Impact of an AI Heifer Calf Rearing Scheme on Dairy Stock Development in the Western Province of Sri Lanka

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ABSTRACT : This study evaluated the impact of an AI heifer calf rearing scheme on dairy stock development, in a coconut grazing and a peri-urban smallholder dairy production system in the Western Province of Sri Lanka. The heifer rearing scheme included free advice on calf rearing, drugs, acaricides, minerals and subsidised concentrates for 30 months. The farmers in the coconut growing area integrate dairying with their plantation, they sell their milk to the main processors. The peri-urban farmers are intensive milk producers, who sell their milk at informal markets. To estimate the effect of the heifer rearing scheme on dairy replacement stock development, scheme farmers were compared with farmers who did not participate in the scheme. Calf mortality was twice as high in non-scheme farms (23-28%) as in scheme farms (12-14%). The scheme had a positive effect on weight development and scheme heifers calved 4.5 months earlier than non-scheme heifers. The calf rearing package is cost effective in both farming systems, however, the required cash inputs are a major constraint. The costs per in-calf heifer under the scheme are much lower than the production of such animals by either multiplication in state farms or importing them. The coconut grazing system showed the highest potential for producing surplus dairy stock. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 17, No. 1 : 18-26)***

Key Words : Impact, Calf Rearing, Smallholders, Sri Lanka

INTRODUCTION

In developing countries smallholder dairy development is seen as an important livestock development strategy to meet the increasing domestic milk demand. Dairying also functions as a source of income to resource-poor farming households. In Asia, Sri Lanka is an example of a country that is rapidly increasing its dairy cattle population. In 1999, about 40% of the cattle herd consisted of upgraded or dairy type animals, whereas this was only 3% in the early eighties (Ibrahim et al., 1999). Sri Lanka imports about 70% of its requirements for the formal milk market. The informal market, 25% of total milk available, consists of a large number of small operators producing milk products or selling milk directly to the consumers (Ibrahim et al., 1999). About 400,000 smallholder farmers have been estimated to depend on milk as an income source. Smallholder milk production is characterised by low milk prices, high input costs, and shortage of dairy stock. This shortage of dairy type animals is a common problem in dairy development in developing countries (De Jong, 1996; Bebe et al., 2003).

In the past, Sri Lanka addressed the problem of shortage of dairy stock by multiplication of breeding stock at state farms and importation of foundation stock in the form of young or in-calf dairy heifers. The estimated annual output of 1,000 animals from the state farms is insufficient to meet the demand for dairy stock. Imported stock are costly and the prices are of the order of US$ 1,000 (transport cost per donated animal) to 2,000 (for purchase and transport from within the Asian region). Also the animals from temperate regions performed rather poorly. They generally experience problems with climate, poor feed status, disease incidence and low standards of management practices (Nell, 1986; De Jong, 1996).

An alternative strategy for dairy development is the use of semen from exotic dairy bulls for crossbreeding purposes. In Sri Lanka, each year about 25,000 female crossbred calves are born by artificial insemination. There is a high mortality among these calves (20-25%) and they take a long time to reach maturity (DAPH, 1997). To increase dairy stock production at smallholder level, the Ministry of Livestock Development initiated an AI heifer calf rearing scheme in 1993. The objectives of the scheme are to reduce the calf mortality rate and age at first calving of the heifers. During the first phase, the calf rearing scheme (1993-1996) included nearly 14,000 crossbred calves, of which 4,000 were from the Western Province. Support to scheme farmers consisted of a limited supply of calf starter and dairy meal at 50% subsidised rate, and mineral mixture, drugs and acaricides free of charge for a period of 30 months. This paper analyses the impact of the AI heifer calf rearing scheme on dairy replacement stock development, the motivation of the farmers in calf rearing and the costs and benefits, in a coconut grazing and a peri-urban smallholder dairy system in the Western Province of Sri Lanka.

MATERIALS AND METHODS

Study area

Sri Lanka is located between 6-10°N and 80-82°E. The

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Received April 11, 2003; Accepted September 4, 2003

