Reducing the Risks in Rainfed Coconut Cultivation

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MOST people in India raise fruit trees, tubers, vegetables, spices and flowers in home compounds, but since they are raised unscientifically, their harvests are poor and irregular.

Horticultural tree crops have a distinct advantage over annual field crops since their energy demands, both in cultivation and harvesting, are less. Unlike field crops, horticultural tree crops are well suited to several agro-ecological fragile zones in India. They have very deep root-systems, can be raised on poor soils, and can make use of groundwater more efficiently and economically. Their well-developed foliar canopy efficiently intercepts radiation. Their shade facilitates microbiological activity in the soil. Their fallen leaves, decaying roots and twigs can be recycled to improve the organic content of the soil. Tree roots check soil erosion and limit the runoff of monsoon water.

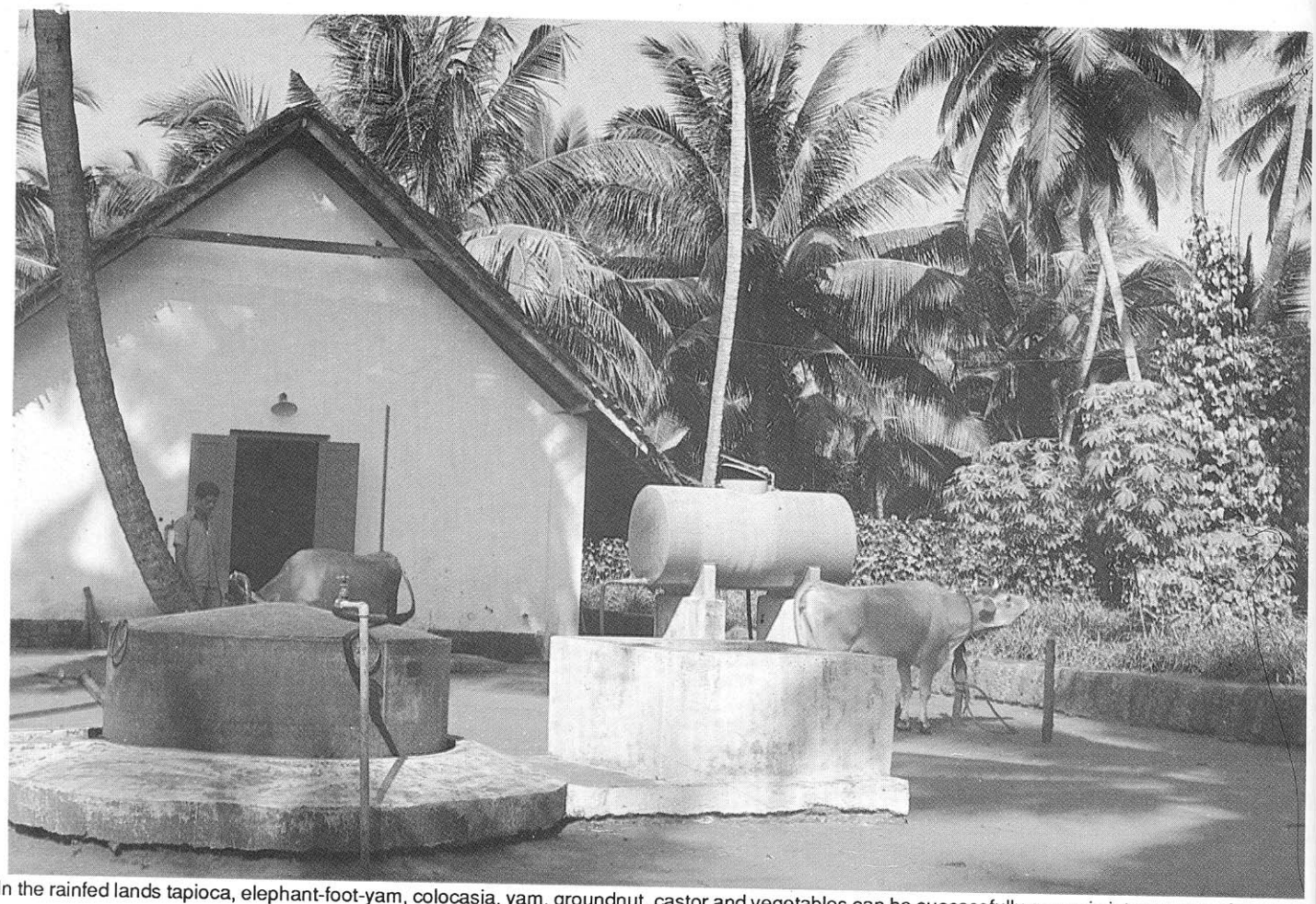
The projects for horticultural crops have improved with the developments of new, viable technologies, favourable market, improvement in transport and storage. The processing industry is also picking up. The demand for the horticultural commodities in the domestic market has dramatically increased in recent years, and there has also been a spurt in the demand in overseas markets. During 1987-88, Rs 522 million worth of fruits and fruit products were exported from India.

