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COCONUT – BASED CROPPING SYSTEMS

IN THE WET AND WET INTERMEDIATE ZONES:

PRESENT CONSTRAINTS AND PROSPECTS

A.S. Ranatunga, L.V.K. Liyanage and R.A.J.R. Perera

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Coconut Based Cropping Systems in The Wet and Wet Intermediate Zones: Present Constraints and Prospects

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Cover photograph: Coconut small holding in the intermediate Zone of Sri Lanka, Banana and pineapple intercropped under coconut.

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1. INTRODUCTION.

Coconut-based cropping systems considered here, refer basically to intercropping of coconut lands with a combination of annual and perennial crops. The Coconut Research Institute (CRI) has pioneered investigational work in intercropping of coconut lands in the wet intermediate zone for over two decades. To begin with, the CRI had evineed an interest on pasture and fodder as intercrops under coconut. In mid seventies however, the scope of intercropping research work has been expanded to include annual and perennial food and cash crops. Based on results of some of the preliminary investigations of the CRI as well as other relevant data available with the Departments of Agriculture and Minor Export Crops, the technical potential for intercropping of coconut lands had been assessed more recently in somewhat broader terms. More specifically, using criteria such as rainfall regimes and soil types, around 290,000 acres of coconut lands have been identified as agronomically suitable for intercropping.

Simultaneously, the Government has also made a number of attempts for nearly two decades to encourage intercropping in coconut lands in order to improve land utilization in monoculture coconuts, mainly with a view to increase returns to growers. Of the various strategies adopted, the most noteworthy is the introduction of a subsidy scheme in 1977 to promote cultivation of coffee, pepper and cocoa etc. as intercrops under coconut. The success of this programme has not been all that impressive, with the total acreage covered being only about 14,300 acres so far. More importantly the 'dropout' ratio after the payment of first instalment of the subsidy had been as high as 95%[1]. In this regard, a recent survey also had indicated that only around 50,000 acres had some form of systematic intercropping, and this too, mainly by non-owner cultivators, largely on leased land. Furthermore, almost one half (52%) of the number of intercropped holdings are reported to be in the size class of less than 5 acres, but, in terms of the total area intercropped, this category constitutes only 6.5 percent of the total. Bulk of the intercropped area (87%) in fact is reported to be in larger holdings of more than 10 acres[2].

The relatively slow progress of intercropping achieved in coconut lands so far, is no doubt a reflection of the presence of a mix of constraints at farm level, largely involving technical, economic and social factors. Although many of them had been identified from time to time as important, it appears that attempts to establish their relative importance as well as the complexities of possible interactions between different crops have not been many. In recognition of this deficiency, the Division of Agronomy of the CRI initiated an exploratory survey of selected coconut-based farms where intercropping is successfully practised. The areas covered are Divulapitiya, Narammala, Dambadeniya, Bingiriya, Kuliyapitiya and Wennappuwa. This exercise is basically a diagnostic survey in which an informal, Rapid Rural Appraisal approach was followed to identify key farmer problems. The body of information gathered during the diagnostic survey could be used as the starting point for the design of Adaptive Research investigations planned by the Agronomy Division of CRI[3].

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* Submitted to the Coconut Research Board Sri Lanka, September, 1987.

1. Opportunities for Intercropping — Special Report 2, Ministry of Finance and Planning, November, 1984.
2. A study of Intercropping in Coconut Lands. Ministry of Finance and Planning, December 1981.
3. "On Farm Adaptive Research" here refers to selection and testing of technical components identified as relevant to the needs and circumstances of target groups of farmers in farmer's fields.

2. DIAGNOSIS OF CROPPING SYSTEMS IN COCONUT LANDS.

In developing newer improved cropping systems, perhaps a suitable starting point is the analysis of the systems currently pursued by the farmers. This approach enables the researchers to gain insights into how and why the current systems operate and thereby develop feasible alternatives. Furthermore, it would also allow them to suggest and test appropriate hypotheses regarding the allocation of resources within the farms and to introduce suitable technical innovations that is likely to improve farm production.

Survey coverage : In keeping with the decision of the Coconut Research Board, that the Cropping Systems Research and Development work be initially confined to holdings of 3-10 acres in the wet and wet intermediate zone, the diagnostic survey was conducted in 28 coconut-based farms falling within the specified target groups. The selection of farm sample was undertaken purely on a purposive basis from intercroppers. The intimate knowledge of the intercropping activities in the study area suggest that the selected farms constitute a reasonable cross section of the target groups to be studied. This approach enabled the researchers to make the best use of the limited manpower available as well as to minimise costs. A more formal approach in conducting the survey would have involved substantially higher costs, and also a major time commitment for the researchers concerned.

Bulk of the study data emanates from the exploratory farm survey carried out personally by the Consultant, Head of Agronomy Division and the Research Assistant (Agricultural Economics). For purposes of gathering data, each of the 28 farms investigated was visited at least twice. The informal interviews covered a broad spectrum of areas of interest including information on farm resources, land use, farm enterprises, husbandry practices, input-output coefficients for various farm enterprises, information on labour inputs, seeds, fertilizer and agro-chemicals, output per unit area of crops both in physical and monetary terms, sales of products and cash incomes, farmer's goals, their perceptions of important production constraints and off-farm activities.

Information gathered through farm interviews was supplemented with those from Field Officers of the Coconut Cultivation Board, the Departments of Agriculture and Agrarian Services engaged either directly or indirectly with intercropping activities in the intermediate zone of the coconut triangle. A total of 34 Coconut Development Officers, 31 Divisional Officers and 32 Agricultural Instructors were interviewed by the Assistant Agronomist to identify problems perceived by the officers as well as to gather their ideas on how to help farmers to overcome them.

Secondary data on holding size, tenancy, rainfall, soil, topography, pests and diseases, input availability and marketing channels etc. were used to gain insights on to some of the management problems raised by farmers. The study also used some information contained in the unprocessed data from a previous sample survey of 200 small holdings in the Gampaha, Kurunegala and Puttalam districts conducted by the CRI in February 1986.

3. STUDY LOCATIONS.

The basic technical parameters relevant to intercropping of coconut lands in the study locations are summarised.

Study locations by agro-ecological zones[1]

Location	*Rainfall*	*Soil Characteristics and Slope*
Divulapitiya	**Low Country Wet Zone** Rainfall averages above 1875 mm (75") fairly well distributed; December-February relatively dry with rainfall less than 3" monthly.	Shallow sloping lands gravelly loams and laterite gravels.
Kuliyapitiya Dambadeniya Narammala Wennappuwa	**Low Country Intermediate Zone (Semi Wet)** Rainfall averages 1500-1875 mm (60-75") fair distribution with dry spell in February-March and July-September.	Deep, sloping loamy soils.
Bingiriya	**Low Country Intermediate Zone (Semi Dry)** Rainfall averages above 1125-1500 mm (45-60") with dry spell in May-September and no rain in June.	Laterite gravelly flat.