annual rainfall varies from 875-1,875 mm in the dry zone to 2,500-5,000 mm in the wet zone. This study was done in the Western Province, in the wet lowland agro-ecological zone. The main monsoon season is from May to July. The province carries about 8% of the national cattle population. The majority of these animals can be found in the coconut growing area. In this farming system, cattle graze grasses and weeds in coconut plantations and along roadsides. In the wet season, they are fed with cut and carried forage from paddy field bunds and live fences. During the dry season crop residues (mainly paddy straw), tree fodder loppings and paddy stubble are available for cattle. Cattle provide milk, meat, nutrients for the coconut grazings, and they help to control weeds in the plantations. Milk is mainly marketed to the main processors. In general, the dairy farmers in this area get a relatively low price for their milk. Dairy type animals are also kept near the urban areas for supplying the urban markets. In this peri-urban system the main purpose of keeping cattle is for milk production. This system is labour intensive and high input-oriented. Cattle are mainly fed with concentrates and grasses from roadsides and wastelands. The milk produced is either sold on the spot or is sold on the doorstep, or to hotels and restaurants. The farmers get a comparatively higher price for their milk than in the coconut grazing area. Depending on the local market situation, milk may be processed into curd and yoghurt.

Data collection

This study was done in eight randomly selected veterinary office areas representing the coconut grazing and the peri-urban dairy production systems. The farms were categorised as:

- scheme farmers: farms that were participating in the heifer rearing scheme
- non-scheme farms: farms that had never participated in the heifer rearing scheme
- former scheme farms: farms that had heifers registered in the scheme once in 1993 and not thereafter.

From the lists of farms of each veterinary office, the scheme, non-scheme and former scheme farms were drawn where a female calf birth had been reported in the first parity within the period of January to June 1999. From the pooled lists, 25 farms for the scheme and non-scheme groups from both the coconut grazing and the peri-urban system were randomly selected. There were 10 and 8 farms with over 3 years of scheme experience from the coconut grazing and the peri-urban system, respectively. In addition, 13 and 12 former scheme farms were available from the coconut grazing and the peri-urban system, respectively. Of the 100 selected scheme and non-scheme farms, five had been either moved or closed by the time of the visit. Each farm selected was visited once during the period July to September 1999.

Data were collected via a structured questionnaire on farm demographics, mortalities, costs and returns of heifer rearing, stock production and farmer motivation. Body weight and calving age data for the scheme heifers were obtained from the calf rearing scheme records. For the non-scheme heifers, body weights were estimated by taking the individual girth measurements and the calving ages were drawn from the calving registers. The animals were classified as Jersey crosses, Australian Milking Zebu (AMZ) crosses, Friesian crosses and Sahiwal crosses on the basis of the type of semen used to inseminate the dam. To estimate the effect of the calf rearing scheme on dairy replacement stock production, the number of young female stock per cow present in the scheme farms with over 3 years of experience and the non-scheme farms were compared. Data on farmer motivation were gathered from the former scheme and non-scheme farms. The effect of the calf rearing scheme to motivate the farmers in adopting the calf rearing practices was assessed on the basis of the frequencies of deworming and deticking, the level of mineral mixtures fed, and the cost of feeding concentrates by the former scheme and the non-scheme farmers. Any increase in the frequencies of deworming and deticking, levels of minerals fed and the feeding of concentrates in former scheme farms was considered to be due to the fact that the farmers had been motivated to do so, during the time they were in the scheme.

The costs and benefits of calf rearing were considered to be the total costs and benefits up to the calving age of non-scheme heifers. Total rearing costs for the scheme and the non-scheme heifers were calculated as:

[costs of milk feeding+costs of deticking, deworming+ costs of drugs, veterinary services+costs of minerals and concentrates+costs of forages]

Although some inputs under the scheme were given free of charge or at 50% cost recovery basis, real costs were used for the calculations. The amounts of milk fed to the calves were estimated by using the conversion factor of 10 kg of milk for each kg of body weight gain up to weaning. The costs of veterinary care and the concentrates and mineral feeding costs were assessed as spent by the farmers. The costs incurred in deworming and deticking up to the calving age of heifers were included in the costs of health management. The costs of forages were based on the total amounts fed by the farmers up to calving by the heifers.

Heifers raised under the scheme were expected to calve at an earlier age than non-scheme heifers. So, the scheme heifers had additional returns in terms of extra milk yield, calf growth, value of the young cow and for its milk production capacity, and the value of the reproductive stage of the cow for the advanced calving period. The advanced

calving period was the difference between the calving age of the heifer under the scheme concerned in a specific system and of a specific crossbred type and the average calving age of a non-scheme heifer of the same crossbred type.

For non-scheme farms the cost of inputs were the heifer rearing costs up to calving. For scheme farms, the extra inputs required for maintaining the young cow and the calf up to the calving age of non-scheme heifers were taken as the costs of inputs. Costs of inputs for the young cow were the real input costs incurred to maintain the young cow during the advanced calving period. For the costs of inputs for calf growth it was assumed that the same input package as in the scheme was used for the young calves. Input costs for calf growth were the costs of total rearing inputs assumed to be given under the scheme during the advanced calving period.

