

Performance of dairy farming on abandoned marginal tea lands in the mid country of Sri Lanka

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ABSTRACT

In 1993, 76 farms that received an interest-free cattle loan and 19 neighbouring control farms were surveyed to evaluate technical and economic performance, land use and gainful self-employment in small-scale farms, established on abandoned marginal tea land in the mid country of Sri Lanka. Five main areas involved were: Galaha, Gampola, Nawalapitiya, Rikilligaskada (Red Cross village) and Menikhinna (Rajawelle). All control farms had obtained cattle between 1985 and 1993 through cash purchase or interest bearing loans. Project loan repayments in 36 fixed monthly reductions of the milk pay cheque, were satisfactory but could not be recovered in full from the project animal's lactations. Dairy cattle were still found on 93% of project farms and of these 77% sold milk at a rate of 4.8 l/d, while all control farms had dairy cattle with 79% selling milk at 6.8 l/d. Home milk consumption was about 0.6 l/d per project family of 5.32 persons and 0.7 l/d for a control family of 4.74 persons. Peak milk yields averaged around 7 l/d over lactations and average daily milk yield per cow in milk was 4.7 litres (project farms) and 4 litres (control farms). Overall long calving intervals of 507 days (n=75) and mortality from tick borne diseases require more technical attention. In NADSA farms, milk, vegetables and perennial crops contributed 66, 15 and 18% respectively to monthly farm gross margin (Rs. 769) and 32, 8, 9% respectively to monthly family gross margin respectively (Rs. 1,582 with 51% for off-farm cash receipts). On control farms, these contributions were 81%, 1% and 18% to farm (Rs. 747) and 46, 0, 10% to family gross margin respectively (Rs. 1,331 with 44% for off-farm receipts). On control farms, milk sales only contributed significantly to farm gross margin and off-farm cash and milk sales to family gross margin. Milk production proved attractive for farm and family gross margin, land improvement (mentioned by 64% of farmers), and livestock sales (Rs. 1,000 per year), while crops so far contributed mainly to subsistence food and some money generation (vegetables and perennials). However, farmers still depended on Government food support to balance their average monthly family cash needs of Rs. 2,000.

Key words: Dairy farming, tea land, mid country

INTRODUCTION

At the time of national independence in 1948, tea and rubber estates occupied over 400,000 hectares in Sri Lanka. A Tea Commission was appointed by the Government in 1968 to review the effects of the tea replanting programme aiming at reversing declining yield and quality of tea in the late 1950s and early 1960s. The Commission concluded that of the

existing 240,000 ha of tea land, 80,000 ha planted with high yielding clonal materials would be sufficient for home production and export demand. Diversification of 160,000 ha of marginal tea lands to other crops was recommended in the Mid Country, since in this area yields and quality of tea were on average lower than elsewhere.

UNDP/FAO technical assistance was requested by the Government in the 1970s to develop a strategy

Abbreviations: DPA- Dairy Producing Associations, IDA- International Development Association of World Bank, LDA- Livestock Development Assistant, MIDCOMUL- Mid Country Milk Producers Union, NADSA- National Agricultural Diversification and Settlement Authority, MLDC- Mid Country Livestock Development Centre, NLDB- National Livestock Development Board, RLDO- Regional Livestock Development Officer, SFDR- Small Farmer Development Project, SHDDP- Small Holder Dairy Development Project, SL- NLDP- Sri Lanka - Netherlands Livestock Development Programme, TLU- Tropical Livestock Unit.

for optimal land use of marginal tea land based on technical and economic feasibility studies of alternative crops. Thereafter, the Government formulated a diversification project for 1 hectare farmsteads for settlers with mostly perennial crops and introduction of a few dairy cows to some farmers. To implement such a project, World Bank assistance was sought for two districts, Kandy and Kegalle. A five year project with a credit of 4.5 million US dollars from the International Development Association (IDA) of World Bank became operational in 1978, to be implemented by the National Agricultural Diversification and Settlement Authority (NADSA) set up for this purpose. Delays in implementation was caused by reluctance of former estate labour to move out of the acquired estates, objections raised to the alienation policy of the Land Reform Commission by previous estate owners, and selection of qualifying settlers led to the withdrawal of IDA, but the Government continued the project with its own funds. Adaptations were introduced in the form of reduced farm allotments of 0.4 ha, grants for settlers to construct their own houses and a special development scheme providing Rs. 3,600 for farm development. To tide settlers over the period required for concentrating on development of their allotments, food aid was requested for a period of five years (FAO/WFP 1988).

The introduction of the dairy component in settler farms was rather slow in the late 1970s and early 1980s through lack of cattle and because of high cost of dairy farm loans. Therefore, the Sri Lanka-Netherlands Livestock Development Programme (SL-NLDP) was requested in 1984 by the National Livestock Development Board (NLDB) to fund a pilot dairy project for 30 resource-poor settler families in the Galaha area of NADSA. SL-NLDP would finance the supply of one in-calf dairy heifer per settler from the calf salvaging farms of NLDB on the basis of an interest-free loan. Training in mixed farming of the settler family would be provided at the demonstration units of the Mid Country Livestock Development Centre (MLDC). The livestock development service of NLDB would assist with cattle shed and farm development. After a first technical review in 1986 (Ariyaratne 1986; Nell 1986) this pilot effort became part of the regular activities of the SL-NLDP's Small Holder Dairy Development Project (SHDDP) between 1986-1989, continued under the Small Farmer Dairy Project (SFDP) from 1990 to June 1991, and thereafter by the DPAs and their apex body the Mid Country Milk Producers Union (MIDCOMUL).

The objectives of this paper are:

- (1) to review financial, technical and economic performance of a large sample of NLDB-NADSA settlers that received dairy cattle between 1984 and 1990,
- (2) to compare the technical results with earlier technical studies in 1986 (Ariyaratne 1986) and in 1987 (Odekerken 1988),
- (3) to check upon the original NADSA strategy towards optimal land use on abandoned, marginal tea land and
- (4) to study if gainful self-employment has been obtained on small-scale farms with diversified crops and some dairy cattle. For this purpose, not only dairy, but also crops (vegetables and perennials) and off-farm resources were surveyed.