1. A study of Intercropping in Coconut Lands; Ministry of Finance and Planning, December 1981.

4. STUDY HIGHLIGHTS

In the study area, coconut is the dominant crop seen on 'uplands'. In the farms studied the palms are generally over 40 years old. The lowlands occupy relatively a small proportion of the land and is devoted to paddy cultivation. The paddy holdings are small in size mostly around 1.5 acres.

The investigations suggested that for purposes of this analysis, two broad groups of intercropped farms namely (a) Commercially Oriented Family Farms; (b) Commercially Oriented Large Farms could be identified using a number of important criteria.

The Family Farms are operated by relatively poor households with restricted access to both land and capital. The Commercially Oriented Larger Farms located mostly on leased lands are operated by more affluent households with greater control over productive resources.

The two farm types differ in respect of the scale of farm operations, resource use pattern in farm production and also in the main sources of household income. However, with regard to farm produce disposal, the two types are very similar in that the entire output of intercrops is marketed. The characteristics of the two groups are summarised as follows :—

Characteristics of the two types of intercroppings[1]

Variable		*Commercially Oriented Family Farms*	*Commercially Oriented Large-Scale Farms*
i.	Labour	Depend almost entirely on family labour. Relatively less dependent on hired labour.	Depend almost entirely on hired labour Operator or his family does not do manual work in the farm.
ii.	Holding size	2 - less than 5 acres	5 and over, mostly under 20 acres
iii.	Land ownership	Owned land	Owned land and mostly on leased lands
iv.	Location	Adjoining homestead	Mostly away from residence and sometimes outside resident village
v.	Number of parcels	often only One	Ranges from 2-4 parcels
vi.	Land preparation	Mostly hand tillage with family labour	Mechanical tillage with owned or hired tractor
vii.	Farm operator	Works full-time in the farm with family	Supervises and controls farm operations more or less on full-time basis

1. Does not include holdings less than 2 acres.

viii.	Principal crops	Ginger, betel, banana, vegetables, root crops, pepper, coffee, pineapple; -diversified farming, sometimes have livestock	Pineapple, ginger, banana more specialised cropping livestock rearing is seldom seen
ix.	Produce disposal	Produce normally transported to marketing outlets including village fairs	Produce often collected at the farmgate by wholesale traders
x.	Household income	Farming has been the main source of income all along	Initially off-farm employment has been the principal source of income, eg. salaried employment, self-employment; but with development of intercropping, over the years main source of income at present is farming

1.4 Intercropping in Commercially Oriented Family Farms :—

Of the 28 farms investigated, 14 are commercially oriented family farms which varied in size from 2.5 acres[1]. A holding coming under this category typically consists of a homegarden with a dwelling house and an upland parcel of about 2-4 acres planted with coconut which carry a variety of intercrops and a lowland allotment planted to rice. The farm unit is owned either singly or jointly by the family which also provides much of the labour required. The upland parcel is usually not fully intercropped due to a variety of reasons. Firstly, family farm holdings are densely planted with coconuts which reduces appreciably the net area suitable for intercrops.

The practice of planting coconut at closer spacing is a common feature seen in small holdings. Furthermore, due to the general tendency to allow the growth of other tree crops such as jak, breadfruit, mango and assorted varieties of fruits both for consumption and sale to supplement family income, appreciable extents in small holdings are overcrowded. In such situations, high density tree canopy does not permit sufficient light penetration to allow satisfactory growth of intercrops. Secondly, the limited availability of family labour and low cash farm incomes also appear to limit the size of commercially oriented intercropping in family farms as seen later on.

The cropping mix seen in family farms involve mostly 2-3 annuals, eg. ginger, manioc and turmeric etc. and one or two semi-perennials eg. banana, betel and coffee, most of which demand relatively less labour for maintenance. Such crops are normally grown systematically with regular spacing and in rows under coconut. The dominance of annual crops no doubt gives greater flexibility to the family farm operator to accommodate any short term adjustments in the cropping systems becoming necessary due to fluctuations in weather and prices as well as incidence of any pests and diseases. Furthermore, enquiries made at the farm level also reveal that the cropping systems adopted are generally

1. Farm holdings below 2 acres have been excluded from this study, in the light of the CRI Board decision to concentrate initial research interests to holdings of 3-10 acres.

arranged so as to spread the use of available family labour more evenly over the year with fewer peaks. This is largely to reduce the demand for hired labour which the family farm operator could ill afford. In general, though the feasibility of any particular crop, depends more on rainfall, soils and the terrain, the extents under individual crops in most family farms are determined largely by the ability of the operator to allocate necesssary cash for purchase of production inputs and family labour for field work as discussed in section 5. The recurring droughts is another factor that influences the choice of crops particularly in the intermediate zone. As average small holder lacks supplementary irrigation, relatively more drought-prone crops such as vegetables though remunerative as intercrops are omitted from the typical cropping patterns. In this regard, a notable exception is the commercial scale cultivation of vegetables under coconut using supplementary irrigation from streams seen in proximity to Kuliyapitiya and Narammala.

Annuals and seasonal crops — notably roots, tubers as well as some types of low country vegetables are grown as intercrops under coconut mostly during south west monsoon season commencing in April. So are the perennials such as pepper and coffee. However, smaller extents are also planted with such crops during October-November as well. Semi-perennials, such as pineapple and banana are generally planted in both seasons. Land preparation is done mostly with manual labour, much of it with family labour. As a standard practice, coconut fertilizer is used for all intercrops other than betel. The main crop, coconut is not fertilized as such, but benefits greatly from liberal applications of fertilizer to intercrops planted for sale. Furthermore, regular cultivations given to intercrops are beneficial to coconut as well. The coconut yields on intercropped lands are reported to be higher than in the non-intercropped holdings. In the farms studied, the annual yields reported ranged from 2000-2500 nuts per acre, compared to about 1000-1500 nuts in similar holdings in the vicinity which were non-intercropped.

4.2. Intercropping in Large Scale Commercial Farms :—

The intercropping units considered here vary in size from 5 to 20 acres, and generally comprise of a number of parcels. Bulk of them are on leased land. Low productive coconut lands of 50-60 years of age are often leased by prospective intercroppers for a period of 7-8 years. The lessee who also collects the coconut harvest is normally required to underplant senile coconut with seedlings supplied by the lesser. Currently, the land rent is around Rs. 500 per acre, but this figure varies from Rs. 200.00 onwards depending on land quality as well as road accessibility. Due to institutional problems associated with leasing in of lands suitable for intercropping in large contiguous blocks, large scale commercial operators often venture outside their own villages to lease in suitable lands. So much so, it is quite common to find many a large scale grower, operating 3-4 different intercropping units of varying sizes outside one's own village. Furthermore, the farm survey information also reveal, that, over the years landowners showing a declining interest to lease out large blocks of suitable land, particularly those with road access. This is in contrast to the situation that had existed in the coconut area about ten years back. The reasons for the declining interest in leasing out land to outsiders are not all that clear, but some tentative ones are presented later on in section 5.