The returns of rearing a non-scheme heifer up to calving were estimated as: [basic value of the pregnant heifer+value of the reproductive stage]. The returns of rearing heifers under the scheme were estimated as: [value of the milking cow+value of the reproductive stage+value of the extra milk yield+value of the calf growth]. The basic value of the pregnant heifer was according to prevailing market values (mentioned below). The value of a milking cow was calculated as: [basic value for the milking cow+value for the average milk production per day], both according to market values. The value for the reproductive stage depends on the reproductive stage in the advanced calving period. The value of additional milk yield was calculated as: [advanced calving period (d)×av. milk sold (kg d^{-1}) from the young cow×av. milk price (Rs. kg^{-1})]. For the value of the calf growth it was assumed that calves of the young cows under the scheme were treated the same as their mothers. Also they were assumed to show the same body weight development as their mothers did under the scheme. The value of calf growth was estimated as: [(birth weight (kg)+(advanced calving period (d)×average weight gain observed for the same breed under the scheme (kg d^{-1})))× Rs. 35]. Birth weights for Jersey, AMZ, Friesian and Sahiwal crosses were estimated to be 25, 23, 28 and 20 kg respectively.

The prevailing market values were:

-basic value for pregnant heifer calving before 3 years=Rs. 9,000

-basic value for pregnant heifer calving later than 3 years=Rs. 8,000

-value for the reproductive stage of the cow:

insemination or service=Rs. 1,000

insemination or service 3 months ago with non-

Table 1. Frequency distribution (%) of management characteristics of 95 scheme and non-scheme farms in the coconut grazing and the peri-urban systems

	Coconut grazing system		Peri-urban system	
	Scheme	Non-scheme	Scheme	Non-scheme
Total number of farmers (n)	23	25	24	23
Farm type				
Dairy activities only	57	52	46	39
Other livestock kept	43	48	54	61
Buffaloes	9	4	33	26
Goats	17	28	29	22
Pigs	4	4	13	13
Chickens	35	24	13	13
Farmer type				
Full-time dairying	9	0	33	43
Part- time dairying	91	100	67	57
Milk marketing				
Main processors	91	80	8	9
Middle man	9	20	13	26
Informal markets	0	0	79	65
Cattle breeding practice				
AI only	65	16	29	13
Combination of AI and studs	35	84	71	87
Feeding system				
Grazing only	52	68	83	87
Grazing+stall feeding	48	32	17	13
Calf housing				
Not available	30	28	37	35
Cemented floor and roof	48	24	17	17
Cemented floor with no roof	0	0	25	22
Earthen floor with roof	22	48	21	26

Table 2. Farm and herd characteristics, means and standard deviations (sd) of 95 scheme and non-scheme farms in the coconut grazing and the peri-urban systems

	Coconut grazing system				Peri-urban system			
	Scheme		Non-scheme		Scheme		Non-scheme	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Farm size (ha)	0.6	0.3	0.7	0.4	0.1	0.1	0.2	0.1
ALU[1] cattle	3.8	1.1	4.1	1.1	6.6	1.2	6.5	1.1
Number of								
Cattle	5.3	1.6	5.7	1.6	8.3	1.4	8.5	1.6
Cows	2.5	0.6	2.8	0.8	4.4	0.8	4.4	0.7
Buffaloes	0.1	0.5	0.1	0.4	1.9	3.1	1.2	2.3
Goats	0.5	1.1	1.0	1.8	0.9	1.6	1.1	2.3
Pigs	0.1	0.6	0.1	0.4	0.8	1.9	0.7	2.0
Chickens	5.2	7.5	4.5	7.8	2.1	5.3	1.4	3.7
Weaning age (months)	5.7	1.0	5.9	1.3	3.3	1.0	3.2	1.1
Peak milk production in 1st lactation (l)	4.2	0.6	4.0	0.6	5.8	0.8	5.9	0.7
Concentrates fed at peak production (kg)	0.8	0.7	0.6	0.6	2.0	0.5	2.1	0.5
Farm gate price per kg of milk (Rs)[2]	10.7	0.8	10.6	1.0	19.9	4.2	18.9	3.6

[1] ALU: adult livestock units. [2] 1 US$=70 Rs

repeated oestrus=Rs. 2,000
insemination or service 3-6 months ago with confirmed pregnancy=Rs. 3,000
insemination or service more than 6 months ago with confirmed pregnancy=Rs. 4,000

- value of milk production: average 1 kg of milk production d-1=Rs. 1,000
- value of calf growth: 1 kg of live weight=Rs. 35

