Dairy goat production systems in Waikato, New Zealand

J. SOLIS-RAMIREZ*, N. LOPEZ-VILLALOBOS and H.T. BLAIR

Institute of Veterinary, Animal and Biomedical Sciences, Massey University. Private Bag 11-222.
Palmerston North 4442, New Zealand
*Corresponding author: solisrj2@yahoo.com

ABSTRACT

Thirteen dairy goat farmers from the Waikato region of New Zealand were surveyed to describe and quantify the main features of their production systems. Twelve herds were maintained indoors and one herd was under grazing conditions, the latter farm was excluded from further analyses. All farms supplied milk to the Dairy Goat Cooperative (NZ) Ltd which produces milk powder for export. A total of 11 breed groups were identified. Out of the total milking does, Saanen was 88%, Toggenburg x Saanen 8%, Toggenburg 2% and others 2%. The average herd comprised 20% replacement kids, 17% does between 7 to12 months-of-age, 59% does 1 to 10 years-old and 4% bucks. Culling of milking does was due to low production (35%), poor fertility (14%), leg problems (6%), mastitis (6%) and other reasons (13%), while 27% died between 1 to 10 years-old. Daily milk yield ± standard deviation per doe and per hectare were 2.8 ± 0.2 and 34.0 ± 3.7 kg respectively; while milk-solids were 0.32 ± 0.02 kg/doe and 4.10 ± 0.43 kg/ha, respectively, over a standardised 270 day lactation. Expenses were mainly feed concentrates (21.5%), dairy wages (20.3%), overheads (14.0%), family labour (14.5%) and other expenses (21.5%). The rates of return on investment were 10.2% and 10.7%, per milking doe and per hectare, respectively.

Key words: dairy goats; return on investment; production system; milk-solids; survey.

INTRODUCTION

Commercial dairy goat farming began in New Zealand in the 1970s and early 1980s (Sheppard & O'Donnell, 1979; Orr, 2010). Dairy goat farming was considered as an "emerging industry" in New Zealand in the 1990s (Singireddy *et al*., 1997).

In the last 50 years the annual increase in total goat population in New Zealand was 5,700 animals, but in the last 10 years a decrease of 9,000 animals per year has been reported (FAO, 2010). Factors like improving animal efficiency, reduction of meat and fibre goat population and competitiveness with dairy cattle and sheep farming have contributed to the decrease in the total goat population in New Zealand. However, in the dairy goat herd, there is evidence that the average number of milking does per herd have increased since 1991 (Morris *et al*., 1997; Morris *et al*., 2006; Singireddy *et al*., 1997; J. Solis-Ramirez, Unpublished data).

The Waikato region has a well established dairy goat industry with about 65% of the New Zealand dairy goat population (Orr, 2010), with the remaining 35% being distributed throughout the rest of New Zealand. Surveyed dairy goat farmers are organised into the Dairy Goat Cooperative (NZ) Ltd. (DGC) located at Hamilton where milk is made into milk powder and exported to several countries. DGC operates a seasonal production system with goats typically in milk from July-August to April-May each year. However, the structure of the New Zealand dairy goat production system has not been described. The objective of this study was to collect data by means of a survey to describe the structure of the dairy goat production system. This will then allow the calculation of economic values to improve current selection schemes for the dairy goat herd in Waikato.

MATERIALS AND METHODS

Location of study site

Thirteen dairy goat farmer members of the DGC from the Waikato region were surveyed with face-to-face meetings. Data were recorded to describe and quantify the main features of the goat production system they used. The farms were located in Hamilton, Cambridge, Te Awamutu, Morrisville, Te Aroha, Taupiri, Walton and Matamata. Twelve farms maintained their herds indoors and one herd was maintained outdoors. For the general description of the production systems in the survey, the outdoor farm was removed from the analysis, as were their Saanen x Boer cross kids bred for meat production.

