Viability of Dairy Ranching compared to beef and milk production systems for small-scale farmers in South Africa

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Abstract

Dairy ranching can be defined as the practice of keeping cows of relatively low milk yield, being parted from their calves in the evening, milked out in the morning, and spend the day with their calves at foot. These cows are usually not milked in the evening. Dairy ranching ensures low production costs with lesser liabilities than intensive milk production systems, which include relative resilience to rising feed prices. The aim of the study was to generate results from a project that imitate dairy ranching that can be used by existing and new emerging cattle farmers and to benchmark the system of dairy ranching in comparison with small-scale dairy production and an ordinary beef cattle suckler (weaner calf) system. The project commenced with an experimental herd comprising of five purebred 24-month-old heifers of the Bonsmara, Brahman, Jersey, Nguni and Red Poll breeds. The animals were compared in the following three systems: Small-scale dairy farming of Jersey cows; dairy ranching of Bonsmara, Brahman, Nguni and Red Poll cows and a weaner production system of Bonsmara, Brahman, Nguni and Red Poll cows. Data from the project was used to simulate results from a small-scale farm with a carrying capacity to sustain 25 Large Stock Units. When comparing different breeds in different production systems, the Nguni cows followed by the Brahman cows showed the highest potential income from a weaner production system. In the dairy ranching system, the dual-purpose Red Poll cows showed the highest potential income. In Jersey cows milked in a conventional dairy system, potential income reduced by 32% when cows were milked once per day instead of twice daily. The conventional dairy produced a higher potential income than a weaner production system but less than the dairy ranching system.

Keywords: Dairy ranching, weaner production, small-scale dairy
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Introduction

With the expected world population of 10 billion by 2050, local, national and global solutions must be found for sustainable food production (Hodges, 2005). As the population in South Africa continues to grow, milk and meat are becoming more important as a source of high quality protein to reduce malnutrition, especially in children (Scholtz *et al.*, 2014). Although many people own cattle in the rural areas of South Africa, there is a perceived need for milk and meat production, specifically from cattle. Therefore, it is important for the emerging and communal farmer to become a role player in dairy production, as milk can be a reliable intermediate product of extensive cattle farming in the resource poor sector of South Africa (Grobler *et al.*, 2008).

Cattle can be a viable option for small-scale farmers to complement other farming enterprises, including milk production (Clark, 2017). Dairy ranching can be defined as the practice of keeping cows of relatively low milk yield, being parted from their calves in the evening, milked out in the morning, and spend the day with their calves at foot. These cows are usually not milked in the evening. In tropical countries, making use of the calf to stimulate milking is a popular practice. It was reported that this system is adopted by 95% of 289 small-scale farms surveyed in the State of Minas Gerais, Brazil (Junqueira *et al*., 2005).

When compared to a conventional dairy system, dairy ranching has lower input costs, labour requirements and limited infrastructure is needed. Dairy ranching development in the rural-based, small farmer-oriented cattle industry can therefor increase productivity, raise income, ensure profitability, promote self-reliance, reduce malnutrition and improve standards of living.

The aim of the study was firstly to generate results from a project that imitate Dairy ranching that can be used by existing and new emerging cattle farmers and secondly to benchmark the system of Dairy ranching for the resource poor sector in comparison with small-scale dairy production and an ordinary beef cattle suckler (weaner calf) system.

Materials and Methods

The study was conducted at the Roodeplaat experimental farm of ARC-Animal Production (25°34'11.27''S; 28°22'05.36''E) on natural rangeland. The vegetation in the study area has been described as Savanna (Rutherford & Westfall, 1994), Sourish Mixed Bushveld (Veld Type 19) (Acocks, 1988), Clay Thorn Bushveld (Low & Rebelo, 1996) and Marikana Thornveld (Mucina & Rutherford, 2006) in the Savanna Biome, Central Bushveld Bioregion described as Marikana Thornveld. The mean rainfall for the past 10 years was 768mm, of which 83% occurred from October to March (spring to autumn). The mean daily minimum/maximum temperatures ranged from 16°C (minimum) to 32°C (maximum) in February (summer) to 1°C (minimum) to 23°C (maximum) in July (winter) (AgroClimatology Staff., 2015).