The large scale intercropper may be described best as an entrepreneur who provides the risk capital and makes all decisions regarding the scale of operations, cropping patterns and manages the enterprise as a commercially oriented farm unit. According to the farm survey data, an initial financial outlay of around Rs. 70.000/— appears necessary

for leasing in of land, fencing, land preparation fertilizer and planting material etc. to establish a 5 acre intercropping unit with pineapple or ginger.

An obvious implication of cash outlays of such magnitude is that the large scale commercial operator is often drawn from the more affluent social groups resident in rural areas. In fact, some of those with regular sources of income from non-farm sources such as the ones in salaried employment and living in the coconut area eg. school teachers, post masters etc. and also few other selected categories of self-employed persons notably village traders, rice and coconut millers figured prominently as large scale intercroppers during the survey. In other words, the very high initial investments as mentioned above generally preclude a vast majority of rural households from embarking on large scale commercial enterprises. Furthermore, the need to allocate adequate time by the commercial operator for closer supervision of field operations, involving heavy cash expenses further reduce the numbers that could gainfully engage in such commercial ventures.

The survey information also reveals that the size of operation in large scale commercial intercropping units had increased steadily during the past decade or so. Many, that had initially commenced with 2-3 acres under intercrops, currently farm around 15-20 acres. Perhaps, timely chanelling of required funds from non-farm sources had greatly contributed to the steady expansion of intercropping in many of these farms. The timely infusion of working capital from non-farm sources, coupled with the general resourcefulness of this category of grower appear to have given many of them a head start in promoting large scale intercropping enterprises very successfully. This is in contrast to the situation found in most family farms discussed earlier, where the intercropped area in individual farms had continued to remain more or less static over the years largely for want of working capital, family labour and sometimes even land.

The larger intercropping units are worked entirely with hired labour drawn from the neighbourhood of such units. Land preparation and transport work is done with owned machinery. Intensive use of fertilizer and agro-chemicals is a standard practice. Since, such commercial units are often located on leased land, the coconut crop does not get any specialised attention of the intercroppers unlike in family farms. Some of the lessers contend that beneficial effects of intercropping on coconuts are short-lived and seen only during the first few years of the lease when intercrops are regularly fertilized and cultivated. Good response to heavy doses of fertilizer applied to intercrops were visible on coconuts as well, in some of the intercropped coconut lands visited. Nevertheless, there were also instances where coconut on leased intercropped lands were in a state of neglect particularly towards the tail-end of leases.

The cropping patterns adopted is more specialised here. Since lands are available on lease for a limited period of only 7-8 years, the perennial crops earmarked for promotion by the government due to their agronomic suitability and marketebility, remain more or less completely excluded from this category of farms which is unfortunate. The major crops seen in them at present are pineapple, banana and ginger in order of importance. Their dominance could be attributed largely to the high profit margins, the individual crops are able to generate and their short pay back period[1] as discussed in section 6.

1. Pay back period — Length of time from planting a crop before the net profits cover the cost of establishment of such a crop.

High cash expenditure for material inputs such as planting material, fertilizer, agro-chemicals etc. and hired labour appear to be of lesser concern to large scale intercroppers due to the ability to channel working capital from non-farm sources as pointed out earlier. In this regard, more or less the opposite situation is seen in family farms, where many a operator faced with low cash farm incomes are more concerned with the level of cash production costs rather than the profit margins of individual crops.

5. CONSTRAINTS TO INTERCROPPING.

The discussion has so far centered largely around the differences in resource use patterns and scale of farm operations in the two categories of farms identified. In this section, the general problems and constraints faced by most intercroppers are examined in the context of the whole farm rather than looking at individual components constituting the farm. The existing cropping systems in many of the intercropped coconut holdings appear to be influenced more by the socio-economic setting of the individual farms rather than the physical environment in terms of soils and climate. Thus, an examination of the relevant socio-economic characteristics of the farm family along with related technical issues is likely to be more helpful in understanding some of the problems faced by intercroppers at present. The knowledge so gained could serve as potential entry points for making necessary changes for improving the existing cropping systems. In this regard, the information collected through the informal farm survey mentioned earlier provides a useful starting point in the identification of major problems and constraints confronting intercroppers in coconut-based farms. Among them, the more prominent are low cash incomes, inadequacy of available family labour, income uncertainties arising from product price fluctuations, problems associated with leasing in of land for large scale intercropping enterprises, inadequate organisational support for supply of disease free planting material, absence of sustained extension support and recurring droughts.

5.1 Low cash incomes

With regard to farm incomes in the coconut-based family farms in the semi-wet intermediate zone, two key characteristics stand prominent. Firstly, the cash incomes from agriculture in many of them are low, as the productivity of coconut is generally low due to lack of regular fertilizer applications, overcrowding of trees, recurring droughts and presence of too many senile palms. Furthermore, even the incomes from paddy holdings in such farms are generally low, due to problems associated with supply of water in much of the rainfed paddy acreage located in the coconut area. A recent socio-economic survey undertaken by CRI in the coconut area in 1986 has generalised the low farm income situation in the following terms;

> "Farm related activities provided the major share of income for about 62% of the households. Coconut cultivation alone provided the major income for 51%. Nevertheless, the bulk of the farmers reported farm incomes below Rs. 500/— per month, only 20% had farm incomes exceeding Rs. 1000/— per mensem"[1]

Even, if the above is an underestimation of income, other available data on farm incomes, show that cash farm incomes in coconut-based family farms are generally low. A recent case study in Kurunegala and Puttalam districts also has revealed that in coconut holdings below 10 acres in extent, 45% of the income generated from coconut was used primarily to satisfy household consumer needs and 28% for purchase of fertilizer for paddy.[2] Such utilization of farm incomes necessarliy mean very limited cash surpluses being available for intensive intercropping. Secondly, the paucity of employment opportunities outside agriculture in much of the coconut area is the other major reason for the low income situation. Besides, the need to accommodate a variety of subsistence crops to meet the day to day consumption needs of the farm family is another

1. Socio-Economic Characteristics of Coconut Base Farming Systems, CRI, 1986.
2. De Silva Sumith et al. 1985. A Case Study on non application of fertilizer by coconut holders.

factor in this regard. Lack of institutional credit facilities for promotion of the more popular intercrops other than the bridging finances available under the subsidy scheme for perennials such as pepper, coffee and cocoa also appear to have restrained the development of intercropping in the low income family farms.

5.2 Inadequacy of family labour

The informal farm survey reveals that only about 2 adult workers per farm are available for full-time work in their own farms. Based on this level of family labour supply, the total annual family labour availability is likely to be around 500 mandays.[1] On the other hand, an approximation of the labour demand in an average family farm in the area without intensive intercropping is also likely to utilise about 300 mandays per annum as presented in Table 1. This suggests that for any significant changes in cropping intenstity could come largely through the use of hired labour. Such a prospect hardly exist at present in a majority of cash deficit family farms considered here. The illustration presented therefore may be useful to understand that any expansion of commercially oriented intercropping based solely on family labour is not all that simple as often assumed in general discussions on more intensive land use in coconut based family farms.