The objective of this paper is to (i) highlight the sound conventional practices adopted by farmers to reduce risks in rainfed horticulture, (ii) briefly indicate the improved technologies developed to enhance the productivity; and (iii) suggest the new thrust areas in horticulture.

Sound Conventional Practices

Many farmers who raised horticultural crops on rainfed lands often follow, by convention, certain practices

'Chowghat Orange Dwarf' x 'West Coast Tall' is a useful coconut hybrid which can efficiently make use of groundwater from deep soil layers.



In the rainfed lands tapioca, elephant-foot-yam, colocasia, yam, groundnut, castor and vegetables can be successfully grown in interspaces of coconut.

mainly aimed at improving the soil physical properties, enhancing the nutrient status and conserving moisture. These practices have a special importance in coconut cultivation in humid tropics where coconut palms are widely grown in sandy and red sandy soils.

Organic Manuring

Farmers usually apply green leaves and twigs in the crop basins. Some grow green-manure crops and incorporate them into the garden soil. Often, farmyard manure is applied to improve both the physical and chemical properties of the soil. These practices are very useful in coastal sandy soils, which are highly porous, amenable to leaching, and have low native fertility.

Some farmers apply oil-cakes, particularly neem-cake, in crop basins as a manure. Scientific studies have confirmed that besides serving as an organic manure, neem-cake serves as an insecticide.

Application of Tank Silt and Red Earth

In coastal areas farmers apply 120 to 150 kg of tank silt to tree crops, especially coconut palms, to improve the water-holding capacity of sandy soils. In heavy soils red earth is applied to improve aeration and reduce water-logging.

Application of Common Salt

Application of common salt to the coconut palm, either at base or on the crown, is a time-honoured practice. Some of the beneficial effects of common salts are:

(i) If contains both sodium and chlorine, both connected with the water relationships of plants enabling them to conserve water during dry periods.

(ii) Sodium acts as a substitute for potash in soils, thereby delaying the effects of potash starvation.

(iii) As a dispersing agent when applied to soils common salt is believed to soften the hard pans and facilitate root penetration.

Use of Rainwater

Earthen pots, trays made of arecanut sheath and unserviceable tins with small holes at the bottom are embedded around the trees. Sometimes a hollow bamboo with the lower end tied with a plastic sheet having a hole is used. They supply water slowly for the growing seedling. These

practices are even followed by some farmers after the establishment of tree crops as a regular source of moisture throughout the year. The system is found to be more effective in areas enjoying rains from both south-west and north-east monsoons.

Intercultivation

Garden land is often ploughed in between the rows and against the slope. Such intercultivation controls weeds, keeps the land loose and friable, and increases water infiltration. If land is not tilled, the water from rains will be lost through runoff. Where the gardens are located in light soils the farmers raise mounds in the pre-monsoon season and level the land after the monsoon to conserve more moisture.

New Technologies

The age-old practices followed by the farmers, though useful, are not adequate to reduce risks and increase yields. Some refinements in these useful methods as well as a few new approaches evolved have been discussed here.