1 US$=70 Rs.

Data analyses

Least squares methods were used to explain the variation in calving age, number of young female stock per cow, intensity of calf rearing inputs used, and rearing costs and benefits. The chi-square test was used to test differences in calf mortality. In the analyses, two main factors were used: the effect of farming system (the coconut grazing area or the peri-urban system) and the effect of the rearing scheme. In the analyses of age at first calving, and the different costs and benefits, the rearing scheme effect considered calves reared under the scheme and calves reared outside the scheme. In the analysis of dairy replacement stock production, the rearing scheme effect represented scheme farmers with more than 3 years of experience and non-scheme farmers. In the analysis of farmer motivation the rearing scheme effect considered former scheme farmers and non-scheme farmers.

The analyses of body weight at 24 months and age at first calving were done by a two-way ANOVA, including the effects of farming system and rearing scheme. Preliminary analyses, however, had shown that breed also has a significant effect on age at first calving, so analyses were done separately for the different breeds. The analyses of the various costs (milk fed, concentrates and minerals, veterinary services, drugs, total costs of rearing, and total costs including maintenance of scheme cows and their calves), and the total returns were done by one-way ANOVA, separately for the two farming systems.

The analyses of the effect of the rearing scheme on dairy replacement stock production and farmers' motivation was done by one-way ANOVA, separately for the farming systems. In the analysis of dairy stock production the rearing scheme effect represented scheme farmers with more than 3 years of experience and non-scheme farmers. In the analysis of farmer motivation the rearing scheme effect considered former scheme farmers and non-scheme farmers.

RESULTS

Table 1 and 2 give information on management, farm size and herd characteristics. The coconut grazing system differs considerably from the peri-urban system. In the coconut grazing system slightly over half of the farmers (52-57%) kept only dairy cattle, whereas in the peri-urban system this was 46-39% (Table 1). About 30% of the farmers in the peri-urban system kept buffaloes as well. A considerable proportion of the farmers in the peri-urban system (33-43%) made their living from full-time dairy farming. They sold their milk at informal markets. Almost all farmers in the coconut grazing system were part-time dairy farmers, who sold their milk to the main processors. The majority (65%) of the scheme farmers in the coconut grazing system used only AI, whereas the majority of the non-scheme farmers in the coconut grazing system (84%) and of all farmers in the peri-urban system (71-87%) used a combination of AI and natural mating. The general feeding practice in the two farming systems was grazing on natural pastures. The majority of the farmers in the peri-urban system (about 85%) and in the coconut grazing system (52-

Table 3. Least squares means (LS means) and standard errors (SE) for body weight at 24 months (kg) of scheme and non-scheme Jersey, AMZ, Friesian and Sahiwal crossbreed heifers reared in the coconut grazing and the peri-urban systems

	Scheme			Non-scheme		
	n	LS means[1]	SE	n	LS means	SE
Overall	47	255[a]	4.3	44	227[b]	3.2
Coconut grazing system	23	273[a]	5.7	22	233[b]	4.2
Peri-urban system	24	238[a]	4.3	22	221[b]	4.8
Coconut grazing system						
Jersey	5	294[a]	3.6	5	241[b]	3.3
AMZ	6	295[a]	5.4	6	236[b]	3.2
Friesian	7	272[a]	3.4	6	249[b]	3.9
Sahiwal	5	229[a]	3.0	5	202[b]	3.4
Peri-urban system						
Jersey	7	248[a]	4.1	7	220[b]	6.1
AMZ	6	241[a]	5.5	5	219[b]	8.1
Friesian	6	251[a]	3.1	6	244[a]	4.0
Sahiwal	5	204[a]	6.4	4	191[a]	6.3

[1] LS means with different superscripts between columns are significantly different ($p<0.05$).

Table 4. Least squares means (LS means) and standard errors (SE) for age at first calving (d) of scheme and non-scheme Jersey, AMZ, Friesian and Sahiwal crossbreed heifers reared in the coconut grazing and the peri-urban systems

	Scheme			Non-scheme		
	n	LS means[1]	SE	n	LS means	SE
Overall	47	970[a]	14.2	48	1,108[b]	13.3
Coconut grazing system	23	933[a]	20.1	25	1,080[b]	16.6
Peri-urban system	24	1,005[a]	17.6	23	1,138[b]	19.6
Coconut grazing system						
Jersey	5	847[a]	15.3	6	995[b]	14.4
AMZ	6	845[a]	27.8	6	1,021[b]	15.4
Friesian	7	1,009[a]	18.2	7	1,116[b]	16.4
Sahiwal	5	1,018[a]	12.1	6	1,181[b]	14.9
Peri-urban system						
Jersey	7	946[a]	30.3	6	1,059[b]	20.7
AMZ	6	947[a]	20.9	5	1,069[b]	17.6
Friesian	6	1,053[a]	17.9	6	1,145[b]	13.8
Sahiwal	5	1,099[a]	18.7	6	1,270[b]	10.8

[1] LS means with different superscripts between columns are significantly different ($p<0.05$).