Table 1. *Estimated Annual Labour Requirements for Routine Farmwork in a Family Farm in the Coconut Triangle**

Component	*Labour requirement (Mandays per acre)*	*Total annual labour requirement (Mandays per farm)*†
Coconut	20	70
Paddy	50	180
Home garden	50	50
Whole farm	120	300

* Estimates made from basic data provided in the Socio-Economic Survey on Coconut Based Farming systems conducted by CRT, 1986.

† The average farm is taken as comprising of 35 acres of Coconut, 1-8 acres paddy and 1.0 acres home garden.

5.3 Problems associated with leasing of land for intercrops

This is applicable largely to commercial scale operators on leased lands as mentioned previously in section 4. The main issue here is really not one of unavailability of suitable land in terms of agronomic considerations, but one of securing of relatively large blocks of 10-15 acres of land suitable for commercial scale intercropping *within or in proximity to the villages from which large scale growers operate.* Due to difficulties encountered in leasing in of suitable land, it is not uncommon to find one commercial operator managing 3-4 different intercropping units of varying sizes in a number of villages located as far a part as 5-10 miles. The management of intercropping units that are scattered no doubt raises many problems to the commercial operator resulting in some production inefficiencies. Field observations made during the survey suggest that much of the suitable land are owned by non-residents of the villages concerned. Many of them are in fact residents in urban areas. Besides, a majority of such absentee land

1. Assuming that one adult worker could provide 250 mandays for full-time farm work during a given year.

owners on their own, appear to be rather disinterested in intensive forms of land use in large coconut holdings The reasons for which could not be ascertained fully during the informal survey

However, with regard to the reported declining interest of absentee land owners to lease out lands to others for intercropping, two tentative reasons could be advanced for the present, but this issue needs deeper study. Firstly, the returns generally received by the landowner for the use of land are relatively low compared to the share of benefits, accruing to the lessee as suggested by the analysis of costs and returns data presented in section 6. In fact, the three intercrops on leased land pineapple, banana and ginger give very high net returns. For example, the undiscounted annual profit margins from a semi-perennial such as pineapple is around Rs. 15,000 per acre. Banana give similar profit margins if planted as the principal intercrop under coconut. Even an annual such as ginger, at the prevailing low prices could provide a net return of around of Rs. 7000/- per acre per annum. On the other hand, the current land rental rates average to about Rs. 500/- per acre per annum and this level of rental is unlikely to attract many non-resident landowners many of whom also belong to high income groups to lease out their lands Secondly, perhaps the more important reason is that coconuts in a high proportion of leased lands planted to intercrops sometimes suffer from neglect towards the tail-end of the leases. Typically, a lease is taken for 7-8 years, but fertilizer applications and moisture conservation etc. by the lessee is generally concentrated in the first few years of the lease. This is because, crops such as pineapple and banana are in prime production mainly during the early years of the lease. As a result, coconut on some of the leased lands were seen to suffer from neglect during the latter years of the lease, particularly when additional catch crops such as manioc are also raised without proper fertilizer applications. However, this issue needs closer observation than was possible during the informal survey discussed here.

5.4 Inadequate research and extension support

Inadequate technical information on income maximising cropping systems under coconut is seen as a problem faced by many of the growers. State assistance in the way of information on improved cultivation techniques at the farm level is vital in order to improve production efficiency and thereby reduce cost of production of intercrops. Over the years, the development of required technology has lagged behind and as a result, information on cropping systems compatible with agro-ecological and socio-economic environments of much of the coconut triangle is lacking. Despite the emphasis given by the National Planners for more intensive use of coconut lands, with a view to raise household incomes and employment levels, the stimulus of public supported research and extension on the development of necessary technology is yet to be felt in much of the coconut area. This may be due to more than one reason. Firstly, the idea that an understanding of the existing cropping systems in the coconut area is a necessary pre-requisite to gain intimate knowledge of constraints and objectives of final users of research information is yet inadequately recognised even by some of the agencies responsible for technology development. Secondly, the failure to recognize the need for integration of different feasible enterprises comprising of annual crops, perennial crops and livestock etc. into socio-economically workable cropping systems that could fit into the coconut small holder sector is perhaps the more important reason.

The above deficiencies may be partly attributed to the fact that no specific agency is specially directed to further the cropping systems development under coconut. In this regard the commodity oriented state institutions that service different sub-sectors of the

agricultural economy such as coconut. minor export crops, annual crops, fruit crops and livestock etc. individually lack both the capacity and also the interest to handle all aspects of necessary research and extension work required. Currently, the Coconut Cultivation Board is mostly immersed in coconut rehabilitation subsidy work and is constrained to undertake extension work in the coconut sector. On the other hand, the Coconut Research Institute whose primary research interests are on the coconut crop has upto now shown only a limited research interest on varied crops identified as suited for intercropping in coconut lands and that too only at the experiment station level. In fact, On-Farm Adaptive Research on intercropping on Coconut Lands is yet to begin by any of the agencies mentioned here. Furthermore, though a number of minor export crops have been identified as suitable for intercropping in the wetter parts of the coconut area, current research investigations on such crops are concentrated mostly in the mid-country where the potential for their expansion is rated high. Similarly, the primary function of the extension wing of the Minor Export Crop Department being the administration of the Subsidy Scheme, limited extension work on this group of crops is seen in the coconut area. With regard to the more traditional intercrops under coconut, notably roots, tubers and fruit crops, the responsibility for both research and extension rests with the Department of Agriculture. and the recently established Regional Research Centre in the coconut area at Makandura should provide a fillip in accelerating the development of cropping systems under coconut in the years to come.

However, considering the various options available for evolving cropping systems models suited to major categories of coconut lands, it is a fair comment to make that none of the above institutions singly has neither the capacity nor the interest to undertake all the necessary research and extension required. Therefore it has to be a collaborative effort by a number of agencies.

5.5 Availability of disease-free planting material

Lack of disease free planting material is another major constraint faced by intercroppers. During the survey, it was striking that disease-free planting material of pineapple, banana and ginger were in short supply. Similarly, improved varieties of pepper though in great demand, were not available as the state agencies supposed to handle such work being unable to cope with such demand. The institutions responsible for the development of coconut holdings in one way or another, currently lack the organisational capacity to supply the required planting material, other than coconut seedlings.

5.6 Incidence of frequent droughts

During the field survey, the effects of drought was very striking both on intercrops and coconuts, as the coconut area was on the grip of a severe drought which is described as the worst since 1951. The problem of moisture stress was more widespread on larger commercial units, many of which are situated on gently undulating land planted to pineapple, banana and ginger. Cropwise, banana and ginger had suffered more due to drought compared to pineapple. The cost of lifting ground water for supplementary irrigation even in commercially oriented large farms is quite prohibitive, in view of the high cost of fuel. Besides, ground water is reported to be not readily available at shallow depths, in much of the semi-wet zone of the coconut area for economic exploitation.

