

Economic Viability of Milk Production Systems in Botswana

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Abstract

Botswana imports approximately 75% of its milk requirement. These imports are mainly from the Republic of South Africa and Zimbabwe and an increase in milk production has been government's concern. However there has not been a study on the efficiency and profitability of milk production in this country.

The purpose of the study was therefore to quantitatively assess the levels of milk production under the two milking systems of machine and hand milking. Primary data from 8 dairy farms around Gaborone and Lobatse for the period 1990/91 up to 1991/92 farming year was obtained. Parameters measured included among others, number of cows handled per person, the herd size, number of employees per herd, time spent to milk a cow, milk production per cow per day, per cent monthly feed and labour expenses were used in the analysis. The student t-test was used for comparison between the two milking systems. The gross margin technique was used to assess the returns that accrue to income from milk sales alone.

The results of this study indicated that there were no major differences ($P > 0.05$) in the above parameters except milk production per cow per day in those herds keeping Friesian cows. Generally a downward trend in milk production throughout the year was observed in this study. Feed costs compared to labour emerged to account for the largest portion of the dairy budget in both hand milking and machine milking systems. As expected, the proportions of labour costs in hand milked herds are higher than machine milked ones.

Gross margins from milk sales of most herds were lower in both cases. If increased income from milk production is to be achieved, improvements in dairy nutrition as well as employment of milking techniques that take advantage of the peak milk "let down" are desirable.

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1 Introduction

At Independence, in 1966, the agriculture sector contributed about 40% to the country's G.D.P. This sectors contribution fell to about 3% in 1989 (NDP 7 1991).

The drastic decline in this sector is attributed to the dramatic development in the mining and quarrying sectors from almost zero at Independence to about 45% in 1987/1988.

Despite the decline in the agricultural sectors, contributions to the G.D.P. and total formal employment, the sector is said to have contributed to the majority of Botswana for food, income and employment, and investible income (MOA, 1991).

About 76% of Botswana live in rural areas and derive their livelihood from agriculture. Other off-farm activities such as beer brewing (traditional), basket making, remittances and wood carvings are also important sources of rural households' incomes.

The livestock sub-sector's contribution in particular, whose population is estimated at 2.6 million, has been through beef exports, a major source of foreign exchange earnings for Botswana. This sector comes second after diamonds.

The distribution, however, of this sector is highly skewed with 40% of the farming households without cattle while over 60% of the national herd (1.56 million) is owned by less than 10% of the farming households (MOA, 1991)

2 Review of the Dairy Sector

Dairying in Botswana is said to have been a by-product of cattle ranching. Milk surplus to the needs of calf rearing was produced mainly during the summer season when skimmed milk and the cream were commercially marketed (FAO, 1982).

According to Governments Policy on agriculture, fresh milk production around towns and semi-urban areas is to be encouraged. In attempting to promote dairying, small farmers, dairy marketing co-operative societies and agricultural management associations have been started in peri urban areas. Presently there are 52 dairy farms involved in dairying throughout the country. There are 2 dairy marketing and cooperative societies, 3 Dairy Agricultural Management Associations and 7 milk pasteurising plants (Animal Production Division 1991). In 1991, the national dairy cow population stood at 2,692 heads, out of which 1,249 were milking, producing 11,150 litres of milk per day. The majority of these projects obtained their funding through the Financial Assistance Policy (FAP) and the Dairy Industry Special Fund. In order to protect the small dairy farmers, import restrictions on fresh milk were imposed and fresh milk imports dropped from 3,004,468 litres in 1988 to about 1,826,527 litres in 1989 (39%) (APD 1991).

The national requirement of ½ a litre per person per day of milk is not met by the local production. Hence most of the fresh milk has to be imported mainly from South Africa and Zimbabwe.

The Dairy Industry in Botswana has been hampered by persistent harsh climatic conditions which militates against optimum performance of exotic breeds in particular. The exotic breeds, besides being susceptible to harsh climatic conditions are rather too expensive (up to US \$892/head) for small farmers. Dairy management personnel is scarce and has often been mentioned as a drawback to efficient and profitable dairy farming. Perhaps most critical of all problems in dairy farming is the shortage of locally available foodstuffs. Since most of the foodstuffs are imported, the prices are usually prohibitive to majority of dairy farmers. There has not been a study on the efficiency and profitability of milk production in Botswana

3 The role of Dairy Products

The importance of milk as a component of diet for human beings lies in its richness in essential amino acids which are often deficient in vegetable protein based diets. Milk however, is a high cost source of protein and fat compared to vegetable sources. Despite the above, the source is still readily saleable especially in the more affluent urban and peri-urban areas. Improving milk production therefore entails that the quality of life of the people could be improved.

