COCOS (2003), 15 60 - 81
Printed in Sri Lanka

SOCIAL ACCEPTABILITY OF COCONUT-BASED AGROFORESTRY MODELS DEVELOPED TO SMALLHOLDERS IN SRI LANKA

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ABSTRACT

Coconut Research Institute of Sri Lanka (CRISL) has designed and established twenty-six coconut-based agroforestry models in different agroecological regions of smallholder coconut farmers' fields commencing 1987. This study evaluates the conformity of four selected models with the existing resource base of smallholder coconut farmers and elicits their perceptions on these models. The selected models include: mixed farming for Wet Zone (model 1), mixed cropping for Wet Zone (model 2), mixed farming for Wet Intermediate Zone (model 3) and intercropping for Wet Intermediate Zone (model 4), established respectively at Gaspe, Hanchapola, Katuneriya and Thulawala. Conformity of these models with the existing resource base of the farmers was analyzed by comparing labor and cash requirement of the models with the availability of these two resources at farmers' disposal while the farmers' perceptions were elicited through a survey using a structured questionnaire supplemented with informal discussions. Results revealed that all the selected agroforestry models conform with the existing cash resource base of the farmer at current scale of operation, but not so with the family labor supply. However, both these resources may turn out to be limiting constraints once the current scale of operation is expanded. The farmers' expressed mix perceptions on agroforestry models in terms of model layout, crop composition, suitability to socioeconomic circumstances etc, with an overall positive assessment implying that the models developed by the CRISL are acceptable for them.

INTRODUCTION

In Sri Lanka, majority of coconut lands are maintained as monocultures. This gives relatively low returns to the farmer per unit land area than its potential under intensified land use systems. Coconut-based agroforestry i.e. cropping and farming with coconut plantations, is one of the strategies to efficient utilization of coconut lands and it also provides many socio-economic advantages.

In mature coconut lands, nearly 75% of land area is available for agroforestry models while the corresponding figure in young coconut plantations, i.e. plantations of > 0-5 years, is 80-90% (Liyanage, 1994).

Liyanage and Dassanayake (1991) have identified several coconut-based agroforestry systems, which include intercropping, mixed cropping, coconut-based alley cropping, coconut-based mixed farming and cultivation of multipurpose trees in coconut lands. Based on these and past experiences, the Coconut Research Institute of Sri Lanka (CRISL) has developed some coconut-based agroforestry models for coconut growers to increase land productivity and farmers' income. These models were established in farmers' fields of different agro-ecological regions (Table A1).

Profitability of these models is one of the major determinants influencing the adoption of them by smallholder farmers[1]. However, profitability of a technology alone is not a sufficient condition to take the adoption decision, especially by smallholder coconut farmers. The technology must be conform to the existing resource base and the diverse objectives of farmers. Therefore, evaluation of the conformity of these crop models to resource base and multiple objectives of farmers is an important area of research as a pre requisite to recommend these models to the farmers.

Objectives of the Study

The objective of this study is to evaluate the social acceptability of agroforestry models developed by the CRISL for smallholders in the Wet and Intermediate Wet Zones of Sri Lanka. The specific objectives are:

i. To determine the conformity of the agroforestry models with the existing resource base of the selected farmers, and
ii. To investigate the farmers' perceptions on the selected agroforestry models.

METHOD

Data

CRISL has established 26 coconut-based agroforestry models in smallholder farmers' fields of different agro ecological regions to investigate the agronomic performance, economic feasibility and the social acceptability

[1] This aspect was explored elsewhere by the same authors and concluded that the annual gross margins and Net Present Values of selected four agroforestry models are higher than coconut monoculture.

of these models by smallholder farmers. Table A1 presents the details of the established models.

A control plot involving only monocrop coconuts has been maintained in each of the models for comparison. Input and output data of each model were collected once a month from the time of establishment.

Of the 26 models, 4 models (a crop model and a crop livestock integrated model each from Wet Zone and Intermediate Wet Zone as detailed in Table 1) were selected for the detailed study considering the time and other resource limitations for the present study. Representation of both crop and crop-livestock integrated models for the detailed analysis forms the basis of selecting these four models.

Farmers' perceptions on agroforestry models

The farmers' perceptions on the selected four models were elicited using a one-page questionnaire with open-ended questions supplemented with informal discussions. The main sections of the questionnaire were: (i) type of land use, (ii) land use history, (iii) comments on layout of the model, (iv) comments on composition of the component crops in the model, such as species and population density, (v) suitability of the model to the socio-economic condition of the farmer (scale of inputs and management), (vi) suitability of the model to the soil conditions in relation to selection of species and varieties and resource competition, (vii) suitability of the model to the agro-ecological region, (viii) acceptability of the model by farmers, (ix) importance of subsidies, (x) household income and expenditure.

Analytical Procedure

A. Conformity of the models with the existing resource base of farmers

a. Additional resource requirement

Additional resource requirements were determined by comparing labor use and capital requirement of monocrop and agroforestry systems. Family man days (FMD), family women days (FWD), family child days (FCD), hired man-days (HMD), hired women days (HWD) and hired child days (HCD) were used for the comparison of labor use.

