

PERFORMANCE OF SMALL SCALE LIVESTOCK/CROP DEMONSTRATION-CUM-TRAINING FARMS IN SRI LANKA

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Summary

Three livestock/crop demonstration-cum-training farms have been established on plots of half, one and two acres, typical of the "Kandyan Forest Garden System". Vegetables, bananas, pepper, coffee, coconut and fruit trees are widely spaced, for intercropping with grass, and have been surrounded with live fences that also provide fodder for livestock to increase the family income. Each unit is operated by a selected employee and his family under a monthly incentive scheme based upon the gross margin. On these farms the technical parameters in dairying are better than elsewhere in the Mid-Country. Economic performance over 1985-1992 showed that dairying contributed most to the total gross margin of the half, one and two acre units, i. e. 31, 63 and 69%, respectively. Next came crops (29%, 37% and 19%), poultry (22%, 0% and 9%), and goats (18%, 0% and 3%). In the three farms the cash income per Sri Lankan Rupee spent was 1.5, 4.6 and 2.1, respectively. The overall ratio was 3.2 for dairying, 1.1 for poultry, 4.5 for goats and 9.9 for crops. Actual family labour in the three farms was 548, 548 and 639 days, compared to the 270, 330 and 440 days anticipated in the initial feasibility study. The average incentive payments, which were 20% (half acre), 61% (one acre) and 133% (two acres) of the parastatal salary of the employee, were only insufficient for the extra labour applied in the half acre unit. Dairying and goats proved to be attractive cash earners with a high labour productivity and a high capital requirement, while manure to improve soil fertility and biogas to replace domestic fuel were important benefits. Poultry did little to improve farm income.

(Key Words: Livestock/Crop Integrated Farming, Performance, Economics, Sri Lanka)

Introduction

The Mid-Country smallholder homestead gardens of Sri Lanka are mainly in the highlands, and are distinct from low-lying lands which are under paddy. The cropping pattern in these highland gardens is known as the "Kandyan Forest Garden System", and is a combination of tree crops, root crops and herbs stratified into layers of overhanging foliage canopies (MLDC, 1987). Livestock is kept on some 20% of the farms, usually in the form of cattle, sometimes as goats and poultry. The average farm size in the village sector of Kandy district is 1.5 acre; 52% of the farms are less than one acre, 23% are 1-2 acres, 11% are

2-3 acres and 14% are 3-20 acres (Westenbrink, 1986), and most dairy farmers keep one or two cows.

Three demonstration-cum-training farms have been set up at the Mid-Country Livestock Development Centre (MLDC), which is a training centre for smallholders and extensionists. MLDC is situated on the Mahaberiyatenna farm of the National Livestock Development Board (NLDB) in Digana, at an altitude of 600 m above sea level where rainfall is 1,200-1,500 mm per year and falls during 100-112 rainy days (MLDC data 1985-92).

The aim is to demonstrate a technically and economically improved Kandyan Forest Garden System with a more open canopy to allow more intensive cash cropping of vegetables, bananas, pepper and coffee under more widely spaced tree crops e.g. coconut and fruit. In addition, livestock such as dairy, goats and poultry are intended to provide more gainful job opportunities for family labour on these small-scale farms, to benefit from more regular income (milk and eggs), to allow conversion of crop waste, and to provide the farmyard manure needed to enhance soil fertility, and biogas for cooking and lighting.

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Materials and Methods

Inventory of the three MLDC farm units

The three MLDC farms were established on bare farm land, with a house for the attendant and his family and a permanent water supply (valued at Sri Lankan Rupees or Rs 15,000), a biogas plant (Rs 3,823) and sheds for the livestock. More details on farm dimensions, crops planted and livestock units kept are given in table 1. The term livestock unit (LU) stands for a crossbred dairy cow of 300 kg or 6 goats of 40 kg or 240 layers, and assumes about 5 kg of manure dry matter is produced per day. The number of dairy cattle per unit depends on the farm size and the total livestock has to be sufficient to enable a family biogas unit of 6 m³ to be operated to save on kerosene for lights and on labour for firewood

collection. Therefore in the half acre farm, poultry and goats have been included. Improved grasses/legumes have been planted in the open spaces between the crops to produce basic forage for the dairy cattle. This is supplemented with leaves from fodder trees (*Leucaena* and *Gliricidia*) planted as live fences around the units or as supports (*Gliricidia*) to pepper vines and from a few jack trees (*Artocarpus heterophyllus*). On the half acre and two acre units a few rabbits are occasionally kept, mainly for demonstration purposes. At the end of 1989 some goats were added in the two acre unit (average 0.25 LU goats over 1985-1992).

The farms were planned and laid out in 1983/84 by the MLDC staff. In addition, labour studies were carried out to check on actual time spent on livestock, crop and household activities (Terwisscha, 1987; MLDC, 1990a,b,d,e).

