

RATIONALE FOR INTERCROPPING

Coconut is cultivated in about 400,000 ha. or 25% of the total cultivated area of Sri Lanka. Of this acreage 70% is concentrated in the "Coconut triangle" formed by the districts of Kurunegala, Puttalam, Gampaha and Colombo in the central west coast and another 15% in the districts of Kalutara, Galle, Matara and Hambantota. The rest of the area is found mostly in the small home gardens in other districts. It has been stated that 250,000 to 350,000 acres of coconut land in the main coconut belt are potentially available for systematic intercropping. At present, however, only 40,000 to 50,000 acres have been intercropped, leaving 85% of the potential area still unutilized.

The majority of coconut lands are distributed in the Low country Wet and Intermediate Zones with a favourable climate and varying soil types. In such areas, it has been observed that the basic natural resources are not being fully utilised in a pure stand of coconut. Also, the increasing pressure on coconut lands due to rapidly increasing human population could be alleviated by resorting to intensive cropping system, because the wide spacing of coconut palms permits the cultivation of a variety of crops underneath. The rationale for intercropping on coconut lands is therefore to maximise crop production per unit of land and time, without causing any adverse effects on coconut yields. Even with a high yield of 100 nuts/palm/year the total biomass production from a pure stand of coconut palm is known to be around 17 tons/ha./year. This low level of productivity has been a salient feature in coconut lands, particularly among small holdings which occupy about 75% of the present acreage. A survey conducted in 1981 revealed that intercropping is more popular in small holdings of 10 acres or less, than in larger estates.

In the present context, coconut plantation offer the best opportunities for systematic intercropping and therefore every effort should be made to introduce this beneficial system in the main coconut growing areas.

by

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SCOPE FOR INTERCROPPING

Considerable scope exists for intercropping in coconut lands and this could be attributed largely to several ecological, agronomic and socio-economic considerations.

Ecological considerations

1. Land utilization. The morphological features of the coconut canopy necessitates its planting at a wide spacing. It is an established fact that the active roots of an adult coconut palm are concentrated laterally within a radius of 2 m from the base and vertically between 0.3 to 1.2 m from the surface of soil (Figure 1). Thus, in a pure stand of coconuts only about 25% of the soil mass is actually utilized by the coconut. A proper utilization of the remaining 75% of coconut land could be achieved by the practice of intercropping.

2. Solar energy utilization. Due to large inter spaces between palms, a considerable amount of daylight reaches the ground. It has been reported that a mature coconut palm during the 6 hour peak bright period of the day (10.00 – 16.00 hr.), actually intercepts only 44% of the total solar radiation. The remaining 56% of the solar radiation could be properly utilized by the canopies of different intercrops. The amount of sunlight available for intercrops varies with the age of the tall palms. Solar radiation is not fully intercepted by the coconut fronds at early stages and after 25 years of age. Therefore, intercrops can possibly utilize the available sunlight effectively up to about 5 years and in a mature plantation beyond the age of 25 years.

3. Utilization of soil moisture and nutrients. Work at CRI has indicated that 74% of the roots of coconut palm do not extend

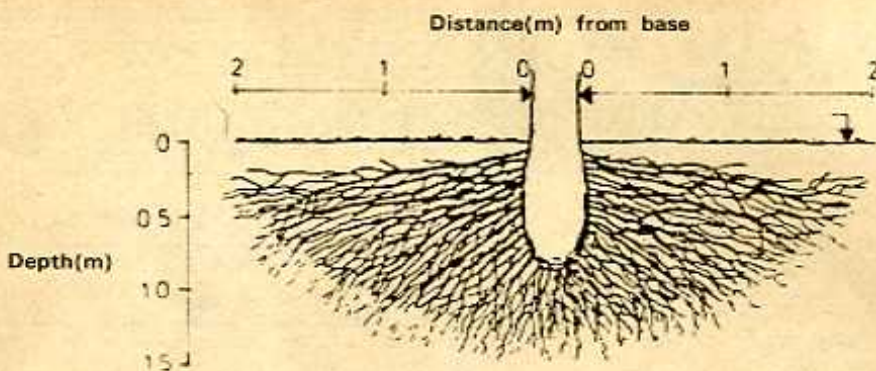


Figure 1: Schematic representation of the root system of a Coconut Palm.

beyond distance of 2 m from the base and also on a depth basis 86% of the roots are concentrated between 30–120 cm. depth from the surface. It has also been reported that there is a moisture gradient from the base of the palm towards the centre of the coconut square. A similar trend can be expected in the distribution of nutrients, and moisture. A high efficiency in the use of available soil moisture and nutrients can be achieved by growing intercrops outside a 2 m radius around the base of the palm.

