ECONOMICS OF COCONUT-BASED FARMING SYSTEMS

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Abstract: The interest for palm based farming systems has stemmed from both technical and economic grounds. Feasibility studies under rainfed situation involving different species and varieties of cereals, pulses, oilseeds, tubers and rhizomes revealed that under Kerala conditions the tubers and rhizomes are relatively more compatible and remunerative intercrops than that of other groups in coconut gardens of Kerala. The economic potential in terms of net profit in the case of coconut + elephant foot-yam system was estimated at Rs 18550/ha/year, while it was Rs 14350 in the case of coconut + ginger system and Rs 5150 in coconut sole crop system.

Among several feasible combinations under irrigation, one of the most promising systems is the integration of coconut + black pepper + cocoa + pineapple in an adult garden of above 20 years. The economic analysis suggests that this combination could generate a net return of Rs 33550/ha/year, while the net return realization from an irrigated middle aged coconut monocrop is estimated at Rs 23200/ha/year. The BCR in this system comes to 1.76, the IRR is higher than 20% and the annual NPW is Rs 32700.

In the case of coconut-based irrigated mixed farming system involving the production of fodder grass in the interspaces of palms, training pepper on coconut, maintaining cross-bred cows and rabbits and raising of subsidiary crops, it was observed that the net return from 1 ha coconut block of 60-70 year age group could be as high as Rs 29500 per annum.

While the annual employment generations in 1 ha rainfed coconut monocrop and irrigated coconut monocrop are assessed at 120 and 144 mandays, the same was estimated at 620 mandays in the case of rainfed coconut + ginger system, 335 mandays on coconut + pepper + coconut + pineapple mixed cropping system and 850 mandays in coconut based mixed farming system.

In the traditional homestead farmings in Kerala, the technical feasibility of coconut-based farming system is grossly misused, thus the opportunities to maximise the economic gains per unit area, input and time are lost.

INTRODUCTION

Coconut is quite an important crop for some parts of India and more so in the case of Kerala State as the economic destine of millions of small holders depends to a considerable extent on the prospects of this crop. It is grown in a predominantly subsistence economy. Under a typical socio-economic situation of Kerala where the average coconut holding size is only 0.222 ha and when many of the families have no other land to raise other crops or alternate sources of income to support them, the traditional practice of coconut farming has often not been sufficient to provide an incentive to improve the coconut productivity by using better management methods which are now available through research investment. On the other hand, the new production technologies which are labour intensive in nature do not find a favourable position in Kerala because of the very high cost of labour. The cost of production of coconut as well as copra in Kerala is relatively higher than that of the other coconut producing states in India because of lower productivity and higher factor costs.

The coastal regions of India in general and Kerala in particular cannot ignore the coconut culture in any account. Some 11 million people are directly or indirectly dependent on this crop for employment. There is therefore, every reason to give due attention to this important crop. Recent developments in coconut production technologies have raised very high hopes and there is no denying the fact that this crop holds great promise. In this paper the prospects of coconut based farming systems in Kerala condition have been critically analysed.

OPPORTUNITIES FOR COCONUT-BASED FARMING SYSTEMS

The opportunities for high density multispecies farming systems in coconut gardens stem from the morphological characteristics of the palms. The spacing for coconut palms ranges from 6 x 6 m to 10 x 10 m, while the optimum spacing is 7.5 x 7.5 m in order to keep the canopies of adjacent palms free from overlapping (Nair, 1979). The effective root zone of an adult palm is however, confined to 2 m radius around its base. Moreover, the top 10 cm soil is more or less devoid of functional roots and more than 80 per cent of the roots are located in 30-120 cm depth (Nelliat *et al.*, 1974). In the case of optimum spacing, the area of active root zone is only 12.57 m^2, while the surface area available to a palm comes to 56.25 m^2. Total area effectively utilized by a palm thus comes to 22.2 per cent. In a wider spacing of 10 x 10 m the same gets further reduced to 12.6 per cent (Creencia, 1978).

The phyllotaxy and other features of coconut crown permit sizable amount of light transmission through its canopy. The interception of solar energy by coconut palm varies considerably with age, spacing and system of planting (Nelliat *et al.*, 1974). For instance, when the palms are less than 8 year old, the percentage of light transmission ranges from 30 to 80, when they are between 8 and 20 year age group, the light transmission comes down to 20 per cent. Subsequently it increases progressively to about 30 per cent at the age of 30, to about 50 per cent at the age of 40 and to about 84 per cent at the age of 70. The variation in transmission rate over different periods is caused by the height of the palms coupled with the position of leaves in the crown. When the palms get older about a third of leaves bend downward and intercept less radiation, giving more light to the ground than the leaves in horizontal or upright position (Nair, 1979). Besides this, the longer trunk heights of the older palms increase the magnitude of slant rays falling under the canopy. All these characteristic features of coconut palms suggest the possibility of growing several crops of compatible nature in the interspaces of coconut groves. However, it implies that from the beginning of planting up to an age of 7 years, annuals can be grown as intercrops and between 21 and 70 years both annuals and perennials can be raised as mixed crops with coconut, but it should be left as pure stands during the age of 8-20 years.