TABLE 1. INVENTORY OF THE THREE MLDC DEMONSTRATION-CUM-TRAINING FARMS

| Farm inventory | Half acre | One acre | Two acre |
|--------------------------------------|-----------|----------|----------|
| Buildings (m ²) | 360 | 300 | 325 |
| Vegetable plots (m ²) | 597 | 780 | 650 |
| Pasture with crops (m ²) | 1,156 | 3,165 | 7,213* |
| Banana clumps | 40 | 187 | 174 |
| Pepper vines/ <i>gliricidia</i> | 44 | 207 | 200 |
| Coffee plants | 8 | 52 | 101 |
| Coconut palms | 10 | 24 | 40 |
| King coconut palms | 6 | 6 | 5 |
| Fruit trees (papaya, citrus) | 19 | 13 | 31 |
| <i>Leucaena</i> in metres of fence | 50 | 190 | 273 |
| <i>Gliricidia</i> in metres of fence | 155 | 384 | 424 |
| Cows | 1 | 2 | 3 |
| Calves/heifers | 1 | 2 | 3 |
| Female goats (+buck & offspring) | 2+ | — | 2+** |
| Layers | 120 | — | 60 |
| Rabbits | + | — | + |
| Total livestock units | 2.25 | 2.50 | 4.25 |

* with 4,086 m² improved pasture ** entered late 1989.

In all units the average value of biogas (6 m³ plant) was estimated at Sri Lanka Rupees 1,200 (in average US \$ 40 or 40 days of hired labour), equal to the money saved by not having to buy kerosene for lighting (0.25 litre per day) and to collect firewood (20 hours per month) for cooking. In the half acre unit part of the biogas value came from poultry (25%) and goats (25%). The average value of manure (biogas slurry) was set at Rs

1,200 per LU, and charged to the crops and to the pasture plots as per actual rate of application.

The MLDC training staff are responsible for the overall supervision of the units. Since 1984, the actual day-to-day management has been in the hands of a labourer employed by MLDC, assisted by his family (wife and 1-2 children). These families share in the profit and loss of the unit at the end of the month and receive a bonus or remain with

a negative balance to be deducted from the next month's bonus. The employees, who are involved in supervising trainees and informing visitors as well as in the day-to-day management, receive their salaries to operate the units at the beginning of the month. At the end of the month MLDC staff draw up the monthly accounts in revenue, costs and gross margins, and discuss them with the staff and the unit families. The actual monthly incentive paid, is the gross margin minus recoveries for basic salary, transport of produce, for land rent at Rs 100 per acre and for the actual upkeep of the buildings (mainly "cadjans" or woven coconut leaves for roofing). The technical and economic data were collected over a period of 8 years (1985-1992).

Analysis of the data collected

This paper presents an assessment of the technical and economic performance of the three farm units. The contributions from vegetables, bananas, pepper/coffee, tree crops, dairying, goats and poultry (including a minor contribution from the demonstration rabbits) to the farm gross margin have been calculated in Sri Lankan Rupees (Rs: From 1985-1992 the exchange rate varied from 20-43 Sri Lankan Rupees per US \$) and in % of the farm result. In addition, the returns in revenue and cash income per Rs spent in material cost have been calculated, and also the return to land (revenue minus material or direct costs minus labour cost) and to capital (revenue minus costs of materials, labour, land and depreciation on livestock sheds), and the labour productivity (revenue minus material costs per planned and actual man-day worked). The results have also been scrutinized per livestock unit and per person labour input between farms, and per acre, to check on the synergetic effects of integrated farming.

Results and Discussion

Management

The management of the small-scale farm units by a selected MLDC employee and his family under guidance of the MLDC staff and the monthly participation in the gross margin have proved to work well. In 1986 the family in the two acre unit was changed, because not enough family labour was available to run the farm properly. In 1991 the family in the half acre unit

opted to move to a newly established two acre dairying/goat/sericulture farm which is expected to provide a higher income.

The parastatal annual salary of the employees rose from Rs 8,000 (US \$ 400) in 1985 to Rs 23,575 (US \$ 548) in 1992. The average incentive paid per annum over 1985-1992 to the half, one and two acre farms was 20%, 61% and 133% (i.e. and extra US \$ 100, 307 and 669). Only in the half acre unit was the incentive payment of 20% above the parastatal salary not sufficient to reward in full the additional labour input of 0.5 household person. In the one acre and two acre units the additional 0.5 and 0.75 person household labour were fully recompensed. However, the tendency for incentives to decline over time indicated that rewards for family labour could not completely follow the trends in labour pay in the parastatal sector.

The very regular income from dairying under the incentive bonus scheme motivated the unit families well, and only in a few months was the deficit carried over to be recovered from the next month. This happened most when the poultry were making a monthly loss, either because pullets were being kept before the point of lay, or in months with low egg prices, and/or while the single cow in the half acre farm was dry.

Dairying

The comparative technical performance for the dairying component over 1985-1992 per farm is given in table 2. Technical dairying parameters such as calving interval and milk yield per cow per annum were better in the half acre unit, which had a larger proportion of concentrates and minerals. Birth weights of calves and growth rates were also higher, while the restricted suckling practice employed during the early years in the two acre unit also showed good growth rates.