68%) did not apply any stall feeding. Housing was provided to the majority of all calves (63-72%) in both systems. In the coconut grazing area all calf houses had a roof, whereas in the peri-urban system only 60-66% of the calf houses had a roof. Table 2 shows that peri-urban farmers kept comparatively larger herds (6.5 adult livestock units (ALU)) with more cows (4.4) than coconut grazing farmers (3.9 ALU with 2.7 cows). Farmers in the peri-urban system also kept more buffaloes (1.2-1.9) than in the coconut grazing system (0.1). They used relatively high levels of concentrates to feed the cows. Milk produced at peak production was 5.9 kg for cows in the peri-urban system and 4.1 kg for cows in the coconut grazing system. Farm gate price per kg of milk, was almost twice as high in the peri-urban system (19.5 Rs) as in the coconut grazing system (10.6 Rs). Calves were weaned almost twice as early in the peri-urban system (3.2 months) than in the coconut grazing system (5.8 months).

Table 3 provides the body weights at 24 months of age for scheme and non-scheme heifers. Scheme heifers were, on average, 28 kg heavier than non-scheme heifers. The differences in body weight between scheme and non-scheme heifers were significant for all breeds in the coconut grazing system and for the Jersey and AMZ crossbred heifers in the peri-urban system. Jersey and AMZ scheme crossbred heifers in the coconut grazing system were about 56 kg heavier than non-scheme heifers of the same breed type. Jersey and AMZ scheme crossbred heifers in the peri-urban system and Friesian and Sahiwal scheme crossbred heifers in the coconut grazing system were about 25 kg heavier than non-scheme heifers of the same breed type in the same system. Overall, the Sahiwals were the lightest animals (191-229 kg). At scheme farms of the coconut grazing system the Jersey and AMZ crossbred heifers were the heaviest animals (295 kg). At non-scheme farms of the coconut grazing system and at all farms of the peri-urban system the Friesian crossbred heifers were the heaviest animals (244-251 kg).

Table 5. Least squares means (LS means) and standard errors (SE) for young female stock present per cow of farms with over 3 years of scheme experience and non-scheme farms in the coconut grazing and the peri-urban systems

	Farms with over 3 years of scheme experience			Non-scheme farms		
	n	LS means[1]	SE	n	LS means	SE
Coconut grazing system	10	0.9[a]	0.1	25	0.6[b]	0.04
Peri-urban system	8	0.6[a]	0.03	23	0.5[a]	0.02

[1] LS means with different superscripts between columns are significantly different ($p<0.01$).

Table 6. Percentage of farmers using inputs and least squares means (LS means) and standard errors (SE) for inputs used and cost of concentrates feeding of 13 former scheme farms and 25 non-scheme farms in the coconut grazing system

	Former scheme			Non-scheme		
	%	LS means[1]	SE	%	LS means	SE
Deworming frequency	85	2.6[a]	0.2	80	1.5[b]	0.2
Deticking frequency	54	5.1[a]	0.4	36	3.7[a]	0.5
Minerals fed (kg)	15	2.0[a]	0	20	1.2[a]	0.3
Concentrates costs (Rs)	69	847[a]	158	52	492[b]	78

[1] LS means with different superscripts between columns are significantly different ($p<0.05$).

Table 7. Percentage of farmers using inputs and least squares means (LS means) and standard errors (SE) for inputs used and cost of concentrates feeding of 12 former scheme farms and 23 non-scheme farms in the peri-urban system

	Former scheme			Non-scheme		
	%	LS means[1]	SE	%	LS means	SE
Deworming frequency	67	1.4[a]	0.2	48	1.4[a]	0.2
Deticking frequency	42	4.8[a]	0.5	35	4.1[a]	0.5
Minerals fed (kg)	17	1.0[a]	0	4	1.5[a]	0
Concentrates costs (Rs)	100	577[a]	43	100	518[a]	29

[1] LS means with different superscripts between columns are significantly different ($p<0.05$).