Table 1: Description of selected models

	Model 1	Model 2	Model 3	Model 4
Location	Gaspe, Banduragoda	Hanchapola, Divulapitiya	Ihala Katuneriya	Thulawala
Model	Mixed farm	Mixed crop	Mixed farm	Catch cropping (replanting)
Farmer	P A Hemachandra	K Amaradasa	Michael Fernando	T Madurapperuma
Agroecological zone	Wet Zone (WZ)	WZ	Wet Intermediate Zone (WIZ), (IL1)	WIZ (IL1)
Soil type	Lateritic gravel	Lateritic gravel	Sandy loam	Lateritic gravel
Coconut Plantation				
Extent	5 ac	20 ac	5 ac	7 ac
Age of plantation	30 years	40 years	40 years	1 year
Planting system	8 x 8m	8 x 8 m	8 x 8 m	10 x 6.5 m. Avenue
Average yield	47nuts/palm/year	57 nuts/palm/year	72 nuts/palm/year	_
Crop/farm model				
a. Season of establishment	May/June, 1992	Oct/Nov, 1987	Yala[a] 1989	Maha[b]91/92
b. Extent of the model	1 acre	0.05 ac	2 ac	0.5 ac (40 palms)
c. Crops/pasture	pasture, NFT's	Pepper 130 vines Coffee 60 plants Ginger 40 plants Banana 40 suckers	Coffee 262 plants Guinea B & Brachiaria milliformis, Pueraria & Gliricidia	Pineapple plants 2600, Banana- 48 suckers, Ginger- 50 Kg,
d. Animals	Local x Jersey	None	Sindhi x Jersey crossbred heifers -2	None

Notes: a – Cultivation season covering the period May to July.
b – Cultivation season covering the period September to January.

Capital requirements of agroforestry systems and monocrop systems were calculated using the cost involved for hiring of labor, purchasing of material inputs, hiring of machinery and transport. Although an opportunity cost is involved for family labor (FL), out of pocket expenditure is not incurred for FL, so it was not considered for calculating capital requirement.

b. Monthly labor requirement and availability

Monthly labor requirement for agroforestry and monocrop systems and household availability in man-days were assessed. Representative data only for two years from each model were used for this assessment although several years' data for the complete monitoring period were available.

c. Cash requirement and availability

The cash availability for each farmer was computed using the income and expenditure data collected from informal discussions with them. The cash availability was compared with the capital requirement of each agroforestry model. As there was a high variation in capital requirement in different years of each model, minimum and maximum capital invested for the models were used for comparisons.

B. Farmers' perceptions

Information gathered from informal discussions with farmers was analyzed descriptively to determine the farmers' perceptions on different attributes of agroforestry models.

RESULTS AND DISCUSSION

A. Conformity of Models with Existing Resource Base of Farmers

Two resources, i.e. labor and cash were considered. Section (a) and (b) discuss the results respectively with regard to labor and cash.

a. Comparison of labor use

a.i Annual labor requirement

\Model 1

Table 2 : Shows the labor use by agroforestry and coconut monocrop systems of model 1.

Year	Mixed farming				Coconut monocrop			
	FMD	FWD	HMD	HWD	FMD	FWD	HMD	HWD
1	74.75	1.75	115	35	39.75	1.75	68	35
2	63.75	-	7	-	3.75	-	13	-
3	62	0.25	7.5	-	8	0.25	7.5	-
4	77.5	2.25	5	-	9.25	0.75	5	-
5	73	5	10	0.75	2.75	-	15	0.75
Total	351 (70.2)	9.25 (1.85)	144.5 (29)	35.75 (7.15)	63.5 (12.7)	2.75 (0.55)	5 (21.7)	35.75 (7.15)

Notes: FMD- family man days; FWD- family women days; HMD- hired man days;
HWD – hired women days.
Figures in parentheses are the averages.
Source: Mixed farming model, Gaspe (1992-1996).

Mixed farming model utilizes higher amount of labor than coconut monocrop. For instance, nearly six times family man days (FMD) over monoculture. This reveals that mixed farming would match to farmers either with a greater availability of family labor or with a greater access and affordability to hired labor. Contributions of family women days (FWD) for total labor use in both systems are low and both systems use hired women days (HWD) in almost equal quantities. Labor use in first year is high in both systems than other years. Utilization of FMDs and HMDs in agroforestry system was respectively 236% and 33% higher than coconut monoculture.

Model –2

Agroforestry system shows a higher labor use (nearly double) than coconut monoculture (Table 3).

Normally perennial crops utilize high amount of labor during the initial growth phase and they need at least ten years to give an attractive yield. During the first five years, total labor utilization of mixed cropping system is considerably high while in the coconut monocrop it is low and equally distributed between years. Use of FMDs, FWDs and HMDs were respectively 146%, 628% and 116% higher than coconut monocrop. Very few or virtually no HWDs and CDs were used for coconut monoculture and a very little of CDs were used for the mixed cropping system.

Table 3: Comparison of labor use in mixed cropping and coconut monoculture – model 2

Year	Mixed cropping						Coconut monocrop					
	FMD	FWD	FCD	HMD	HWD	HCD	FMD	FWD	FCD	HMD	HWD	HCD
1	2.65	-	-	21	7	-	2.14	-	-	7	-	-
2	12.52	2.5	-	17	7	-	8.63	2.5	-	7	-	-
3	14.37	8.5	-	11	10	4	5.72	0.5	-	6	1	-
4	26.54	7.5	-	13	-	-	7.21	-	-	5	-	-
5	13	8.75	1.5	21	4.25	-	6.5	0.5	-	5.5	-	-
6	9.25	1	-	4.75	-	-	4.25	-	-	5.5	-	-
7	9.25	1.5	-	4.5	1	-	3.5	-	-	5	-	-
8	7	1	-	9.75	1	-	2	1	-	8.5	-	-
9	11.75	2	-	7.5	3.25	-	3.25	-	-	1	-	-
Total	106 (12)	32.7 5 (4)	1.5 (0.16)	109.5 (12)	33.5 (3.72)	4 (0.44)	43 (4.8)	4.5 (0.5)	-	50.5 (5.6)	1 (0.11)	-

Notes: FMD- family man days; FWD- family women days; HMD- hired man days; HWD – hired women days.
Figures in parentheses are the averages.
Source: Mixed cropping model, Hanchapola (1987-1996).

