.1. Materials

Many species (*Brachiaria decumbens*, *B. brizantha*, *B. ruziziensis*, *B. humidicola*, and *B. mulato*) exhibit good adaptability and forage production under this environment. However, *Brachiaria ruziziensis* was selected for this experiment due to its good balance of seed production, forage palatability and quality, and pasture establishment.

Six young bulls from the local breed were used. Their initial weight ranged from 92 to 115 kg and their total initial value was US$765. The trial started with two bulls on the 26th of May, and as fodder resources increased this number was progressively raised from two to six by the 29th of July. Table 3 shows the initial weight, period of fattening, estimated and measured weight, entry and exit price for each animal. Fattening was stopped at the beginning of the dry season (end of November and end of December) and four of the bulls were followed from January to March to estimate their growth fluctuation during the dry season. During this period they were feed in clear forest in the vicinity of the village. Salt stones were used as a diet supplement, while vaccines (against haemorrhagic fever) and deworming treatment were applied at the beginning of the trial. Ticks were controlled with insecticide spray.

2.2. Experimental Design and Management

1.5ha was manually sowed on 21st of April 2005 with *B. ruziziensis* at a density of 12 kg.ha^{-1}; this field was used in 2004 for upland rice screening. After the forage sowing, natural weeds were controlled by use of glyphosate (4 l.ha^{-1}). Of five 0.3 ha blocks, four were designated for cattle fattening with one block for seed production. The bulls were kept on one block for a week at a time. Half of a 200 l barrel was as a water trough on each block.

Before sowing fertiliser was applied consisting of 30 kg N as ammonium sulphate, 80 kg P_2O_5 as thermophosphate and 60 kg K as K_2O per hectare. An additional 30 kg of N was applied at two intervals: 15 kg on 19th of May and 15 kg on 11th of July. The cost of this fertiliser was \$138.ha^{-1}. The mineral content of the thermophosphate is given in Table 1. Seeds were harvested from the fifth block at the end of October.

Table 1: Mineral content of thermophosphate ($100 per tonne). Analysis performed at CIRAD, France.

Element	Content	
	%	mg/kg^{-1}
SiO_2	27.76	
CaO	28.05	
MgO	21.43	
K_2O	0.63	
P_2O_5	15.45	
Mn		3744.60
S		1225.00
Zn		30.00
Cu		10.50
Mo		2.22
B		0.02

2.3. Environmental Conditions

Rainfall data recorded at the proximity of this field (2 km) are presented in Table 2. Temperature data was provided by Pek district agriculture and forestry office.

2.4. Data Collection

Growth Rate

Every month morphometric data (breast length, shoulder–tail length) was recorded and linear regression performed between the measured weight (recorded every two months) and the estimated weight by the use of two morphometric equations. The first equation used breast and shoulder-tail length (Equation 1) and the second, commonly used in Thailand, is a quadratic function using only breast length (Equation 2).

Equation 1 = $(\text{breast length})^2 * (\text{breast-tail length}) * 88.4$

Equation 2 = $-3.687 * (\text{breast length}) + 0.02898 * (\text{breast length})^2 + 160.2$

Economic Analysis

Economic data recorded during this trial is presented in Table 4. Labour inputs for land preparation, fencing, sowing and fertiliser spreading, and expenses for management of the bulls were also recorded. Two scenarios are presented: i) reimbursement of all expenses (fencing, barbed wire, seeds, fertiliser etc.) at the end of the first season; and ii) three years to pay off the fencing (barbed wire, wooden posts and nails) and field costs.

