A Comparative Evaluation of Integrated Farm Models with the Village Situation in the Forest-Garden Area of Kandy, Sri Lanka

M. N. M. Ibrahim* and G. Zemmelink
Animal Production Systems Group, Wageningen Institute of Animal Sciences (WIAS)
Wageningen Agricultural University, P.O. Box 338, 6700 AH Wageningen, The Netherlands

ABSTRACT : Data from a village household dairy survey was compared with technical parameters of three model farms (0.2, 0.4 and 0.8 ha in extent) established by the Mid-country Livestock Development Centre (MLDC). In terms of land size, about 67% of the 250 dairy farmers interviewed corresponded with the MLDC models, but only 33% of the farmers were keeping dairy cattle under conditions comparable to the MLDC models (no regular off-farm income). In the 0.2 ha category, village farmers kept more cows, and in the other two categories the village farmers kept less cows than their MLDC model counterparts. In all three categories, the milk production per cow was higher in the model farms (1540 to 2137 vs. 1464 to 1508 litres/cow/year), and this could be attributed to higher feeding levels of concentrates in the model farms as compared to the village farmers (430 to 761 vs. 233 to 383 kg/cow/year). The amount of milk produced from fodder was higher in the village situation in comparison to the models. In the mid country, dairy production seems to depend on access to fodder resources rather than on the extent of land owned. Except in the 0.8 ha village category, the highest contribution to the total income was made by the dairy component (44 to 60%). With 0.8 ha village farmers, the income contribution from dairy and crops was similar (41%). Income from other livestock was important for the 0.2 ha MLDC model, but for all other categories their contribution to total income ranged from 0 to 10%. Access to fodder resources outside own-farm land is vital for economic dairy production. As such, an in-depth analysis of feed resources available and their accessibility needs to be further investigated. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 1 : 53-59*)

Key Words : Integrated Models, Village Situation, Forest-Garden, Sri Lanka

INTRODUCTION

Over the past three decades several dairy development projects have been implemented in the mid country region of Sri Lanka. The mild climatic conditions in this region favour the rearing of exotic breeds of cattle, and this together with an established milk marketing network makes this a potential area for expansion of the dairy industry. The mid country smallholder homestead gardens of Sri Lanka are mainly in the highlands, and are distinct from the low-lying lands which are under paddy. The cropping pattern in these highland gardens is popularly known as the 'Forest-Garden Farm' (FGF) System (FAO, 1985), and is a combination of tree crops, root crops and herbs stratified into layers of overhanging foliage canopies (MLDC, 1987). The average farm size in the village sector of the Kandy district is 0.6 ha; 52% of the farms are less than 0.4 ha, 23% are 0.4 to 0.8 ha, 11% are 0.8 to 1.2 ha, and 14% are 1.2 to 8.0 ha (Westenbrink, 1986), and most dairy farmers keep one or two cows.

Dairy farming in the mid country of Sri Lanka is particularly important for poorer households without income from off-farm employment (Zemmelink, 1996). Economic performance of self-contained Mid Country Livestock Development Centre (MLDC) crop-livestock model farms (de Jong et al., 1994) showed that dairying contributed most to the total gross margin as compared to crops and other livestock. The aim in setting up the models of three (0.2, 0.4 and 0.8 ha) land sizes was to demonstrate a technically and economically improved 'FGF' system with a more open canopy to allow more intensive cropping, and livestock husbandry. The farmer and his family who were managing these model farms, had to completely rely on resources (land, fodder, etc.) available within the unit to sustain their dairy system. Recent studies in Indonesia, India and Sri Lanka have shown that at the individual household level, access to feed resources was largely determined by the availability of labour, and not by farm size (Zemmelink, 1996).

The objective of the study reported in this paper was to compare the performance of the Mid Country Livestock Development Centre (MLDC) model farms with the village farms in the vicinity. The evaluation is based on on/off-farm feed resources (fodder, concentrates), milk production, opportunities for casual employment and income composition.

MATERIALS AND METHODS

An elaborate household survey covering 250 dairy

* Address reprint request to M. N. M. Ibrahim. Department of Animal Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka. Fax: +94-8-388041, E-mail: mibrahim@slt.lk.
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farmers in the mid country 'Forest Garden Farms' (FGF) of Sri Lanka was conducted in 1994/1995 (Zemmelink, 1996). The objective of this survey was to identify constraints and limitations for increased milk production. Households were visited once, and the household members were interviewed using a structured questionnaire in order to gather information on (1) household composition and social characteristics, (2) livestock production, (3) land and crop production, (4) off-farm employment, and (5) income level and composition.