Agronomic desirabilities.

1. **Better retention of water:** Because of the shade under coconut stand, evaporative demand is very much reduced and intercropping allows a better retention of water in the soil for a longer period.

2. **Improvement of soil fertility.** There is a gradual build up of organic matter in the soil by the addition of leaf litter, pruned material and by incorporation of post harvest crop residues of intercrops. Studies at CPCRI, India have demonstrated beneficial effects from coconut/cacao system. These beneficial effects are due to the increased activity of useful microbes such as phosphate solublizers and nitrogen fixers, probably due to the favourable eco-climate and the addition of leaf litter from cacao.

3. **Check soil erosion.** In high rainfall areas, particularly in the Wet Zone intercropping can be useful to check soil erosion in sloping coconut lands. It has been already reported that a large proportion of intercropped coconut holdings (60%) had sloping to undulating lands.

4. **Better control of weeds.** Intercropping gives a better control of weeds in the interspaces of coconut lands, by replacing them with economically useful crops which ultimately minimises costly intercultivation operations.

5. **Coconut as a shade tree.** Tall coconut palm often serves on a economic shade tree, particularly for shade loving crops such as coffee, cacao, pepper, clove, ginger, turmeric, colocasia and dioscorea species.

Socio-economic considerations.

1. **Provision of additional income** The long unproductive period of the coconut palm makes intercropping more attractive as an alternate source of income from young coconut plantations. Intercropping also leads to a higher cash return than from a pure stand of coconut. The additional income from intercrops is particularly useful when there is a loss in coconut yields due to natural causes like drought etc.

2. **Increased employment prospects.** Labour inputs required for maintaining a coconut crop are generally low. Intercropping can generate employment prospects by increasing the labour use for a greater part of the year. For example, with intercropping the use of labour can be increased to 350 mandays/ha./year compared with 150 mandays in a pure stand of coconut.

3. **Guard against market risks.** The variety of crops produced by intercropping can ensure at least a partial guarantee against market risks and price fluctuations of the coconut crop.

EFFECT OF INTERCROPPING ON THE YIELD OF COCONUT

In general, it is assumed that intercropping practices should make full use of the available resources without adversely affecting the nut yield. Therefore, from the long term point of view, the effect of intercropping on the coconut production is rather important.

Adverse effects of intercropping

Any adverse effect of intercropping on the coconut yield mainly depends on the extent to which intercropped species compete with coconuts for soil moisture and plant nutrients. If any one of these two factors is in short supply below the combined demand of both coconut and intercrop, it would indicate that the intercrop is utilizing the growth resources that would have been otherwise available to coconuts, resulting in a reduction of nut production.

In a mature stand, where the canopy is held at some considerable height there would not be any competition for light detrimental to coconut yield. Furthermore, competitive effects of light can always be minimised by growing intercrops only up to 5th year (excluding tall growing crops) and beyond the age of 25 years.

Research work done at C.R.I. have demonstrated that intercropping with perennials and semi-perennials does not adversely affect the yields of coconut grown in the wet and intermediate zones receiving an annual rainfall of 1750 mm (75") or more. Thus to prevent or minimise any competition for soil moisture, it is recommended that coconut growing areas should be intercropped only according to the rainfall pattern.

Availability of plant nutrients is one of the most important factors for which intercrops would compete with coconuts.

Experiments done at C.R.I. has clearly shown that when no fertilizer was added to *Brachiaria miliiformis* the yield of coconut was reduced by 14%. When Pusa Giant Napier grass was grown under coconut without fertilizer copra yield was reduced from 1173 kg/ha/year to 619 kg/ha/year. This data clearly demonstrate the fact that competition for plant nutrients could be greatly reduced or eliminated by adequate and separate manuring of both coconuts and intercrops.