Coconut triangle in particular has experienced wide fluctuations in rainfall over the past decade. During this period, not only the total rainfall but also the number of rainy days have shown a substantial decrease during the relatively dry months of February, March, July and August. Infact, the reported total annual rainfall in the main coconut growing districts in the last two decades has declined markedly as reproduced below.[1]

Table 2

Rainfall station	*Annual rainfall* 1963 — 72 (*Inches*)	*Annual rainfall* 1973 — 82 (*Inches*)	*Change* (%)
Kurunegala	91.9	76.3	— 16.9
Puttalam	47.2	45.5	— 3.6
Chilaw	57.1	56.5	— 1.1
Lunuwila	79.5	71.4	— 10.2
Average —	68.9	62.4	— 9.4

1. Coconut Development strategy, Ministry of Coconut Industries October 1984

Furthermore, the available rainfall records in a number of selected weather stations in the coconut area for the 20 year period just prior to 1963, indicate that even during the dry months of January to March and July to September, the number of rainy days per month had not been all that low. Unfortunately, recent weather patterns in the coconut area bear little resemblance to those of the past. For example, the rainfall records in respect of Bandirippuwa, Walpita, Ratmalgara and Isolated Seed Garden, Ambakelle for the seven year period from 1977-1983 shows that there had not been a single rainy day during the months of January and February, except in 1981. Though it is not intended to draw firm conclusions regarding changes in weather patterns based on such scanty information on rainfall, it is the view of most coconut growers that recurring droughts is a major constraint for production of both intercrops as well as coconut in much of the coconut triangle. The observed changing weather patterns in major coconut areas is an aspect that require deeper understanding for developing cropping system under coconut.

5.7 Marketing of intercrops

Produce of intercrops flow through different channels from the farms to the local consumer and in the case of some crops to the exporter. A marketing study, involving the identification and analysis of various marketing and processing intermediaries in each channel was well beyond the resources available to the team responsible for the present study. The comments made here, therefore are based largely on casual observations made during the field survey and some of the published information on marketing of crops identified as suitable for intercropping under coconut.

Marketing of intercrops is handled by the private trade and there is no intervention by the state sector in this sphere of activity. Generally, intercrop marketing functions through a system of fixed markets, periodic markets (polas) and regular buying activities of village collecters and an array of intermediaries from village to district level. A market survey of selected crops undertaken in 1980 reveals that the producer's share of the consumer's rupee exceeded 0.50 cts. in respect of all the popular intercrops grown in the

coconut area, other than manioc (0.46 cts.), ginger (0'49 cts.) and turmeric (0.45 cts.)[1] A more recent study on the Minor Export Crop sector, estimates the producer's share of the exporters rupee as 0.79 cts. and 0.66 cts. for pepper and coffee respectively[2]. On the basis of the price analysis of a range of crops covered in the above mentioned surveys, it appears that a share exceeding 60% of the consumer's rupee is generally received by the producer.

Based on such evidence, it is reasonable to infer that the producer's share of the consumer's rupee spent on commodites discussed here, is not all that unsatisfactory as generally assumed. In fact, during the field survey, hardly any complaints on this score were received. On the other hand, considering that the intermediaries have to cover not only transport and storage costs, but also losses due to driage and spoilage, an understanding of the ramifications of produce marketing is quite necessary for successful development of crops identified for intercropping. In this regard a study on problems of marketing of a few selected intercrops in the coconut area is scheduled for 1988.

Both farmers and traders are accustomed to low prices during peak season and high prices during off-season and whenever possible adjust their activities to take advantage of price fluctuations. Field observations show that price fluctuations affect more, severely seasonal crops like ginger, turmeric and vegetables. For example, ginger that was selling around Rs. 700/— to Rs. 800/— per cwt in November 1986 dropped to about Rs. 400/— per cwt by January 1987 in a matter of 6-8 weeks or so, as seen during the field survey resulting in great despair among the producers. However, price stabilisation through devices such as price supports or production quotas are unlikely to materialise for such intercrops, as they cannot be regarded as essential components of domestic food consumption Thus, for any expansion of intercropping under coconut, apart from the profitability of individual intercrops, their ready marketability either in the domestic or export markets should be a key consideration. In this regard, the two important perennial crops identified as suited for coconut lands — pepper and coffee satisfy the above criterion. In the case of other crops, particularly, pineapple, banana, passion fruit, manioc and ginger, also the prospects for expansion are considered good, according to a market survey commissioned by the Sri Lanka Export Development Board.

With regard to supply of inputs, fertilizer availability does not appear to pose problems The most commonly used fertilizer, is coconut fertilizer mixture which is well stocked in the coconut area through a network of fertilizer stores and dealers. Supply of appropriate agrochemicals was raised as a problem mostly by the pineapple growers, due to their inability to secure a particular brand of hormone required to induce flowering to which the growers have got accustomed to over the years.

5.8 Thefts

The incidence of thefts is another widespread problem applicable largely to crops such as banana, ginger, pepper, coffee and sometimes even pineapple. In the case of larger intercropping units established on leased lands, damage from cattle also poses problems to some of the growers. Security measures such as boundary fencing on lands leased for intercropping is costly and reported to be around Rs. 4000/— per acre. Furthermore, employment of a full-time watcher is also a costly item unless the individual intercropping units are large. According to growers, a minimum extent of at least 7 acres is necessary to justify the employment of a full time watcher on a regular basis. In small family farms, however, the problems of thefts are of lesser importance.

1. Supply and Market Survey of 18 Selected Crops, Vol. 1, Agro Skills Ltd., 1980.
2. Minor Export Crp Sector, Vol. 1, Agro Skills Ltd., 1985.

6. ECONOMIC VIABILITY OF INTERCROPPING ACTIVITIES

6.1 Limitations of the analysis

Information on costs and returns gathered during the informal data collection exercise involving 28 farms was used for analysis of production costs and profitability of individual intercrops. In this analysis, a further simplification was made by not drawing a distinction between commercially oriented family farms and large-scale commercial farms as described in section 4 of this report. This is mainly because of the difficulties encountered in collecting reliable quantitative data particularly on unpaid farm inputs such as family labour used extensively in family farms. Since the family farm operator, often had to rely entirely on his memory for details on items such as family labour use, much of the data generated on this aspect did not appear sufficiently reliable. Thus, as a compromise, labour use data from large scale commercial farms worked entirely with hired labour was used to construct profits on labour costs for production of individual crops. In this exercise, the market wage rates of hired labour used though appropriate for the large-scale commercial farms, is likely to have introduced an upward bias in labour costs in family farms[1]. Furthermore, in view of the small number of farms studied and due to difficulties experienced in obtaining detail quantitative information through an informal survey such as the one adopted in the present case, it is suggested that the results of the analysis given below be treated largely as indicative of trends underlying profitability.

6.2 Production costs

The costs and returns of selected intercrops as presented in Table 3 are applicable primarily to large scale commercial intercropping units where generally all labour is hired and much of the land is leased. Thus, in small farms worked with family labour in owned lands, the overall production costs should be lower than those in Table 3. With regard to costs and returns of the two perennials, the figures indicated here should be treated as tentative estimates. These being new crops under coconut, many of the growers in the coconut area lacked sufficiently long experience with them in order to provide the researchers with more precise input-output information.