Model 3

Total labor requirement for agroforestry system of model – 3 was greatly higher than for its monocrop coconut counterpart (Table 4). Equally, the labor requirement of the agroforestry system was greatly higher than the labor supply by the household. Therefore, the farmer has to depend on HL. Of the total labor force, contribution of family labor is higher in mixed farming system whereas approximately equal contribution of HL and FL can be seen as regards to coconut monocrop. Mixed farming model had utilized 8.5 and 23.6 times more FMD and FWD respectively as compared with coconut monocrop. Labor use in coconut monocrop system is almost uniformly distributed except in first two years. Dairy management and coffee needed higher labor inputs initially. Therefore, this model is economically more viable with households having a greater supply of family labor or for households having greater accessibility and affordability to hired labor.

Table 4: Comparison of labor use in mixed farming and monoculture –model 3

Year	Mixed farming						Coconut monocrop					
	FMD	FWD	FCD	HMD	HWD	HCD	FMD	FWD	FCD	HMD	HWD	HCD
1	67.75	72.25	-	61	12	7	23	3	-	-	2	-
2	127.5	148.5	-	22	4	-	22	5	-	-	-	-
3	142	157.25	23.5	9	2	-	7.5	3	-	20	-	-
4	135.5	101.5	-	10	2	-	9	9.25	-	20	-	-
5	66.5	75	-	4.5	4	-	5	3.5	-	20	-	-
6	99.75	43	-	5.35	15.5	-	5.75	1.5	-	20	-	-
7	9.25	4.75	-	6	-	-	4.25	0.25	-	24	-	-
Total	648.25 (92.6)	602.25 (86)	23.5 (3.36)	117.85 (16.83)	39.5 (5.64)	7 (1)	76.5 (11)	25.5 (3.64)	-	104 (14.8)	2 (0.28)	-

Notes: FMD- family man day; FWD- family women day; HMD- hired man day; HWD – hired women day.
Figures in parentheses are the averages.
Source: Mixed farming model, Ihala Katuneriya (1989-1997).

Model 4

In model 4, coconut monocrop and mixed cropping systems had utilized mainly HL and the labor requirement of the mixed cropping system is greater than coconut monocrop (Table 5). Total labor requirement for both cropping systems has declined with time. The contribution of HMD and HWD for mixed cropping was respectively 126% and 620% greater than the monocrop. For all models, contribution of child labor was negligible.

Table 5: Comparison of labor use for mixed cropping and monoculture model 4

Year	Mixed cropping						Coconut monocrop					
	FMD	FWD	FCD	HMD	HWD	HCD	FMD	FWD	FCD	HMD	HWD	HCD
1	-	-	-	80.51	16.25	2	-	-	-	31.5		-
2	-	-	-	20.64	18.75	1	-	-	-	11	0.75	-
3	3	-	-	20.25	4.5	-	-	-	-	9.5	-	-
4	-	-	-	21.5	5.5	-	-	-	-	11	5.5	-
Total	3 (0.75)	-	-	142.9 (35.72)	45 (11.25)	3 (0.75)	-	-	-	63 (15.75)	6.25 (1.56)	-

Notes: FMD- family man days; FWD- family women days; HMD- hired man days; HWD – hired women days.
Figures in parentheses are the averages.
Source: Mixed cropping model, Thulawala (1991-1995).

a.ii. Monthly labor requirement and availability

Model 1

As Figure 1 shows, the labor requirement of the coconut monocrop during May to November of first year was met by the household, whereas the labor requirement of the agroforestry system was higher than the availability during the same period. There was a labor peak in December for both agroforestry and coconut monocrop systems, during which time the available labor was significantly less than the requirement. This was due to the establishment of husk pits. The labor requirement of the agroforestry system from January to April was met by the supply, whereas the labor requirement for coconut monoculture during the same period was less than the supply. All these suggest that coconut monoculture is feasible with the available labor whereas agroforestry system requires more labor than the supply from the household. Therefore, HL component plays an important role in the adoption of the agroforestry systems.

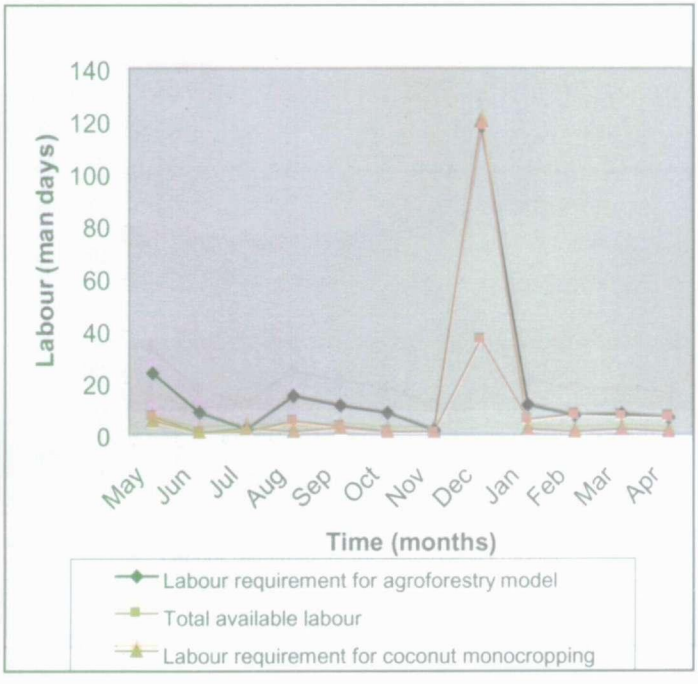

Figure 1 Monthly labor requirement and availability in the first year of model -1

As Figure 2 shows, labor requirement of the coconut monoculture system during the 4th year was less than the supply. There was a labor peak in December for coconut monocrop due to the weeding. There were labor peaks in May, August, November and April in agroforestry system, during which the labor demand could not be met by the household supply (Figure 2).