Contour-bunding and Terracing

Contour-bunding, terracing and staggered trenching across the slope at short intervals would intercept runoff and increase percolation.

Water Harvesting

In an orchard with palms spaced at 7.5 m x 7.5 m, if rainwater is collected in a basin having a diameter of 1.8m, an additional 260 litres of water can be provided if soil pores are sealed by bentonite clay or bitumen. The interspaces so shaped and the gradient provided will result in the concentration of runoff water into the basins.

Additions of Tank Silt and Organic Manures

Application of 100 to 200 kg of tank silt per basin improves the physical conditions of the soils. Addition of organic matter, green leaves or 50 kg of cowdung in the basins would improve the water-holding capacity. Organic manures should be blended with inorganic nutrients for improving the water-holding capacity of the soil (Table 1).

Table 1. Effect of application of organic materials (alongwith inorganic sources) on some physical properties of soil in coconut garden

Treatment	Water-holding capacity (% by weight)	Bulk density (g/cc)	Saturated hydraulic conductivity (cm/hr)
Coir dust	33.8	1.37	181.2
Coconut sheddings	27.1	1.48	194.8
Forest leaves	27.2	1.50	175.8
Cattle manure	26.5	1.57	150.7
Control (NPK alone)	23.4	1.60	133.3

Table 2. Effect of cultural practices on yield of coconut (nuts/palm)

Treatment	Pre-treatment (1959-62)	Post-treatment mean of 1965-69
Two diggings (Aug/Sep and Dec/Jan)	37.2	40.9
Clean surface removal of grass	35.2	43.3
Leguminous cover	28.9	38.6
Control	32.7	28.9

Table 3. Cumulative nut yield per palm as influenced by spacing and manuring (1976-1985)

Spacing (m)	Levels of NPK (g/palm)			Mean
	0-0-0	340-225-450	680-950-900	
5.0 x 5.0	13.9	149.1	156.6	106.5
7.5 x 7.5	121.9	501.9	629.3	417.7
100 x 10.0	187.6	596.5	764.3	516.1
Mean	107.5	415.8	516.7	—

CD (0.05) 73.6

Table 4. Effect of fertilizer levels on yield of three coconut genotypes (average number of nuts/palm/year)

	No manure	500, 500, 1000 g N, P_2O_5 and K_2O/palm/year	1000, 1000, 2000 g, N, P_2O_5 and K_2O/palm/year
'West Coast Tall'	30	59	73
'Chowghat Orange Dwarf' x 'West Coast Tall'	39	85	86
'West Coast Tall' x 'Chowghat Orange Dwarf'	22	70	67

Mulching

Mulching the basins with coconut husks, leaves and coir-dust would reduce the soil temperature and conserve moisture. Coir-dust mulching reduces the water requirement by 40 to 55%. Coconut fibre absorbs moisture 3 to 6 times its own weight.

Table 5. Effect of fertilizer application on coconut yield

Treatment	Cumulative nut yield/palm (1974-75 to 1978-79)	Percentage increase over treatment 1
Farmer's practice No manuring	100.8	—
1/3 dose in first year, 2/3 dose in second year and full dose from third year onwards	178.9	77.4
1/2 dose in first year and full dose from second year onwards	230.1	128.2
Full dose from first year onwards	220.9	119.1
Double dose in first year and full dose from second year onwards	265.3	163.1
Double dose in first and second year and full dose from third year onwards	259.4	157.3

Table 6. Effect of management practices on coconut yield

Treatment	Palms in bearing (%)	Nut yield	
		Total since bearing	Mean/palm (1986 to 1990)
Cultivation + Organic and inorganic manuring	100	842	102.5
Cultivation + Inorganic manuring	100	743	85.9
Fertilizer application + forking basins	100	644	83.2
Cultivation alone	88	189	28.4
Weed control through herbicides	25	76	10.9
No cultivation and no manuring	8	3	0.4

Cultivation, ploughing in Aug and Oct; Organic, 30 kg green leaves/palm; Inorganic, 500 g N + 320 g P_2O_5 + 1200 g K_2O/palm/year.

