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Profitability of dry season beef feed-lotting in grain deficit countries: the case of Botswana

P Malope, C M Tsopito*, A A Aganga* and O R Madibela*

Department of Agricultural Economics, Education and Extension, Botswana College of Agriculture/University of Botswana,
Private Bag 0027 Gaborone. Botswana
**Department of Animal Science and Production, Botswana College of Agriculture/University of Botswana*
pmalope@bca.bw

Abstract

In grain deficit countries such as Botswana, the costs of feed may render beef cattle feed-lotting uneconomical because of competition with human for grains. An experimental trial was conducted with forty-nine beef cattle comprising of indigenous Tswana, pure exotic breeds and crossbred animals in order to determine profitability of beef feed lotting during the dry season of 2002.

The results of the study indicate that the average daily weight gain is 1.13 kg per animal. This translates into a financial profit of P118.20 per animal for the 90 days feeding period. The economic profit per head is P48.05 for the same feeding period. Thus, the results of the study show that feed-lotting can both be financially and economically profitable. However, these results are highly sensitive to feed costs and prices of feeder cattle which together comprise of 92% of the operating costs of the feedlot. For instance, the results of a sensitivity analysis carried out indicate that a slight decrease (6%) in the selling price of finished animals will result in a zero profit.

Although small-scale feedlotting is economically viable, it is important for farmers to increase the number of animals they keep up to a certain threshold level in order for them to obtain high profits because profits per head are quite low.

Key words: breakeven analysis, feedlot, profitability, sensitivity analysis

Introduction

Botswana's agriculture is dominated by livestock production, which accounts for about 80% of the sector's gross domestic product (GDP). Within the livestock sector, the beef industry is a major sector both in terms of output and employment (Ministry of Finance and Development Planning (MFDP), 2003). In Botswana, there are two beef production systems, the traditional system, which accounts for over 80% of the national herd and the commercial system, which accounts for the reminder of the national herd. In the traditional system animals are kept in open rangelands with no defined property rights while in the commercial sector animals are kept in fenced ranches. However, both types of beef production systems are extensive in that over

90% of the feed requirements are provided from natural grazing with limited supplements during the dry season especially in the commercial sector.

Thus beef production in Botswana relies heavily on the natural pastures and hence its expansion has been cited as one of the main causes of range degradation (Republic of Botswana, 1975 and Ministry of Agriculture (MoA), 1991). The expansion of the beef industry in terms of cattle population has meant that grazing animals should be supplemented in order to minimise range degradation. Coupled with increased pressure from other land uses the Botswana's rangeland has reached its carrying capacity. Expansion of the beef industry through increase in cattle numbers will require modification of the beef production system to include supplementation.

Beef cattle feed lotting therefore appear as an alternative way of expanding output from the beef industry without any undue damage to the range. Lot feeding involves keeping animals in a confined area and providing them with feed with the sole purpose of meat production. Thus, feed-lotting converts feed (input) especially grain into meat, which fetches a higher price. Lot feeding reduces the number of animals kept in the range; hence the stocking pressure and releases land for other uses. During the dry season the pastures are poor and animals normally loose condition and hence fetch low prices when sold to abattoirs. It is precisely because of this reason that the Botswana Meat Commission (BMC), the country's sole exporter of beef normally experiences low supply during this period. Feed lotting can overcome this problem by ensuring that there is steady supply of cattle for slaughter throughout the year. However, in grain deficit countries such as Botswana beef feed lotting rely on high cattle numbers for it to be a profitable business venture. Where animals compete with humans for grain, feed costs may be very high such that they reduce the profit margin in feed lotting.

Studies on the profitability of feed lotting in Botswana are limited. To date Animal Production Research Unit (APRU) has conducted only two such studies. The first study (APRU, 1978) was carried to find out how indigenous breeds performed in terms of weight gain and carcass quality under feedlot conditions compared to range conditions. The study concluded that given high feed costs at that time feed-lotting of the indigenous breeds was uneconomical. The study used indigenous breed because it was the most prevalent breed at that time. The situation has now changed in that the indigenous breed comprises only 40% of the national herd. In addition the study used very few numbers of cattle, groups of between 6 and 8.