Table 4 shows that scheme heifers calved, on average, 4.5 months earlier than non-scheme heifers. Heifers in the coconut grazing system calved about 2 months earlier than heifers in the peri-urban system. Jersey and AMZ crossbred heifers in the coconut grazing system calved earliest (28 months), whereas non-scheme Sahiwal crossbred heifers in the peri-urban system calved latest (42 months).

Calf mortality for the scheme farms was 12.5% and 14.2% for the coconut grazing and the peri-urban system, respectively. For the non-scheme farms calf mortality was 23.4% and 28.7% for the coconut grazing and the peri-urban system, respectively. The calf mortalities were significantly (χ^2 0.05) lower for the scheme farms than for the non-scheme farms. About 50-60% of calf deaths occurred within the first three months of age.

Table 5 shows that in the coconut grazing system, there was a significantly ($p<0.01$) higher proportion of young female stock per cow on the scheme farms with over 3 years of experience (0.9) than on the non-scheme farms (0.6). In the peri-urban system there was no difference in the proportion of young female stock per cow between scheme farms with over three years of experience (0.6) and non-scheme farms (0.5).

The percentage of former scheme and non-scheme farmers using calf rearing inputs and the intensity of use of inputs is given in Tables 6 and 7. Most non-scheme and former scheme farmers applied deworming drugs (48-85%) and fed concentrates (52-100%). About 42% of the farmers applied deticking, only few farmers (4-20%) fed minerals. The former scheme farmers in the coconut grazing system had a significantly ($p<0.05$) higher frequency of deworming and used more concentrates ($p<0.05$) than the non-scheme farmers. In the peri-urban system, the levels of calf rearing input used by the former scheme farmers were low and similar to the non-scheme farmers.

Table 8 and 9 show the amount of inputs used and the costs and returns for calf rearing in the two systems. Overall the level of inputs for farmers outside the scheme were lower than the scheme farms in both systems (Tables 8 and 9). In both the coconut grazing and the peri-urban system, the non-scheme farmers spent Rs. 6,500 per heifer (Tables 8 and 9). In the coconut grazing system the total rearing costs per heifer under the scheme amounted to Rs. 13,300, in the peri-urban system this figure was Rs. 12,500. In both farming systems the scheme and non-scheme heifer rearing costs were significantly different ($p<0.01$). The additional inputs were Rs. 6,800 and Rs. 6,000 in the coconut grazing and the peri-urban system, respectively. Farmers contributed 75% of the total input costs under the scheme. Because of the early calving, heifers reared under the scheme had additional returns of milk, calf growth, and value for reproduction stage and milk production of the cows. The returns for the scheme farms amounted to Rs. 22,600 and 27,500 in the coconut grazing and the peri-urban system, respectively, for the non-scheme farms these returns were Rs. 12,700 and Rs. 12,400 in the coconut

Table 8. Least squares means (LS means) and standard errors (SE) for inputs used and costs and returns incurred up to calving for a scheme and non-scheme heifer in the coconut grazing system

	Scheme			Non-scheme		
	n	LS means[1]	SE	n	LS means	SE
Input use						
Milk fed (kg)	23	660[a]	28	25	572[b]	22
Concentrates fed (kg)	23	646[a]	21	13	112[b]	20
Minerals fed (kg)	23	14.3[a]	0.5	5	1.2[b]	0.3
Deworming frequency	23	4.9[a]	0.2	20	1.5[b]	0.2
Deticking frequency	23	17.3[a]	0.6	9	3.7[b]	0.5
Costs (Rs)[2]						
Milk fed	23	7,007[a]	272	25	6,041[b]	234
Concentrates & minerals	23	5,693[a]	120	16	408[b]	79
Veterinary services	3	183[a]	17	5	230[a]	20
Health management	23	558[a]	12	21	101[b]	12
Total costs of rearing[3]	23	13,281[a]	333	25	6,432[b]	262
Costs of maintenance of cow	23	791	114	-	-	-
Costs of calf growth	23	730	82	-	-	-
Total costs	23	14,737[a]	387	25	6,432[b]	262
Returns (Rs)						
Value of the pregnant cow	-	-	-	25	12,666	98
Value of extra milk yield	23	5,541	426	-	-	-
Value of young milking cow	23	12,582	81	-	-	-
Value of calf growth	23	2,780	173	-	-	-
Value for reproductive stage	21	1,857	171	-	-	-
Total returns	23	22,598[a]	672	25	12,666[b]	98
Value added		7,861			6,234	

[1] LS means with different superscripts between columns are significantly different ($p<0.01$). [2] 1 US$=70 Rs.
[3] Average of individual farms excluding cost of labour.

grazing and the peri-urban system, respectively. The value added for the scheme farmers was higher in the peri-urban system (Rs. 13,100) than in the coconut grazing system (Rs. 7,900), mainly because of the high milk prices and the resulting higher value of the extra milk yield for scheme animals.