Format construction and features of survey

The survey format was developed to record the general, physical, economic and management characteristics of the dairy goat farm. Therefore, herd structure, milk yield and milk-solids production, land area and use, farm expenses and overheads, number and age of animals, buildings and equipment available, causes of culling and deaths, live weight and breed groups were recorded. Data for protein, fat and lactose were provided by

the DGC (C.G. Prosser, Personal communication). The survey was undertaken during the first week of June 2010, when data from the previous lactation season was available.

Data were analysed on a per milking doe and a per hectare basis for an average of 270 days in milk. The milking period ranged from eight and a half to ten months. The most frequent lactation length was about nine months (270 days in milk). Mean, maximum and minimum, standard deviation and percentage values for different characteristics were calculated.

Herd structure

Herd structure information requested included the number of animals in the following classes: birth to six-seven months old (males and females), 7 to 12 months old (males and females), and 1 to 2 years, 2 to 3 years, 3 to 4 years, 4 to 5 years, 5 to 6 years, 6 to 7 years, 7 to 8 years, 8 to 9 years, 9 to 10 years, and 10 years and older does. This age structure was organised as male and female kids (0 to 7 months of age), replacement female and males (7 to 12 months old age), milking does, and bucks. Milking does were female goats that were milked at least once and provided revenue during the season.

Deaths and culling

The deaths and disposal recorded per age category were those that occurred after removal of surplus kids at birth. The main causes of death and culling in the herd were recorded.

Breed groups

Breed groups were all the purebred and crossbred animals with a known breed pedigree.

Farm revenue

Dairy goat farm revenue (R) was calculated as:

$$R = (MS_y \times P_{ms}) + (A_c \times P_a)$$

where MS_y = total kilograms of milk-solids produced, P_{ms} = price per kilogram of milk solids, A_c = the number of culled animals and P_a = average price received for the culled animals.

Cost of production

All the expenses influencing the cost of production on the farm in order to calculate the total costs per doe and per hectare were recorded (Table 1). Farm expenses and overheads were added to get the total farm expenses.

Capital value

The capital value invested (C) per farm was recorded as the value of land, livestock, milking shed, DGC shares, houses and other buildings and current value of equipment.

Return on investment

Return on investment (ROI) was calculated as:

ROI = R/C (Horngren *et al*., 1997)

TABLE 1: Economical and technical information recorded for each dairy goat farm.

General expenses	Overheads
Dairy wages	Administration
Herd testing	Repairs and maintenance
Breeding costs	Vehicle expenses
Animal health	
Bedding (shavings)	
Farm dairy expenses	
Purchased concentrates	
Purchased minerals	
Purchased silage	
Purchased hay	
Run-off	
Cropping including contract hay and silage making	
Pasture renovation	
Seed cost	
Weed and pest	
Fertilizer and spreading	
Freight	
Electricity	
Other costs such as dogs, water supply, insurance	

TABLE 2: Number and percentage of animals per breed group in the whole group of surveyed dairy goat herds including kids, does, and bucks, and milking does alone.

Breed group	Herd		Milking does	
	Total	Percentage	Total	Percentage
Saanen (S)	11,170	85.6	6,893	88.5
Toggenburg (T)	322	2.4	163	2.1
T x S	1,170	9.0	590	7.6
S x T	145	1.1	105	1.4
S x N	161	1.2		
Other[1]	91	0.7	37[2]	0.5[2]
Total	13,055	100.0	7,788	100.0

[1]Other includes: Alpine (A), Nubian (N), Boer (B), A x S, N x T and S x B.
[2]Only Alpine were present.

At the request of the Dairy Goat Cooperative Ltd., all items of expenditure and revenue, and return on investment were expressed as a percentage of the total for each farm.

RESULTS AND DISCUSSION

General farm characteristics

Out of the total farms considered in this survey 12 maintained their does indoors and one

maintained their does outdoors. Indoor production is characterised by harvesting forage and crops, and transporting and offering the feed to goats held indoors. Additional supplementation with concentrates may be offered. In contrast, outdoor production is the classical grazing animal system. Some supplementation with feed concentrates may occur. Indoor farms had about 66% of the total farm area dedicated to goats with the remaining 34% being dedicated to other activities, such as beef and sheep production, forestry or conservation. All farms had milking sheds, refrigeration for milk storage, tractors, pasture harvesting and other equipment, and transport for family and goods to the farm. Milk was collected by the DGC.