Another study APRU (1993) determined the profitability of feed-lotting and the findings were similar to the first one, thus feed-lotting was found to be unprofitable. However, this was not an experimental study, it was rather a budgetary analysis using data from major feedlotters and the results cannot be relied upon because feedlotters

can not be relied upon to provide accurate information on their costs and hence profitability. It is against this background that the present study uses experimental data obtained from exotic, indigenous and crossbred animals. The number of animals used in the study is 49, which is representative of small-scale feedlot operation in Botswana. The major objective of this study is therefore to measure profitability of small-scale beef feedlots in Botswana during the dry season. The experiment was conducted during the dry season because during the wet season animals are able to get enough forage from the range and are normally in good condition. Therefore there is no need to feedlot the animals during the wet season.

The rest of this paper is organised as follows; the rest of this section deals with the development of the feedlot industry in Botswana. This is followed by the theoretical framework for measuring profitability in a feedlot business and the experimental design used in the study. Data used in the empirical estimation and the empirical results are then presented followed by conclusions.

The development of the feedlot industry in Botswana

Commercial cattle feed-lotting is a relatively new phenomenon in Botswana and is not widely practiced. At present there are a few feedlots operating in the country, two are situated in Lobatse and Francistown and another one in Tlokweng. However, there are farmers who are known to feed lot their cattle for about 30 days in their ranches or cattle posts before selling them for slaughter to the BMC especially during the dry season. (Kenneth, 2004). Most established feedlotters are situated in towns and cities where BMC abattoirs are operational or where there are other meat processing plants. Thus, the location of the feedlot has primarily been dictated by among other things the nearness to both the input and output markets.

In addition, the BMC, which is the major buyer of all cattle destined for slaughter in Botswana, has a scheme in which large-scale feed lotters are given advance money of P600 per head for purchasing feeder cattle. The feedlotters enter into contract with the BMC to fatten the animals and sell them to the BMC for a minimum period of ten months in a year. Advanced money received is interest free; however, feedlotters are required to provide security in the form of a guarantee from a commercial bank or a reputable financial institution. The main objectives of the scheme are to; increase cattle supply to BMC abattoirs, improve both quality and reliability of cattle supplied to BMC abattoirs. Since its inception, the scheme has attracted about seven large-scale feedlotters. The size of the feedlots ranges from 1000 to 10000 standing capacity. While a lot of prospective feedlotters have shown keen interest in participating in the scheme, many have not been able to do so because of lack of security in the form of guarantees from commercial banks or reputable financial institutions.

Theoretical framework for measuring profitability

Profitability of any business is measured by the difference between total revenue and costs. Thus, the profit equation is given as;

$\pi = TR - TC \quad (1)$

Where π is profit
TR is total revenue and
TC is total costs.

Profit maximization involves maximizing the difference between total revenue and total costs. Maximising the difference between total revenue and total costs implies maximising TR and minimising TC.

The total costs comprise of the operational/variable and fixed costs. The variable costs in the beef feedlot business include; the costs of feeder cattle, feed, medications, water and transportation. These costs do vary with the level of production and the feedlotter can control them even in the short run. The fixed costs in a feedlot business include depreciation of machinery and equipment, interest on capital and labour costs. These costs do not vary with the level of production and are difficult to control especially in the short run. Therefore, in the short run the level of the operational costs will determine profitability of the feedlot business.

There are two ways of measuring profitability; accounting and economic. The two differ in what is included in the total costs. In the calculation of accounting profits only explicit costs are subtracted from the total revenue, whereas in the calculation of economic profits both the implicit and explicit costs are subtracted from total revenue. Implicit costs in the feedlot business include depreciation, interest on capital and management's time and these costs do not require any outlay of money. Profits from feedlotting also depend on the value of output. The major output from the feedlot is finished animals. The value of the finished animals depends on the body condition, carcass quality and cold dressed weight. The higher the value of the finished animal and hence the total revenue the higher the profit.