Milk is a product from good management and good care of dairy cows. The management and care of these animals uses resources such as labour, feed and veterinary drugs. The dairy farm operations are paid for from the harvested milk. Several methods of harvesting milk are and the commonly used are calf suckling, hand milking and machine milking. Among the resources utilised in milk products, labour seems to be the largest input in milking and accounts for about 55% (DIGGINS et al, 1984). Labour productivity and availability is therefore an important determinant of the number of dairy cows that can be handled in a farm. Feed is also an indispensable input since the type and quantity of feed given to the dairy cows influences the amount and quality of milk produced (BOITUMELO, 1993). Local milk suppliers are said to meet only 26% of the country's milk requirements and 74% is imported mainly from South Africa and sometimes from Zimbabwe. Many dairy operations are characterised by low productivity, a prominent feature faced through low milk yields, a larger labour force, poor cattle nutrition, low calving rates but high calf mortality rates and a very high incidence of mastitis.

The low productivity is mainly due to poor management, poor abilities and capabilities, poor husbandry practices and milking systems.

These factors affect the amount and quality of milk product hence the ultimate returns of the farm.

4 Hypotheses Testing

The following hypotheses are stated below in order to analyse the Economic Viability of milk Production by Comparing the two milking systems in Botswana. Broadly, the two milking systems are hand milking and machine milking.

- i) machine milking uses less labour than hand milking
- ii) there is relatively more milk obtained using a machine rather than milking by hand.
- iii) machine milking takes less time hence able to handle a relatively larger herd than hand milking.
- iv) machine milking is cheaper and more efficient than hand milking.

This study hopes to test the above hypotheses and to determine the response of dairy productivity to specified variable factors of production. The variable factors applied in this study includes, among others, feed and labour as factors used in milk production in both milking systems.

There has not been a study on the efficiency and profitability of dairy production in Botswana; hence the inception of this study.

The main objective of this paper is to describe how the husbandry practices affect milk products. The other aim is to economically analyse the response of milk products to inputs such as feed and labour (for both milking systems).

5 Literature Review

Despite Botswana's large livestock Population (3 million cattle), great (75 %) quantities of milk is imported to satisfy the domestic consumption. There are mainly two reasons that led to such a deficit. First, the majority of cattle are indigenous Tswana breeds, which are poorly suited to milk products. Second, availability of resources such as foodstuff and skilled manpower also contribute to such low yields. With demand for milk in Botswana's urban areas growing by up to 25% per year (E. GODDARD AND B KIFLEWAHID, 1993), import levels will increase dramatically unless domestic production increases. Domestic production can increase if husbandry and milking systems are improved.

Digging et al (1984) found out that milking is the largest labour item in dairy management and it accounts for about 55% of the labour input. The amount and quality of labour available in the dairy team has a direct bearing on the herd size that can be milked, otherwise a big herd with limited unskilled labour or very high labour costs may necessitate the use of labour and time saving technologies such as machine milking.

A study carried by Nalbant and Alger (1989) to determine hand and machine milking in Turkey using eight different milking machines found a correlation between milking time and yield. The faster the milking, the more the yield. In this study, the milking times ranged from 0.9 to 2.2 minutes per cow. The average number of milked cows per hour was 11 and 30 cows for hand and machine milking respectively. It was found that for herds with less than ten cows, machine milking was found to be uneconomic.

Mechanised milking has many advantages for the farmer though success with very simple systems has also been recorded in systems such as bucket, hand milking and pipeline milking used by a total of 24 farmers in Switzerland.

Microeconomic analysis has shown that cost reductions and productivity increases to the introductions of new technologies in dairy operations.

Feed is undoubtedly the major input in dairy farming and it accounts for about 60% of a dairy budget. For high yields to be obtained, adequate amounts of high quality feeds are necessary. Smith (1984) indicated that most feed energy for milk production under traditional management in developing countries is provided through the natural grazing on rangeland and pastures and crop residues.