2.5. Statistical Analysis

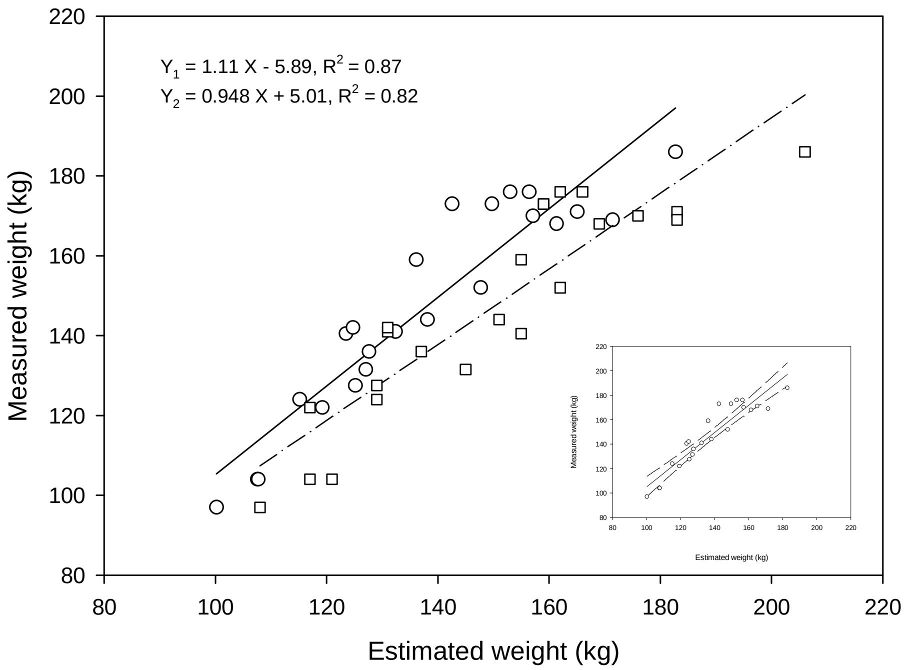
Graphic representations and calculations of confidence intervals for regressions were carried out with SigmaPlot 9.0 for Windows (Jandel Scientific).

3. Results

3.1. Estimated vs. Measured Weight

The linear regression between morphometric data and measured weight is presented in Fig. 1. Significant regressions were obtained between measured and estimated weight using the two equations presented here before. The coefficient of determination, R^2, showed that both models describe the data well. However, a higher R^2 was obtained using the first equation, and this was used for the model representation of daily growth.

Fig. 1: Regression models between estimated weight vs. measured weight. Linear regression and confidence interval (95%) for equation 1 is given in insert



3.2. Optimal Fattening Period

Four models follow, in Table 2 and Fig. 2, of the bulls' growth rate during the different fattening periods. The first model represents daily growth during the rainy season, from end of May (26th) to end of September (28th). High growth was obtained during this period with a mean daily growth of 401 g/day^{-1}, a high rate considering that the bulls were not fed with protein supplements and were from a local breed. It does seem, however, that the animals originate from a crossbreed between native cattle and Redsindhi.

After this period, daily growth drops rapidly and averages at 276 g/day^{-1} for the period end of May to end of December. Differences in the slope of these relationships were not determined by covariance analysis, but a drop of daily growth rate could be observed after the beginning of November. The bull fattening period was then revised to include only May to the beginning of November (Fig. 3, Y_3 equation), giving a mean growth rate of 364 g/day^{-1}.