Breed groups

Herds consisted of a composite breed pool with 11 breed groups identified (Table 2). The basis of dairy goat production in Waikato utilises purebred Saanen or Saanen by Toggenburg crosses which accounted for 97.5% of milking does. No does from Boer and Nubia were found. Purebred Boers were bucks which were crossed with Saanen does to produce kids for meat production at 5 to 6 weeks of age with an average carcass weight of 8 kg.

Herd structure

The average dairy goat herd structure present in the 2009-10 production year is shown in Table 3. The value of 20.2% and 24.5% is an indicator of the replacement rate in the whole herd and in the milking does, respectively. The number of breeding does and bucks indicate an average mating ratio of 22 does per buck (1:22). This is lower than values reported by Mellado *et al.* (1996) (1:75), Lindsay and Skerritt (2003) (1:50), Bett *et al.* (2007) (1:50) and Bett *et al.* (2011) (1:25), and higher than values reported by Lindsay and Skerritt (2003) (1:20 and 1:15) and Dzakuma (2010) (1:20) for some dairy goat systems overseas. Examples of ram: ewe ratios used in sheep under New Zealand and Australian grazing conditions are 1:40 (Howe, 1987), 1:50 and 1:100 (Davis *et al.,* 1990), and 1:50, 1:81 and 1:100 (Kilgour, 1993). Artificial insemination of does is still not a widespread practice in the New Zealand dairy goat industry, but its use is increasing (Morris *et al.*, 2006; C.G. Prosser, Personal communication). The age structure of the herds showed a typical production animal distribution with the biggest number of rearing kids and pregnant does for replacement during the first year and the lowest in the last years of productive life of does (Table 3). The average number of milking does or mixed animals (does, bucks, and kids) per hectare was 12.4 (range = 8.0 to 16.0) and 20.6 (range = 13.7 to 31.7), respectively. The average number of does per herd reported in Northland (Morris *et al*., 1997; 2006) and in Waikato farms (J. Solis-Ramirez, Unpublished data) grew from 180 in 1991 to 648 milking does per herd in 2010 suggesting that the average dairy goat herd size is increasing in New Zealand.

TABLE 3: Herd structure by age category within the surveyed dairy goat farms.

Age category	Total	Mean	Minimum	Maximum	Percentage of herd	Percentage of milking does
Under 12 months						
0-7 Kids (Both sexes)	2,635	220	100	600	20.2	
7-12 Does[a]	2,191	183	21	378	16.8	
Subtotal juvenile	4,826	201	200	978	37.0	
Milking does (years)						
1-2	1,902	159	73	300	14.5	24.5
2-3	1,686	141	74	300	12.9	21.7
3-4	1,406	117	69	250	10.8	18.1
4-5	1,153	96	40	225	8.8	14.8
5-6	640	64	10	108	4.9	8.2
6-7	354	35	3	108	2.7	4.6
7-8	209	23	6	72	1.6	2.7
8-9	161	18	4	71	1.2	2.1
9-10	142	18	1	69	1.1	1.8
>10	123	21	7	68	0.9	1.6
Subtotal does	7,776	648	383	1075	59.6	100.0
Bucks	453	38	12	92	3.5	
Subtotal bucks	453	38	12	92	3.5	
Total	13,055	1,088	596	1679	100.0	100.0

[a]Pregnant replacement does.

TABLE 4: Culling and deaths of milking does within the surveyed dairy goat herds.