Experimental design

This study was conducted during the dry season of 2002 and the animals used in this trial were all males, some castrated and others intact. Six different breeds of animals were used which comprised of pure Tswana (indigenous breed), Brahman, Tuli, Composite and Tswana-Brahman crosses and Brahman-Sussex-Tswana crosses. All these animals were aged 18 months and above.

When the animals arrived in the feedlot they were treated for both internal and external parasites. The animals were gradually introduced to the complete feedlot ration over a 7-day period. Animals were given clean water all the time and feed was provided every morning after cleaning feeding troughs. The feedlot ration was formulated at the project site and composed of 12% crude protein (CP). The ingredients used for preparing 1000 kg feed comprised of sorghum bran (7%), maize stover (47.7%); maize grain (28%); urea (1.4%), molasses powder (6.5%), dicalcium phosphate (0.8%), limestone (1.5%), cotton seed cake (6%), salt (0.6% and vitamin-mineral premix (0.5%). Data collected from the trial consisted of the amount of feed, weight of animals in order to determine daily weight gain and revenue from sales.

Data

The data used for calculating profitability of the feedlot treatment was obtained from experimental trial conducted during the dry season. However, some of the data has been adjusted to make it more representative of farmer's condition.

Prices of feeder cattle

Feeder cattle were obtained from the Animal Production Research Unit (APRU) of the Department of Agricultural Research (DAR) in the Ministry of Agriculture (MoA). These animals were acquired from DAR without any payment and hence no price tag was attached to them. However, if we are to conduct any meaningful profitability analysis we need to estimate the value of these animals. This was done by using the prices paid by major feedlotters for similar animals as a proxy. The prices for the same period in which our study was conducted were as follows; for a weaner weighing 300 kg above, P3.20 per kg (At the time of experiment US$ was equivalent to approximately P5.00); 300-349 kg, P3.00 per kg; 275-299 kg, P2.70 per kg and below 275 kg, P2.50 per kg of live weight. Using these prices the average price per kg of live weight for the feedlot animals was P2.76 in 2003. However, to arrive at the prices for 2002 we adjusted the 2003 prices by 6% being the inflation rate for that period. The prices used for the feedlot animals were P2.60 per kg live weight.

These prices compare well with those paid by the BMC for similar animals (weaners) although the BMC only bought animals weighing above 300 kg. The BMC paid P3.20 per kg live weight for similar animals weighing above 300 kg. The BMC operated a direct purchase scheme whereby animals of all ages were bought direct from cattle farms for fattening before slaughter. The average live weight for the weaners used in this study was 260 kg. However, the BMC direct purchase scheme was stopped in March 2003. Due to the fact that the BMC prices are for animals of higher weight than the average of the animals we used in the feedlot and the fact that BMC direct purchase scheme was stopped we used the prices paid by major feedlotters.

Feed costs

The feed used for the feedlot animals was formulated at the project site. To determine the feed costs we included all the costs of ingredients and excluded the machinery costs feed grinding, mixing and labour. These were all included separately under the fixed costs.

Veterinary Medicines

Veterinary expenses consist of the costs of 100 ml of vitamin ADE 500 and ivamectin for deworming. No other veterinary expenses were incurred. We did not cost the services of a veterinarian because veterinary services are free in Botswana especially for the smallholder farmers.

Water

Water costs were estimated to be P2.00 per animal per month. This was estimated as one-third of the total charge, which ranch owners charge livestock owners for renting the ranches in the surrounding areas. This charged was P600.00 per 100 herd per month during the period of this study.

Transport

The transport costs were estimated by taking the average charge per kilometre of the major transport companies transporting cattle for the BMC. These include costs of transporting finished cattle to the nearest BMC abattoir in Lobatse.