DISCUSSION

The current development focus on intensification of smallholder livestock production is centred around dairying. Prospects for maintaining and expanding smallholder dairying are hampered by scarcity of replacement stock resulting from the combined effects of low reproductive rates and low survival rates (De Jong, 1996; Bebe, 2003). Sri Lanka has initiated crossbreeding programmes to increase local milk production. An AI heifer calf rearing scheme, including free advice, drugs, acaricides, and minerals and subsidised concentrates for 30 months, was introduced to reduce the high calf mortality and late age at first calving of crossbred heifers. The heifer rearing scheme was introduced irrespective of the possibilities and constraints of the prevailing dairy production systems. In the Western province, the smallholder dairy system in the coconut growing area and the peri-urban system differ in resources and market opportunities. The peri-urban farmers are milk production-oriented: they keep more cows per farm, they also keep buffaloes, wean their calves earlier, have a higher peak milk production and are able to receive a higher milk price than coconut farmers. Peri-urban farmers are intensive milk producers on very little land, whereas farmers in the coconut grazing system are almost all part-time dairy farmers, who keep livestock to graze weeds and grass between the coconut grazing trees, hardly feed concentrates, deliver milk mainly to main processors and receive almost half the price per liter of milk compared to peri-urban farmers. Coconut grazing farmers have better calf housing facilities, wean calves late and feed them more concentrates compared to peri-urban farmers. Consequently, heifers in the coconut-based area are slightly heavier and calve on average almost two months earlier than heifers in the peri-urban system (Tables 1 and 2).

The numbers of animals in the different breed types groups were small. A general trend noticed was that Jersey and AMZ crossbred heifers calved 3-5.5 months earlier than Friesian crossbred heifers (Table 4). In both systems, Friesians were given a similar treatment as other crosses. They were comparable to Jersey and AMZ crosses in body weight (Table 3). This suggests that Jersey and AMZ crossbred heifers mature earlier than Friesian crossbred heifers to the current management practices. Sahiwal

crossbred heifers were relatively late maturing, they calved 5-7 months later than Jersey and AMZ crossbred heifers.

To estimate the effect of the heifer rearing scheme on dairy stock development, scheme farmers were compared with farmers who had never participated in the scheme. There was hardly any difference in farm size, number of cattle and production level between scheme and non-scheme farms. In both production systems, calf mortality was twice as high in non-scheme farms. The poor calf housing conditions (Table 1), along with comparatively low levels of health management adopted (Tables 8 and 9) in the peri-urban farms, can explain the higher calf mortality in the peri-urban system. The scheme had a significant positive effect on weight development and age at first calving, except for weight at 24 months of Friesian and Sahiwal crossbred heifers in the peri-urban system. Overall, heifers reared under the scheme calved 4.5 months earlier than non-scheme heifers.

In the coconut grazing system there was a significantly higher proportion of young female stock per cow on the scheme farms with over 3 years of experience than in the non-scheme farms (0.9 vs. 0.6). This shows the positive impact of the calf rearing scheme on generating surplus dairy stock on coconut grazing farms. This positive impact can be explained by the reduced calf mortality and the reduced age at first calving in coconut grazing farms. In the peri-urban system there was no real difference in proportion of young female stock per cow between scheme and non-scheme farms (0.6 vs. 0.5), despite the fact that calf mortality and age at first calving were reduced due to participation in the scheme. The peri-urban farms have very little land available and they concentrate on keeping lactating cows instead of youngstock. As a result, performances of the youngstock in the peri-urban system were lower (slow growth and late calving) than in the coconut grazing system. Peri-urban farmers were also less motivated to continue with calf rearing practices after the scheme had stopped. This was assessed by comparing the use of calf rearing practices between former scheme farmers and non-scheme farmers. In the coconut grazing system, the former scheme farmers dewormed more frequently and fed more concentrates to their calves than non-scheme farms (Table 6). In the peri-urban systems, the adoption of calf rearing practices did not differ much between former scheme farmers and non-scheme farmers (Table 7). Some peri-urban farmers own land in the coconut growing area where they keep their non-lactating animals. Also middlemen sell lactating animals to peri-urban farmers.