Reason	Mean	Minimum	Maximum	Percentage
Culling				
Poor fertility	23.3	1	69	12.3
Mastitis	11.1	1	32	6.2
Leg problems	11.1	1	71	6.2
Low production	62.5	7	157	34.9
Other reasons	33.9	6	80	18.4
Subtotal culling	141.9			77.0
Deaths	42.3	4	191	23.0
Subtotal deaths	42.3	4	191	23.0
Total	184.2			100.0

Deaths and culling age

The number of deaths and culling of milking does are presented in Table 4. About 40% of culling of milking does was directly related with production performance, while other health problems and deaths accounted for 41%. The remainder of culling in the herd was due to fertility and lameness problems.

The indoor production system restrains parasites to very low levels due to better control of animal health. One farm had nine bucks culled because of parasites, but these animals were run on grass during the non-breeding season. Other reasons for culling and deaths mentioned by farmers, with an unknown specific frequency, were pneumonia, high somatic cell count, listeriosis, pregnancy toxaemia, intoxications with fungi, blood poison, Johne's disease, kidding problems, ketosis, eczema, injuries and caprine arthritis encephalitis.

Milk and milk-solids production

The mean daily values per doe and per hectare of milk yield, milk solids, fat, protein, lactose and minerals are presented in Table 5. These values assist in understanding the level of production efficiency compared with other animal production systems. The mean of milk yield and milk solids per doe and per hectare were similar to average production levels for milking does under indoor

TABLE 5: Daily milk and milk-solids production, percentage values for cost of production, revenues and return on investment per milking doe and per hectare of dairy goat farms in New Zealand.

Parameter	Per milking doe				Per hectare			
	Mean	Minimum	Maximum	Standard deviation	Mean	Minimum	Maximum	Standard deviation
Milk production (kg)								
Daily milk production	2.78	2.10	4.10	0.63	34.00	120.10	61.22	12.44
Milksolids	0.33	0.24	0.46	0.08	4.10	2.33	7.35	1.56
Fat	0.10	0.07	0.14	0.02	1.27	0.70	2.36	0.53
Protein	0.09	0.06	0.12	0.02	1.07	0.62	1.92	0.40
Lactose	0.12	0.09	0.17	0.03	1.50	0.86	2.66	0.55
Minerals	0.02	0.01	0.05	0.01	0.23	0.12	0.53	0.12
Expenses (%)[1]								
Family labou	14.8	4.4	34.7		14.2	5.4	32.4	
Dairy wages	20.1	9.1	38.5		20.4	7.3	43.2	
Concentrates and minerals	21.1	8.9	45.0		22.1	7.3	63.0	
Fertilizer and bedding	8.2	1.9	15.5		7.9	1.5	14.0	
Other farm expenses[2]	21.8	6.7	44.6		21.3	6.7	45.8	
Overheads	14.0	9.1	23.5		14.1	6.5	30.8	
Total	100	53.0	138.5		100	42.5	160.0	
Revenue (%)[1]								
Milksolids	99.9	72.5	141.6		99.9	57.2	180.3	
Cull does	0.098	0.003	0.130		0.080	0.005	0.016	
Cull bucks	0.006	0.002	0.010		0.005	0.003	0.007	
Total	100	72.6	141.7		100	57.3	180.3	
Return on investment (%)	10.2				10.7			

[1]Minimum and maximum values for expenses and revenues are expressed as percentage value of the mean.
[2]Full list of expenses given in Table 1.

conditions from other countries (Torres-Vazquez *et al*., 2009; Donkin & Boyazoglu, 2010), but higher than the previous values reported by Morris *et al*. (2006) from a New Zealand herd.

Data provided by DGC showed an average concentration of 0.118 kg milksolids per day per milking doe per kilogram of milk, and 3.7%, 3.2%, 4.4% and 0.7% for fat, protein, lactose and minerals, respectively. Fat content in goat milk in this study of 3.7%, was very similar to that reported by other authors (Andonov *et al*., 2007: Torres-Vazquez, 2009; Donkin & Boyazoglu, 2010; Reynolds, 2010), but the content of protein in this study of 3.2%, was slightly higher than other authors in different countries (Andonov *et al*., 2007: Torres-Vazquez, 2009; Donkin & Boyazoglu, 2010) and also higher than a previous study in New Zealand (Morris *et al*., 2006). The variation in milk yield and milksolid figures suggests there is a scope for genetic improvement.