Depreciation

The depreciation charge was calculated for the hammer mill and the feed mixture. The method used was the straight-line method assuming a 10% salvage value and useful life of ten years. The annual depreciation was then converted to the 90 days feeding period. For other items such as kraal and feeding troughs no depreciation was allocated because the original cost was not known and the cost was negligible. We also did not include interest charges because we did not use borrowed money and in addition the BMC offers interest free money for farmers who want to establish feedlots.

Labour

Labour costs were also included under the fixed costs. The labour costs do not represent the amount actually paid to permanent labourers employed in the project. Botswana College of Agriculture (BCA) (BCA employed the field assistants and as

such paid them according its established pay structure, which is well above the average wages in agriculture and similar occupations) as a parastatal is required to pay the minimum wage paid by government. Although there is no minimum wage in agriculture, the minimum wage paid by government, hence BCA is well above the minimum wage for similar occupations. The labourers working in the project were paid P44.12 per day, which is equivalent to P4.80 per hour and P1157.72 per month (taking into account that the rate doubles during weekends).

The statutory minimum hourly rate for similar trade and industry workers ranged from P2.07 and P2.45 for the same period amounting to about P4622.64 per annum or P385.22 per month. MoA (2004) found that the average remuneration package for labour in traditional agriculture in 2003 was generally below P3000.00 per annum (P250 per month) which was well below the hourly rate for similar occupations in trade and industry which stood at approximately P4900.00 per annum or (P408.33 per month). In the commercial sector, the annual remuneration is slightly higher than that obtained in the traditional sector; it stood at P4106.37 which is equivalent to P342.20 per month. Surely using BCA's hourly wage rate of P4.80 would have greatly over valued agricultural labour and hence render our results unrepresentative of the prevailing conditions in the farm sector. Having the above in mind and the fact that the feedlot assistants also performed other farm activities other than the project activities, the labour cost actually incurred was adjusted by 0.4. This results in a monthly wage of P423.55, which is still above the minimum wage in the agricultural sector and even in trade and industry sectors.

Empirical results

Herd characteristics and performance

All animals used in the trial were males and the majority (35) were intact while the remaining were castrates. The average initial weight was 259.90 kg and final average weight after feeding for 90 days was 361.33 kg yielding an average daily weight gain of 1.13kg.

Carcass performance

Animals slaughtered in BMC abattoirs are graded in order to arrive at the price for each beast. The grading system uses several parameters such as age, cold dressed weight (CDW), body confirmation and condition. The grading system is such that the highest grade is super sound (SS), super 1 (S1), super (S2), super 3 (S3), S4 (super 4), detained super (DS), detained 1 (D1), detained 2 (D2), detained (D3), detained (D4) and condemned.

The majority (69%) of the animals obtained the highest possible grade (SS). Of the remaining animals 5 obtained S1, 3 obtained S2, 1 obtained S3 and 4 animals obtained detained super grade (DS). Only two animals obtained detained grade, one obtaining D1 and the other one obtaining D2. The carcass yield percentage or dressing percentage was on average 55%. Thus, in terms of carcass performance the animals performed quite well.

Profitability

The profitability of feedlotting has been measured using net farm income analysis. The results of this analysis are shown in Table 1.

Table 1. Profitability analysis

Variable	**Value/cost, Pula**
(a) Revenue	
Sales of finished animals	60,956
(b) Variable costs	
Feeder animals	33,111
Feed	20,528
Medication and Vitamin injection	42
Water	294
Transport	1,235
Sub-total – variable costs	55,210
(c) Gross margin (a-b)	*5,747*
Gross margin per head	118
(d) Fixed costs	
Depreciation	851
Labour	2,541
Sub-total – fixed costs	3,392
(e) Total costs (b+d)	*58,602*
(f) Net farm income (a-e)	*2,355*
Net profit per head	48

Source: Authors' construction from 2002 experimental data

As indicated in Table 1 feeder animals and feed costs form a major component of the total costs in the feedlot operation. Together they account for about 92% of the total costs of the feedlot business. Feed costs alone contribute about 37% of the total variable costs. However, when the costs of feeder cattle are excluded, feed costs alone account for 93% of the remaining variable costs. Thus, profitability of the feedlot business depends not only on the price of the finished cattle but to larger extent on both the cost of feeder cattle and feed.