In addition, a number of neighbouring farms were surveyed to compare results without dairy or with cattle obtained from cash or bank loans. Also farm and family gross margin (cash receipts minus expenses) were compared with average monthly cash flows over 1985-1992 (De Jong *et al.* 1994) of the three MLDC demonstration units on which farmers were trained before receiving the project animal.

MATERIALS AND METHODS

The National Livestock Development Board (NLDB) operated an IDA funded Dairy Development Project from 1973 to 1981. The IDA credit was at concessional rates of interest for total farm development, including the provision of in-calf heifers, either imported or supplied locally from NLDB farms to smallholders. Training and extension to cattle recipients was provided through mobile training courses and a development service of Regional Livestock Development Officers (RLDOs) and Livestock Development Assistants (LDAs). From 1982 onwards the selection and follow-up of recipients continued through the RLDOs and LDAs in the Mid Country, supported by training of the Mid Country Livestock Development Centre (MLDC) through one day visits, one and two week residential courses and/or mobile training courses.

In 1984 a pilot project was initiated for the introduction of dairying for 30 resource-poor settlers on abandoned marginal tea lands in the Galaha area (Wariyagala and Gurukelle-Nillambe DPAs) in the Mid Country. Aspiring dairy farming settlers were invited for a one day visit to MLDC at

Mahaberiattenne to become acquainted with integrated crop-dairy farming at the demonstration units of 0.2, 0.4 and 0.8 ha. Subsequently, a member of each interested settler family attended a one week resident course at MLDC to gain experience in farm development (grass establishment, planting of *Glyricidia*, pepper, vegetables and perennials, cattle shed lay-out). Upon return farm development was undertaken under guidance of the RLDOs and their LDAs. This included cattle shed development with 6 bags of cement, roofing materials and masonry, and plant materials (grass, seedlings of coconut, pepper and fruit trees, *Glyricidia* sticks, vegetable seeds and initial fertilizer), all free of charge. Upon completion, a member of each family was sent to MLDC for another one week course to learn all dairy activities before receiving the in-calf heifer. Also the functioning of the dairy producers associations (DPAs) was explained for dairy inputs and marketing of the milk.

The pilot project provided per settler one in-calf heifer insured for three years, interest-free on the basis of 36 capital instalments deducted from the DPA milk cheque during the months the cow produced sufficient milk to pay for inputs and loan repayment. Together with the animal the farmer received a bag of coconut meal and a packet of minerals to facilitate a good start before the animal would calve down. The NLDB livestock development staff supported the trainees further with extension on dairy management and monitoring of performance.

The pilot scheme was expanded over time to other DPAs in the NADSA areas, such as Kalugamuwa and New Gurukelle DPAs, Nawalapitiya DPA, and the Angammana, Kahawatta and Orayanwatte DPAs in the Gampola area. In addition, farmers in Rikilligaskada DPA that lost their land after a landslide and were settled in the Red Cross Village, and poor semi-urban families of Menikhinna DPA settled in the Rajawelle Special Project received assistance under the NLDB-

NADSA interest-free cattle loan scheme.

From 1984 to 1990, in total 134 single cattle loans had been issued to NLDB-NADSA cattle loan beneficiaries in the various DPAs. The distribution and financial details per June 1991 are presented in Table 1 (NLDB/DDD, 1991). The proceeds of the capital repayments went into a NLDB-NADSA aspiring dairy farmers development fund to continue the scheme on a revolving fund basis once SL-NLDP would pull out.

In 1993, a survey was conducted to collect data on a large sample (about 50%) of these NLDB-NADSA farms and some control farms at the rate of 1 neighbour per 3 project farms along the same milk collection routes of the DPAs. General data included the farmer's family composition, home milk consumption, farm crops and livestock and the status of the loan. Farm details referred to plot size with the number and species of perennial bushes, vines, clusters and fruit trees, and the vegetable area in square meters.

Livestock information was gathered on the number and composition of livestock kept, and the fodder resources such as type of feeds and length of live fence (mainly *Glyricidia* trees). The farm history was recorded in terms of starting date, type and length of training in dairying received and by whom. The livestock history on the farm recalled the date of reception of the in-calf heifer, the breed, the supplying farm (Haragama, Rosita, Ambewela, MLDC or private farm) and the value of the issued in-calf heifer, the number and sex of the calves produced, and the fate of the animals. Milk productivity was characterized by the peak yield of the cow in litres per day (l/d), the length (months) of the milk production period per lactation, and the calving interval in days (d). Development of the dairy cattle activity was obtained by recording what happened with the first in-calf heifer and her calves in terms of either kept on the farm, shared, sold (price and age) or died and the cause of death.

Also farm cash receipts and expenditure per month were recorded and differentiated among vegetables, perennial crops and milk to derive at monthly farm gross margin. Source and amount of off-farm cash was obtained to calculate monthly family gross margin. Monthly family cash needs outside farm activities were collected as well. Based on price and age of sold offspring an estimate was made on annual stock sales.

In October 1993, final year students from the Agricultural School at Kundasale were trained in the use of the questionnaire and 76 farmers with a NLDB-NADSA cattle loan and 19 control farmers were interviewed.

Table 1. Distribution and financial details (in Rupees) of NLDB-NADSA cattle loans per main area per June 1991.

Main Area	Number of NLDB-NADSA loans	Amount issued	Amount repaid	Balance outstanding	Balance (%)
Galaha	48	151 491.05	118 602.00	32 889.05	22
Kalugamuwa DPA ¹	5	17 534.75	10 950.20	6 584.55	38
New Gurukelle DPA ¹	4	12 697.00	11 023.50	1 673.50	13
Nawalapitiya	21	84 943.60	12 520.00	72 423.60	85
Gampola	25	99 115.70	32 328.60	66 787.10	67
Red Cross Village	18	73 837.10	5 900.00	67 937.10	92
Rajawella Special-Project	13	50 861.20	36 795.80	14 065.40	28
Total	134	490 480.40	228 120.10	262 360.30	53
Average per loaner		3 660.30	1 702.39	1 957.91	

¹Because of small numbers these DPAs were left out in the 1993 survey (see Table 2)

The data were analyzed with DbStat (Brouwer 1992). Least square methods were used to explain the variation in monthly farm gross margin (farm cash receipts minus expenses) in relation to the following factors: main area, who received the training (farmer, farmer's wife, or relative), farm of origin and period in which the first animal was received (for convenience of sizable numbers per group divided in 1984, 1985-1987, 1988, and 1989-1990). Covariables adjusted for their average were: family size (persons), training periods (1-4) and total training days (d), farm size (ha), vegetable area (m²), number of tea bushes, number of trees (vines, clusters and fruit trees), number of dairy cattle (expressed in TLU, a tropical livestock unit of 300 kg with cows and bulls at 1 TLU, calves at 0.25 TLU, and young heifers and young bulls at 0.5 TLU), number of calves (male and female) produced by the first animal and litres of milk sold to the DPA during the last month (l/month). Similarly, by adding off-farm cash receipts, monthly family gross margin was

Table 2. Number of NLDB-NADSA loanees (total, with cattle, with milk sales) per main area and details on their average cattle loan situation in Sri Lanka Rupees in October 1993.