Fig 2: Linear regressions for different fattening periods are given

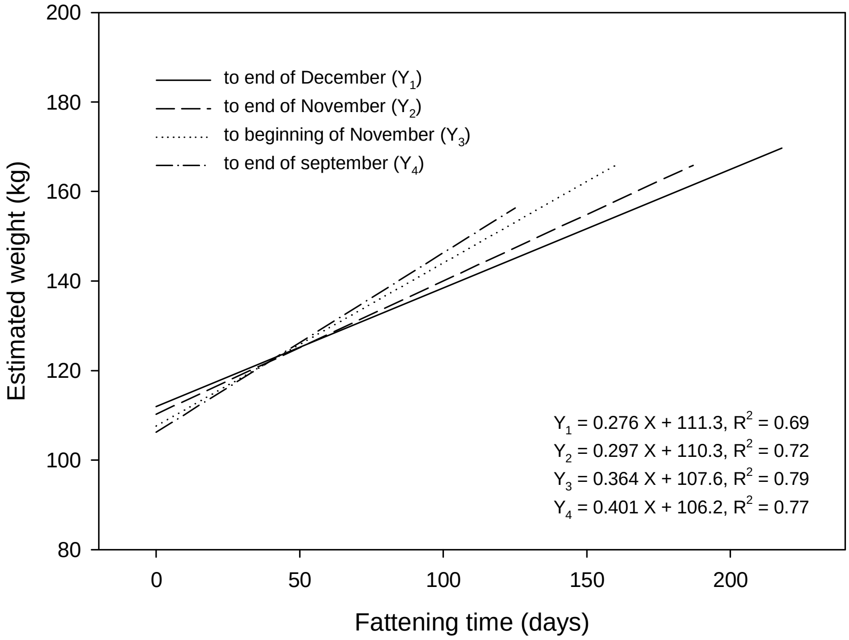
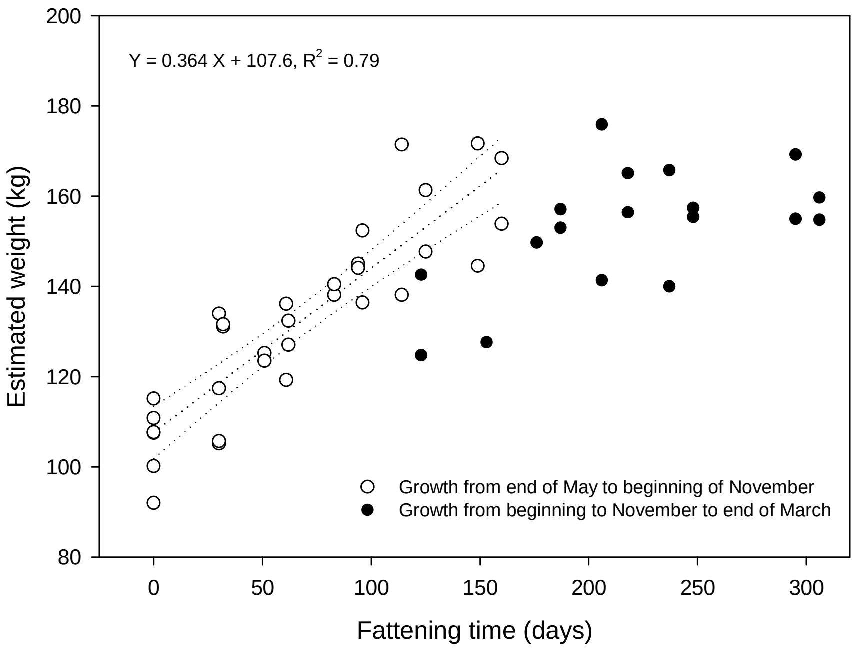
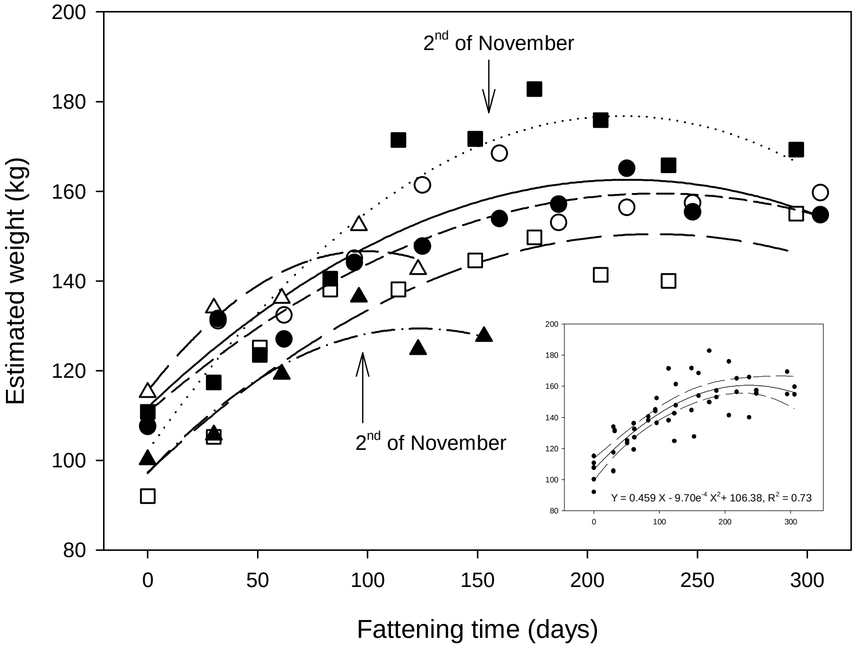