Provision of higher quality foodstuffs supplementation with concentrates are necessary for increasing milk production from subsistence levels. However concentrates are often in limited supply, and very costly. Studies by Boitumelo (1993) showed that lack of adequate nutrition, especially during the dry season, is one of the major constraints to sustainable milk production. FAO (1992) reported that forage from natural rangelands in Botswana are of very low nutritive value characterised by high crude fibre, low digestible dry matter, low crude protein and low calcium and phosphorus. Because of the above constraints, most of the foodstuffs are imported directly from South Africa at prices which are sometimes unaffordable to many dairy farmers in Botswana.

6 Methodology of Study

The study covered randomly selected dairy farms in an around Lobatse and Gaborone. Lobatse is about 70 km from Gaborone the capital city. Secondary data was also used to supplement the primary data that was collected.

The total sample was 8 dairy farms comprising 4 hand and machine 4 milking systems during the 1991/1992 and 1993 farm management year. A questionnaire was employed as a data collection instrument. Personal observations and discussions with farm owners was also employed in this study. Each dairy farm operator was asked to respond to the questionnaire once per year. Average production data over two years (1991/ 1992/ 93 was collected.

7 Results

Management Systems and Breeds kept

The heads studied varied both in management as well as the type of breeds of cows kept. All the 3 except one that was highly intensive are kept under the semi-intensive management system. The most predominant breed was found to be the Friesian.

Herd size

The average herd size for hand and machine milked cows were 32 and 59 cows respectively. However no significant differences ($P > 0.05$) in herd size were observed between the two milking systems (Table 1).

Number of dairy employees

The average number of employees per herd was found to be 6 and 5 people for hand and machine milking respectively. There were no significant differences ($P > 0.05$) (Table 1) between the two systems.

Table 1: Comparison of herd Performances for 8 Dairy Farms

Parameter	Hand		Machine		tcal	tst
		SEM		SEM		
Herd size	32	7.8	59	8.4	2.35	2.45
Av. No. of Employees per herd	6	2.7	5	1.6	0.4	2.45
Av. No. of cow handled per employee	5	1.7	12	3.8	1.7	2.45
Time spent per cow per milking (mins)	9	0.9	6	1.2	1.3	2.45

source: Calculated from study

Key

SEM = Standard error of the mean

tcal = Calculated student t-value

tst = tabulated student t-value

$P > 0.05$, 6 d.F = 95% level of significance and 6 degrees of freedom.

The standard error of the mean was higher for the machine milked herds than the hand milked ones, 8.4 and 7.8 respectively.

Time spent to milk a cow:

The study found out that machine milking took less time compared to hand milking. It took 6 minutes to machine milk a cow compared to 9 minutes for hand milking. Statistically however, no significant differences were observed in the duration of milking ($P > 0.05$).

Number of cows handled per person

Machine milking can handle an average of 12 cows per person compared to 5 cows (Table 1).

Again no significant differences were observed with respect to the number of cows handled per person at 5 % level of significance.

Productivity per cow per day

Milk production per cow per day is higher in machine milked herds than in hand milked.

Hand milking yielded 2.7 litres as opposed to about 6.90 for machine milking per cow per day (Table 2).

Seasonal fluctuations in milk production occur with high levels for both systems during April and May.

Average Monthly expenses

The study found out that about 57% and 72% of the dairy budget for hand and machine milked herds is spent on feed purchases while about 34% and 13 % respectively goes to labour costs (Table 2).

Table 2: Average milk Production coefficients and Gross returns for period 1990/1991 - 1991/92

Parameter	Milking Systems	
	hand	machine
Average daily milk yield per cow per day (litre)	2.7	6.9
Average income (monthly)/cow from milk sales (P)	66.4	169.70
Average monthly expenses/cow (P)	181.6	175.5
Monthly feed expenses (%)	57	73
Monthly labour expenses	34	13
Monthly returns per cow (p)	(115.2)	(5.8)

Source: calculated from study

8 Discussion

The results of the study indicated that there is no apparent significant differences ($P > 0.05$) in the herd size, the number of employees per herd, the average number of cows handled per person and the average time spent to milk a cow between the milking systems. There were, however, individual herd variation. The average herd size of 32 and 59 cows for hand and machine milking systems respectively seem to justify machine milking systems in both cases. These figures seem to justify what Nalbrant and Ulger (1989) reported as economical herd sizes for machine milking. These studies reveal that herd sizes of less than 10 cows were not economic for machine milking.