The data from the above survey was grouped according to land size comparable to those of the Mid Country Livestock Development Centre (MLDC) farm models established in 1983. Three model farms (one each of 0.2, 0.4 and 0.8 ha in extent) were established on bare farm land, with a house for the attendant and his family, a biogas plant and sheds for the livestock (de Jong et al., 1994). The aim of these MLDC model farms was to demonstrate a technically and economically viable 'FGF' system with a more open canopy to allow intensive cropping, and in addition included livestock enterprises such as dairy, goats and poultry to provide additional income, farmyard manure and biogas for cooking and lighting (de Jong et al., 1994). The MLDC model farms are managed by the selected households and they try to derive their income only from the farm, and in turn the management guarantees a minimum annual income. A complete economic analysis on the performance of these models over a period of 8 years (1985 to 1992) was published by de Jong et al. (1994), and the data was re-analysed in 1996 covering a period of 10 years (M.N.M. Ibrahim unpublished data).

The household survey data was stored in Dbase IV, and the Dbstat version 2.1 (Brouwer, 1992) software program was used to obtain information on the effect of farm size on household, cropping and livestock characteristics; feed resources and milk production; annual household income and its composition.

Rapid appraisal of the 'FGF' in the Kandy area on the aspect of types of fodder resources available and their accessibility to dairy farmers was also carried. All regions of the Kandy district was covered, and information was gathered from farmers, village heads, field level extension workers and the Veterinary Surgeons of the various ranges.

RESULTS AND DISCUSSION

Household characteristics

The area of own farm land is often considered to be a limiting factor for livestock farming. The choice of farm sizes in the MLDC model farms correspond well with the land size of farm holdings in the village. The results of the different households classified as per farm size are presented in table 1.

The dairy farming households were about equally distributed over the different area classes. The large number (18%) of households in the landless category also indicates that own land is not a necessity for dairy farming. Moreover, there is no significant difference ($p>0.05$) between the number of animals reared in the different land size farm classes (1.1 to 1.4). Although the households with limited land could compensate their income by keeping more dairy cows, the question arises why they choose dairy and not other activities. In an earlier study (Zemmelink, 1996), it was shown that such households either had no opportunity for other type of activities or they were widows, and about 12% of the households fell in this category.

Dairy production

The percentage of cows in lactation did not differ much between the farm sizes and ranges from 71 to 82% (table 1). Average milk production per lactating cow on the day of the visit was highest in the farms with the largest land size (6.4 litres), and was about 1 litre more than in the other farm groups. This higher milk production could be related to higher feeding of concentrate feeds in this group. However, notably there was no clear relationship between concentrate supplementation and milk production. Probably households with more land area (>0.8 ha) have access to fodder, and the animals are fed more of a better quality fodder. With the other groups (land area <0.8 ha) there was a trend for higher milk production with increase in concentrate supplementation. The percentage of farms having a cow producing more than 10 litres of milk was highest in the largest farm size group followed by the group having 0.8 ha of own land.

Household income

It was found that when the land size of the farm increased, more men and less women were involved with dairy as the main activity (Zemmelink, 1996). The household income increased with the increase in land size (see table 1). Income from off-farm was the major source (about 40%) for farm sizes equal to or less than 0.4 hectare, and it was about a third of the total income for farm sizes more than 0.8 hectare. Landless households compensate for the lack of income from crops mainly through casual labour. In the group with more land, the relative share from dairy production was low because the overall income was high. The absolute income from dairy was between Rs. 14,000 to Rs. 18,000 (US$ 233 to 300) for the land sizes studied.

Table 1. Characteristics of the village households for each own-land size grouping