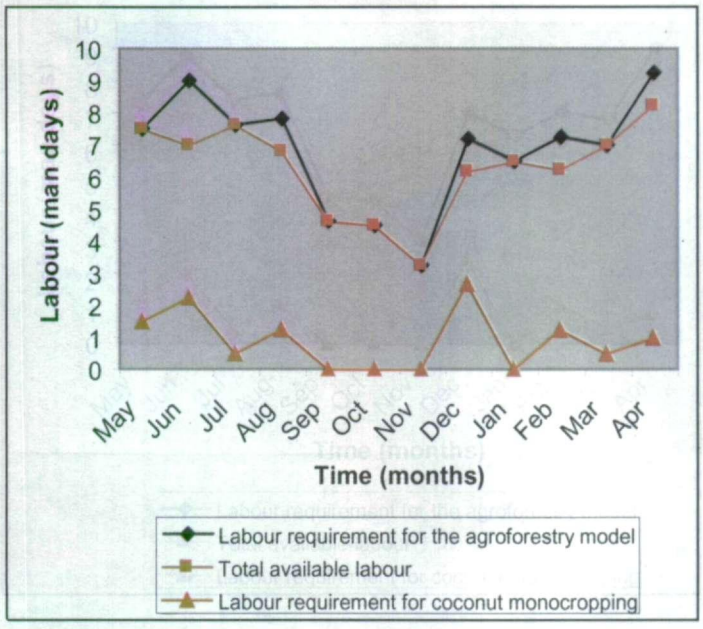

Figure 2 Monthly labor requirement and availability in the 4th year of model 1

In summery, agroforestry system of the model -1 is less feasible with the available household labor, so farmer has to depend on hired labor to some extent.

Model 2

Figure 3 shows the monthly labor requirement of year 4 of: a) agroforestry system, b) coconut monoculture system, and c) monthly labor supply by the household. Labor requirement of two different cropping systems and supplied by the household show a discernible pattern of variation. The coconut monocrop system shows a labor peak in September due to higher weeding requirement. Agroforestry system shows three labor peaks in June, August and November. Whereas labor peaks of agroforestry system in the 7th year occurred in March and September (Figure 4). Coconut monocrop system shows the highest labor peak in May of 7th year due to the weeding requirement.

In all the years, labor requirement of the coconut monocrop system was less than the agroforestry system as well as total available labor in the household. This emphasizes that coconut monoculture is feasible under existing family labor supply. Whereas the labor requirement of the agroforestry system has marginally exceeded the supply in some months, necessitating the hiring of labor.

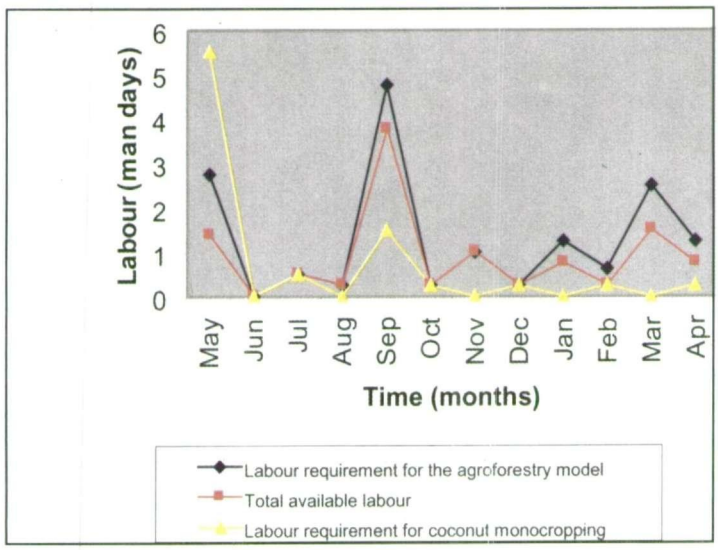

Figure 3 Monthly labor requirement and availability in the 4th year of model 2

Model 3

Figure 5 and 6 show the monthly labor requirement and availability during the 1st and 7th year of model –3, respectively. Except in May of 7th year, labor demand of coconut monoculture was well below the supply from the household. Meanwhile, the labor demand of the agroforestry system was marginally higher than the household supply except in May of both 1st and 7th year. In year one, this labor peak for agroforestry system (about 94 man days) was due to the establishing of crops and pastures.