In general, seasonal crops such as ginger and turmeric are more popular in small holdings. Their production costs per acre are relatively less compared to semi-perennials and the waiting period before output is realised is also short. However, with regard to ginger, the current high price of planting material which is around Rs. 5000/— per acre appear to restrict the extent under this crop in many a small farm. On the other hand, in the case of semi-perennials, the high establishment costs and longer waiting period before any output is realised are two general problems faced by the growers. For example, in the case of pineapple, the establishment costs range from Rs. 10,000/— to Rs. 14,000/— per acre, all of which need to be incurred in the first year itself. In the case of the two perennials, the high establishment costs ranging from Rs. 5000/— to Rs. 8000/— per acre, coupled with a long waiting period of about 5-6 years before cash flows from such crops became positive tend to make them less attractive to many of the coconut holders both small and large, as witnessed during the informal survey.

1. This is because the opportunity cost of family labour in the coconut area is not necessarily equivalent to market wage rates, as such labour cannot readily find off-farm employment on the market wage rates during most parts of the year.

Table 3. Profitability of Selected Intercrops under Coconut (Per Acre)

	Pineapple	*Banana*	*Coffee*	*Pepper*	*Ginger*	*Turmeric*
Economic Life (Years)	4	5	15	15	Seasonal	Seasonal
Output :						
Total yield	24,000 fruits at	1400 bunches at	3505 pounds at	3845 pounds at	60 cwt. at	100 cwt. at
Price per unit	Rs. 3.50	Rs. 40.00	Rs. 24.00	Rs. 40.00	Rs. 400.00	Rs. 100.00
Total Gross Returns	Rs. 84,000	Rs. 56,000	Rs. 86,040	Rs. 153,800	Rs. 24,000	Rs. 10,000
Input :						
Land Rent (a)	Rs. 2,000	Rs. 2,500	Rs. 6,000	Rs. 6,000	Rs. 500	Rs. 500
Labour (b)	Rs. 9,080	Rs. 5,600	Rs. 18,000	Rs. 37,000	Rs. 3,600	Rs. 2,800
Planting Material	Rs. 5,000	Rs. 1,500	Rs. 300	Rs. 500	Rs. 5,400	Rs. 1,500
Machinery	Rs. 1,000	Rs. 1,000	—	—	Rs. 1,000	Rs. 500
Fertilizer (c)	Rs. 10,500	Rs. 7,200	Rs. 4,800	Rs. 7,200	Rs. 2,100	Rs. 1,000
Others eg. agro-chemicals mulching material etc.	Rs. 5,600	Rs. 2,000	Rs. 3,250	Rs. 8,600	Rs. 2,000	Rs. 1,000
Total Cost	Rs. 33,180	Rs. 19,800	Rs. 32,380	Rs. 59,900	Rs. 14,600	Rs. 7,300
Net Return (Undiscounted total net returns)	Rs. 50,820	Rs. 36,200	Rs. 53,600	Rs. 93,900	Rs. 9,400	Rs. 2,700

(a) Land lease rent costed at Rs. 500— per acre per annum.
(b) Labour priced at Rs. 40— per day.
(c) Fertilizer priced at Rs. 150— per cwt.

Heavy financial outlays in the cultivation of perennial and semi-perennial crops raises the critical issue of financing the initial investment required for crop establishment Perhaps, it is partly due to this reason that the government introduced a subsidy scheme in 1977 to promote selected perennial crops — pepper, coffee and cocoa in coconut lands. In fact, the subsidy rate has been raised several times since 1977, yet the amount of subsidy presently payable does not bear much relationships with current development costs as shown in Table 4 below. Although subsidies are not designed to cover the total establishment costs, they should reimburse much of cash costs in respect of material inputs, if small holders with low cash income are to benefit.

Table 4. *Development costs and existing subsidies per acre.*

	Coffee			**Pepper**		
Year	*Development cost*	*Subsidy*	*Subsidy as a %development cost*	*Development cost*	*Subsidy*	*Subsidy as a % development cost*
	Rs.	*Rs.*	*%*	*Rs.*	*Rs.*	*%*
1	4260	1200	28	6700	1750	26
2	1960	550	28	3450	525	15
3	2200	375	17	4250	350	8
4	2250	—	—	4700	—	—
5	2250	—	—	4700	—	—
	12,920	2215	17	23,800	2650	11

In coffee, the estimated establishment costs per acre amounts to Rs. 12,920/— during the first five years. Of this amount, the first two subsidy instalments cover around 28% of the first and second year costs respectively. The third instalment takes care of around 17% of the production costs assigned to the third year. In the case of pepper. whose establishment costs per acre is estimated around Rs. 23,800 and the present subsidy covers about 26% of such costs in the first year, 15% in the second year and 8% in the third year respectively. However, as both these crops generate some income commencing from the third year onwards. It is some relief to the growers, even though the cash flows from initial harvests would still be small, until after the 5th year or so from planting.

6.2.1 Structure of production costs

The structure of production costs reveals that planting material is the most prominent cost item in ginger, accounting for over a third of the total, followed by pineapple with a sixth of the production costs (Table 5).

Table 5. Cost Structure of Cultivation of Selected Intercrops Under Coconuts.

Cost	*Pineapple* %	*Banana* %	*Coffee* %	*Pepper* %	*Ginger* %	*Turmeric* %
Land rent	6	12	18	10	3	7
Labour	27	28	56	63	24	38
Machinery	3	5	—	—	6	7
Planting material	15	7	1	1	37	20
Fertilizer	32	36	15	12	15	14
Others (eg. Agro-chemicals, mulching material	17	12	10	14	15	14
TOTAL (%)	100	100	100	100	100	100
Rs./Ac	33,180	19,800	32,380	59,900	14,600	7,300

This information shows that in the case of pineapple, very heavy cash outlays are required for fertilizer and agro-chemicals. Both these items account for about one half of the total costs, which no doubt keeps many a smallholder away from commercial cultivation of pineapple. Even in the case of banana, cash costs are high in commercial cropping due to heavy fertilization. On the other hand, labour costs figure prominently in the case of the two perennials. This is partly because of the accounting of the total labour input used for the long duration of maintenance and harvesting, all as hired labour. In such instances, substitution of family labour no doubt could reduce labour costs, but the amount of labour available in family farms is inadequate as discussed earlier in section 5.2. In commercial scale family farms worked almost entirely with family labour, only very limited extents under perennial crops such as pepper are seen. In contrast, in larger commercial ventures, most of which are located on leased lands, the short term leasing arrangements generally preclude the cultivation of perennials such as pepper and coffee as noted below. Such limitations in available labour and land need to be adequately recognised in developing cropping patterns for coconut-based farms of varying sizes.