Table 7. Green-matter yield and nutrient addition by green-manure crops in coconut basins

Legume species	Fresh weight (kg/basin)	Total N added (g/basin)
Calopogonium mucunoides	14.71	102.61
Macrotyloma axillaire	0.95	6.67
Mimosa invisa	17.00	153.19
Pueraria phaseoloides	19.43	121.29
Leucaena latisliqua	2.95	16.55
Sesbania sesban (syn. S.) aegyptiaca	1.30	6.98
Macroptilium atropurpureum	9.10	66.64
Glycine wightii	2.35	19.20
Stylosanthes guianensis	3.50	12.70
CD at 5%	7.59	53.24

Several studies have indicated that i coir from 100 nuts is incorporated as mulch in the basin of a coconut palm the yield of nuts would increase b 50%. The first improvement as a resul of such mulching is the change in th colour of leaves from pale to dar green, followed by an increase in func tional leaves, which resulted in highe yield. The effect of husk persists fo about six years only. Thereafter, incor poration of husk in the basin shoul be repeated.

Interculture and Weed Managemen

Substantial increase in coconu yield has been reported due to inter culture and weed management at th Agricultural Research Station Kumarakom (Kerala). The study indi cated that surface removal of weed produced more nuts (Table 2).

Optimum Plant Spacing

A high density of coconut palm per unit area is one of the factor responsible for the low productivity o the palms, especially in rainfed lands Palms optimally spaced come early t bearing and yield higher than uneven ly spaced and densely populated or chards. At the Coconut Researc Station, Balaramapuram, wider spac ing led to marked increase in yield pe palm on rainfed lands (Table 3).

Judicious Fertilizer Application

At Kasaragod, 'West Coast Tall responded to very high doses of fer tilizers, whereas hybrids responde only up to medium fertility level (Table 4). Hybrids, apparently, are ef ficient converters of nutrients, and ar hence better suited to rainfed cultiva tion by small holders.

Palms in neglected gardens can b improved with the application o double the recommended dose of fer tilizer in the first year, and the full dos of recommended fertilizers thereafte (Table 5).

Management of Coconut Gardens

In a long term trial at Kasaragod, management was found to have a significant effect on the yield of nuts. Even if farmer applies fertilizer and forks the basins, he can realise good yield (Table 6). Addition of blended organic sources, particularly forest leaves and cattle manure, markedly enhance the growth and vigour of coconut palms, compared with palms treated with NPK fertilizer alone.

Cover Crops

Growing of cover crops conserves soil, smothers weed and reduces ground temperature. At Kayangulam, tropical Kudzu (*Pueraria phaseoloides*) reduced soil temperature by 10 to 20°C compared with adjacent bare land.

Pueraria phaseoloids, Mimosa invisa and *Calapogonium mucunoidia* were reported to yield 19.43, 17 and 14.71 kg of green matter per basin (Table 7). Green manuring at 20 kg per palm induced high level of zymogenic response by micro-organisms in the coconut rhizosphere. Basin management using green-manure legumes in the root (wilt)-affected coconut gardens was found to have restricted the spread of the disease.

Intercropping

About 90% of the coconut holdings are smaller than one hectare, making it uneconomical to the owners to invest large amounts on irrigation and land development.

As a result, most of the coconut holdings are rainfed. Intercropping not only meets the varied food requirements of the farmers but also acts as an insurance against crop failures and price fluctuations. Tapioca, elephant-foot yam, colocasia, yam, lesser yam, groundnut, castor and vegetables can be successfully grown in the interspaces of coconut.

Raising tuber crops has no adverse effect on coconut provided the same intercrop is not grown in the same plot every year, and both the main crop and the intercrop are manured adequately and separately (Table 8). The net profit from coconut + elephant-foot yam in 1988 worked out to Rs 18,550 per hectare per year. The profit from coconut + ginger was estimated at Rs 14,350 whereas the sole crop of coconut gave a net return of only Rs 5,150 per hectare per year (Table 9).