The project commenced with an experimental herd comprising of five purebred 24-month-old heifers of the Bonsmara, Brahman, Jersey, Nguni and Red Poll breeds. The animals were compared in the following three systems:

1. Small-scale dairy farming of Jersey cows (milked daily under small-scale conditions from natural veld with limited resources);
2. Dairy ranching of Bonsmara, Brahman, Nguni and Red Poll cows (milk production determined by the weigh-suckle-weigh technique (MacNeil & Mott., 2006));
3. Weaner production system of Bonsmara, Brahman, Nguni and Red Poll cows.

Data collection from the small-scale Jersey herd commenced in 2011 until 2016. Only milk production from cows in first lactation and second lactation was used for the project as all other breeds included in the project consisted of 24-month-old heifers initially. A basic portable two-point milking machine was used to milk the cows in a very basic tandem parlour. Cows grazed natural veld described as Sourish Mixed Bushveld and received 500g commercial dairy supplement (21% protein) per litre of milk produced while being milked in the milking parlour. Although this is less than recommended by feeding companies, 500g per litre of milk was used as this is the rule of thumb in rural areas as communicated by successful small-scale dairy farmers in Jane Furse Limpopo interviewed on 24 February 2017. Cows were milked twice daily from 2011 to 2013 at 08:00 in the morning and 14:30 in the afternoon. From 2014 onwards cows were milked only once per day at 08:00 in the morning. Calves were separated from their dams 24 hours after birth to ensure adequate colostrum intake and bottle-fed up to 2 months with *ad lib* calf starter. Calves were weaned at 2 months and received thereafter calf growth pellets while grazing natural veld.

Heifers of all breeds were bred at 24 months with a Pinzgauer bull. Animals were kept on natural veld with only lick supplementation. Standard herd management included weighing, dipping and vaccination against Anthrax, Botulism, Black quarter, Three-day stiff sickness, Lumpy skin and Rift valley fever. Calves were weaned at approximately 210 days of age.

Although machine milking is the preferred approach to assess beef cow milk production in scientific experiments due to the higher correlation with weaning weight, than when milk production is measured by the weigh-suckle-weigh technique (Rodrigues *et al*., 2014), the weigh-suckle-weigh technique was used in the current project for practical reasons.

The weigh-suckle-weigh technique entailed that cows and calves were separated from 15:00 pm to 18:00 pm the day before measurement, then reunited, and allowed to suckle to ensure that all cows were "milked out" at the beginning of the separation period. After sucking, the calves were separated from their dams until 07:30 am the following morning. Calves were weighed, where after they were reunited with their dams to allow each calf to suckle its dam until satiated or milk is no longer available and quickly reweighed. The difference between weights of the calf before and after suckling was assumed to reflect milk produced by the cow during the preceding 12 hours (MacNeil & Mott, 2006). This was done 4 times (within the 1, 3, 5, 7 month of lactation) over a 210 lactation period where after the calves were weaned. The 210 day lactation yield was calculated by making use of the standard calculation procedure used by the ARC to estimate milk production.

Due to grazing land differing in carrying capacity and breed frame size impacting the amount of animals that can be sustained on a specific farm, data from the project was used to simulate results from a small-scale farm with a carrying capacity to sustain 25 large stock units (LSU), using the approach of Mokolobate *et al.* (2015). The average weight of the individual cows within the project was used and not national breed standards, to calculate LSU of the different breeds and the amount of cows sustainable on such a farm with a carrying capacity of 25 LSU. This related to 15 Bonsmara cows, 16 Brahman cows, 21 Jersey cows, 20 Nguni cows and 21 Red Poll cows.