Parameter	Landless (<0.1 ha)	0.2 ha	0.4 ha	0.8 ha	Large (>1.1 ha)
General:					
Number of households	46	58	56	54	36
Household size (persons)	4.9[a] (0.9)	4.7[a] (0.8)	4.7[a] (1.0)	5.3[a] (1.1)	4.8[a] (0.9)
Herd characteristics (mean):					
Cow	1.1[a]	1.4[b]	1.1[a]	1.4[b]	1.2[a]
Heifer	0.5	0.6	0.4	0.5	0.4
Young bull	0.2	0.1	0.2	0.2	0.1
Heifer calf	0.5	0.6	0.6	0.4	0.5
Male calf	0.4	0.3	0.2	0.4	0.4
Livestock units (LU)*	2.0[a]	2.1[a]	1.8[a]	2.2[a]	1.9[a]
Main fodder source (%):					
Own farm	7	28	34	39	67
Outside farm	70	50	55	48	33
State farm	17	15	9	13	0
No information	6	6	2	0	0
Total	100	100	100	100	100
Concentrate feeding (mean) (kg/day)	1.0[a] (0.3)	1.1[a] (0.3)	1.2[a] (0.4)	0.8[a] (0.3)	1.3[a] (0.3)
Milk production:					
Cows in lactation (% within group)	71	78	82	76	79
Production (litres/day)	4.9[a] (1.2)	5.2[a] (1.1)	5.3[a] (0.9)	4.8[a] (0.9)	6.4[a] (1.4)
Farms with cows producing > 10 litres/day (% within group)	17	17	16	26	33
Household income (×000 Rs):					
Annual income	45 (8.1)	50 (6.9)	58 (7.7)	66 (9.8)	87 (11.1)
From Dairy	14 (1.8)	17 (2.9)	14 (2.6)	18 (3.9)	15 (2.3)
Income composition (% of household income):					
Dairy	31	35	24	27	17
Other livestock	0	3	1	3	1
Crop	5	12	19	29	44
Off-farm	39	41	45	33	30
Casual labour	25	9	11	8	8
Total	100	100	100	100	100

Figures in parentheses are standard errors.
Within rows, means with similar superscripts are not significant ($p>0.05$); *1 LU = 300 kg.

Source and accessibility to fodder

With an increase in land size the own-farm as the main fodder source became more frequent (table 1). However, at the 0.8 ha-farms still half the farms relied mainly on fodder from outside, and for large farms this was still a third. It is evident that for dairy farming, all landless households and the majority of households with land rely mainly on fodder from surrounding farms and common or public property.

The descriptive information collected from the rapid appraisal on the types of fodder sources available in the 'FGF' system area and the availability and access to these resources are presented in table 2. It was evident that much of fodder, which was a mixture of grasses and creepers collected by the dairy farmers was from outside their farm. Feeds used included grass, tree leaves (mainly gliricidia and jak), various creepers, coconut cake and rice bran. Grass was harvested from crop fields as well as a range of other sites such as roadsides, railway dikes, land belonging to temples and mosques, cemeteries and government estates (mainly coconut farms). Grass from paddy fields was mainly used by the owner of the field if he has cattle. It was common to see animals grazing in paddy fields when the land was not cropped with rice (January - April and August -

Table 2. Description of fodder sources and their accessibility in the Forest Garden Farms

Type of Fodder and Source	Availability/accessibility
GRASSES	
Outside farm:	
- From road sides, railway reservations	Throughout the year, may be during the dry-months (Feb-April) & (July-Sept) the quantity is limited. Unfertilized grasses (mainly guinea A) from roadsides and railway reservations. Good grass growth both in the paddy field & bund because of the use of fertilizer for rice cultivation.
- Government livestock - coconut farms grow grow improved grasses (quantity unlimited)	These are fertilized, but access is limited and if a member of the household is working in the farm he/she has preference.
- From land belonging to temple/ mosque and cemetery	Access is limited to those who know or have friends in the management committees.
On farm:	
- Paddy field bunds (own/others)	Throughout the year, except during land preparation when the bund is also weeded and re-plastered.
- Paddy fields (own)	Animals could be grazed when the land is not cropped with rice. Some farmers grow vegetables in their paddy fields after rice is harvested. In such cases they are not allowed to graze, but weeds could be cut and fed.
- Highland	The homestead and/or the highland garden is intensively cropped with a mixture of crops, namely; spices (pepper/ nutmeg/cloves), coffee, cocoa, arecanut, coconut, jak. As such the grass production under forest garden system is limited.
TREE LEGUMES	
Outside farm:	
- From road sides	Throughout the year if regularly harvested or pruned, if not the leaves are shed during the dry season and they start flowering.
On farm:	
- From perimeter fence	Usually regularly harvested, but the quantity available per farm depends on the spacing between plants. Unusual to see tall glyricidia trees or glyricidia flowering when planted along the fence of homegardens.
- From live support for pepper	Not allowed to growing over 3.0-3.5 m in height (easier for pepper harvesting), and usually the leaves and twigs are pruned. The branches are needed for spread of pepper branches.
- From shade tree for coffee/cocoa	Availability of fodder may be limited because the height and the side spread of branches are needed to provide shade.
CREEPERS	
Outside farm:	
- From road side, railway reservations, land belonging to temple/ mosque, cemetery	Availability same as for grass. May also include leguminous creepers like mimosa and centrosema.
On farm:	
- From paddy field bunds, paddy fields	Same as for grass.
JAK LEAVES	
- Only on farm, because the purpose of having a jak tree is primarily for fruits.	You should have a tree in your garden to get leaves. You should climb the tree to cut branches, on the contrary you can pluck a fruit without the need to climb the tree (with a curved knife attached to a bamboo). So it is not common to see farmers feeding jak leaves everyday, because of the above constraint (the need to climb) and if harvested daily (heavy defoliation) which might affect fruit production.