Fig 3: Mean daily growth rate of six young bulls from beginning of fattening to end of March. Linear regression represents optimal fattening period from May to beginning of November; confidence interval (95%) is given



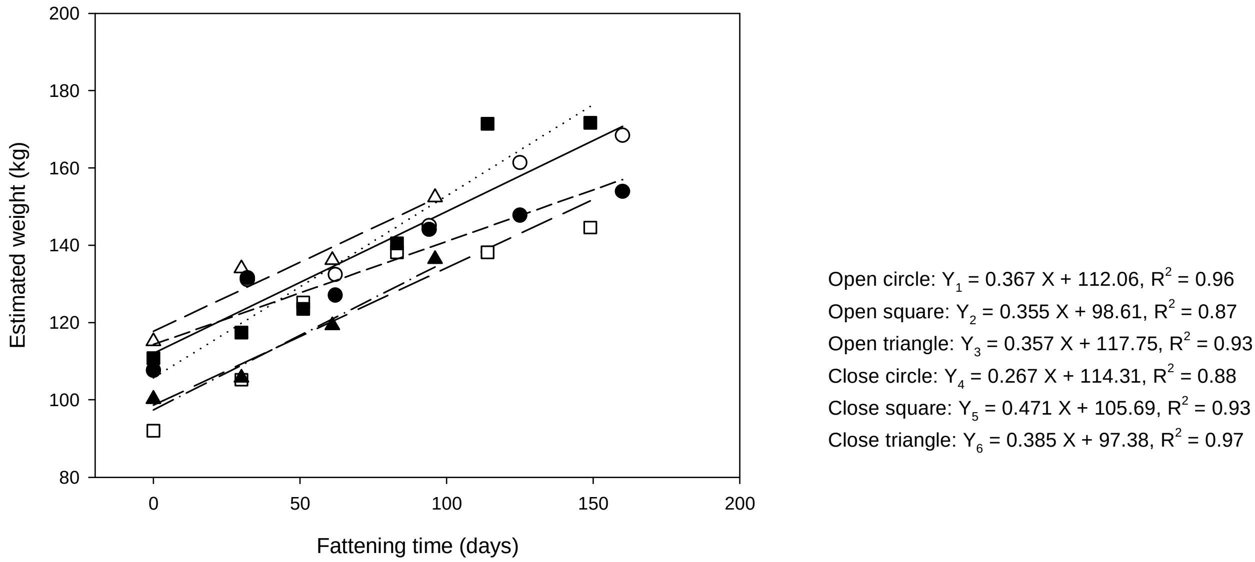
A clear break point could be identified at the beginning of the dry and cold season (Figs. 3 and 4), indicating that fodder resources were not sufficient to maintain the same daily growth rate. A steady state was observed from November to the end of March but the overall loss of weight during this period was not very pronounced. The model, calibrated under our conditions, gave reasonably good predictions of growth during the rainy and dry season (Fig. 4).

Fig 4: Growth rate of six young bulls from beginning of fattening to end of March



The growth rate of each bull during the same period (end of May to beginning of November) was calculated using linear regression (Fig. 5). No statistical analysis was performed to compare these models. However, the daily growth rate seems relatively uniform for four of the bulls (1, 2, 3 and 6) with a mean of 366 g/day^{-1}; the fourth presents a growth rate of 267 g/day^{-1} and the fifth 471 g/day^{-1}.