Some vegetable crops like amaranths, brinjal, coccinia, snakegourd and vegetable cowpea can be successfully grown in association with coconut as intercrops.

Table 8. Yield of coconut palm before and after the experimental periods as influenced by intercropping

Intercrop	Mean yield of nuts/palm/year		Per cent increase (+) or decrease (–)
	Before the experiment	After the experiment	
Control	48.2	45.2	–6.2
Tapioca (every year)	54.8	51.2	–6.6
Elephant-foot yam (")	68.3	59.3	–13.2
Tapioca and elephant-foot yam in alternate years	73.0	68.2	–6.6
Elephant-foot yam and tapioca in alternate years	66.6	62.4	–6.3
Tapioca, elephant-foot yam, sweet-potato, ginger and turmeric in a 5-year rotation	49.7	52.1	+4.8
Yam, lesser yam, colocasia and coleus in rotation	60.8	69.8	+14.8

Table 9. Economics of rainfed coconut-based mixed cropping system with annual crops in marginal land (Rs/ha)

Particulars	Coconut monocrop	Coconut + cassava	Coconut yam	Coconut + ginger
Cost				
Labour wages @ Rs 28/day	3,350	7,000	7,030	17,340
Planting materials	—	250	4,500	6,500
Organic manure @ Rs 10.0/tonne	450	1,700	1,100	3,450
Fertilizers:				
Urea @ 2.40/kg	460	840	700	850
Superphosphate @ Re 1/kg	350	800	500	660
Muriate of Potash @ Rs 1.40/kg	490	660	620	600
Plant protection	450	600	600	1,000
Contingencies	450	650	550	1,000
Total Variable cost	5,950	12,500	15,600	31,400
Annuity value @ 14%	10,800	10,800	10,800	10,800
Gross cost	16,750	23,300	26,400	42,200
Returns				
Coconut @ Rs 2.50/nut	21,000	23,450	23,450	23,450
Byproducts	900	1,400	900	900
Cassava @ Re 1/kg	–	9,600	–	–
EF Yam @ Rs 2/kg	–	–	20,600	–
Ginger @ Rs 7/kg	–	–	–	32,200
Gross return	21,900	34,450	44,950	56,550
Net return	5,150	11,150	18,550	14,350

In locations where moisture stress is acute in summer, care should be taken to restrict the cultivation of intercrops.

Though these studies have direct bearing on coconut crop, the approaches discussed are relevant to the management of most horticultural tree crops.

New Thrust Areas

Breeding programmes have to be oriented towards evolving drought-resistant varieties specific to varied agroclimatic zones. Stress also has to be laid on the selection of shade-tolerant varieties of fruits, vegetables, spices and rhizomatous crops so that they will find a suitable place in cropping systems. Intensive use of insecticides and pesticides is not desirable in horticultural crops. Insecticides are not only expensive but pose health hazards. Emphasis has to be laid on the breeding for resistance to diseases and pests and on biological control.

There is a shortage of quality planting material in horticultural and plantation crops. Considerable success has been achieved in standardizing vegetative propagation techniques. These methods have to be commercially exploited through the establishment of scion banks and nurseries to multiply quality planting materials. Considerable success has also been achieved in large-scale multiplication of elite planting materials through tissue culture and other biotechnological means in banana and cardamom. Such programmes have to be diversified into other crops.

Agro-techniques should be standardized to provide high yields with limited moisture. Nutrient management should be judicious through organic and inorganic combinations. Most horticultural gardens are low yielders because of uneven spacing, use of unsuitable varieties and non-implementation of recommended production practices. Hence attempts have to be made to rejuvenate the unproductive gardens. To create an awareness among cultivators about the advantages of the improved package of practices in horticultural crops national demonstrations in horticulture have to be suitably designed keeping in view the special characteristics of these crops having long gestation and productive periods.

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