Table 1 shows that total gross margin is P5, 746.50 and gross per head is P118.28. The net profit/farm income and net profit/farm income per head are P2, 354.53 and P48.05 respectively. Although net farm income is positive, it is very low and hence sensitive to both the input and output prices as shown below. The profits or net farm income shown in Table 1 is economic profit. The total accounting profit (that is excluding depreciation) is P3, 2005.29, which is higher than the economic profit as expected.

Break-even analysis

Break even analysis is important in cattle feeding programmes because it can help us determine the maximum prices we should pay for inputs and the minimum prices for output and amount of output in order for profit to be zero given the prevailing cost structure. Thus, at the break-even point total costs are exactly equal to total revenue.

Break even level of output/minimum herd size

Following Boyles et al (2004), the break-even level of output is calculated using equation (2);

$$BLO = TFC/ (P-VC) \quad (2)$$

Where:

BLO is the break-even level of output,
TFC are total fixed costs,
P is the unit price of the output (price per animal), and
VC are variable costs per unit.

The break-even level of output, which is the minimum number of animals to keep in a feedlot in order to obtain zero profit, was found to be 29 animals. Numbers below this figure will produce a loss and numbers above will produce positive profit. Therefore, one should keep animals above the break-even number in order to maximise profit. However, the exact number to keep can only be determined if we knew how the fixed cost structure will change as output is increased. This is because the fixed costs will not remain fixed at certain output levels; they will rise if the size of the feedlot rises up to a certain threshold level.

Breakeven selling price

In addition to the breakeven level of output, a number of break-even levels of certain variables can be calculated. For instance, to find the break-even price at which to sell the animals after feeding we use equation (3);

$$BSP = [(IBW*PP) + (WG*CG)]/FBW \quad (3)$$

Where:

BSP is the break-even selling price,
IBW is the initial body weight,
PP is the purchase price of the animals entering the feeding program,
WG is the weight gained during the feeding period and
FBW is the final body weight of the animals at the end of the feeding period.

Using the above equation the break-even selling price was found to be P3.32 per kg of live weight. Given that the average final body weight for the feedlot animals was 361.33 kg this translates to P1199.62 per animal. This is the average price at which each animal should be sold in order for profits to be zero. For profits to be positive, given the prevailing cost structure the average selling price must exceed the break even selling price. The more the selling price exceeds the break-even selling price the more the profit and vice versa. Equation (3) can be manipulated to obtain break-even levels of other variables contained in the equation.

Break-even purchase price

Breakeven purchase price is the price at which the feeder animals should be bought in order for profits to be zero. This price is found as;

$$BPP = [(SP*FBW)-(WG*CG)]/IBW \quad (4)$$

Where BPP is the break-even purchase price and other variables are defined as before.

The break-even purchase price was found to be P2.78 per kg of live weight. This translates to P722.52 per beast given that the average initial weight of the animals entering the feedlot was 259.9 kg.

Break-even weight gain

Break-even weight gain is the amount of gain that is required for the total costs of that gain to be exactly equal to the total revenue derived from the gain. This is calculated as;

$$BWG = [(SP*FBW)-(IBW*PP)]/CG \quad (5)$$

Where BWG is the break-even weight gain and other variables are defined as before.

The break-even weight gain was found to be 110.28 kgs in 90 days. Thus, for the feedlot to break-even meaning that the total costs are exactly equal to the total revenue we require that each animal should gain on average 110.28 kgs during the feeding period or 1.23 kg per day.