Results and discussion

The potential income from a Dairy ranching system (Table 1), weaner production system (Table 2) and a small- scale dairy (Table 3) was calculated, not taken into account mortalities, labour, facilities and veterinary costs. Rural farmers usually struggle with inadequate market information systems, poor transport facilities, high cost of transport and low farm gate prices. Therefore, the reduced price of R20/kg was used when calculating income from weaner calves. For milk production, the amount of R7 per litre of milk was used, as this is the current price received by small-scale farmers in the ARC's Dairy value chain project in the Limpopo province.

From Table 1 it is clear that the Red Poll, which was the only dual-purpose breed in the project, presented the highest potential income (milk and calf sales) and the medium frame Bonsmara, bred exclusively for beef production, showed the lowest potential income within the Dairy ranching system. Although the Nguni cows generated the second highest potential income within the Dairy ranching system, it must be noted that milk production was calculated on a 210-day lactation period and it has been shown that Nguni cattle has a tendency for shorter lactations. In the current project, it was observed that the Nguni cows weaned their calves at approximately 180 days and the 210 lactation data was estimated by means of a mathematical calculation from the milk recording scheme, estimating milk production from five weigh-suckle-weigh milk recordings. Therefor it will be more realistic to look at milk production from Nguni cattle up to 180 days instead of 210 days. This is in line with a study by Alvarez *et al.,* (1989) where crossbred cattle derived from Zebu (Bos indicus), showed a negative linear relationship between the proportion of genes derived from the Bos Taurus parent and the incidence of short lactations.

Table 1 Potential income from milk and weaner production from a Dairy ranching system on veld sustaining 25 LSU

	Bonsmara (n=15)	**Brahman (n=16)**	**Nguni (n=20)**	**Red Poll (n=21)**
Saleable milk production(kg/cow)	1162	1036	1037	1384
Calf 210 corrected weaning weight	182	196	173	119
Dairy concentrate fed (kg) over 210 day lactation at 500g concentrate per kg milk produced	3kg	2.5kg	2.5kg	3.5kg
Income from milk (R7/l)	R122 010	R116 032	R145 180	R203 448
Income generated from calves sold at R20/kg	R54 600	R62 720	R69 200	R49 980
Direct income from milk and calves	R176 610	R178 752	R214 380	R253 428

Table 2 indicates the potential income from a weaner production system from four different breeds on a farm able to sustain 25 LSU. No mortalities, labour, facilities and veterinary costs were included in the calculation. The small frame Nguni cows produced the highest income followed by the medium frame Brahman and Bonsmara cows. Although studies have shown that the variation in calf weaning weight can be attributed up to 60% to milk production of the dam (Albuquerque *et al*., 1993; MacNeil & Mott, 2006), the Red Poll cows produced the most milk but weaned the lowest kg calf per livestock unit. The weaner production system produced less potential income than the Dairy ranching system, indicating that Dairy ranching is a viable option for small-scale farmers to increase income from cattle production.

The direct income generated from the conventional small-scale dairy is indicated in Table 3. The Jersey cows were milked from natural veld with minimal supplementation at milking time. The weighted average 305 day lactation yield from first-, and second lactation cows was used to estimate milk production. From 2011 to 2013 cows were milked twice daily and from 2014 to 2016 cows were milked only once per day. The direct income was 32% higher when cows were milked twice daily instead of once per day. The conventional small-scale dairy produced a higher potential income when milked once or twice daily than when milked once per day. Furthermore, the conventional small-scale dairy produced a higher potential income than the weaner production system, even when milked once per day. However, Dairy ranching, using the Red Poll, resulted in the highest income.