The economic performance in dairying is shown in table 3 under revenue, costs and gross margin. The financial or cash components are indicated as cash income, cash expenses and cash flow. The average milk sales of 1,457 litres per cow per year from 598 kg concentrates (coconut meal and rice bran) on the MLDC farms compared well with the results of surveys carried out (Linders, 1986; Meinderts, 1988; Houterman, 1989) in the Mid-Country over the period 1985-1989. In average, the smallholders interviewed, kept more young

stock and over longer periods than the MLDC farms resulting in larger amounts of concentrates per average cow.

The ratios of milk produced per kg concentrate fed on the MLDC farms imply that milk produc-

tion could be increased when there was more intercropping of crops with grass, which was more feasible in the two larger units. The milk produced per m² of grass was highest in the half acre unit, but that farm unit relied partly on grass from

TABLE 2. AVERAGE TECHNICAL PERFORMANCE OF THE DAIRY COMPONENT ON THE THREE MLDC FARMS (1985-1992)

| | Half acre | One acre | Two acre |
|--|-------------|-------------|-------------|
| Milk/cow/annum (l) | 1,990 | 1,822 | 1,642 |
| Concentrates/cow/annum (kg) | 750 | 660 | 505 |
| Minerals (kg/cow/year) | 31 | 17 | 21 |
| Milk per lactation* (l) | 1,740 (n=7) | 1,792 (n=8) | 2,222 (n=9) |
| Calving interval (days) | 347 | 372 | 397 |
| Milk/cow/day calving interval (l) | 5.7 | 4.9 | 4.2 |
| Milk per kg concentrate (l) | 2.65 | 2.76 | 3.25 |
| Milk per m ² improved pasture (l) | 1.7 | 1.2 | 1.2 |
| Birth weight calves (kg) | 27 | 25 | 23 |
| Calf growth rate (g/d) | 323 | 278 | 323* |
| Age of first calving (days) | 871 | 885 | 928 |

* n gives the number of completed lactation records.

** most records were from the initial period when calves were on restricted suckling.

TABLE 3. AVERAGE ECONOMIC DAIRY PERFORMANCE OF THE MLDC FARMS (1985-1992)

| | Half acre | | One acre | | Two acre | |
|-------------------------------|-----------|-------------|----------|------------|----------|-------------|
| | kg | Rs | kg | Rs | kg | Rs |
| Milk sales | 1,527 | 6,802 | 2,915 | 14,025 | 4,300 | 21,713 |
| Milk (calf/home) | 463 | 2,259 | 728 | 3,635 | 626 | 3,360 |
| Stock sales | | 981 | | 4,599 | | 6,033* |
| Manure value | | 1,500 | | 3,000 | | 4,500 |
| Biogas value | | 600 | | 1,200 | | 1,200 |
| Total revenue (Rev) | | 12,142 | | 26,459 | | 36,807 |
| Cash income (in % of Rev) | | 7,782(64) | | 18,624(70) | | 27,747(75) |
| Concentrates | 750 | 2,403 | 1,319 | 4,112 | 1,515 | 4,938 |
| Minerals | 31 | 311 | 34 | 303 | 64 | 319 |
| Artificial fertilizer | 34 | 134 | 109 | 357 | 127 | 374 |
| Milk to young stock | 284 | 1,392 | 551 | 2,785 | 452 | 2,508 |
| Other expenditure | | 1,086 | | 1,132 | | 2,016 |
| Manure on pasture | | 1,000 | | 1,000 | | 1,200 |
| Total direct cost (DC) | | 6,326 | | 9,314 | | 11,355 |
| Cash expenditure (in % of DC) | | 3,878(61) | | 5,487(59) | | 7,647(67) |
| Gross margin (GM) | | 5,817 | | 17,145 | | 25,451 |
| Cash flow (in % of GM) | | 3,905(62) | | 13,137(77) | | 20,099(80) |
| Gross margin/LU dairy) | | 4,654(1.25) | | 6,858(2.5) | | 6,707(3.75) |
| Cash flow/(1.U dairy) | | 3,124 | | 5,254 | | 5,360 |

* including Rs 52 grass sales.

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outside.

The technical and economic parameters at MLDC also show good achievements by comparison with the results of studies of the cost of milk production in Kandy District of the Mid-Country (LPU, 1984 and 1987; SL-ADB, 1990), indicating what is possible under attentive and good farm management. The cost of milk production (cost per litre of milk sold) at MLDC farms ranged from Rs 1.78 (2 acre unit) to Rs 2.84 (half acre unit) as compared to Rs 4.73 from the above surveys.

The gross margin and the cash flow per LU dairying at MLDC differed, favouring the larger units with more grass, which resulted in higher sales of older and therefore heavier young stock, and less expenses for concentrate feeding per cow.

Crops

The contribution from vegetables, banana, pepper/coffee and tree crops such as fruits and coconut is shown in tabel 4. The gross margin of crops per acre was highest in the half and one acre units, which had large contributions from vegetables and bananas.

The productivity of the various crops as calculated per m² or plant was high on the half acre unit (2.25 IU) as a result of large applications of manure and compost. The larger units have relatively less manure available (the one acre farm has

2.5 LU and the two acre farm 4.25 LU) and/or find it more difficult to manure all plants properly. An exception is the category "coconuts" on the two acre unit, but on this farm one-quarter of the coconuts had been established long before the unit itself and was producing coconuts from the outset.