Main area	NLDB-NADSA loanees surveyed		Average loan	Average repaid	Balance	Balance (%)
	Total	With cattle With milk				
Galaha	30	27	23	3 210.33	3 134.32	125.21 4
Navalapitiya	16	15	8	3 505.79	1 677.15	1 828.64 52
Gampola	19	18	14	3 791.98	2 889.73	919.76 24
Red Cross - village	10	10	9	3 901.97	3 425.97	476.00 12
Rajawelle	1	1	1	4 000.00	4 000.00	0.00 0
Average	76	71	55	3 519.34	2 816.17	726.97 21

¹in the visited area only one farmer out of 7 loanees was present and attending his farm

Table 3. Means and coefficients of variation (c.v. in %) of family composition, home milk consumption, training periods received, farm size with vegetable plot size, number of tea bushes, perennial tree crops, and length of live fences on 76 farms of NLDB-NADSA loanees surveyed per main area and 19 control farms in October 1993.

Main Area	Galaha	Navalapitiya	Gampola	Red cross village	Rajawella	Total NLDB-NADSA Farms	Control farms
No. of farms surveyed	30	19	16	10	1	76	19
Family size	4.8	5.6	5.4	6.0	7.0	5.3(31)	4.7(34)
adult male	1.4	1.3	1.0	1.2	1.0	1.2(63)	1.2(44)
adult female	1.5	1.3	0.9	1.0	1.0	1.2(41)	1.3(52)
boys	1.2	1.9	1.9	1.6	3.0	1.6(82)	1.3(105)
girls	0.8	1.2	1.6	2.2	2.0	1.3(88)	1.0(100)
Milk consumed (l/month)	18.4	18.9	16.8	22.5	0.0	18.3(64)	21.8(74)
Training periods (number)	1.4	2.7	2.1	1.8	3.0	1.9(47)	0.9(122)
Farm size (ha)	0.4	0.7	0.4	0.4	0.2	0.5(30)	0.5(32)
Vegetable (plot (m ²))	14.4	166.9	28.0	552.0	0.0	120.5(298)	67.6(335)
No. of tea bushes	189.0	189.3	337.4	1050.0	0.0	337.0(146)	169.5(111)
No. of coconut trees	6.3	2.6	11.8	2.1	20.0	6.5(109)	6.3(162)
No. of clove trees	20.3	8.8	6.5	0.4	0.0	11.5(130)	8.3(94)
No. of pepper vines	79.9	254.9	224.9	0.2	15.0	139.8(99)	136.7(160)
No. of jak trees	4.4	14.6	6.3	8.6	8.0	7.6(108)	9.3(124)
No. of bread fruit trees	0.8	1.0	0.7	0.1	0.0	0.7(114)	0.8(91)
No. of mango trees	0.7	7.6	4.1	1.4	1.0	3.1(123)	4.6(242)
No. of avocado trees	1.7	6.5	1.6	4.8	8.0	5.5(144)	4.7(72)
No. of banana clusters	14.8	63.1	70.3	24.0	75.0	40.8(169)	23.3(142)
No. of coffee trees	5.9	258.4	142.9	13.1	6.0	94.3(137)	80.5(146)
Total tree crops	134.7	608.5	479.0	54.7	133.0	310.0(87)	274.5(91)
Live fence (m)	326.8	260.6	234.8	137.0	180.0	263.0(96)	275.3(90)

*figures in parentheses are c.v. in %.

analysed for the above factors and covariables.

RESULTS

In October 1993, 76 farms (57%) of 134 NLDB-NADSA cattle loanees were surveyed along the milk collection routes of the DPAs participating in the NLDB-NADSA cattle loan scheme. Of these farms, 71 had dairy cattle and 55 sold milk. Number and financial details of loans of these 76 farmers are given in Table 2. Over time the cattle loan increased from Rs 3,175 in 1984 to about Rs 4,000 in 1989/90 reflecting a small increase in cattle prices. Rajawelle farmers paid their loans in full, using in part off-farm income. Repayments in Galaha and Red Cross Village were almost completed but repayments in Gampola and Nawalapitiya were lacking behind

The 19 control farms surveyed, comprised 8 farms in the Galaha area, 8 in the Gampola area and only 3 could be covered in the Nawalapitiya area. In the Red Cross Village no control farmers were found since all farmers participated in the loan scheme. In the Rajawelle area other project farmers and control farmers had left farming due to further fragmentation of the small plots. All control farmers surveyed along the milk collection route had either obtained cattle through cash purchase or cattle loans from the People's Bank. Average purchase value of control cows amounted to Rs. 6,650 reflecting the higher purchase prices of dairy stock after 1989. All 19 farms had cattle and 15 (79%) sold milk at the time of the survey.

Details per main area on family characteristics and farm details are presented in Table 3. Average

Table 4. Means and coefficients of variation (c.v. in %) of the dairy cattle population (number per farm) on 71 NLDB-NADSA farms with cattle per main area and per period of receiving the first animal and on 19 control farms, surveyed in October 1993.