6.3 Pay back period of selected intercrops[1]

The large-scale commercial operators are hardly involved with perennial crop cultivation under coconut though they have the necessary access to required finances. This may be due to more than one reason. Firstly, in large-scale intercropping, farm management is often entirely different from the land ownership. As noted already, land is generally leased for about 7-8 years only. Under such management conditions, perennial crops like pepper and coffee with a long economic life of 15 years or more could hardly find a place. Field observations also point out that a majority of successful large-scale intercroppers are often not the landed proprietors, but others resident in rural areas such as those with business interests and/or in employment and who have access to non-farm income sources. Perhaps, the absentee landlordism which is more common in the larger holdings of 10 to 50 acres may be one of the reasons in this regard, but this issue needs a

1. This is the length of time from planting a crop before the net profits cover the cost of establishment of such a crop.

closer study to draw any firm conclusions. Secondly, the entrepreneurs who embark on large scale intercropping enterprises even on their own lands, prefer semi-perennials and even annuals such as ginger as the 'pay back' period of such crops is very short. For example, in pineapple, the pay back period is less than two years and in banana, it is slightly over two years. On the other hand, in the case of perennials, it is much longer, generally over 5-6 years. Crops with a shorter pay back period face much lesss uncertainties arising from weather and commodity price fluctuations. This perhaps partly explains the strong preference shown for such crops by large such growers.

6.4 Net returns.

The net revenue figures computed by a simple comparison of costs and returns as presented in Table 3 are directly applicable only to the two seasonal crops and not for multi-period crops. In the case of turmeric, the returns per acre is Rs. 2700/— and in ginger Rs. 9400/— which is quite high, considering the relatively depressed market price of Rs. 400/- per cwt. of fresh ginger at the time of the survey. In the case of longer duration crops, both perennials and semi-perennials, the normal method of comparing costs and returns is by discounting, as the projected income in the future is worth less now. Accordingly, a number of discounted measures of profitability are used to illustrate the relative profitability of multi-period crops.

6.4.1 Profitability.

Table 6. Net Present worth of Costs and returns of Multi-period Crops.

Crop	*Economic life*	*Gross cost per acre*	*Present worth at 15%*	*Gross return per acre*	*Present worth at 15%*	*Total net present worth at 15%*
	Years	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
Pineapple	4	33,180	26,033	84,000	57,448	31,415
Banana	5	19,800	14,800	56,000	34,520	20,227
Coffee	15	32,380	14,138	86,040	24,202	10,064
Pepper	15	59,900	26,061	153,800	46,216	20,149

Total net present worth given in Table 6 is simply the sum of net returns (gross returns less costs) in each year discounted back to present values using a discount rate of 15%[1]. The period of discounting applicable to individual crops corresponds with their economic life as indicated in Table 6. The discounted cash flow measures of profitability depends on the reliability of annual cost and gross return estimates. In respect of costs, the informal farm survey was fully made use of to build reliable estimates for different intercrops. However, with regard to returns, which are determined by yields and prices, estimation posed a number of problems particularly in the case of pepper and coffee. Firstly, there are the yield uncertainties arising from weather variables, due to the lengthy life-span of such crops. Secondly, there are the price fluctuations depending on the demand/supply situations — again largely because of the long term nature of the two crops. Furthermore, both these perennials being new crops under coconut, there was little or no experience for the researchers to go by in projecting future yields. This necessitated the use of value judgements of the researchers particularly in computing gross returns as realistically as possible.

1. This is the annual rate of interest payable by Commercial Bank at the time of survey.

Table 7 Measures of Profitability

Crop	Establishment cost per acre	Internal Rate of return[1] (IRR)	Benefit/Cost ratio[2] (B/C)	Payback period[3]
	Rs.	%		Years
Pineapple	18,300	>50	2.2	$1\frac{1}{2}$
Banana	6,900	>50	2.4	$2\frac{1}{2}$
Coffee	7,220	29	1.7	5
Pepper	8,600	>41	1.8	5
Ginger	14,600	50*	1.6	1
Turmeric	9,300	29*	1.3	1

*Seasonal Crops — the figures are a simple rate of returns.

1. IRR — This is the discount rate at which the net present worth of cash flow equal to zero.
2. B/C — This is the ratio of total discounted gross returns to total discounted gross costs.
3. This is the duration from planting a crop before the net benefits cover the cost of its establishment.

Based on three discounted measures given in Table 7, the two semi-perennials, pineapple and banana stand prominent with regard to their profitability. Both these crops are able to provide an internal rate of return of over 50%. This simply means,that an initial investment of around Rs. 18,300 to grow an acre of pineapple or Rs. 6,900 for banana generally could provide a return of over 50%. Such returns are very attractive compared to the interest rates currently payable by commercial banks which are around 15%. In a sense, IRR represents the average earning power of funds invested on a given enterprise, which in this particular instance amounts to over 50%. Besides the Benefit/Cost ratio of these two crops is high. It is over 2, indicating that gross benefits outweigh costs heavily. A further advantage is that both these crops have a very short payback period. It is less than two years in pineapple and slightly more for banana as mentioned previously. With regard to the profitability of seasonal crops, ginger is quite prominent. Its rate of return is also over 50% and the payback period is extremely short. On the other hand, perennials show a lower IRR with 41% and 29% for pepper and coffee respectively. Besides, their payback period is more than twice that of pineapple and banana and five times that of the popular annual — ginger. Perhaps the above economic consideration could largely explain the dominance of pineapple, ginger and banana in large scale commercial farms.

Despite the relatively high profitability of perennial intercrops shown above, the enthusiasm seen regarding their expansion on a commercial scale in coconut based farms is not all that high. Financial considerations such as heavy establishment costs in the first year and previously mentioned long payback period are relevant here. Less important, but yet relevant are also some of the organisational deficiencies relating to the supply of high quality planting material which no doubt, could be overcome with proper planning. Furthermore, as already mentioned perennials have to compete with relatively more remunerative and shorter duration crops under coconut such as pineapple, banana and ginger for the farmers' resources — land, labour, and capital. This is by no means easy, as perennials generally face greater uncertainties arising from weather and price fluctuations during their long productive phase compared to short duration crops.

As mentioned previously in section 5.6, the significant decline in total annual rainfall and it's very uneven distiribution in the premier coconut producing areas has over the years increased the uncertainty for intercropping in the study area. The production stability of minor export crops, eg. pepper and coffee generally seen in the traditional producing areas in mid country — Matale and Kandy are hardly attainable in much of the coconut area, mainly due to weather fluctuations. Pepper and coffee in particular being vulnerable to drought conditions in their early years, commercial scale intercropping of such crops under coconut carry considerable financial risks. Apart from above, the price instability arising from supply fluctuations that occur during the long productive life of perennials such as pepper is another major factor that small scale growers have to contend with.

The calculations underlying the profitability analysis presented in Table 3 is based on the conventional approach of using average prices. For instance, in the case of pepper, the analysis uses an average farmgate price of Rs. 40/- per pound which was the most recent price available to the survey team. However, it may be noted that this price being a point estimate does not provide the 'best' estimate of the likely future profits obtainable from the crop This is particularly because the pepper prices had been low during the five year period from 1981 to 1985 or so. An attempt was therefore made to gauge the potential profits obtainable from pepper from a more realistic long term perspective based on past price experiences.