The contribution in quantities of the crops over the years is given in figure 1, showing the change from short-term via medium-term to tree crops over the years. The contribution of medium-term crops (pepper and coffee) has been relatively small. Initially, it took time to start bearing. Thereafter the unexpected fall in prices in the nineties resulted in low revenue and less attention. The production of tree crops is rising but not sufficiently to compensate for the drop in vegetable and banana production and the resulting gross margin.

Within crops, the physical and financial contribution from vegetables and bananas declined, particularly after the first four years. It seems that biogas slurry with annually decreasing application of artificial fertilizer (especially in the nineties, when fertilizer prices rose steeply), is not sufficient to maintain soil fertility. One way of avoiding the use of expensive artificial fertilizer would be to alternate the vegetable and banana plots with the pasture plots, and/or to step up compost making from grass-refusal and crop waste and use the compost on the crop plots.

TABLE 4. AVERAGE COMPOSITION OF CROP REVENUE (IN RS AND %), TOTAL COSTS AND GROSS MARGIN PER ACRE CROPS IN THE THREE MLDC FARMS (1985-1992)

| | Half acre | | One acre | | Two acre | |
|------------------------|-----------|-----|----------|-----|----------|-----|
| | Rs | % | Rs | % | Rs | % |
| Vegetables | 3,480 | 46 | 4,269 | 32 | 2,981 | 25 |
| Banana | 2,577 | 31 | 4,473 | 34 | 2,659 | 23 |
| Pepper/coffee | 786 | 10 | 3,505 | 26 | 3,440 | 29 |
| Coconuts and fruits* | 998 | 13 | 1,075 | 8 | 2,675 | 23 |
| Total revenue of crops | 7,841 | 100 | 13,321 | 100 | 11,754 | 100 |
| Cost of animal manure | 1,700 | | 2,000 | | 3,525 | |
| Expenditure on crops | 708 | | 1,296 | | 1,092 | |
| Gross margin per acre | 10,868 | | 10,025 | | 3,569 | |

* Coconut palms and fruit trees were planted about a year later in the half acre unit. Some of the coconut trees in the two acre unit pre-date the establishment of the two acre unit.

Farm economies

The economics for all farm activities are sum-

marized in table 5. The average gross margin generation in the farms increased with the acreage,

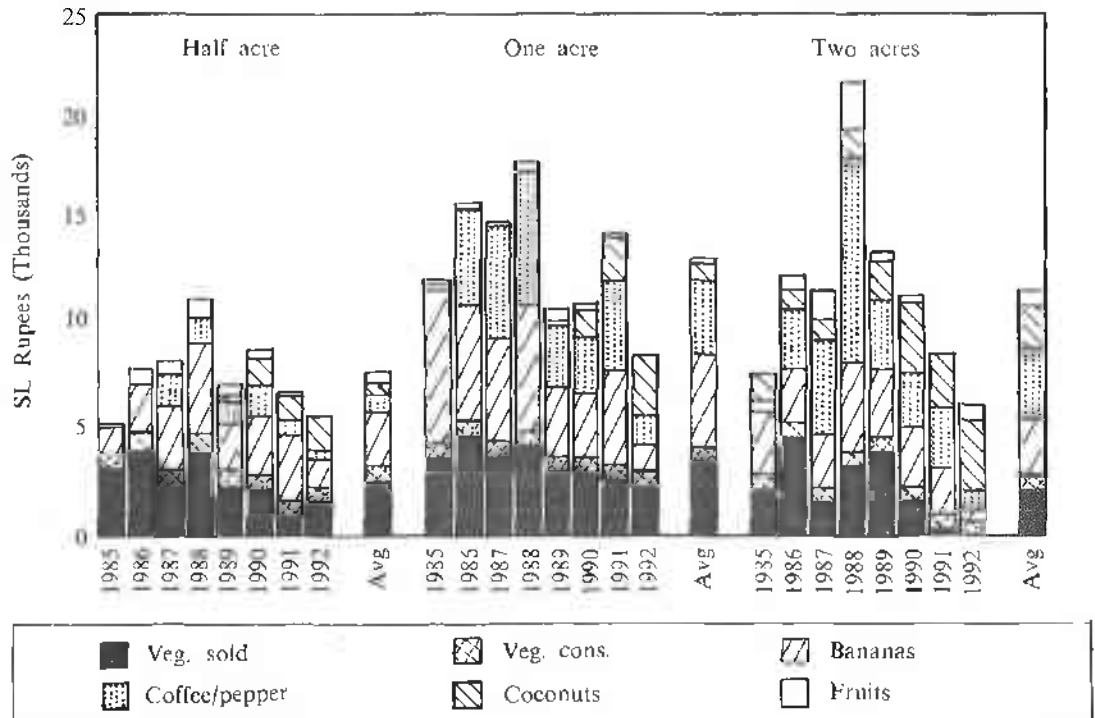
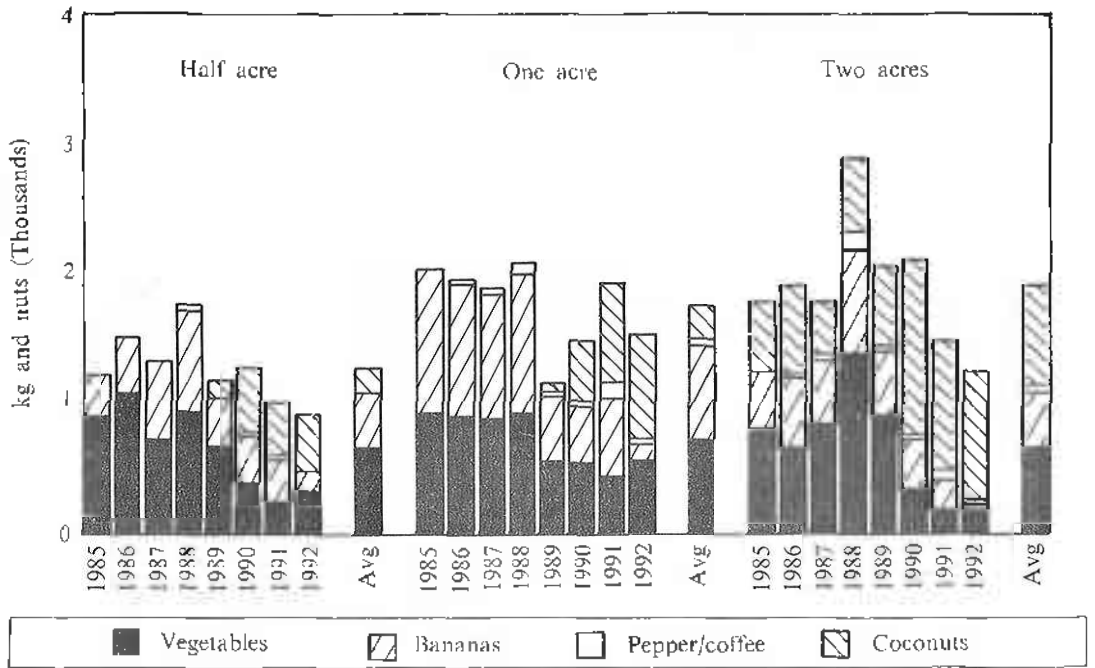