Fig 5: Daily growth rate of six young bulls from beginning of fattening to beginning of November (optimal fattening period) is given.



3.3. Economic analysis

Weight gain obtained during this trial represents a gross income of $615 and covers all expenses for fencing, fertiliser, seeds, and bull management over the first year. Fencing (barbed wire) and fertiliser formed the main expenses. In the medium term, the cost of fencing could be reduced by growing living fences (hedges) using species such as *Acacia mangium*, *A. auriculiformis*, *Calliandra calothyrsus*, and *Jatropha* sp. Additional income was provided by the 132 kg of seeds produced on the fifth block. Growing these seeds provides an opportunity to extend the amount of improved pasture land or to sell the seed to others smallholders who wish to generate new income. Sowing *Stylosanthes guianensis* on 5 m contours on the forage fields would protect the pasture from wild fires during the dry season and provide protein supplements for the cattle.

Assuming the three-year pay off period for the fencing and field arrangement, a net income of $380 with a labour productivity of $2.38 per day were obtained. The labour requirement for management of the bulls was estimated at 50 days.

4. Discussion

Fattening of the bulls during the rainy season appears to be a very efficient activity with high growth rates recorded. This cattle breed used seems well adapted for fattening and showed a strong response to improved fodder. This trial has been extended through 2006 to corroborate the first economic and agronomic results. Further work remains in estimating the maximum stocking rate on improved pasture for the dry season, and in comparing the animal growth rate on improved pastureland with the traditional extensive method of free grazing on savannah grasslands, clear forest and paddy fields.

This bull fattening activity presented three major constraints. First, animal fattening is clearly related to market access and meat demand. Rural areas of Laos have traditionally struggled to find markets for products because of low population density and poor transport links. However, Xieng Khouang province has begun to show a high commercial rate of cattle export to Vietnam (Onekeo, 2004; Syphanravong et al., 2006) and the recent experiences of the Forage for Smallholders Projects (CIAT-NAFRI) show increasing commercial opportunities in places where smallholders are growing forage for cattle feeding. Second, it seems difficult for smallholders to carry out this kind of livestock production without technical support for land preparation, pasture growing and cattle management. The local ecologies on schist and granite present good physical properties but low mineral contents (Hacker et al. 1998) with high deficiencies of N, P, K, Ca, Mg and micronutrients (Zn, Bo, Mn). Thermophosphate addition is thus essential, providing reasonable quantities of Ca, Mg and P and allowing implementation of efficient livestock production and cropping systems. A market channel for such fertiliser is already operational in Xieng Khouang province through Vietnamese traders. Moreover, the soil does not need to be disturbed by mechanical actions if ploughing and land preparation are based on direct sowing of forage species after control of natural pasture land. Direct sowing shows very good results (reducing production costs and land erosion) on the Plain of Jars and could be extended to staple and cash crop production. However, specific equipment adapted to local economic conditions (sowing machine for hand-tractor) must be promoted to decrease labour inputs for land preparation and sowing. The third limiting factor could be that the system was first perceived as requiring an initial cash investment. On these high plains, innovative farming systems based on direct mulch-based cropping and better integration of livestock and cropping activities could be stable and profitable if, at the same time, economic incentives (access to market, inputs, credit, agriculture and livestock product processing) are promoted.

Seed production does not seem to be problematic in this ecology. Promising results have been observed with growing seeds for *Brachiaria* species as *B. ruziziensis*, *B. decumbens*, *B. brizantha* and for *Stylosanthes guianensis* (CIAT 184). Development of specific market channels for seeds could indirectly improve pasture management, avoid high stocking rates and generate new income that could be invested in fertiliser and animal care. As reported by Hacker et al. (1998), the best option may be to improve small areas through strategies that are specific to smallholders' particular situations, using adapted forage species and thermophosphate.