Main Area	Galaha	Nawalapitiya	Gampola	Red cross village	Rajawella	Reception of 1st animal				NADSA farms	Control Farm
						1984	1985	1988	1989		
						/1987	/1990				
Number of farms	27	15	18	10	1	12	17	31	11	71	19
Cows in milk	1.11	0.60	0.83	0.90	1.00	1.25	0.94	0.74	0.91	0.90(67)	1.37(92)
Dry cows	0.33	0.33	0.33	0.20	0.00	0.25	0.35	0.32	0.27	0.31(167)	0.21(200)
Heifers	0.41	0.27	0.33	0.20	1.00	0.50	0.59	0.23	0.09	0.34(167)	0.68(163)
Heifer calves	0.22	0.60	0.22	0.70	0.00	0.17	0.24	0.58	0.18	0.37(125)	0.37(134)
Bull calves	0.37	0.13	0.06	0.30	0.00	0.50	0.12	0.16	0.27	0.23(250)	0.26(216)
Young bulls	0.11	0.27	0.17	0.00	0.00	0.25	0.00	0.19	0.09	0.14(400)	0.21(255)
Bulls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05(458)
Total cattle	2.55	2.20	1.94	2.30	2.00	2.90	2.24	2.22	1.81	2.27(48)	3.11(76)
Total in TLU	1.85	1.38	1.45	1.45	1.50	2.04	1.68	1.46	1.39	1.60(48)	2.24(76)

Figures in parentheses are Coefficient of Variation in %.

Table 5. Means and coefficients of variation (c.v. in %) of the average cattle productivity on 76 NLDB-NADSA farms and 19 control farms surveyed in October 1993.

Main Area	Galaha mean	Nawalapitiya mean	Gampola mean	Red Cross village mean	Rajawelle mean	Total NLDB-NADSA farms		Control Farms	
						mean	c.v.	mean	c.v.
Number of farms surveyed	30	19	16	10	1	76		19	
Number of calves produced	3.23	2.88	2.47	3.00	4.00	2.95	47	2.00	84
male calves	2.17	1.56	0.79	1.80	3.00	1.66	85	0.68	161
female calves	1.07	1.30	1.68	1.20	1.00	1.29	78	1.32	105
Peak mil yield (l/d):									
1st lactation	6.7(27)*	5.6(16)	6.1(16)	7.2(10)	5.0(1)	6.4(70)	43	6.6(14)	35
2nd lactation	8.1(24)	5.9(14)	7.2(12)	7.4(9)	5.0(1)	7.3(60)	33	7.7(9)	30
3rd lactation	8.0(19)	5.5(10)	6.9(9)	7.5(6)	5.0(1)	7.1(45)	35	7.8(6)	34
4th lactation	7.3(12)	5.0(5)	7.3(4)	8.3(3)	5.0(1)	6.9(24)	35	10.0(2)	28
5th lactation	7.3(7)	6.0(1)	6.0(1)	7.5(2)		7.1(11)	34	10.0(2)	28
6th lactation	4.0(1)		5.0(1)			4.5(2)	16	12.0(1)	
Lactation period (months):									
1st lactation	7.5(26)	9.9(16)	9.9(16)	8.6(10)	8.0(1)	8.8(69)	28	7.7(13)	33
2nd lactation	7.5(23)	11.0(14)	10.6(12)	7.8(8)	8.0(1)	9.0(58)	25	8.9(9)	27
3rd lactation	7.1(18)	9.8(10)	9.4(7)	8.8(5)	8.0(1)	8.4(41)	31	8.7(6)	24
4th lactation	7.0(11)	10.0(4)	10.7(3)	8.5(2)		8.3(20)	22	8.0(3)	18
5th lactation	7.2(6)		11.0(2)	9.0(1)		8.2(9)	22	7.5(2)	9
6th lactation	7.0(1)					7.0(1)		7.0(1)	
Calving interval (days):									
First	460(9)	527(10)	490(8)	613(5)		512(32)	23	493(1)	
Second	481(6)	652(8)	492(7)	433(3)		535(24)	28	367(1)	
Third	630(4)	462(3)	377(4)	393(2)		477(13)	37	526(1)	
Fourth	548(2)	396(1)	411(1)	346(2)		432(6)	32	395(1)	

* figures in parentheses are number of records

family size of NLDB-NADSA families of 5.32 persons (range 3 to 10) was larger than at control farms (4.74 persons), mainly because of more children. Milk consumption at home averaged 0.6 litres per day in NLDB-NADSA farms, slightly lower than at control farms consuming 0.7 litres per day. The range was from 0 litres (10 project and 2 control farms) to 45-60 litres per month for a family (6-10 persons).

Average farm size was around 0.46 ha with larger farms (0.69 ha) in Nawalapitiya and a smaller farm in Rajawelle (0.20 ha). Remaining tea bushes on the land were more abundant in Gampola and especially in the Red Cross Village. Vegetable plots were largest in the Red Cross Village, followed by Nawalapitiya and very small plots in other areas and control farms. The composition in tree crops (vines, clusters and fruit trees) was quite different per area with very few trees in the Red Cross Village, Galaha and Rajawelle. The length of live fence was less in

the Red Cross Village and Rajawelle, where fences were merely demarcation lines between farms, while fences in the other areas were in part demarcations between developed and non-developed areas.

On average 1.9 training periods, totalling 9.8 days were attended by project beneficiaries at MLDC and 0.9 periods by control farmers. The project farmer went to MLDC in the case of 53 (70%) loans, the farmer's wife attended the training for 5 (7%) loans, while both were trained for 11 (14%) loans and relatives for 7 (9%) loans. Of the control farms only 11 persons (7 male and 4 female) received some training at MLDC or directly by NADSA, averaging 6 days in 1.5 periods.

The average dairy cattle population per main area surveyed, is detailed in Table 4. Furthermore, the dairy cattle composition per farmer that had cattle at the time of the survey is given for 4 groups of farms in relation to the period (1984, 1985-1987, 1988 and 1989-1990) of receiving the first in-calf heifer.

Table 6. Fate of 76 NLDB-NADSA in-calf heifers (supplied between 1984-1990) up to October 1993.

Fate/Year of animal supply	1984	1985	1986	1987	1988	1989	1990	Total	%
Number supplied	13	7	4	8	31	11	2	76	
Number up to October 1993:									
- present on farm			1	2	13	3	1	20	26.3
- died	1	2		1	4	1		9	11.8
- culled (to trader/butcher)	2	1	1	1	1			6	7.9
- sold (to another farmer)	9	3	2	4	14	5		37	48.7
- shared	1			1			1	3	4.0
- exchanged					1			1	1.3

Control farms had more dairy cattle (3.11 animals, 2.24 TLU) compared with the NLDB-NADSA farms (2.27 animals, 1.60 TLU), mainly because of more cows in milk and heifers. According to the period of reception of the first animal, the older NLDB-NADSA farms kept more cows in milk and heifers than farms that received initial stock more recently. Only 6 NLDB-NADSA farms kept goats (18 in total), and poultry was kept on 5 farms (1 with 800 birds and the other four had in all 18 birds).