September). However, grazing was not possible if the field was used to grow vegetables, though harvesting of grass and weeds was still possible. Paddy field bunds also form an important source of grass. As cutting of the grass growing on the bunds helps to maintain it, the use is not restricted to the owner of the field. Bunds are a source of grass throughout the year, except during land preparation when the bunds are re-plastered. Because rice fields are fertilized regularly, the grass from the field and the bunds, is often of relatively high quality (Ibrahim, 1988). Also, grass on the bunds must be kept short and is therefore usually harvested at a young stage of growth. Grass on roadsides and railway banks (mainly Panicum maximum - guinea A) is not fertilized, but freely available. Grasses grown on government coconut estate farms are often improved varieties, but not frequently fertilized. The management of the grass undercover on estates is determined by the requirements for the main crop (usually coconut). As such, only the coconut trees (around the base of the palm) are regularly fertilized. However, access to the estates is not free; farmers who work as labourers in the estate have first rights. Yields of grass from homesteads and highland gardens are low because these areas are intensively cropped with trees and other perennial crops.

Tree leaves include mainly gliricidia. Three sources may be distinguished: road sides, perimeter fences and gardens, where gliricidia is used as a support for black pepper creepers and as shade trees for coffee and cocoa. Gliricidia produces leaves throughout the year if harvested regularly. If not, the trees shed their leaves during the dry season and start flowering. It was common to see big trees (3-4 m high) on roadsides. Usually after cutting the branches, either the leaves were stripped off or only leaves plus young twigs were taken to the farm. Female farmers may find it difficult to reach the tall branches. Gliricidia close to perimeter fences were usually harvested regularly. It was unusual to see tall and flowering trees along the fence of home gardens. Thus, twigs with leaves can easily be harvested by women. The quantity per farm depends on the spacing between plants. Gliricidia trees grown as support pepper are not allowed to grow over 3-3.5 m. On the other hand, shade trees must grow higher. Creepers include a variety of plants, including some leguminous species such as centrosema. Areas from which they were harvested were as for grass. Jak leaves were also a popular feed. However, because trees are high, most women depended on their partner to harvest jak leaves. Because heavy defoliation may affect the yield of fruits, amounts of leaves which could be harvested for forage were limited. Usually the leaves were harvested when the tree was climbed to harvest the fruit. Climbing of trees by strangers was not condoned.

Comparison of village farms with MLDC model farms

The number of households in the survey sample that kept dairy cattle under conditions comparable to that of the MLDC models farms are presented in table 3. Selection comparable to the MLDC model farm sizes of 0.2, 0.4 and 0.8 ha was performed by a count down procedure as per conditions listed below in table 3.

Table 3. Number of village households comparable to MLDC model farms by land size

Parameter	0.2 ha	0.4 ha	0.8 ha	Total
N1=farm size	58	56	54	168
N2=N1+no off-farm income	32	23	27	82
N3=N2+no casual labour income	19	13	20	52
N4=N3+fodder mainly from own farm	6	3	8	17

In terms of land size about two thirds (168 out 250) of the households interviewed during the general household survey corresponded with the 3 MLDC model farms. Also the distribution of households within the three land sizes is similar. When the condition of no income from off-farm activities was included (N2), the number of households was reduced to 82 (about a third of the dairy farming population), and it further reduced to 52 households when the condition of no income from casual labour was included. The final condition of usage of fodder only from own land (N4) reduced the number of households comparable to those of the MLDC models to 17, which is 7% of the dairy farming households studied in the area. As such, only a small proportion of farmers were keeping dairy cattle under comparable conditions to those of the MLDC farm models.