Farm expenses and overheads

Percentage values for farm expenses and overheads are presented per doe and per hectare in Table 5. In general the mean values per milking doe and per hectare were similar. The range was greater on a per hectare than on a per doe basis, except for family labour and fertiliser and bedding. The major expense is labour, the combined values of family labour and dairy wages. This was 34.8% of the total cost, while concentrates and mineral supplements were 21.6%. Other expenses related to pasture renovation and management were 21.5% and overheads accounted for 14.0%. Family wages were higher on a per doe than on a per hectare basis, whereas expenses for concentrates and minerals were higher on a per hectare than a per doe basis. This indicates that increasing the stocking rate will decrease the cost of production, but cost of concentrates and minerals will increase. These results show the important role of family labour and the small amount spent on supplementary concentrate feedstuffs in the indoor production system, where cropping and transporting the forages to the goats assist in increasing feed production costs. However the advantage of the New Zealand production system is the good climatic conditions for forage production which reduces the production cost.

No comparable literature for dairy goat or sheep farming obtained under similar circumstances to this work was found. However, Bett *et al.* (2011) recently published an estimate of lower production costs for smallholder production systems in Kenya with higher costs for veterinary services, labour and selection. In a comparisons with dairy cattle farming costs (DairyBase, 2007; DairyNZ, 2009; 2010) the average area in dairy cattle farms is two and a half times greater than the area of dairy goat farms. Dairy goat farms expenses on a per hectare basis were around 50% higher; with twice the useage of supplementary concentrate, similar fertilizer useage, double the labour costs and 1.7 times higher animal health costs than on the average dairy cattle farm.

Farm revenue

Dairy goat farm revenue is dependent on milk-solids production due to the low price for goat meat. Milk-solids revenue was more than 99% of the total revenue, while culled does and culled bucks accounted for less than 1% (Table 5). Only one out of 13 farms were involved with goat meat production and one farm sold a small number of breeding animals. The sales were not accounted for, as the purpose of this survey was to focus only on milk production traits.

Return on investment

Considering the capital value invested per milking doe and per hectare, the ROI was 10.2% per doe and 10.7% per hectare (Table 5). In general, these values are lower than the lowest value of 11.3% reported for dairy cattle (DairyBase, 2007; DairyNZ, 2009), except for the survey in 2008-09 where the value was negative due to a decrease in livestock and dairy company share value (DairyNZ, 2010).

CONCLUSIONS

Dairy goats in the group of farmers surveyed in the Waikato region of New Zealand were predominantly maintained under indoor conditions with production focussed on powder milk production for export. This survey showed that the size of New Zealand dairy goat herds has increased in the last two decades with a high dependence on Saanen breed with dairy goat farmers obtaining an acceptable return on their investment. The information collected in this survey will be used to prepare a farm model which will enable the calculation of economic values for traits contributing to farm revenue and costs. The economic values to be calculated will be used in the construction of a dairy goat selection index.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. Colin Prosser and Dr. Vicki McLean as well as the Dairy Goat Cooperative (NZ) Ltd. for providing technical information and encouragement to undertake this task.

REFERENCES

Andonov, S.; Odegard, J.; Boman, I.A.; Svendsen, M.; Holme, I.J.; Adnoy, T.; Vukovic, V.; Klemetsdal, G. 2007: Validation of test-day models for genetic evaluation of dairy goats in Norway. *Journal of Dairy Science* **90**: 4863-4871.

Bett, R.C.; Kosgey, I.S.; Bebe, B.O.; Kahi, A.K. 2007: Breeding goals for the Kenya Dual Purpose goat. II. Estimation of economic values for production and functional traits. *Tropical Animal Health and Production* **39**: 467-475.

Bett, R.C.; Kosgey, I.S.; Kahi, A.K.; Peters, K.J. 2011. Definition of breeding objectives and optimum crossbreeding levels for goats in the smallholder production systems. *Small Ruminant Research* **96**: 16-24.