Break-even cost of gain

The break-even cost of gain can be defined as the maximum cost of gain that is required for profits to be zero. This is calculated as;

$$BCG = [(SP*FBW)]-[(IBW*PP)]/WG \quad (6)$$

Where BCG is the break-even cost of gain and other variables are defined as before. This has been found to be P5.55 per kg of weight gained. Thus, in order for the feedlot to break-even, the cost of producing 1 kg live weight must be equal to P5.55.

Break-even final weight

This is the minimum weight at which to sell the animals for you to just break-even. This is found by the following equation.

$$BEFW = [(IBW*PP) + (WG*CG)] \quad (7)$$

Where BEFW is the break-even final weight and other variables are defined as before.

The break-even final weight for our study has been found to be 348.56 kgs. Thus, in order to just break-even the animals leaving the feedlot should at least weigh an average of 348.56 kgs.

Sensitivity analysis

Sensitivity analysis technique can be used in conjunction with break-even analysis. The technique helps us determine how sensitive a particular variable is to profit. For example, one might be interested in knowing by how much should the feed prices increase in order to obtain a zero or negative profit. Sensitivity analysis can also guide us as to what input or variables we should change in order to obtain highest returns.

Selling price

The breakeven selling price is P3.32 per kg but the selling price we obtained for the feedlot animals is P3.44 per kg. Thus, for the feedlot operation to make a profit the selling price for the animals should be higher than P3.32 per kg. If the selling price of the animals falls below P3.32 per kg while other things such as the feed costs, prices

of feeder cattle and all other costs remain constant the feedlot operation will make a loss. But the question is by how much should the selling price fall for profit to be negative. The answer to this question is that a 6% decrease in the selling price will result in a zero profit and a decrease above this figure will result in a loss.

Feed costs

One of the important variables determining profitability of a beef feedlot operation is feed costs. As argued earlier these amounted to 93% of variable costs for this trial (excluding the cost of feeder animals). A sensitive analysis of the feed costs show that an increase in feed costs by more than 11.5% results in losses.

Purchase price

The break-even purchase price for the feeder animals was found to be P2.78 per kg live weight. The average purchase price for the feedlot animals was found to be P2.60 per kg of live weight. This means that an increase of less than 5% in the price of feeder cattle will result in zero or no profit.

Conclusions

- The results of this trial show that small-scale feedlot operation can be profitable in grain deficit countries such as Botswana. However, feedlot profitability depends to a large extend on the price of both feeder cattle and finished cattle as well as feed prices. As mentioned earlier feed costs account for the largest proportion of total costs when the price of feeder cattle are excluded. The results of sensitivity analysis show that profit is more sensitive to purchase and selling prices of animals than it is to feed costs. However, profit is still sensitive to feed costs, because a 11.5% increase in feed prices will result in zero profit or loss.
- An increase of less than 5% in the price of feeder cattle will result in a loss, while a decrease of more than 6% in the selling price of finished animals will result in a loss. It is worth noting that these two prices are beyond the feedlotters control. However, in the case of finished cattle it is worthwhile to note that the BMC operates a seasonal pricing system in which prices differ in four seasons; January-March, April-July, August-September and October-December. Prices are lowest during April-July period when animals are in their peak body condition and hence sales are greatest and are highest during October-December when animals are in poor condition and supply to BMC is lowest. Thus, for feedlotters to obtain greatest returns from the sale of their

animals, they should aim to sell during October-December when BMC prices are highest.

- Although prices are highest during the October-December period it is of paramount importance for the feedlotter to produce quality animals for him/her to take advantage of the good prices offered by the BMC.
- While we have concluded that small-scale feedlotting is profitable, the results show that the profit margin is very low per animal. The profit per animal for the 90 days feeding period was found to be P48.05, which translates to about P16.02 per animal per month. If the size of the feedlot is such that it has a standing capacity of 50 this translates into P801 per month. Although this amount is lower than the government minimum wage of P1157.72 per month during the trial, feedlotting can contribute positively to net farm income especially when it is undertaken with other farm activities.

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