The AI heifer calf rearing scheme intensified the level of calf rearing in both production systems. The input costs

Table 9. Least squares means (LS means) and standard errors (SE) for inputs used and costs and returns incurred up to calving for a scheme and non-scheme heifer in the peri-urban system

	Scheme			Non –scheme		
	n	LS means[1]	SE	n	LS means	SE
Input use						
Milk fed (kg)	24	328[a]	19	23	298[a]	23.3
Concentrates fed (kg)	24	569[a]	12.1	23	66[b]	4.6
Minerals fed (kg)	24	13.9[a]	0.3	1	1.5[b]	0
Deworming frequency	24	4.7[a]	0.2	11	1.3[b]	0.2
Deticking frequency	24	15.7[a]	0.4	8	4.1[b]	0.4
Costs (Rs)[2]						
Milk fed	24	6,626[a]	534	23	5,809[a]	292
Concentrates & minerals	24	5,141[a]	94.8	23	520[b]	29.9
Forage	6	800[a]	161	2	525[a]	75
Veterinary services	3	225[a]	14.4	7	339[b]	17.9
Health management	24	518[a]	11.3	14	95[b]	12.9
Total costs of rearing[3]	24	12,514[a]	583	23	6,531[b]	608
Costs of maintenance of cow	24	1,353	169	-	-	-
Costs of calf growth	24	575	89	-	-	-
Total costs	24	14,419[a]	571	23	6,531[b]	608
Returns (Rs)						
Value of the pregnant cow	-	-	-	23	12,434	105
Value of extra milk yield	24	10,664	1,155	-	-	-
Value of young milking cow	24	13,537	109	-	-	-
Value of calf growth	24	2,158	127	-	-	-
Value for reproductive stage	16	1,625	179	-	-	-
Total returns	24	27,482[a]	1,418	23	12,434[b]	105
Value added		13,063			5,903	

[1] LS means with different superscripts between columns are significantly different ($p<0.01$). [2] 1 US$=70 Rs.

[3] Average of individual farms excluding cost of labour.

increased by 106% and 92% in the coconut grazing and the peri-urban system, respectively. Scheme-farmers contributed 75% of these costs. The extra investment made under the scheme was compensated by the value of additional benefits, even when the subsidised inputs were included in the calculations as real costs. The free issued inputs and the subsidised concentrates given under the scheme were attractive to the farmers. However, the scheme farmers did not fully use the quota of concentrates and the other free issued inputs. The full quota of concentrate feeds (817 kg) given under the scheme per heifer cost Rs. 3,500. The costs incurred by the scheme farmers varied between Rs. 2,800 in the coconut grazing system and Rs. 2,500 in the peri-urban system (Tables 8 and 9). Normally the veterinary offices did not issue the free inputs unless the farmers bought the concentrates. Also the monthly quota per heifer had to be purchased within the same month. Most farmers spent the milk receipts to purchase the inputs. When there were too many pressing needs they opted to sacrifice the investment in calf rearing against those. In this way farmers lost the concentrate feed quota as well as the other calf rearing inputs. Veterinary offices discontinued their services to those farmers who did not buy the concentrate feeds continuously for two months. It was difficult for the poorer farmers to continue with the scheme, because of the investments required. The majority of the former scheme farmers reasoned that the high continuous financial inputs forced them to quit the scheme. The farmers who continued with the scheme had both a general interest in their stock as well as the financial capacity to afford the long-term investment. So, high input-oriented calf rearing packages are not addressing the poorest farmers.

The total costs per in-calf heifer (190 US$) under the scheme is much lower than the production of such animals, either by multiplication on state farms or of those that are imported. Government support at an average rate of 60 US$ (50% concentrate cost and infrastructure) per in-calf heifer could result in the local production of 16 well-adapted dairy animals in Sri Lanka at a cost similar to importing one less suitable heifer from abroad. This is in agreement with experiences in other developing countries showing that importation of exotic stock and multiplication of breeding stock at (para)statal farms have a poor record for expanding dairy cattle populations (De Jong, 1996).

Development of dairy stock on smallholders' own farms might assist in local independence and self-sufficiency (De Jong, 1996; Ibrahim and Jayatileka, 2000). The AI calf rearing scheme in the Western province of Sri Lanka proves that smallholder farmers are receptive to applying better calf rearing practices, provided that some calf rearing incentives are available. Such incentives could result in better technical performance compared to the normal management. However, once the government ceases the support, the question remains whether the farmers have the resources to continue the calf rearing practices. An option may be to tailor the scheme according to the resources available and farmers interests in calf rearing in a particular farming system, as in this study it was found that in the coconut grazing system, the heifer calf rearing scheme was more successful in increasing replacement stock production than in the peri-urban system.

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