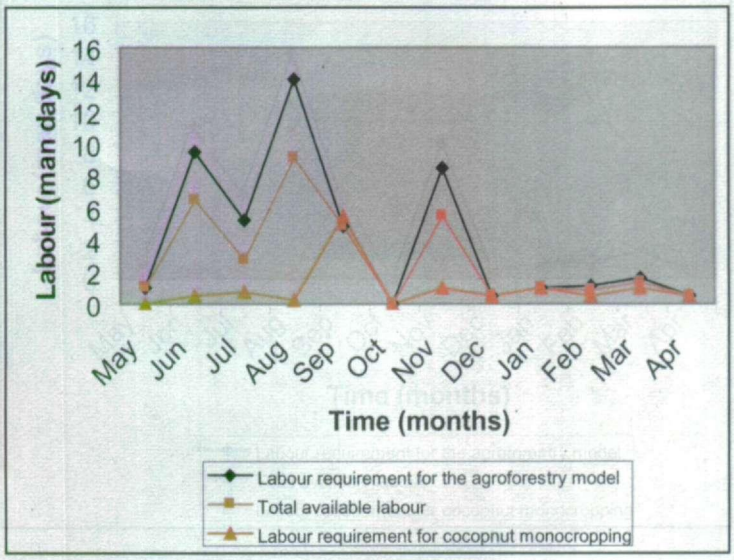

Figure 4 Monthly labor requirement and availability in the 7th year of model 2

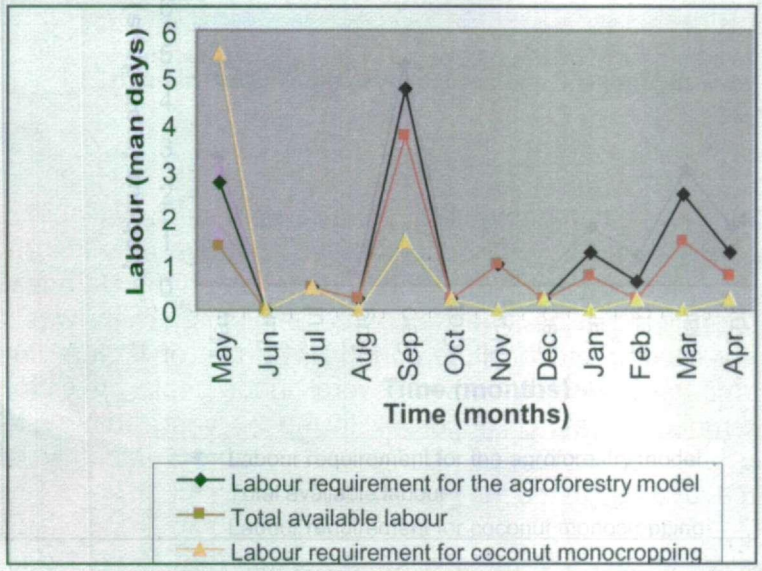

Figure 5 Monthly labor requirement and availability in the 1st year of model 3

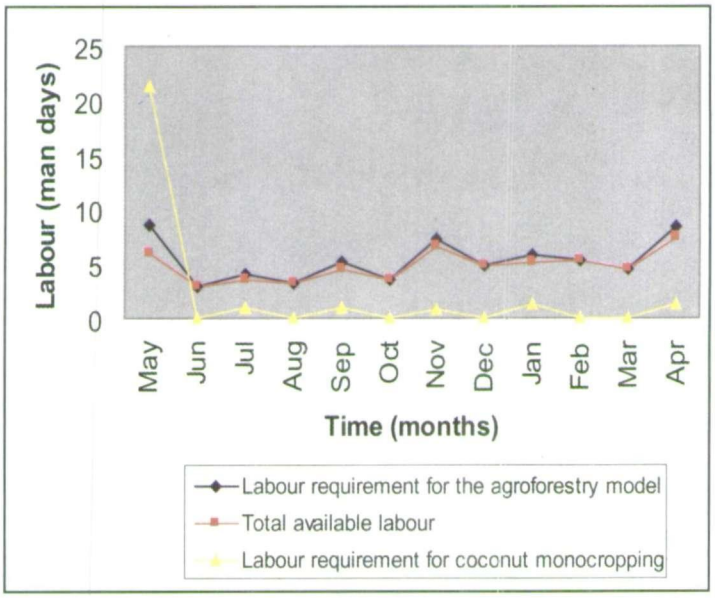

Figure 6 Monthly labor requirement and availability in the 7th year of model 3

Model 4

Figures 7 and 8 show the monthly labor requirement and availability, of model 4 during the 1st and 2nd year respectively. Total available labor was zero in both years, which means farmer totally depends on the HL because he is involved in farming only as an extra source of income. There was only one labor peak for coconut monoculture during November of 1st year. In the same year, agroforestry system shows several labor peaks in October, November, December and March (Figure7). In the 2nd year, both systems demanded low labor as compared with year 1. Figure 7 Monthly labor requirement and availability in the 1st year of model 4

Agroforestry system shows several labor peaks within the 2nd year (Figure 8). Since farmer totally depends on the HL for both cropping systems, cash is required to purchase the labor. So, cash availability influences the adoption of the model.

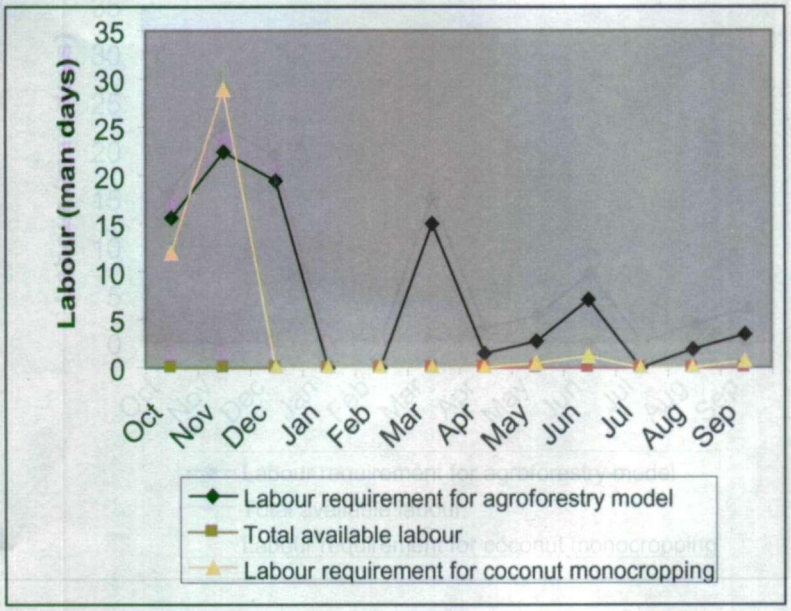

Figure 7 Monthly labor requirement and availability in the 1st year of model 4

b. Comparison of cash requirement

Model 1

Table 6 compares the cash requirement of coconut monocrop and mixed farming system of model -1 for different inputs, namely HL, material inputs, transport services and machinery rentals.