DairyBase, 2007: DairyBase Economic survey 2005-06. DairyBase, Hamilton, New Zealand.

DairyNZ, 2009: DairyNZ economic survey 2007-08. DairyNZ, Hamilton, New Zealand. 56 pp.

DairyNZ, 2010: DairyNZ economic survey 2008-09. DairyNZ, Hamilton, New Zealand. 56 pp.

Donkin, E.F.; Boyazoglu. P.A. 2010: Milk production from goats for households and small-scale farmers in South Africa. In: http://www.ais.up.ac.za/vet/goat/documents/donkin1.pdf [Accessed 19 October 2010].

Dzakuma, J.M. 2010: Goats: Breeding and genetics. *In*: http://www.informaworld.com/smpp/content~db=all~content=a929869218 [Accessed 2 January 2011].

FAO, 2010: FAO Statistical databases and data-sets. *In*: http://faostat.fao.org/site/573/default.aspx#ancor [Accessed 5 October 2010].

Davis, G.H.; Knight, T.W.; Sorenson, E.; Shackell, G.H.; Holmes, M.R.; Farquhar, P.A. 1990: Mating performance in Texel rams. *Proceedings of the New Zealand Society of Animal Production* **50**: 453-454.

Horngren, C.T.; Foster, G.; Srikant, M.D. 1997: Cost accounting a managerial emphasis. Prentice Hall. Ninth edition. New Jersey, U.S.A. 1011 pp.

Howe, P.A. 1987: Practical buck management. *In*: Proceedings from Goat Seminar. Publication Number 115. Foundation for Continuing Education of the New Zealand Veterinary Association, Massey University, New Zealand. p. 53-55.

Kilgour, R.J. 1993: The relationship between ram breeding capacity and flock fertility. *Theriogenology* **40**: 277-285.

Lindsay, D.; Skerritt, J. 2003: Improved breeding in dairy goats and milking sheep. Rural Industries Research and Development Corporation, Barton, ACT, Australia. Publication Number 02/150. 71 pp.

Mellado, M.; Cantu, L.; Suarez, J.E. 1996: Effects of body condition, length of breeding period, buck:doe ratio, and month of breeding on kidding rates in goats under extensive conditions in arid zones of Mexico. *Small Ruminant Research* **23**: 29-35.

Morris, C.A.; Wheeler, M.; Lanuzel, M. 2006: Genetic trend and parameter estimates for milk yield traits and kidding date in a Saanen goat herd in New Zealand. *New Zealand Journal of Agricultural Research* **49**: 175-181.

Morris, C.A.; Wheeler, M.; Hosking, B.C.; Watson, T.G.; Hurford, A.P.; Foote, B.J.; Foote, J.F. 1997: Genetic parameters for milk yield and faecal nematode egg count in Saanen does. *New Zealand Journal of Agricultural Research* **40**: 523-528.

Orr, M. 2010: Farming dairy goats: an introduction. *In*: http://www.lifestyleblock.co.nz/goats/dairygoats/article/846-farming-dairy-goats-introduction.html. [Accessed 5 October, 2010].

Reynolds, M. 2010: Saanens. The great goats. *In*: http://www.dairygoatjournal.com/issues/87/87-1/saanens_the_great_white_goats.html [Accessed 19 October, 2010].

Shepperd, R.L.; O'Donnell, D.K. 1979: A review of the New Zealand goat industry. Agricultural Economics Research Unit, Lincoln College, New Zealand. Discussion paper No. 42. 51 pp.

Singireddy, S.R.; Lopez-Villalobos, N.; Garrick, D.J. 1997: Across-breed genetic evaluation of New Zealand dairy goats. *Proceedings of the New Zealand Society of Animal Production* **57**: 43-45.

Torres-Vázquez, J.A.; Valencia-Posadas, M.; Castillo-Juárez, H.; Montaldo, H.H. 2009: Genetic and phenotypic parameters of milk yield, milk composition and age at first kidding in Saanen goats from Mexico. *Livestock Science* **126**: 147–153.