Figure 1. Crop yields in kg and nuts, and in Sri Lanka Rupees on the three MLDc farms (1985-1992).

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but not linearly. The productivity per acre was higher for the smaller farms. Even if poultry keeping is excluded, since it requires hardly any land, the gross margin per acre of the half acre unit at Rs 29,665 (100%) compares favourably with the one acre unit at Rs 27,169 (92%) and especially

with the two acre unit at Rs 16,861 (57%). The main reason for this is the higher productivity of crops in the half acre and one acre units. The gross margin per livestock unit was lowest in the half and two acre units, reflecting the small contribution from poultry.

TABLE 5. AVERAGE ECONOMIC PERFORMANCE PER YEAR, PER ACRE AND PER PERSON OF THE FARM ACTIVITIES OF THE THREE MLDC FARMS (1985-1992)

| | Half acre | | One acre | | Two acre | |
|--------------------------------------|-----------|-----------|----------|----------|----------|-----------|
| | Rs/year | Rs/acre | Rs/year | Rs/acre | Rs/year | Rs/acre |
| Total revenue | 55,483 | 110,966 | 39,780 | 39,780 | 70,455 | 35,227 |
| Total direct cost | 36,937 | 73,874 | 12,611 | 12,611 | 33,401 | 16,700 |
| Total gross margin | 18,546 | 37,092 | 27,169 | 27,169 | 37,054 | 18,527 |
| In % of 0.5 acre farm | 100 | 100 | 147 | 73 | 200 | 50 |
| Gross margin/(L.U) | 8,243 | (2.25 LU) | 10,868 | (2.5 LU) | 8,719 | (4.25 LU) |
| Gross margin/(person) | 12,364 | (1.5 p) | 18,113 | (1.5 p) | 21,174 | (1.75 p) |
| In % of 0.5 acre farm | 100 | | 147 | | 171 | |
| Gross margin per Rs 1,000 investment | 387 | | 594 | | 599 | |

The gross margin per actual person unit worked was larger in the one and two acre units. This proves that a family can produce a higher gross margin on larger plots. The gross margin per Rs 1,000 invested was low in the half acre unit, because the investment in general farm premises was proportionally much larger.

The average ratios of revenue (REV) over material or direct costs (DC) and cash income (CINC) over cash expenditure (CEXP) are presented per farm activity in tabel 6. Goat keeping had high revenue/direct cost ratios, because goats are fed on cheap Jack and Gliricidia leaves, and

no separate charges for manure or fertilizer were assigned to goats. The ratio for dairying increased with the farm size, reflecting the value of grass for dairying. The high ratio of cash income over expenditure in crops is due to the large non-cash input of animal manure. Very low figures resulted for poultry; this demonstrates that given the prevailing prices for birds and eggs and the cost of poultry feed, poultry contributes little to improving smallholder income. On the other hand, poultry determine a large part of the cost and cash income of the farm. The result is low overall ratios for the poultry keeping in the half and two acre units.