In 2006, to evaluate the feasibility of cattle fattening under smallholder conditions, this new livestock system scheme was proposed to various farmer groups in seven villages (27 families) of Pek district. Field areas ranged from 0.3 to 1 ha per household. Forage species were direct sowed after (chemical) control of natural pasture land. Technical support was given for land preparation, sowing and pasture management. Forage seeds were provided by the project. Households were responsible for fencing, pasture and animal management. Fertiliser cost was shared between the project and the farmers. A one-year credit deal was proposed for fertiliser with farmers able to repay with forage seeds ($1.5/kg of *B. ruziziensis*).

5. Conclusions

This study analysed the economical and technical viability of 'workshop' fattening on altitude plains. It used a simple mode to evaluate the daily growth rate of young bulls, while focusing on fattening during the rainy season. The model, calibrated under our conditions, gave reasonably good predictions of growth during the rainy and dry seasons. In conclusion, despite positive economical and technical results, a holistic approach involving credit access, technical and political support has to be defined to develop productive and efficient systems on this ecology. This poses a great challenge which, if grasped, could yield great benefits.

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Table 2: Climatic data recorded at Xoy Nafa in the vicinity of Phonsavanh (Xieng Khouang province): annual rainfall of 1,688 mm.

2005	January	February	March	April	May	June	July	August	September	October	November	December
1	0,0	0,0	0,0	10,0	20,6	5,5	29,2	68,0	28,0	0,0	0,0	0,0
2	0,0	0,0	0,0	1,4	9,4	1,2	45,0	5,3	2,8	0,5	0,0	0,0
3	0,0	0,0	0,0	1,9	0,7	26,7	8,9	0,9	30,8	0,0	0,0	0,0
4	0,0	0,0	0,0	0,0	0,4	2,0	31,0	2,5	13,4	0,0	0,0	0,0
5	0,0	0,0	0,0	0,0	0,0	1,8	11,2	22,0	4,3	0,0	0,0	0,0
6	0,0	0,0	0,0	0,0	0,0	1,0	6,2	0,7	0,6	0,0	0,0	0,0
7	0,0	0,0	0,0	0,0	0,0	1,0	0,0	11,0	0,0	0,0	0,0	0,0
8	0,0	0,0	0,0	0,0	15,0	8,6	0,0	0,9	0,0	0,0	0,0	0,0
9	0,0	0,0	0,0	0,0	3,9	2,0	20,8	7,0	0,0	0,0	0,0	0,0
10	0,0	0,0	0,0	0,0	0,9	20,8	7,5	15,5	0,0	0,0	0,0	0,0
11	0,0	0,0	0,0	1,4	0,0	0,7	1,2	0,9	0,0	0,0	0,0	0,0
12	0,0	0,0	0,0	3,4	17,0	0,4	0,0	70,0	0,0	0,0	0,0	0,0
13	0,0	0,0	0,0	1,0	11,7	0,0	0,0	19,0	0,0	0,0	0,0	0,0
14	0,0	0,0	6,8	0,0	11,0	13,0	0,0	0,6	2,6	0,0	0,0	0,0
15	0,0	0,0	0,0	0,0	0,0	0,0	0,7	17,0	2,3	0,0	0,0	0,0
16	0,0	0,0	0,0	0,0	4,7	18,0	0,0	10,0	1,8	0,0	0,0	0,0
17	0,0	0,0	1,5	0,0	1,2	16,2	0,0	1,5	0,0	0,0	0,0	0,0
18	0,0	0,0	0,0	25,0	38,5	4,5	2,3	30,0	0,4	0,0	0,0	0,0
19	0,0	0,0	38,0	1,1	0,0	0,0	0,0	9,2	34,0	0,0	0,0	0,0
20	0,0	0,0	0,0	0,0	0,0	0,0	13,8	21,0	9,3	0,0	0,0	0,0
21	0,0	0,0	0,0	16,0	4,0	0,0	1,6	0,0	5,4	0,0	0,0	0,0
22	0,0	0,0	0,0	10,0	0,0	0,0	14,7	6,2	27,2	0,0	0,0	0,0
23	0,0	0,0	0,0	13,0	4,3	0,0	19,0	21,0	0,0	0,0	0,0	0,0
24	0,0	0,0	0,0	0,0	0,0	35,0	7,0	16,0	8,0	0,0	0,0	0,0
25	0,0	0,0	0,0	0,5	0,5	4,0	36,5	0,0	54,0	0,0	0,0	0,0
26	0,0	0,0	0,0	5,7	2,2	25,2	110,0	3,3	2,8	0,0	0,0	0,0
27	0,0	0,0	0,0	4,0	5,5	1,6	0,6	1,3	134,3	0,0	0,0	0,0
28	0,0	0,0	0,0	13,0	22,0	0,0	0,0	1,2	3,8	0,0	0,0	0,0
29	0,0	0,0	0,0	28,0	0,0	1,0	0,0	1,0	0,0	0,0	0,0	0,0
30	0,0	0,0	0,0	2,0	1,7	5,0	0,0	3,4	0,0	0,0	0,0	0,0
31	0,0	0,0	0,0	0,0	9,3	0,0	11,7	13,0	0,0	0,0	0,0	0,0
Total (mm)	**0,0**	**0,0**	**46,3**	**137,4**	**184,5**	**195,2**	**378,9**	**379,4**	**365,8**	**0,5**	**0,0**	**0,0**