Beneficial effect of intercropping

Various research work done in India, Malaysia, Phillipines and Sri Lanka reveal that intercropping can lead to beneficial results, resulting in an increased production of coconuts.

Experiments done at C.R.I. have shown that pasture species *B. miliiformis* and *B. brizantha* grown under coconut over a period of seven years under proper management increased nut yields relative to control which had no pasture (Table 1). Recent work carried out by C.R.I. with other perennial crops such as coffee, cocoa, pepper, cloves, cinnamon and also a rotation with annual crops suggest a similar trend in increased coconut production as shown in Table 2. The increase in nut yields may be mainly due to the addition of leaf litter, retention of moisture, suppression of weeds and improved microbial activity. Similarly in India, intercropping with pepper has increased the nut yield during the experimental period. In mature coconut plantations over 40 years, it has been suggested that heavy application of nitrogen and potash fertilizer to pineapple can indirectly benefit coconut, leading to increased nut production.

Nutrient removal by the coconut palm as well as the intercrops is an important factor that should be considered in the application of adequate amounts of fertilizer. As indicated in the Table 3 it is apparent that various crops remove different quantities of nutrients while the highest requirement of most crops is for nitrogen and potash. In view of the high requirement of coconut palm for potash, considerable attention should be paid when intercropped with tubers and yams, banana pineapple, sugarcane etc. which also require high potash. Furthermore, beneficial effects of potash always depends on the presence of adequate amounts of nitrogen. Therefore adequate application of nitrogen and potash is particularly important since most of the coconut soils are deficient in these nutrients. Thus, unless the nutrients removed by the coconut as well as intercrop are replenished, there will be a decline in nut yields.

In most cases, intercropping is practised in adhoc manner without paying sufficient attention to the optimum requirements of both coconut and intercrops. Evidence accumulated so far demonstrates that intercropping with coconut when practised systematically by selecting suitable crops according to climatic region, soil type and terrain, by having compatible crop combinations of varying root

habits; planting intercrops leaving space for coconut manure circle, adequate and separate manuring of both crops, and preventing indiscriminate use of available space for intercropping could be beneficial to coconuts. It is clearly evident that intercropping is a practice which ensures optimum utilization of coconut lands and provide several economic benefits to the grower.

TABLE 1
EFFECT OF GRASSES ON THE YIELD OF COCONUT (NUTS/AC/YEAR)

<i>Treatments</i>	1956	1957	1958	1959	1960	1961	1962	Mean	Percentage increase %
Estate/control	3068	3156	2819	3222	3190	4153	4641	3512	0
Brachiaria brizantha	3001	3542	3078	3446	3612	4248	4854	3737	6.4
Brachiaria miliiformis	2806	3723	2876	3700	3700	4213	4867	3726	6.1

Source: Santhirasegaram (1966)

TABLE 2
EFFECT OF INTERCROPPING ON THE YIELD OF COCONUT IN THE WET ZONE

<i>Treatments</i>	Average yield of nuts/ha (78/79/80/81/82/83)	Yield of nuts/ha (1984)	Copra yield (nut (1984) (g)	Percentage increase
Control (no intercrops)	5171	4667	239.0	—
Cocoa ..	6501	5285	240.0	19.8
Coffee ..	7183	6400	237.0	38.1
Pepper ..	5389	4726	229.6	2.8
Cloves ..	5752	4843	230.9	7.7
Cinnamon ..	7337	6661	231.7	42.2
Rotation with annuals	6837	5051	224.6	20.8

Source: Report of the Agronomy Division, CRI for 1984 (unpublished)

TABLE 3
REMOVAL OF MAJOR NUTRIENTS BY DIFFERENT CROPS

<i>Crop</i>	<i>Nitrogen kg/ha</i>	<i>Phosphate kg/ha</i>	<i>Potash kg/ha</i>
Coconut	66	28	123
Coffee	27	5	40
Cocoa	31	6	38
Banana	56	14	185
Pineapple	98	27	245
Citrus	94	20	129
Cassava	54	45	232
Sugarcane	76	54	170
Sweet Potato	62	18	98
Ground nut	80	22	54
Soyabean	80	22	54
Maize	114	43	125

Source: Jacob, 1958