Although herd size influences milk production, there are other important factors such as the type of breed, management system and capabilities of the operator, his attitude towards dairy enterprise, the environment in which one is operating and unit price of milk are also indispensable factors to consider in assessing the economic viability of a milking system.

In terms of the economics of scale, a big herd size does not necessarily mean increase returns to the farmer but may lead to increased costs of production for the farmer if management and resource allocation is poor.

Although the number of cows handled by one person for machine milking appears to be higher (12 cows per person) than for hand milking (5 cows per person), it is rather low compared to what other studies found. For example, Barrett and Larkin (1974) found out that one trained man is capable of feeding and milking at least 60 cows. This implies

that labour productivity per unit of output in this area is low resulting in reduced income for the producer.

The average milk production per cow per day is variable between and within the two milking systems and a significant difference ($P > 0.05$) occur in the Friesian herds.

This variation is mainly attributable to management practices particularly feeding. APRU (1990) reported that an intensively managed Friesian herd can produce up to 15 litres of milk per cow per day.

Although there are no significant differences in time spent to milk one cow were observed, machine milked herds produced more milk because among other factors, machine milking is capable of completing the "let down" stimulus created by oxytocin (BARRETT AND LARKIN, 1994). The variability in management could account for these differences. Herds under semi-intensive management keeping Friesian cows seems to follow a similar trend in milk production with increase in yield occurring during the months of April and May for machine and hand milking respectively. This is the case because of the availability of good grazing at this time of the year. After these months, milk yield generally decreases. Farms usually have difficulty in feeding animals good quality feed during the dry season.

Although zero grazing is a recommendation in commercial dairy farming, in practice dairy cows are left to graze naturally because farmers cannot afford to meet the costs for supplementation. The negative returns (Table 2) experienced need to be interpreted with caution because the expenses for feed and labour are not exclusive to milked cows only, but include feed and labour costs spent on culled cows, stress dry cows, calves and bulls. It was rather difficult to apportion expenses exclusive to milked cows. If the available records from farmers enabled one to apportion costs, probably a different situation could have emerged. It was found out that the income realised from milk sales is occasionally re-invested into dairy activities but instead was used to finance other investments other than dairy. This deprived the dairy activities of sources of cash.

9 Conclusion and Recommendations

This study found out that the predominant dairy management system in use in the study areas is the semi-intensive system with the Friesian being the most popular breed.

The relative production from the Friesian keeping herds under the semi-intensive management is low while the proportion of expenses on feed and labour are rather high in hand milking and machine milking systems.

Labour input costs is high in hand milked herds as compared to their counterparts.

The average number of cows handled per employee is higher in machine milked herds but it is relatively low by international standards.

Although there are no major differences in time spent to milk a cow, machine milked herds produce more milk than hand milked ones. The results therefore prove that the hypotheses are indeed true.

There is a general downward trend in milk production throughout the year for both systems. This is due to perhaps poor management and lack of adequate quality feeds in many dairy farms.

Dairy farmers (particularly hand milking ones) should be encouraged to minimise costs rather than increase the size of their herds.

Finally, proper records for each cow and type of milking systems should be kept and costs should be apportioned to each cow in order to determine the exact costs per cow per system.

Die Ökonomie von Milchproduktionssystemen in Botswana

Zusammenfassung

Botswana importiert rund 75 % seiner benötigten Milch und Milcherzeugnisse. Eine Erhöhung der Eigenproduktion ist Anliegen der Regierung und diese Studie soll Fragen der Wirtschaftlichkeit beantworten. Die Untersuchung befaßt sich mit der Milcherzeugung in Betrieben mit Handmelken und Maschinenmelken und untersucht die verschiedenen Parameter. Die Ergebnisse zeigen keine großen Unterschiede ($P > 0.05$), außer der Milchmenge per Kuh bei Friesian Herden. Die Futterkosten haben den höchsten Anteil, neben den Lohnkosten, die beim Handmelken höher sind. Haltung und Management sind stark verbesserungswürdig.

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