TABLE 6. AVERAGE RATIO OF REVENUE OVER DIRECT COSTS (REV/DC) AND OF CASH INCOME OVFR EXPENDITURE (CINC/CEXP) PER FARM ACTIVITY OF THE THREE MLDC FARMS (1985-1992)

| | Half acre | | One acre | | Two acre | | Overall | |
|----------|-----------|-----------|----------|-----------|----------|-----------|---------|-----------|
| | Rev/DC | Cinc/Cexp | Rev/DC | Cinc/Cexp | Rev/DC | Cinc/Cexp | Rev/DC | Cinc/Cexp |
| Dairying | 2.0 | 2.0 | 3.0 | 3.4 | 3.4 | 3.6 | 2.8 | 3.2 |
| Poultry | 1.2 | 1.1 | — | — | 1.2 | 1.2 | 1.2 | 1.1 |
| Goats | 9.1 | 6.2 | — | — | 3.3 | 2.8 | 5.7 | 4.5 |
| Crops | 3.3 | 10.0 | 4.0 | 9.7 | 2.6 | 10.1 | 3.2 | 9.9 |
| Overall | 1.5 | 1.5 | 3.2 | 4.6 | 2.1 | 2.3 | 2.0 | 2.5 |

Figure 2 shows the contributions from dairying, crops, goats and poultry to revenue (Rev), material or direct costs (DC) and gross margins (GM). Dairy cattle contributed most to the gross margin in the three MLDC farms; respectively 31% (half acre), 63% (one acre) and 69% (two acres), followed by crops (29%, 37% and 19%), poultry (22%, 0% and 9%) and finally goats (18%, 0% and 3%). Figure 2 also clearly illustrates that crops and goats require relatively little money to generate a good gross margin, whereas dairying and poultry, particularly the latter, require more funds to generate a gross margin.

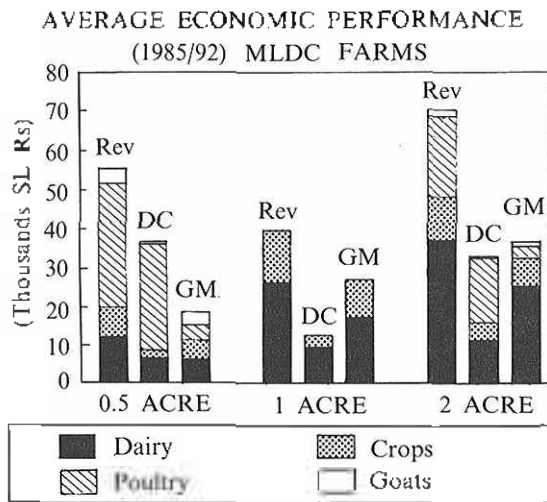


Figure 2. Average annual economic performance of three MLDC farms (1985-1992) in revenue (Rev), direct cost (DC) and gross margin (GM) for dairying, crops, goats and poultry.

Labour assessment

Comparing the labour estimates of the feasibility study (De Silva, 1986) with actual labour observations and studies done on the units (table 7) shows that in practice all units, especially the half and one acre ones, applied much more labour than originally envisaged. Also, the labour estimates used in the above feasibility study of 270 days in the half acre, 330 days in the one acre and 440 days in the two acre unit assumed some under-employment of family labour in the two smaller units and some need for contracted labour in the two acre unit. This was based on 260 man-days worked per farmer per year on average, augmented with family labour at a maximum contribution of 130 days by the wife.

The labour observations (Terwisscha, 1987) were additions of time schedules kept by the employee and his family with detailed descriptions of farm activities attended to during a month and extrapolated over the year. MLDC considered these additions of time spent on activities by these resident families as rather high, so per farm it estimated the hours the family members spent per enterprise over the day and the year (MLDC, 1990a, d, e).

The fourth study on the half acre unit was a compromise between the observations of the Terwisscha and MLDC studies (MLDC, 1990b). Whereas the units employed hardly any labour from outside, the actual labour studies indicated clearly that the employees' wives contributed substantially to the actual work on these small farms.

Although labour estimates were considered high by MLDC, they compared favourably with the

TABLE 7. OUTCOME OF ESTIMATES AND STUDIES OF LABOUR PER YEAR (DAYS) ON THE THREE MLDC FARMS

| | Half acre | | | 4) | One acre | | | Two acre | | |
|----------------------|-----------|-----|-----|-----|----------|-----|-----|----------|-----|-----|
| | 1) | 2) | 3) | | 1) | 2) | 3) | 1) | 2) | 3) |
| Dairying (+goats) | 120 | 329 | 183 | 256 | 150 | 479 | 183 | 210 | 609 | 183 |
| Poultry | 60 | 140 | 91 | 110 | | | | 40 | 65 | 46 |
| Vegetables | 50 | 102 | 171 | 130 | 60 | 167 | | 50 | 133 | 182 |
| Perennial crops | 40 | 44 | 103 | 52 | 120 | 95 | 365 | 140 | 103 | 228 |
| Subtotal | 270 | 615 | 548 | 548 | 330 | 741 | 548 | 440 | 910 | 639 |
| Household activities | | | 182 | | | | 182 | | | 182 |
| Total days | | | 730 | | | | 730 | | | 821 |

1) De Silva, 1986 2) adapted from Terwisscha, 1987 3) MLDC, 1990^{a,c} 4) MLDC, 1990^b.