In comparing the MLDC models with the village situation, the group of village dairy farmers with income from casual labour was included because the income from casual labour can be regarded as comparable to the assurance of a minimum income guaranteed by the MLDC to the families running the models. Also, village households with the main fodder source outside their own farm were included, on the assumption that these households had land and if they wanted they could grow their own fodder (Zemmelink, 1986). The model farm operators did not obtain fodder from outside sources (de Jong et al., 1994).

The results of the comparison between village

dairy farmers and MLDC models are presented in table 4. In the 0.2 ha category, the village farmers kept more cows than the MLDC counterparts (1.7 vs. 1.0), but in the 0.4 and 0.8 ha categories the number of cows in the village set up was lower than the MLDC model farms (1.2 vs. 2.0 and 1.6 vs. 3.0, respectively). In the 0.2 and 0.4 ha farm size categories, the average milk production per cow at the village level was lower than at the MLDC models (629 and 339 litres lower, respectively). But, for the 0.8 ha farm size the difference in milk production between the village-based and MLDC model was only 76 litres. At the model farms the animals received more concentrates than on the farms in the village. For example, in the 0.2 ha category the difference was 435 kg/cow/year. The high level of supplementation and the smaller herd size in the model farms indicated that it is difficult to keep dairy cattle on a farm of 0.2 ha without using fodder sources from outside.

When only the model farms are compared, the milk production per cow at the 0.2 ha farm was about 300 litres higher than at the 0.4 ha farm, and also the concentrate supplementation is 170 kg higher in the latter. Similar differences in milk production and use of concentrate supplements existed between the 0.4 ha and 0.8 ha models (about 300 litres and 160 kg, respectively). These differences suggest that on an average 1 kg of concentrate produced 2 litres of milk. This ratio is in line with the generally accepted norms (Anonymous, 1988). As shown in table 4, this ratio explains the observed difference in milk production between the model farms by the differences in concentrate supplementation. The difference in milk production between the 0.2 and 0.4 ha model farms (299 litres), could be attributed to the production of 346 litres more from concentrates and 47 litres less from fodder.

In the MLDC models, the quantity of milk produced from fodder is lower than at the village counterparts, and the difference is more pronounced in the 0.8 ha category. In this category the average milk production for the MLDC model is similar to the village situation (1,540 vs. 1,464 litres), but the amount of milk produced from fodder is higher in the village situation as compared to the MLDC model (68% vs. 45%). It can be concluded that the farmers in the village succeed in producing milk with less concentrate feeding, but the genetic potential of the cow for milk production is not achieved due to lack of proper supplementation.

Even though the village households with off-farm income were excluded in this analysis, the income composition between the MLDC model farms and village their counterparts were different. In the 0.2 ha category, the MLDC farmer derived one third of their income from other livestock (poultry and dairy goats), while at the village level the households kept more

Table 4. Dairy production and economic performance of MLDC models versus village farms

	0.2 hectare		0.4 hectare		0.8 hectare	
	MLDC[3]	Village (n=32)	MLDC[3]	Village (n=23)	MLDC[3]	Village (n=27)
Number of cows (mean)	1	1.7	2	1.2	3	1.6
Milk production[1] (litres/cow/year)	2137	1508 (132)	1838	1499 (123)	1540	1464 (118)
Concentrates fed[2] (kg/cow/year)	761	326 (53)	588	383 (59)	430	233 (36)
Milk production from concentrates (@ 2 *l*/kg)	1522	652	1176	766	860	466
Milk production from fodder	615	856	662	733	680	998
Income composition (% of total):						
Dairy	39	57	54	44	60	41
Other livestock	32	6	0	1	10	5
Crops	29	17	46	30	30	41
Casual labour	0	20	0	25	0	13
Total	100	100	100	100	100	100

[1] Calculated as follows for the village farms: (Total milk production on the day of visit × 365 days)/Total number of cows.
[2] Calculated as follows for the village farms: (Total concentrates used on the day of visit × 365 days)/Total number of cows.
[3] Derived from de Jong et al., 1994.
Figures in parentheses are standard errors.

cattle and derived about 20% of their total income from casual labour. For the 0.8 ha category, income from crops and dairy were equally important for village households (41%), while dairy farming was the most important income source for the MLDC counterpart (60%).

This comparative evaluation of model versus village farms highlights the importance of access to ouside fodder sources, and the greater extent of crop-livestock integration in the village situation. In-depth analysis of the village farm systems taking into consideration the socio-economic aspects, and labour allocation to varies farm and non-farm activities are warranted firm recommendations could be made.

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