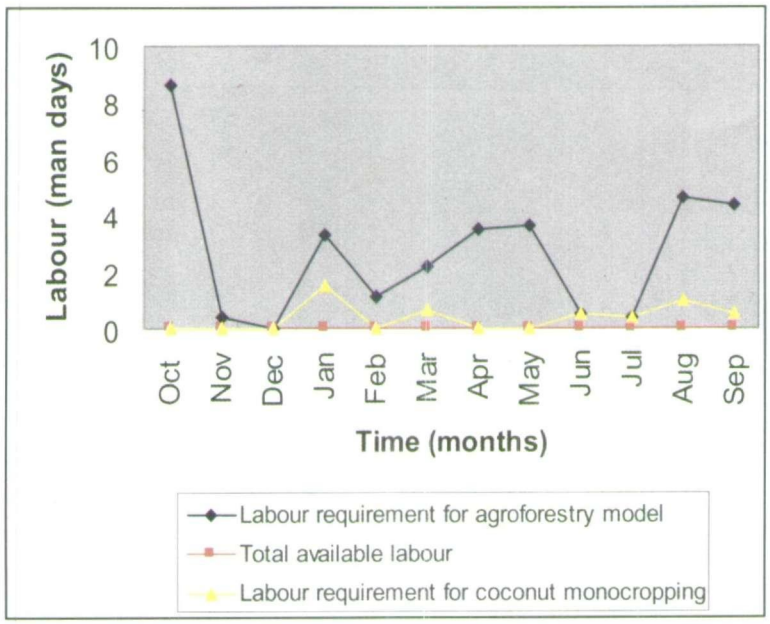

Figure 8 Monthly labor requirement and availability in the 2nd year of model 4

Table 6: Comparison of cash requirement- model 1 (Rs/ac)

Year	Mixed farming				Coconut monocrop			
	HL (Rs)	Material cost (Rs)	Transport cost (Rs)	Machinery cost (Rs)	HL (Rs)	Material cost (Rs)	Transport cost (Rs)	Machinery cost (Rs)
1	77275.00	21915.40	1527.85	1350.00	4202.50	2050.90	52.00	-
2	210.00	6817.00	284.26	850.00	570.00	-	36.00	-
3	330.00	11432.34	118.70	-	330.00	1100.34	36.00	-
4	175.00	9958.3	257	-	175.00	1505.30	25.00	-
5	770.00	25747.35	936.25	-	620.00	1950.00	37.25	-
Total	78760.00	75870.00	3124	2200.00	5897.00	6606.00	186.00	-
	(15752.00)	(15174.00)	(625.00)	(440.00)	(1179.00)	(1321.00)	(37.00)	

Note : HL – Hired Labor.
1 US$ = Rs 64.32 as on May 1998.
Figures in parentheses are the averages.
Source : Mixed farming model, Gaspe (1992-1996).

In the first and the second year, machinery cost was involved only for the mixed farming system. Five-year total material, transport and hired labor costs were respectively 11.5, 16.8 and 13.35 times higher in mixed farming system than coconut monoculture. In both systems, total cash requirement has increased with time. Material costs for coconut monoculture were higher over other cash requirement in each year except in first year. Material cost was also prominent over the other costs in mixed farming system, except in the first year, during which rent hired labor cost was the highest.

Total cash requirement of the agroforestry system of model–1 has exceeded that of coconut monocrop. Therefore the farmer must have a greater accessibility to cash to adopt agroforestry systems.

Model 2

Table 7 compares the cash requirement of coconut monocrop and mixed cropping systems of model 2.

Table 7: Comparison of cash requirement – model 2 (Rs/0.5ac)

Year	Mixed cropping				Coconut monocrop			
	HL	Material cost	Transport cost	Machinery cost	HL	Material cost	Transport cost	Machinery cost
1	1025.00	1141.25	38.50	-	275.00	360.00	31.50	-
2	700.00	1666.5	63.88	-	345.00	350.00	30.63	-
3	1035.00	979.50	17.50	-	410.00	-	-	-
4	1462.50	2982.70	2494.85	-	750.00	561.00	23.10	-
5	1933.75	7479.22	680.86		482.00	934.32	12.21	-
6	467.50	2727.47	66.20	-	515.00	1090.98	25.00	-
7	590.00	4030.72	64.94	-	590.00	1363.45	25.08	-
8	2313.75	2762.78	70.05	-	2107.50	1687.80	29.05	-
9	1245.00	2185.46	91.60	-	400.00	-	-	-
Total	10772 (1197)	25956 (2884)	3588 (399)	-	5874 (653)	6348 (705)	177 (20)	-

Note : Such practices as coconut harvesting, fertilizing, digging of husk pits are often carried out on contract basis. So, labor use for these practices in man-days has not been included.
1 US$ = Rs 64.32 as on May 1998.
Figures in parentheses are the averages.
Source : Mixed cropping model, Hanchapola (1987-1996).

The 9-year total cash requirement of mixed cropping was higher than the coconut monocrop and there was no machinery cost for any of the cropping systems. HL, material cost and transport costs were respectively 2, 4 and 20 times greater in mixed cropping than coconut monoculture.

In each year of mixed cropping system also, HL, material and transport costs were greater than that of monocrop. The total cash requirement in each year has fluctuated in both models.

Model 3

Cash requirement of the coconut monocrop and mixed farming systems of model –3 has fluctuated highly (Table 8).