Table 2 Potential income from weaner production system on veld sustaining 25 LSU

	Bonsmara	**Brahman**	**Nguni**	**Red Poll**
Cows grazing veld sustaining 25 LSU	15	16	20	21
Average Calf birth weight (kg)	35	35	32	32
Average 210 day corrected weaning weight (kg)	203	222	188	140
Calf average daily gain (kg)	0,80	0,89	0,74	0,51
Average cow weight at weaning (kg)	565	531	406	382
Average cow LSU at weaning	1,63	1,56	1,23	1,18
Kg calf weaned/LSU	124,5	142,3	152,8	118,6
kg calf weaned from 25 LSU	3045kg	3552kg	3760kg	2940kg
Income generated from calves weaned/25 LSU	R60 900	R71 040	R75 200	R58 800

Table 3 Direct income generated from milk sales and calf sales from 25 LSU Jersey cows (21 cows) milked once or twice daily on natural veld with minimal supplementation

	Milking twice per day	**Milking once per day**
Av. Cow weight (kg)	345kg	345kg
Total 305 day milk production (kg)	56 966	39402
Milk fed to calves (3 to 60 days of age 4kg milk per day)	4788	4788
Total milk production - Milk fed to calves = Saleable milk (kg)	52178	34614
Income from milk sold at R7.00 per kg	R365 246	R242 298
Calf sales from cows at R20 per kg (210 day corrected weaning weight 154kg)	R64 680	R64 680
Concentrate fed at 5kg per day for 305 days (R5.26/kg)	R168462	
Concentrate fed at 3kg per day for 305 days (R5.26/kg)		R101 071
25kg Calf starter fed to calves up to 60 days of age (R5.56/kg)	R2 919	R2 919
Calf grower fed at 2kg per day (2-6mnths) (R5.56/kg)	R28 489	R28 489
Direct income milk and calves (excl. milk loss, mortalities)	R230 056	R174 499

When comparing the three different systems including a conventional small-scale dairy, Dairy ranching system and a weaner calf beef production system consisting of 25 LSU (Table 4), it is clear that the Dairy ranching system has the potential to produce the highest income, while producing milk and meat. According to Ugarte (1991), this system allows for greater economic effectiveness since:

- It uses the maximum milk potential of the cows through the consumption by the calf of the residual milk
- It achieves high milk yields at milking and good calf growth
- It attains satisfactory reproductive performance and a low incidence of mastitis
- It maintains a low calf mortality rate

When comparing different breeds in different production systems, the Nguni cows followed by the Brahman cows showed the highest potential income from a weaner production system. In the Dairy ranching system, the dual-purpose Red Poll cows showed the highest potential income. With Jersey cows milked in a conventional dairy system, potential income reduced by 32% when cows were milked once per day instead of twice daily. The conventional dairy produced a higher potential income than a weaner production system but tend to produce less than the Dairy ranching system, depending on the breed.

Table 4 Potential direct income generated (milk and weaner sales) from 25 LSU production in different production systems (excluding mortalities, overheads etc.)

Breed	**Weaner production**	**Dairy ranching**	**Conventional dairy (milking 1x/day)**	**Conventional dairy (milking 2x/day)**
Bonsmara	R60 900	R176 610		
Brahman	R71 040	R178 752		
Nguni	R75 200	R214 380		
Red Poll	R58 800	R253 428		
Jersey			R174 499	R230 056

Conclusion

Small-scale milk producers have their own constraints including poor access to support services, lower productivity, limited access to market outlets and low capital reserves. However, Dairy ranching ensures low production costs with lesser liabilities than intensive milk production systems, which include relative resilience to rising feed prices.

When comparing different breeds in different production systems, the Nguni cows followed by the Brahman cows showed the highest potential income from a weaner production system under small-scale production systems. It is unfortunate that the Afrikaner was not included in this study. In the Dairy ranching system, the dual-purpose Red Poll cows showed the highest potential income. With the Jersey cows milked in a conventional dairy system, the potential income reduced by 32% when cows were milked once per day instead of twice per day. The conventional dairy produced a higher potential income than a weaner production system but less than the Dairy ranching system.

When compared to a conventional dairy system, Dairy Ranching has lower input costs, labour requirements and limited infrastructure needed. It can also add value to small-scale beef production enterprises. Dairy Ranching development in the rural-based, small farmer-oriented cattle industry can therefor increase productivity, raise income, ensure profitability, promote self-reliance, reduce malnutrition and improve standard of living.

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