Cattle productivity up to October 1993 as obtained by recall method from the farmers or their household members is presented in Table 5. The number of records recalled, are indicated in brackets. The number of offspring produced showed a large variation (2.47-4.00 calves) per area and between project (2.95 calves) and control animals (2 calves), but control farmers started 1-3 years later with dairying. Also the sex ratio varied greatly with a large percentage of male calves in Galaha, Red Cross Village and Rajawella. The number of records on calving intervals was much less than on peak yield and lactation length. Calving intervals were very long in all areas with an average of 507 days, based upon a total of 75 NLDB-NADSA records. Registration of calving dates on control farms was very limited. The fate of the 76 NLDB-NADSA in-calf heifers per October 1993 is shown in Table 6.

Calving rate and fate of calves produced by these 76 NLDB-NADSA animals (Table 7) and those of the first cow at 19 control farms (Table 8) are given in numbers and in percentages. Calving rates over time of project cows are higher than in control animals suggesting a more rapid movement in control farms, while loanees depend much more on their first animal to repay the loan.

Based on these 87 known sales at a total price of Rs 173,600 out of 110 animals sold during 454 NLDB-NADSA farm/years (farms times years between reception and 1993), annual average offspring sales were calculated at Rs 483 per farm. Including the value of project animals culled or sold at an average rest value of Rs 5,000 per head and an estimated few sales of offspring of farm-born animals, average monthly cash from livestock sales

Table 7. Calving rate and fate of calves of 76 NLDB-NADSA project animals.

Project animal's calf number	1	2	3	4	5	6	Total	%
Female calves	34	26	19	13	6	0	98	
- on farm	12	12	10	9	5	-	48	49.0
- died	7	3	3	2	-	-	15	15.3
- sold	14	10	5	2	1	-	32	32.7
- shared	-	1	1	-	-	-	2	2.0
- left at Haragama farm	1	-	-	-	-	-	1	1.0
Male calves	40	37	29	14	5	1	126	
- on farm	1	1	1	3	2	-	8	6.3
- died	12	8	8	2	2	-	32	25.4
- sold	24	28	18	7	1	1	78	61.9
- shared	1	1	1	-	-	-	3	2.4
- unknown destiny	2	1	1	1	-	-	5	4.0
Total calves	74 ¹	63	48	26	12	1	224	
Calving rate in % of the 76 animals	97 ¹	63	63	34	16	1	295	

¹ two heifers did not produce a live calf

Table 8. Calving rate and fate of calves of the first dairy cow on the 19 control farms.

First dairy cow's calf number	1	2	3	4	5	6	Total	%
Female calves	11	5	3	4	1	1	25	
- in farm	5	2	1	1	-	1	10	40.0
- died	1	1	-	-	-	-	2	8.0
- sold	2	1	-	1	-	-	4	16.0
- shared	1	-	-	1	-	-	2	8.0
- unknown destiny	2	1	2	1	1	-	7	28.0
Male calves	6	3	2	1	0	1	13	
- in farm	3	1	-	-	-	-	4	30.8
- died	-	-	-	-	-	-	0	0.0
- sold	1	1	2	1	-	1	6	46.2
- shared	1	-	-	-	-	-	1	7.7
- unknown destiny	2	-	-	-	-	-	2	15.3
Total calves	17 ¹	8	5	5	1	2	38	
Calving rate in % of the 76 animals	89 ¹	42	26	26	5	12	200	

¹ from two farms no information on calves was available

was estimated at about 125 Rs per farm on average. This represents about 25% on top of the gross margin for milk (Rs 507) on the surveyed farms (Table 9).

The composition of average monthly farm gross margin (cash received minus expenditure) per main area is given in Table 9, with details for milk, vegetables and perennial crops. Estimated average livestock sales (125 Rs per farm) are not included. Off-farm cash receipts are added to derive at average family gross margin. In addition, average monthly cash needs for the family, outside those for farm activities, are given, as indicated by the interviewees.

The 5 NLDB-NADSA farms without cattle had a monthly farm gross margin of Rs 180 derived from perennial crops only. Monthly family gross margin was Rs 730 through off-farms receipts of Rs 550. Dairy expenditure on feeds and minerals amounted to 42% of the receipts from milk on project farms with cattle and lower than the 51% found on control farms. Average farm gross margin of NLDB-NADSA farms (Rs 769) differed considerably per main area (from 525 in Rajawella to 1,446 in the Red Cross Village) and for farms with cattle (810) and

Table 9. Mean composition and coefficient of variation (c.v. in %) of monthly farm and family gross margin, and expressed monthly family cash needs of NLDB-NADSA cattle loanees (all farmers, farmers with cattle in milk, and farmers with cattle) per main area and of 19 control farmers interviewed in October 1993.

Economics per month	Galaha	Nawalapitiya	Gampola	Red Cross Village	Rajawella	NLDB-NADSA Loanees All farmers			Control Farmers
						(1)	(2)		
Number of farms	30	19	16	10	1	76	55	71	19
Sale of mil (litres)	142	76	113	122	100	118(81)	163	126	165(83)
Milk receipts (Rs)	1021	662	784	950	800	874(85)	1207	935	1248(97)
Expenses on dairy (Rs)	443	228	366	364	350	367(90)	507	393	642(120)
Vegetables receipts (Rs)	90	113	12	1010	0	195(328)	244	209	4(436)
Expenses on vegetables (Rs)	28	35	3	415	0	74(441)	94	79	0
Perennials receipts (Rs)	138	82	237	295	75	171(122)	185	170	145(242)
Expenses on perennials (Rs)	10	43	51	30	0	30(355)	26	32	8(436)
Farm gross margin (Rs)*	767	550	612	1446	525	769(87)	1010	810	747(70)
Off-farm cash receipts (Rs)	992	773	855	265	750	813(141)	822	831	984(126)
Family gross margin (Rs)*	1759	1323	1468	1711	1275	1582(77)	1831	1641	1331(68)
Expressed cash needs for the family	2026	1706	2045	2175	1550	1977(62)	2136	2060	2196(57)

(1) NLDB-NADSA loanees with cattle in milk.