Table 3: Characteristics of fattening experiment conducted during the season 2005 in Xoy Nafa, Xieng Khouang Province (Plain of Jars)

Characteristic		**Bull 1 - Open circle**					**Bull 4 - Close circle**				
Entry price (USD)		**$124**					**$124**				
Weighing date and measurement	**Nb of days**	**Chest length (m)**	**Shoulder-Tail length (m)**	**Estimated weight (kg, Y1)**	**Estimated weight (kg, Y2)**	**Measured weight (kg)**	**Chest length (m)**	**Shoulder-Tail length (m)**	**Estimated weight (kg, Y1)**	**Estimated weight (kg, Y2)**	**Measured weight (kg)**
26/5	0	1.15	0.92	117.00	107.56	104	1.17	0.89	121.00	107.70	104
27/6	32	1.20	1.03	131.00	131.11		1.22	1.00	137.00	131.57	
27/7	62	1.20	1.04	131.00	132.39	141	1.23	0.95	145.00	127.05	131.5
28/8	94	1.25	1.05	151.00	145.03		1.24	1.06	148.00	144.08	
28/9	125	1.30	1.08	169.00	161.35	168	1.28	1.02	162.00	147.73	152
2/11	160	1.36	1.03	190.00	168.41		1.30	1.03	169.00	153.88	
29/11	187	1.29	1.04	166.00	152.99	176	1.32	1.02	176.00	157.11	170
30/12	218	1.28	1.08	162.00	156.42	176	1.34	1.04	183.00	165.08	171
29/1	248	1.29	1.07	166.00	157.40		1.30	1.04	169.00	155.37	
28/3	306	1.27	1.12	159.00	159.69		1.31	1.02	172.00	154.74	
Growth gain (kg)	**From 26th of May to 2nd of November**			**73.00**	**60.85**				**48.00**	**46.18**	
Exit price (USD)		**$241**					**$241**				