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324, 219 and 411 man-days per year found for dairying in Kandy District in the studies on cost of milk production done in 1983, 1986 and 1990 (LPU, 1984 and 1987, and SL-ADB, 1990). Generally, in Kandy District much more time is needed to collect roughage (outside the farm) and to transport and market the milk than at MLDC, where the milk is collected at the centre. Another advantage of the MLDC farms was the installation and proper functioning of the biogas plants which produced enough domestic fuel for cooking and lighting, and saved on household labour for fire-wood collection. The data from the feasibility study of de Silva (1986) and the MLDC studies (MLDC, 1990a,d,e) were used for the following analyses.

Actual performance versus feasibility study

Table 8 shows the projected economic versus actual performance for revenue and material cost with the resulting gross margin (excluding labour costs), cash flow and the return to land (including calculated labour). Also indicated is the net result of the farms in the actual situation of revenue minus the costs of materials, salary paid and incentive received, and the depreciation on the

livestock sheds at 10% per annum. Whereas the cost of land rent and of marketing and of repairs to buildings have been deducted already under the final incentive payment, the net result is a measure of the return on capital. The difference between projected and actual investment is, besides the cost of the house, the initial wire fence, since this investment is not common in smallholder farms.

Only the two acre farm exceeded the projections in gross margin and return to land. This was because of inflation (see table 9) and the addition of the goat enterprise. The half and one acre farms exceeded the gross margin projection because of inflation, but both farms fell below the projected returns to land because much more labour was actually applied than envisaged. The return to capital was low for all three farms, especially in the half acre unit, which had little income from poultry and a relatively high investment in general farm and poultry premises.

The 3-11% return to capital also indicates, that it will be difficult for smallholders to instigate instant improvements in the Kandyan Forest Garden System by means of dairying, goats and poultry, because commercial credit is currently

TABLE 8. PROJECTED AVERAGE (10 YEARS) AGAINST AVERAGE ACTUAL PERFORMANCE OF THE THREE MLDC FARMS (1985-1992) IN SRI LANKAN RUPFFS

| | Half acre | | One acre | | Two acre | |
|---------------------------|-----------|---------|-----------|---------|-----------|---------|
| | Projected | Actual | Projected | Actual | Projected | Actual |
| Investment | 47,845 | 39,801* | 45,765 | 31,068* | 61,848 | 43,228* |
| Revenue | 42,275 | 55,483 | 31,734 | 39,780 | 53,226 | 70,455 |
| Material cost | 24,480 | 36,937 | 8,900 | 12,611 | 25,906 | 33,401 |
| Gross margin | 17,795 | 18,546 | 22,834 | 27,169 | 27,320 | 37,054 |
| Cash flow | | 15,737 | | 24,442 | | 34,448 |
| Calculated labour** | 8,100 | 16,440 | 9,720 | 16,440 | 13,020 | 19,170 |
| Return to land | 9,695 | 2,106 | 13,114 | 10,729 | 14,300 | 18,884 |
| Return per acre | 19,390 | 4,212 | 13,114 | 10,729 | 7,150 | 9,442 |
| In % of projection | 100 | 22 | 100 | 82 | 100 | 132 |
| Net farm result: | | | | | | |
| Salary + incentive*** | | 16,488 | | 23,475 | | 32,409 |
| Depreciation on sheds | | 850 | | 350 | | 800 |
| Return to capital | | 1,208 | | 3,344 | | 3,845 |
| In % of actual investment | | 3.0 | | 10.8 | | 8.9 |

* investment in dairying, crops, goats, poultry, water system and biogas.

** at 30 Rs per man-day projected and at 30 Rs per man-day using the man-days found during the MLDC studies done in 1989/90.

*** actual salary + incentive (gross margin-land rent-marketing cost-repairs).

available at interest rates of 16-19%. This becomes even more complicated in the light of the high increase in the price of breeding stock in recent years. A more gradual investment in phases of annual cash crops, medium term crops, long-term tree crops and livestock seems more appropriate and is also more in line with the smallholder's way of farm improvement by taking small steps and avoiding high risks.

The low return to capital on the MLDC farms is also caused by the high initial investments. In the actual situation of the smallholder, the farm house, water source, boundary fence and buildings are already largely present and therefore the actual investment in the village will easily be about 20,000 Sri Lankan Rupees below the 47,000 to 62,000 Sri Lankan rupees budgeted for the demonstration-cum-training farms at MLDC (MLDC,

1988). Investments in livestock sheds in the Mid-Country are usually lower too. In Kandy District, the total investment in dairying was Rs 6,388 in 1983 (LPU, 1984) and Rs 7,918 in 1986 (LPU, 1987) and Rs 15,738 in 1990 (SL-ADB, 1990) compared to Rs 13,982-Rs 21,285 in 1985/86 for the MLDC farms. The main difference was cost of investment in buildings and equipment.