(2) NLDB-NADSA loanees with cattle

Figures in parentheses are coefficient of variation in %

Table 10. Least square (l.s.) mean and regression coefficients of characteristics after step-wise regression on monthly farm gross margin of 76 NLDB-NADSA farms and 19 control farms surveyed in October 1993 (Rs).

Characteristics	l.s. Mean ⁽¹⁾	s.e. ⁽²⁾	Regr. Coef.	s.e. ⁽³⁾
NLDB-NADSA Farms (n=76):				
Overall monthly farm gross margin	861	82		
Main area				
Galaha	852a	88		
Nawalapitiya	522b	130		
Gampola	456b	103		
Red Cross Village	1487c	148		
Rajawelle	988abc	371		
Milk sales to DPA (l/month)			5.32****	0.53
Male calves produced by first animal			-121**	37
Training periods (number)			114	62
Vegetable area (m ²)			0.23	0.14
Vines, clusters and fruit trees (n)			0.45	0.26
R² model - 75%⁽⁴⁾				
Control Farms in NADSA Area (n=19):				
Monthly farm gross margin	747	66		
Milk sales to DPA (l/month)			4.21	0.43
Training periods (number)			-108	55
Year of reception of first cow			42	31
R² model - 87%⁽⁴⁾				

¹l.s. Means with different superscripts are significantly different (P>0.01);

²Standard error;

³Coefficient of determination.

** P<0.01, ****P<0.0001

those with cattle in milk (1,010) but not with control farms (Rs 774). Dairying contributed 66% to monthly gross margin of the farm and 32% of the family on the surveyed NLDB-NADSA farms, and 81% and 46%, respectively on control farms. Off-farm income contributed around 50% except for the Red Cross Village where income from vegetable production contributed 41% to farm gross margin and 35% to family gross margin. The majority of farmers indicated that the productivity of abandoned tea land had improved through the application of

cattle dung and urine (64%), others (36%) mentioned the beneficial use or combination of compost, mulching and artificial fertilizers, soil conservation and farm management.

Results of the step-wise regression of total monthly farm gross margin of project and control farms on the characteristics of family size, farm size, crops, livestock and training are presented in Table 10. NLDB-NADSA farmers in the Red Cross Village earned significantly (P<0.01) more farm gross margin, followed by Rajawella and Galaha, than the ones in Nawalapitiya and Gampola. In addition, the average milk sales (117.7 litres per month) improved and number of male calves produced by the first animal (1.7) decreased significantly (P<0.01) the monthly farm gross margin by Rs 5.32 per extra litre and Rs 121 per extra male calf. More than average vegetable area (120 m²), training periods (1.9) and trees (310) contributed with Rs 0.23 per extra m², 114 per extra period and Rs 0.45 per extra tree, but these effects were not statistically significant (P>0.05). This model explained 75% of the variation in farm gross margin.

Variation in control farmers' farm gross margin was explained for 87% by differences in the sale of milk, year of reception of the first cow and number of training periods. More than average milk sales (164.5 litres per month) improved monthly farm gross margin significantly by Rs 4.21 per extra litre. More than average training periods (0.9) reduced it by Rs 108 per period and first cows received after 1989 improved it with Rs 42 per year, but these two effects were not statistically significant (P>0.05).

When off-farm cash receipts of NLDB-NADSA farmers were included in the step-wise regression,

Table 11. Least square (Ls.) mean and regression coefficients of characteristics after step-wise regression on monthly farm gross margin of 76 NLDB-NADSA farms and 19 control farms surveyed in October 1993 (Rs).

Characteristics	L.s. Mean ⁽¹⁾	s.e. ⁽²⁾	Regr. Coef.	s.e. ⁽³⁾
NLDB-NADSA Farms (n=76):				
Overall monthly farm gross margin	1 666	79		
Main area				
Galaha	1 688a	86		
Nawalapitiya	1 311b	126		
Gampola	1 283b	100		
Red Cross Village	2 237c	146		
Rajawelle	1 809abc	359		
Off-farm cash receipts (Rs)			0.91****	0.04
Milk sales to DPA (l/month)			5.28****	0.48
Male calves produced by first cow (n)			-111**	37
Training periods (number)			151*	62
Vegetable area (m ²)			0.26	0.14
Trees (vines, clusters, fruit trees (n))			0.41	0.26
R ² model -93% ⁽³⁾				
Control Farms in NADSA Area (n=19):				
Monthly farm gross margin	1 331	53		
Off-farm income			1.07****	0.07
Milk sales to DPA (l/month)			4.25****	0.43
Training periods (number)			-108	55
Year of reception of first cow			42	31
R ² model -95% ⁽³⁾				

⁽¹⁾ L.s. Means with different superscripts are significantly different (P>0.01);

⁽²⁾ Standard error;

⁽³⁾ Coefficient of determination.

* P<0.05; ** P<0.01; **** P<0.0001

93% of the variation in monthly family gross margin could be explained (Table 11). Area differences followed the same pattern as under farm gross margin. In addition, more than average off-farm cash receipts (Rs 822), milk sales (117.7 litres per month) and number of training periods (1.9) contributed positively and number of male calves (1.7) negatively to family gross margin (Rs 1,582) statistically significantly by 0.91 per Rs off-farm cash, 5.28 per litre, 151 per training period and minus Rs 111 per male calf. More than average vegetable area (120 m²), and number of trees (337) increased average monthly family gross margin with 0.26 per m², and Rs 0.41 per tree, but effects were not significant (P>0.05).

Step-wise regression of monthly family gross margin of control farmers (Table 11) showed that 95% of the variation could be explained, positively by more than average off-farm income (Rs 584) and milk sales (164.5 litres per month) at the rate of Rs 1.07 per extra Rs off-farm cash and Rs 4.25 per extra litre. Extra training periods (average 0.9) reduced it by Rs 172 per period and a first cow received after 1989 improved it by Rs 42 per year, but these effects were statistically not significant (P>0.05).