Table 8. *Future Price Expectations on the Basis of Weighted Average of Pepper Prices of* 1982 — 1986

Year	*Auction Price*[1] *(Rs./lb)*	*Estimate Farmgate price*[2] *(Rs.xlb)*	*Probability of past Prices occurring in the future*[3] *p(x)*	*Expected Future price* *p(x).x*
1982	13	11.70	0.1	1.17
1983	16	14.40	0.1	1.44
1984	18	16.30	0.3	4.86
1985	41	36.80	0.3	11.07
1986	53	47.70	0.2	9.57
	Expected long term farmgate price = {p(x) x =			28.08

1. Based on Bartleet Market Reports.
2. Estimated from the relevant auction price.
3. A higher weightage was given to more recent prices.

Accordingly, if it is assumed that the farmers' price expectations would be based on the past prices of pepper for a number of years immediately preceding the current year, the most likely price to be used in this computations would be around Rs. 28/— per pound as seen in Table 8. Such price expectations are in fact perfectly normal in agricultural production. If the above farmgate price of Rs. 28/— per pound is used for the financial analysis in Table 6, the internal rate of return from pepper gets reduced from 41% to 26% — a drop of 15% which is substantial from the growers point of view. Simultaneously, if the pepper yields also drop by 10% due to weather factors, the

internal rate of return gets further reduced to 23%. Furthermore, a change in farmgate price from Rs. 40/— to Rs. 28/— per pound reduces the Cost/Benefit ratio also from 1.8 to 1.2 in the case of pepper.

Agricultural crops in general are well known for production instability which is partly an outcome of weather variability. Farm gate prices in turn are dependent on a host of factors outside the control of producers. Accordingly, the financial risks/uncertainties faced by those undertaking commercial scale intercropping need to be appreciated. In the coconut area, even those who have the capital and land give first preference to crops with shorter payback period, such as pineapple. banana and ginger as seen during the informal survey. Such crops too face production instability, but to a much lesser degree compared to perennials. The relevant issue here is to understand the way farmers make decisions which is crucial for designing cropping systems for coconut–based farms

SUMMARY AND CONCLUSIONS

Despite almost two decades of consistently heavy government sector emphasis on popularising the adoption of commercial scale intercropping in coconut lands, the study suggests that except in limited circumstances, the practice has not reached high levels of of acceptance among coconut growers on a sustained basis. This problem is rather chronic and is therefore rightly receiving increasing attention by many policy planners, economists and scientists concerned with the improvement of coconut land use. The paper highlights that a key factor responsible for this state of affairs is the lack of detailed information and inadequate appreciation of the dynamics of socio-economic forces underlying the adoption of intercropping systems by the coconut growers.

The study is based on an informal survey of intercropped farms in coconut lands which was primarily designed to gain a rapid understanding of farmer's circumstances, practices and problems. This is necessary to plan 'On-Farm Adaptive Research' to find solutions for at least some of the problems identified. Normally, an informal diagnostic survey as the one discussed in the preceeding pages is followed by a more formal sample survey, firstly to verify the hypotheses developed during the informal survey, secondly to quantify key agronomic and economic characteristics of the farms in order to gain a deeper understanding of the cropping systems. However, the resource limitations in the way of research staff, time constraints and funds did not permit undertaking of such an exercise, Consequently, the constraints, needs and flexibility in the existing cropping systems as revealed in the informal survey could form the basis for the design and testing of improved cropping systems which constitute the next phase in the research process.

The survey findings suggest the presence of two broad categories of intercropped farms distributed across a fairly homogenous ecological zone in the coconut triangle. The two farm types designated as (a) commercial Oriented Family farms and (b) Commercial Oriented Large Scale Farms are characterised by differences in the scale of farm operations, resource use patterns in farm production and sources of household income particularly earnings from off-farm sources. Consequently, in the two categories of farms identified, the researchable problems and the opportunities available for improving the existing cropping systems are somewhat different and could serve as a useful starting point for cropping systems research. However, since small holdings dominate the coconut sector, with 60% of the area being in holdings of less than 10 acres, it is felt that the researchable problems in Commercially Oriented Family Farms should receive priority consideration in planning On-Farm Adaptive Research.

Cropping systems research proposals for introduction of new technologies and or modifications of the existing ones should not only have the potential to increase farm productivity, but also be both acceptable and feasible to farmers to adopt. Thus, in planning 'On-Farm Adaptive Research' the circumstances of different farm size groups have to be taken adequate note of, because in many instances their problems differ. As raised in the study findings, the solutions appropriate for one group may not necessarily be appropriate for many others. With regard to the cropping systems research process itself is concerned, the informal survey just concluded covers the descriptive stage. In order to move on to the next stage, namely the design of improved cropping systems and

their testing in farmer's fields, there appears to be a need for shift of emphasis in the intercropping work currently done exclusively in experimental stations of the Coconut Research Institute. Though intercropping investigations under coconut had progressed in Walpita and Sirikandura experiment plots of the CRI for a decade or so, no adaptive research has been undertaken so far. The suggested shift of emphasis in intercropping research may involve re-ordering of some of the priorities with regard to allocation of staff and funds for cropping systems research work at the CRI Agronomy Divison itself. The technically feasible solutions emanating from the experiment stations, whether they would be socio-economically feasible in farmer's fields is another and harder question.

Among the mix of social and economic problems identified in the study as affecting the wider adoption of intercropping practices in coconut lands, the more crucial are major uncertainties associated with production and marketing, requirement of substantially large cash investments in the initial stages and low yields of research and extension activities. However, a critical factor that needs particular emphasis in this regard is the high level of producer risks associated with the commercial intercropping enterprises. The risks primarily arise from (a) uncertainties in achieving the expected production targets (mainly due to droughts that are not uncommon in the coconut triangle); (b) market uncertainties (mainly due to lack of steady, competitive marketing channels and (c) high levels of fluctuations of output prices at the harvesting time.

More importantly, the lack of a specific agency specially directed to further cropping systems development under coconut is seen as a great drawback. The commodity oriented state institutions that currently service different sub-sectors of the national agricultural sector such as coconut, minor export crops, annual crops, fruit crops and livestock etc. individually lacks both the capacity as well as the interest to embark on a comprehensive research programme necessary for development of intercropping under coconuts. Thus, it has to be a collaborative research effort by a number of state agencies, which is easier said than done. So far, the stimulus of public supported research and extension on the development of cropping systems under coconut is yet to be felt in the survey area. In fact, information on cropping systems compatible with socio-economic and agro-ecological environments found in bulk of the coconut based farms is lacking. Much of the technical information available on crops identified as suited for intercropping deals with their cultivation in pure stands and not as intercrops under coconut. Consequently, much work remains to be done in developing income maximising cropping systems suited for coconut based farms.

In concluding, it could be said that the informal survey findings have focussed a good deal on the predominance of profit and financial goals of the two categories of intercroppers identified. Besides, a series of technical, economic and institutional constraints faced by the growers together with uncertainties arising from fluctuations in weather in the coconut area have been highlighted in the foregoing discussion. In particular, in assessing the economic viability of multi-period crops for intercropping, the need to work out profits from a longer term perspective rather than rely on single value expectations of returns based on current prices is another important consideration raised in the study. All in all, in developing technologies for Adaptive On-Farm Research, the issues raised in the report should be of some interest to those responsible for development of cropping systems under coconut in future.

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