Characteristic		**Bull 2 - Open square**					**Bull 5 - Close square**				
Entry price (USD)		**$134**					**$143**				
Weighing date and measurement	**Nb of days**	**Chest length (m)**	**Shoulder-Tail length (m)**	**Estimated weight (kg, Y1)**	**Estimated weight (kg, Y2)**	**Measured weight (kg)**	**Chest length (m)**	**Shoulder-Tail length (m)**	**Estimated weight (kg, Y1)**	**Estimated weight (kg, Y2)**	**Measured weight (kg)**
6/6	0	1.12	0.83	110.00	92.04		1.18	0.90	126.00	110.78	
6/7	30	1.15	0.90	117.00	105.22		1.25	0.85	151.00	117.41	
27/7	51	1.19	1.00	129.00	125.18	127.50	1.26	0.88	155.00	123.50	140.50
28/8	83	1.25	1.00	151.00	138.13		1.28	0.97	162.00	140.49	
28/9	114	1.25	1.00	151.00	138.13	144.00	1.34	1.08	183.00	171.43	169.00
2/11	149	1.26	1.03	155.00	144.55		1.36	1.05	190.00	171.68	
29/11	176	1.27	1.05	159.00	149.71	173.00	1.39	1.07	206.00	182.75	186.00
29/12	206	1.24	1.04	148.00	141.36		1.37	1.06	198.00	175.87	
29/1	237	1.24	1.03	148.00	140.00		1.33	1.06	179.00	165.75	
28/3	295	1.28	1.07	162.00	154.97		1.37	1.02	198.00	169.24	
Growth gain (kg)	**From 6th of June to 2nd of November**			**45.00**	**52.52**				**64.00**	**60.90**	
Exit price (USD)		**$241**					**$259**				

Characteristic		**Bull 3 - Open triangle**					**Bull 6 - Close triangle**				
Entry price (USD)		**$134**					**$105**				
Weighing date and measurement	**Nb of days**	**Chest length**	**Shoulder-Tail length**	**Y1**	**Y2**	**Measured weight**	**Chest length**	**Shoulder-Tail length**	**Y1**	**Y2**	**Measured weight**
29/7	0	1.19	0.92	129.00	115.17	124.00	1.11	0.92	108.00	100.20	97.00
28/8	30	1.25	0.97	151.00	133.98		1.14	0.92	115.00	105.69	
28/9	61	1.26	0.97	155.00	136.13	159.00	1.15	1.02	117.00	119.25	122.00
2/11	96	1.30	1.02	169.00	152.38		1.23	1.02	145.00	136.42	
29/11	123	1.27	1.00	159.00	142.58	173.00	1.20	0.98	131.00	124.75	142.00
29/12	153						1.22	0.97	137.00	127.63	136.00
Growth gain (kg)	**From 29th of July to 2nd of November**			**40.00**	**37.22**				**37.00**	**36.21**	
Exit price (USD)		**$213**					**$139**				

Table 4: Economic data recorded for improved pastureland (1.5 ha)

Improved pasture land	Unit	Unit cost (US $)	Quantity	2005 (US $)	
				1 year paying off	3 years paying off
COSTS					
Plot fencing					
Wood posts	piece	0,4	440	176	59
Barbed wire		5	60	300	100
Nails	kg	0,9	20	18	6
				494	**165**
Field arrangement					
Shelters for animals	piece	5	4	20	7
Drinking trough	Oil barrel	8	2	16	5
				36	**12**
Land preparation					
				35	**35**
Seeds					
B. ruziziensis	kg	2	23	46	46
				46	**46**
Fertilizer					
15-15-15	Ton	340	0,34	116	116
Urée (46-0-0)		300	0,12	36	36
Thermophophate (0-16-0)		100	0,51	51	51
KCl (0-0-60)		280	0,09	24	24
				226	**226**
Animals care					
Salt stone	piece	3	2	6	6
Vaccine and vermifuge		3	3	9	9
				15	**15**
TOTAL COSTS				**852**	**499**
LABOUR					
Fencing	working.day		20		
Land preparation			3		
Sowing			55		
Fertilizer broadcasting			2		
Seeds harvesting			30		
Bulls management			50		
TOTAL LABOUR			**160**		
BENEFITS					
Bulls added value (difference intial-final value)	US Dollars		6	615	615
Seeds production	kg	2	132	264	264
GROSS INCOME				**879**	**879**
NET INCOME				**27**	**380**
LABOUR PRODUCTIVITY (US $/day)				**0,17**	**2,38**