DISCUSSION

The outcome of the survey was disappointing in the sense that very few farmers without cattle were found to compare dairy farming with non-dairy

farming on small-scale farms on abandoned tea land. All neighbouring control farms had cattle, although they started dairying 1-3 years later than NLDB-NADSA loanees. The five project farmers (only two had not repaid the loan in full) that were found without cattle, showed no gainful alternative for dairy farming: they had a low average family gross margin of Rs 730, composed of perennial crops and off-farm cash receipts only. Repayment in the Rajawelle Special Project had been completed early, for which also off-farm cash receipts were used. According to the Menikhinna DPA's secretary in that area, 6 (86%) of the 7 loanees had stopped farming mainly due to further fragmentation of the small plots (0.2 ha) in the semi-urban area and low returns from dairy compared to urban off-farm jobs.

NLDB-NADSA single cattle loan repayments in 36 fixed amounts, varied from 85 Rs per month for 1984 beneficiaries to 125 Rupees for loanees that started in the late 1980s. This amount equalled about 18 litres per month or 0.6 litres per day (13% of daily milk yield). This is much lower than the amount farmers in Indonesia paid for imported cattle at 3 litres per day (30% of daily milk yield) over a seven year period (Ibrahim et.al., 1991). Based on an average lactation length of about 8.5 months (Table 5), repayment required over 4 lactations. With an average production of 2.95 calves, and subsequently 2.95 lactations, farmers could not complete payment from the lactations of the original animal. Some used other sources of funds, but most farmers used part of the milk of the offspring of their first animal to settle their loans completely. Overall repayment by these resource-poor farmers was satisfactory, although farmers in Gampola and especially Nawalapitiya were behind schedule, associated with low fractions (74 respectively 50%) of farms producing milk or low ratios of cows in milk (72 respectively 65%) at the time of the survey (Table 2 and 4).

In October 1993, calf production of 2.95 calves per supplied animal for NLDB-NADSA farmers was composed of 2.82 calves from 56 animals that left the farms (either dead, culled or sold) and 3.22 calves so far of 20 original animals (26%) still present in the farms. First cows of control farmers produced up to October 1993 on average 2 calves, but these farmers had 14 animals (74%) still in the farms.

Over time, daily milk sale figures improved from 1986 to 1987, due to more productive second and third calvers in 1987. No further improvement was seen in October 1993, except in control farms, that had more cattle and cows in milk (Table 4). Average production per cow in milk was low in 1993 due to very high concentrate prices which affected the control farmers with more cattle even harder.

Odekerken (1988) found that farmers were feeding 2 kg concentrates per cow per day, while in the 1993 survey, estimated from the level of dairy expenses of Rs 542, project farmers fed in average about 1.5 kg per cow per day.

Calving intervals were long on project farms in particular between first and second lactation (512 days) and between second and third lactation (535 days). Causes were initially the late introduction of bulls but also farmers' reluctance to early breeding because of noted drops in milk production in pregnant cows. Resource-poor farmers depended heavily on milk for income and loan repayment, and that would assist in explaining that generally peak milk yields are lower and lactation lengths longer in project animals (Table 5). Average peak milk yields also tended to be slightly higher within NLDB-NADSA farms (Table 5) in areas with a high percentage of male calves (Galaha, Red Cross Village). The latter may be due to smallholder practices of allowing male calves less milk suckling than female calves. Adjusted l.s. gross margins for male calf effects were therefore considerably higher than actual in Galaha, Red Cross Village and Rajawelle. Lactation periods were longer within NLDB-NADSA animals for areas with a higher percentage of female calves.

Overall average long calving interval of 507 days (75 records) in NLDB-NADSA farms equalled those of the study of Nholope et al. (1993), who calculated an average calving interval of 511 days for 925 cows that calved between 31st March 1992 and 1st April 1993 in the Kagera Smallholder Dairy Extension Project in Tanzania. Average lactation lengths of 8-9 months, as recalled by the farmers during the survey, are short in view of these long intervals. Odekerken (1988) found at one DPA that 34 farmers had delivered milk during 7,630 farm-milk delivery days (in average 82%) out of 9 months' milk collection data. In October 1993, 55 (77%) out of 71 NLDB-NADSA farmers with cattle produced milk and 15 (79%) of control farmers, suggesting an average lactation length of about 12.8 months per average overall calving interval of 507 days in project animals.

On control farms more cattle and cows in milk were kept than on the NLDB-NADSA farms, but monthly gross margin from milk differed only by 64 Rs, due to less milk per cow in milk and higher concentrate expenses. Widodo et al. (1994^b) found a similar trend of reduced gross margins per cow between one cow dairy farms and larger units (2, 3, 4 and more cows) in small mixed dairy/crop farms in East Java.

Livestock other than cattle, i.e. goats and

poultry were limited to a few farmers only. This is not surprising for poultry in the light of large negative poultry gross margins in 1992 on the MLDC farms (De Jong *et al.* 1994), but goat keeping deserves more attention for income generation. On the other hand there is limited supply of breeding goats versus high demands of rural and urban projects going for high prices of goat milk (about double the price of cow milk).

NLDB-NADSA farms and control farms showed a large variation in vegetable area size, number of remaining tea bushes, number and type of trees (vines, clusters and fruit trees) planted between and within areas. Apart from home consumption not much gross margin was generated from crops (Table 9). The exception was from vegetables and perennial crops in the Red Cross Village area with farmer settlers from Rikilligaskada, that have grown vegetables traditionally and that still do a lot of tea picking.

On NLDB-NADSA farms, milk, vegetables and perennial crops contributed 66, 15 and 18% respectively to average monthly farm gross margin (Rs 769) and 32, 8, 9% to average monthly family gross margin (Rs 1,582 with 51% from off-farm cash receipts). On control farms, these contributions were 81%, 1% and 18% to farm (Rs 747) and 46, 0, 10% to family gross margin (Rs 1,331 with 44% from off-farm receipts). These gross margins on abandoned, tea land were considerably lower than average family gross margin found by Widodo et al. (1994^b) in 1989/90 on small-scale dairy farms on more fertile land in East Java in three farming systems (cassava, horticulture and sugar cane dominated). In East Java, average family size was smaller (4.5 versus 5.3 and 4.7 persons, farm size larger (0.58 ha versus 0.46 and 0.47 ha), and farmers kept more TLU in dairy cattle (3.31 versus 1.60 and 2.24) than in NLDB-NADSA and control farms. Average contributions to family gross margin of 42% from dairy, 29% from crops and 29% from off-farm revenue indicated that dairy-crop farming yielded more gross margin in absolute and relative terms in East Java than obtained so far on abandoned tea land under rehabilitation.