Projected data did not include inflation, assuming that prices of inputs and produce would rise at the same rate and hence so would the gross margin. As shown in table 9 the price levels of a number of items changed over the period 1985 to 1992. Salaries, the price of a dairy heifer/cow and the fertilizer price rose much faster than the exchange rate of the US dollar against the Sri Lanka Rupee, whereas crop prices increased slightly or even fell, especially in the case of coffee/pepper.

TABLE 7. PRICE DEVELOPMENTS IN SRI LANKAN RUPEES OVER 1985-1992

| | Base level in 1985 | Price level in 1992 | Overall change (1985 = 100) |
|----------------------------|-----------------------|------------------------|--------------------------------|
| Value of 1 US dollar | 20 | 43 | 215 |
| Parastatal salary per year | 8,000 | 23,575 | 295 |
| Milk price/litre | 3.25 | 7.25 | 223 |
| Dairy heifer/cow | 3,000 | 11,000 | 367 |
| Fertilizer price/kg | 2.01 | 6.33 | 315 |
| Vegetable price/kg | 4.16 | 4.32 | 104 |
| Banana price/kg | 6.60 | 9.51 | 144 |
| Coconut price/nut | 2.29 | 3.37 | 148 |
| Pepper/coffee/kg | 91.7 | 35.0 | 38 |
| Egg price/unit | 1.28 | 2.25 | 176 |
| Poultry mash/kg | 4.84 | 7.98 | 165 |
| Concentrate price/kg | 2.53 | 3.92 | 155 |

Labour productivity or efficiency, calculated as revenue minus material costs, is presented as gross margin in Rs per man-day (and in US \$) in table 10. The actual labour productivity in US \$ per man day was lower than projected especially for the smaller units, because relatively more labour was applied than initially estimated. This implies that compared to off-farm employment at the rate of US \$ 1.5 per day, intensive livestock/crop farming can provide an alternative for those families who have at least a half acre, but preferably a minimum of one acre of land, and who can obtain or generate enough starting capital for the introduction of dairy cattle and/or goat keeping.

Labour efficiencies in crops and poultry were lower than for dairying and goats, and therefore over the period studied dairying and goat keeping were more attractive options for generating regular, financially rewarding self-employment of rural families in the Kandyan Forest Garden System. The intensive cropping of vegetables, bananas, coffee, pepper and tree crops can absorb much family labour, but requires a good market and price. Moreover, a good mix of crops is essential, to compensate for the seasonality in harvests and for the fluctuations in price common in single crops. Elsewhere in the Mid-Country an extra risk is felt by farmers because of increasing abundance

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of wild boars, especially since the destruction of crops can only be prevented by expensive fencing or by guarding the crops on the farm.

In conclusion, good management and performance of small-scale demonstration-cum-training units proved very feasible from 1985-1992 at MLDC, thanks to selected employees and their families, attentive monitoring of MLDC staff and an incentive bonus system based on monthly gross margins. The intensive technical and economic data collection and evaluation clearly illustrate the requirements, role and scope of various crops, poultry,

goats and dairying in the use of resources such as land, capital and labour, and the achievable technical output and economic returns. As such, the MLDC experience became an interesting intermediate between on-station and on-farm management for the demonstration and training of smallholders, staff and visitors, interested in improved, small-scale integrated livestock/crop farming. It would be worth further investigating more rotation between temporary crops and grass production and/or the use of more compost to maintain soil fertility for vegetables and bananas.

TABLE 10. PRODUCTIVITY OF LABOUR: PLANNED (10 YEARS) VERSUS ACTUAL (1985-1992) GROSS MARGIN IN RS / MAN-DAY AND MAN-DAYS (MD) IN THE THREE MLDC FARMS

| | Labour productivity | | | | | | | | | | | |
|------------------------|---------------------|-----|--------|-----|----------|-----|--------|-----|----------|-----|--------|-----|
| | Half acre | | | | One acre | | | | Two acre | | | |
| | Plan | | Actual | | Plan | | Actual | | Plan | | Actual | |
| | Rs/Md | Md | Rs/Md | Md | Rs/Md | Md | Rs/Md | Md | Rs/Md | Md | Rs/Md | Md |
| Dairying (man-days) | 58 | 90 | 43 | 137 | 59 | 150 | 94 | 183 | 63 | 210 | 150 | 170 |
| Goats (man-days) | 45 | 30 | 72 | 46 | | | | | | | 84 | 13 |
| Poultry (man days) | 86 | 60 | 44 | 91 | | | | | 75 | 40 | 72 | 46 |
| Crops (man-days) | 17 | 90 | 20 | 274 | 79 | 180 | 28 | 365 | 59 | 190 | 17 | 410 |
| Overall (man-days) | 74 | 270 | 34 | 548 | 69 | 330 | 50 | 548 | 63 | 440 | 58 | 639 |
| Ditto in US \$ | 3.7 | | 1.13 | | 3.45 | | 1.65 | | 3.10 | | 1.93 | |

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