Table 8 Comparison of cash requirement (Rs/2ac) – model 3

year	Mixed farming				Coconut monocrop			
	HL (Rs)	Material cost (Rs)	Transpor t cost (Rs)	Machinery cost (Rs)	HL (Rs)	Material cost (Rs)	Transport cost (Rs)	Machinery cost (Rs)
1	4360.00	8394.00	668.98	-	640.00	1480.00	55.00	-
2	1705.00	12701.16	252.00	-	245.00	10718.04	111.00	-
3	1420.00	25140.50	709.20	-	2270.00	-	-	-
4	1775.50	23756.17	527.31	-	2403.00	12439.15	122.49	-
5	1697.50	14973.23	485.20	-	2670.00	5542.23	58.20	-
6	2610.00	12055.36	482.23	-	3070.00	7070.88	58.20	-
7	1235.00	8423.12	448.80	-	3395.00	5577.88	58.20	-
Total	14803.00 (2115)	105443.00 (15063)	3574.00 (510)	-	14693.00 (2099)	42828.00 (6118)	463.00 (66)	-

Note : 1 US$ = Rs 64.32 as on May 1998.
HL – Hired Labor.
Figures in parentheses are the averages.
Source : Mixed farming model, Ihala Katuneriya (1989-1997).

The highest labor cost in the mixed farming system has occurred in the first year. Then it has reduced and remained with a low variation. But in coconut monocrop system, cash requirement for HL has increased yearly. This was due to the labor requirement for weeding. Normally weeding cost is reduced when agroforestry models are adopted. In both cropping systems, material cost has exceeded the HL cost and transport cost in each year. HL cost of both cropping systems in later years was nearly same despite the fact that agroforestry systems are known to be labor intensive. This is because the household supplies the rest of the additional labor requirement of agroforestry system.

Model 4

Monoculture and mixed cropping systems require high amount of cash during the first year, but in both systems the cash requirement has reduced and remained at a low range thereafter (Table 9).

However, these values were higher in mixed cropping system than monoculture. Machinery cost was only involved in mixed cropping system for the land preparation for establishing pineapple. The HL cost, material and transport costs were 2, 9 and 9 times respectively higher in mixed farming than coconut monoculture.

Table 9 : Comparison of cash requirement (Rs/0.5ac) - model 4

Year	Mixed cropping				Coconut monocrop			
	HL	Material cost	Transport cost	Machinery cost	HL	Material cost	Transport cost	Machinery cost
1	6106.99	14641.43	2607.30	650.00	4149.50	759.00	231.50	-
2	2299.56	3843.28	81.10	-	952.50	702.80	30.75	-
3	2158.75	3504.23	72.25	-	928.75	595.10	18.55	-
4	2650.00	3302.24	73.20	-	1425.00	665.00	28.00	-
Total	13215.00 (3304)	5291.00 (6323)	2834.00 (708)	650.00 (162)	7456.00 (1864)	2722.00 (680)	309.00 (77)	-

Note : 1 US$ = Rs 64.32 as on May 1998.
HL – Hired Labor.
Figures in parentheses are the averages.
Source : Mixed cropping model, Thulawala (1991-1995).

We next compare the cash demand by the different agroforestry models with corresponding cash supply by households.

Table 10: Cash availability in households and cash requirement by different agroforestry models

Cropping model	Household Income (Rs/year)	Household expenditure Rs/year)	Cash availability (Rs/year)	Cash requirement (minimum and maximum) for agroforestry model (Rs/year)
Model 1	164592	60000	104592	8161-102068
Model 2	90000	42000	48000	2032-10094
Model 3	126000	60000	66000	10107-27270
Model 4	168000	71100	96900	5735-24006

Note : 1 US$ = Rs 64.32 as on May 1998.
Source : Data collected from on-farm models (1987-1996).

The cash requirement does not exceed the cash availability of the farmer in all the models. Therefore, the farmer can meet additional labor requirement and other resource requirement for the agroforestry models. One should notice that only a fraction of the monocrop coconut land, was taken for the mixed farming in all four models. For instance, in model 1, only 1 ac out of 5 ac was taken for mixed farming. So, what the results reveal is that mixed farming models conform to the existing resource base of the farmers at the above scale of operation.

B. Farmers' Perceptions on Agroforestry Models

Although the perceptions of the selected four farmers were elicited with a reasonable depth, obviously generalizations on social acceptability cannot

be drawn from this limited sample. Subject to this caveat, the following results are presented. Quite often, farmers have multiple objectives. As shown in Table 11, the farmer in crop-livestock integrated model 1 has adopted his cropping system to gain various products such as milk, cattle manure and coconuts.

Table 11: Farmers' perceptions on different attributes of the models

Attribute	Model 1	Model 2	Model 3	Model 4
• Farmer objectives	products and cash	satisfaction	cash	cash
• Land use history	natural pasture with coconut	coconut monocrop	natural pasture with coconut	coconut monocrop
• Layout of the model	SF	NSF	SF	SF
• Composition of crops	SF	NSF	NSF	SF
• Suitability to socio-economic condition	SF	SF	SF	SF
• Suitability to soil condition	SF	SF	SF	SF
• Suitability to agroecological region	SF	SF	SF	SF
• Overall acceptance of the model	accept	accept	accept	accept
• Importance of subsidies- Establishment -Maintenance	Important	important	important	not much important

Notes : SF-Satisfactory, NSF-Non satisfactory.
Source : Survey on farmers' perceptions, 1999.

Farmer of the 2nd model adopted the cropping system for his satisfaction (see Table 11) after seeing a well-managed coconut + pepper intercropping model. The other farmers adopted the models to gain an extra income (Table 11). Therefore, it is clear that the farmers' objectives of adopting agroforestry systems are diverse, ranging from income generation, self-supply of farm products, to deriving mental satisfaction.