Gross margins of project and control farms were also different from the monthly gross margins achieved monthly over 1985-1992 from farm activities (no off-farm employment was allowed) at the demonstration farms at the MLDC, where farmers were trained: Rs 1,311 in the 0.2 ha; Rs 2,037 in the 0.4 ha; and Rs 2,807 in the 0.8 ha farm. Level and composition of farm and family gross margin between surveyed farms and farm cash flow on MLDC demonstration farms showed that farmers in Galaha (0.4 ha), Nawalapitiya (0.7 ha),

Gampola (0.4 ha) and Rajawelle (0.2 ha), only through off-farm cash receipts surpassed the 0.2 ha farm, but obtained less than at the 0.4 ha and especially the 0.8 ha farm. Farm size in MLDC farms was important for farm gross margin, but at field level differences were not marked. Intensity of farming was higher at MLDC farms, so original NADSA's objectives of gainful employment and improved land use as shown at MLDC, have only in part been realized at NLDB-NADSA farms, but farmers' problems were higher due to shortage of water and wild boars attacking vegetables and food crops (Ariyaratne 1989).

Regression analysis showed statistically highly significant contributions of milk sales to farm and family gross margin of project and control farmers (Table 10 and 11). Over time there was a tendency that more farmers reached higher milk sales per day, although in 1993 also a good number were in the category of no milk sales, since records were based on one month only compared to an average picture over 14 months in 1986 and 9 months in 1986/87.

In addition, off-farm cash receipts contributed ($P < 0.05$) significantly to family gross margin (Table 10 and 11). Area differences and number of male calves produced by the first project animal were important, significant factor and covariable respectively. Size of vegetable area and number of trees supported gross margin but this was not significant ($P > 0.05$). When number of male and female calves were taken out of the step-wise regression, farm of origin of the first animal became statistically significant with Rs 200 more for ex-Haragama animals compared to ex-Rosita animals. De Jong *et al.* (unpublished) found that ex-Haragama stock farmers obtained 59 female and 54 male calves from 40 in-calf heifers, while 33 of Rosita produced 64 male and 37 female calves. The very different sex ratio caused a delay in expanding dairying and generating more gross margin from milk (Table 4 and 9). Expansion of the dairy enterprise was slow also since more first female calves were sold than kept on the farm (Table 7). Thereafter, the ratio kept on farm vs sold female calves increased rapidly, resulting in more heifers and cows on the older dairy farms (Table 4).

Length of dairy farming (period/year of animal reception, number of calves born), after step-wise regression, did not contribute positively to gross margin. In fact, more bull calves produced over time reduced monthly farm and family gross margin with farm gross margin with Rs 121 and family gross margin with Rs 111 per bull calf above average (1.7).

MLDC training periods (average 1.9, totalling 8.9 days) of project farmers in mixed dairy/crop

farming contributed positively to farm gross margin and even significantly to family gross margin (Table 10 and 11). Less and shorter training periods (average 1.5 totalling 6 days for 11 persons) by MLDC or NADSA for control farmers had a negative contribution to gross margin (Table 10 and 11).

The general impression on the status of the farm crops, the cattle shed and the cattle condition was in the majority of farms moderate to poor. Lack of funds for intensification and maintenance of farms, and shortage of interested family labour in small-scale farming seemed to impede more intensive farming in NADSA farms.

Off-farm work, mainly as casual labourers, was the most important source of family gross margin of the surveyed farmers except in the Red Cross Village area where dairying and crop farming (vegetables and perennials, especially tea picking) dominated and on control farms where dairying and perennial crops together was higher than off-farm cash receipts (Table 9). Almost all farmers indicated that the cash needs of the family (Rs 1,977 for project farmers and Rs 2,195 for control farmers) were higher than the money obtained from off-farm work and farm activities, and only through food supporting programmes by the Government families managed to survive.

The large dependence on off-farm cash receipts so far, defeated the original 5 year NADSA concept that farmers would find gainful self employment on small-scale farms with diversified crops and some dairy farming on abandoned, marginal tea land. Neither, generated farm nor family gross margin turned out to be sufficient to cover their cash needs for purchasing cereals, salt, clothes, schooling and medical services. Also, due to the small size of the dairy herds, milk yields do fluctuate much during the year. In spite of these fluctuations, NLDB-NADSA loan scheme farmers were more enthusiastic than the economic outcome justified (Ariyaratne 1986) and there is great demand for more cattle in the NADSA areas. Also, breeding female stock becoming available from NLDB-NADSA farms allowed more farmers to start dairying.

At the end of 1994 close to 200 resource-poor farmers (on average 20 annually from 1984-1994) had received a NLDB-NADSA loan and also other farmers started dairy farming through cash purchases and bank loans as could be observed on the control farms. In view of rising cattle prices from 1990, the NLDB-NADSA revolving fund that does not charge interest to resource-poor settlers can in future serve less new farmers per year. The fund handed over by SFDP mid 1991 amounted to almost

Rs 500,000 and if repayment rates are kept up some 10 resource-poor farmers can annually benefit from the scheme at the 1993 price of in-calf heifers (10-12,000 Rs).

CONCLUSIONS

Financially, overall loan repayment of resource-poor NLDB-NADSA farmers that obtained an interest-free single cattle loan was satisfactory, although slow in Gampola and Nawalapitiya. Repayment in 36 monthly instalments could not be completed from the average 2.95 lactations of the first animal. Long calving intervals and mortalities from tick borne diseases indicated that sufficient technical attention should be given to arrive at higher potential contributions of dairying. Off-farm income (mainly casual labour) contributed around 44 to 51% to family gross margin defeating the original NADSA concept of gainful self employment on small-scale farms. Short term activities such as vegetable growing and long term tree cropping have so far contributed mainly to subsistence food and relatively little to income generation on project farms and even less on control farms. Dairy farming proved a potentially, attractive cash earner next to off-farm cash receipts for settlers on abandoned and marginal tea lands. NADSA's objectives of gainful employment and improved land-use have only in part been achieved, while settlers still depended on food support of the Government.

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