Natural pasture with coconut was the previous land use of the model 1 and 3, while coconut monocrop was the previous land use of the model 2 and 4 (Table 11). Except the farmer of model 2, all the others were satisfied about the layouts of their models. In model 2, the farmer believes that spacing between the pepper row is not enough and it creates competition for resources. He is also of the view that pepper and gliricidia can be damaged, when coconut fronds fall on the ground. The farmers of model 2 and 3 were not much satisfied about the composition of crops in the models. Second farmer was of the view that the pepper density is too much in the model, while the 3rd farmer says fruit crops like papaw could have been incorporated into the model during the initial stages, to compensate the low return during that stage. All the farmers agree with the models in terms of the suitability to their socio-economic conditions, soil condition of the field and agro-ecological region. All the farmers generally accept the models.

Farmers of the model 1, 2 and 3 emphasized the importance of the subsidies to motivate the farmers in adopting agroforestry systems. They indicate that this cash support is important, especially during the initial stages of the cropping system, to compensate the high cost involvement, whereas these considerations were less important for the farmer in model 4.

CONCLUSIONS

This study evaluated the conformity of four selected coconut-based agroforestry models developed by the Coconut Research Institute of Sri Lanka, with the existing resource base of smallholder coconut farmers and elicited their views on these models. These models were: i) mixed farming for Wet Zone (model 1), ii) mixed cropping for Wet Zone (model 2), iii) mixed farming for Wet Intermediate Zone (model 3) and iv) intercropping for Wet Intermediate Zone (model 4), established respectively at Gaspe, Hanchapola, Katuneriy and Thulawala. The study concluded the followings.

- All the agroforestry systems require additional resources (labor and capital for the establishment and maintenance of their components), as compared with coconut monocrop. Agroforestry system in each of the four models constitutes only a small fraction of the entire monocrop coconut land belonging to respective farmers and hence the scales of operation of agroforestry systems were relatively low. Even under this low scale of operation, family labor supply was not adequate for most agroforestry systems, implying that they do not match with the household labor availability. However, the cash requirement for agroforestry systems were less than the availability of each farmer, which implies that the agroforestry systems conforms to the cash resource of the farmer, given the small-scale of operation. However, if these farmers wish to expand the scale of operation of these agroforestry systems, their cash resource base may also turn out to be a limiting factor.
- Models 1 and 4 were readily acceptable to farmers while models 2 and 3 required slight modifications to make them socially acceptable.
- In model 2 and 3, perennial intercrops were less labour and cash intensive and hence these agroforestry systems would ideally match to part–time coconut growers, whose main concern would be their high caliber professions or other businesses.

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ACKNOWLEDGEMENT

We are grateful to Dr. (Mrs) C. Jayasekera, Director of the CRISL, for approval to publish this paper. Authors also wish to acknowledge the early hard work of Messrs. K D D Appuhamy, E M Gunerathnebanda and Ryle Silva in establishing the on-farm agroforestry models. Support of Mrs. Nilmini Jayalath and Mr M. J. I. Costa is gratefully acknowledged.

ANNEX I

Table A1: On-farm coconut–based agroforestry models established by CRISL

Serial no	Agro-ecological region	District	Soil type	Location	Type of model	Components
1	WIZ	Puttalam	LG	Kahatawila	Intercropping	Banana, ginger
2	WIZ	Puttalam	LG	Thulawala	Mixed crop	Pepper, lime,Ginger
3	WZ	Gampaha	LG	Walpita	Mixed crop	Pepper, banana, ginger
4	WZ	Gampaha	LG	Hanchapola	Mixed crop	Pepper, coffee, ginger
5	WZ	Gampaha	LG	Gaspe	Mixed farm	Pasture, NFT's, local x jersey
6	WZ	Gampaha	LG	Banduragoda	Intercropping	Banana, ginger
7	WZ	Gampaha	LG	Mirigama	Mixed farm	*Brachiaria ruziziensis*, NFT, gliricidia, pepper, coffee, Sindhi x Jersey
8	WIZ	Puttalam	SL	Ihalakatuneriya	Mixed farming	Coffee,Guini B, *B.milliformis*, *pueraria,Gliricidia*, Sindhi x Jersey
9	WIZ	Puttalam	LG	Thulawala	Intercropping	Pineapple, ginger, banana
10	WIZ	Puttalam	LG	Kahatawila	Mixed crop	Banana, pepper, ginger, coffee
11	WZ	Gampaha	LG	Divulapitiya	Mixed crop	Banana, pepper, yams, coffee
12	WZ	Gampaha	LG	Mirigama	Mixed crop	Pepper, coffee
13	WI,IL1	Puttalam	LG	Pothuwatawana	Mixed crop	Pepper, coffee, banana, ginger
14	WL3	Gampaha	LG	Divulapitiya	Mixed crop	Pepper, coffee
15	WL3	Gampaha	LG	Walpita	Intercropping	Banana
16	WL3	Gampaha	LG	Walpita	Intercropping	Pineapple
17	WL3	Gampaha	LG	Udulla	Mixed crop	Ginger, pepper, coffee, yam
18	WL3	Puttalam	LG	Katuneriya	Mixed crop	Pineapple, ginger, cashew
19	IL1	Puttalam	LG	Kahatawila	Mixed crop	Pepper, coffee
20	IL1	Puttalam	LG	Rathmalagara	Mixed farming	NFT's, pasture, goat
21	IL1	Kurunegala	LG	Deegalla	Mixed crop	Cashew, lime, NFT's
22	IL1	Gampaha	LG	Divulapitiya	Mixed crop	Lime, mango
23	WL3	Gampaha	LG	Madurupitiya	Mixed farm	pepper, pasture, cattle
26	IL3	Puttalam	SL	Katuneriya	Mixed farm	pepper, pasture

Key : LG-Lateritic Gravel, SL-Sandy Loam, NFT's-Nitrogen fixing trees.