ASSESSMENT OF ECONOMIC POTENTIALS

The interest for palm-based farming system has stemmed from both technical and economic aspects (FAO, 1966). A considerable amount of success has been made in coconut-based farming system research at the Central Plantation Crops Research Institute (CPCRI), Regional Agricultural Research Station, Pilicode of the Kerala Agricultural University, All India Co-ordinated Improvement Project on Palms and elsewhere outside India during the last one and half decades. The farming system research at CPCRI

Table 1. Economics of coconut-based multistoreyed cropping system

Particulars	Coconut monocrop	Coconut + cocoa + pepper + pineapple
Costs	(Rs)	(Rs)
Labour wages @ Rs 28/day	4050	9400
Organic manure @ Rs 100/t	450	
Urea @ Rs 2.40/kg	920	1400
Superphosphate @ Rs 1/kg	700	950
Muriate of potash @ Rs 1.40/kg	980	1300
Plant protection	450	800
Contingencies	650	900
Total variable cost	8200	14750
Annuity value @ 14%	16400	20650
Gross cost	24600	35400
Returns		
Coconut @ Rs 2.50/nut	46800	46800
Byproducts	1000	1000
Mixed crops		17900
Gross return	47800	65700
Net return	23200	30300

Table 2. Cost-benefit analysis of coconut + cocoa (SH) + pepper + pineapple system

Age of coconut palm, years	Cost Rs/ha	Return Rs/ha	Incremental benefit Rs/ha	Discounted incremental benefit @ 14% DF (Rs)
25	33240	52000	18800	16500
26	31400	52000	20600	15800
27	32000	58300	26300	17750
28	33000	60400	27400	16200
29	31150	61800	30650	15900
30	31150	62500	31350	14300
31-40	31150	64600	33450	104400
			NPW	200850
			BCR	1.76
			IRR	>20
			ANPW	32700

has revealed that the scientifically planned farming system approach provides coconut growers with a sustainable high return (Nair, 1979; Nelliat, 1979; Gomez and Gomez, 1983). The economic prospects of some of the promising models have been highlighted here.

RAINFED SYSTEMS

The possibility of successfully raising semi-perennials or perennials, particularly those demanding water during the summer months, is very much restricted in rainfed coconut gardens; under such situations, the only choice is to raise seasonals or annuals in the interspaces of coconut palms.

Feasibility studies involving different species and varieties of cereals, pulses, oilseeds, tubers and rhizomes revealed that under Kerala condition the tubers and rhizomes are relatively more compatible and remunerative intercrops than that of other groups in coconut gardens. The economic potential in terms of net profit in the case of coconut + elephant-foot-yam system under the 1988 factor product market situations, was worked out as Rs 18550/ha/year. In the case of coconut + ginger system the same was estimated as Rs 14350/ha/year. Coconut sole crop under similar situation, however, gives a small net return of Rs 5150/ha/year.

IRRIGATED SYSTEMS

Among several feasible combinations under irrigation, one of the most successful systems is the integration of coconut + black pepper + cocoa + pineapple in an adult garden of above 20 years. In this system the vines of black pepper were trained on coconut palms, and cocoa and pineapple were raised in the interspaces of coconut palms in such a way that both root and canopy competitions could be avoided. The number of stands under each species in 1 ha plot was 175 coconuts, 175 black pepper, 400 cocoa and 10600 pineapple. The entire block was given irrigation during the dry months with perfo-spray.

An economic analysis of this system under the 1988 factor-product market situations suggests that this combination could generate a net return of Rs 33550/ha/year. The net return realization from an irrigated middle aged coconut sole crop is, however, estimated at Rs 23200/ha/year (Table 1). The cost benefit analysis of this system at 14% discounting factor reveals that the benefit cost ratio (BCR) in this system is 1.76 while the internal rate of return (IRR) is higher than 20% and the annual net present worth (ANPW) is Rs 32700 (Table 2).

MIXED FARMING

In this system, hybrid napier and other fodder grasses were raised in the interspaces of 60-70 year old coconut palms; black pepper was trained on palms; banana and vegetables were grown in the backyard of farm house; and 5 units of cross-bred cows and 30 units of rabbits were maintained on fodder produced from the 1 ha coconut block and supplemented with dry fodder and concentrated feed. Summer irrigation was provided to the field. The economics of this system when worked out at the factor-product price of 1988, the net return from 1 ha coconut block could be of the order of Rs 29500 per annum. On the other hand, an irrigated coconut garden of 60-70 year age group, when raised as a pure stand, may give at the most a net return of Rs 17000/ha/year provided it receives all other cultural energies at their optimum level without any sort of intervention (Table 3).

Table 3. Economics of coconut-based mixed farming (Rs/ha)

Particulars	Rainfed monocrop	Irrigated monocrop	Mixed farming system
Cost			
Labour wages Rs 28/day	3350	4050	23800
Organic manures Rs 100/t	450	450	
Fertilizers	1300	1300	2400
Plant protection	450	450	550
Cattle feed, dry fodder and concentrate			15660
Veterinary charges			560
Expenditure for rabbits			400
Contingencies	400	650	2430
Total variable cost	5950	6900	45800
Annuity value 14%	10800	16400	18400
Depreciation			2100
Gross cost	16750	23300	66300
Returns			
Coconut @ Rs 2.50/nut	26250	39400	38500
Pepper @ Rs 30/kg for 235 kg			7050
Milk @ Rs 5/l for 8760 l			43800
Rabbits (30 numbers)			1000
Subsidiary crops			4450
Byproducts	900	1000	1000
Gross return	17150	40400	95800
Net return	10400	17100	29500
Return from family labour	2900	3200	20500
Total return to family	13300	20300	50000

EMPLOYMENT GENERATION

These farming system models of CPCRI have conclusively proved that the scientifically designed coconut-based farming system is not only capable of generating higher income, but also employment potentials of small-holders. While the annual employment generations in 1 ha rainfed coconut monocrop and irrigated coconut monocrop are estimated at 120 and 144 mandays, the same were assessed as 620 mandays in the case of rainfed coconut + ginger system, 335 mandays in coconut + pepper + cocoa + pineapple mixed cropping system and 850 mandays in coconut-based mixed farming system.

DEMERITS OF TRADITIONAL HOMESTEAD FARMING

The traditional homestead farming is perhaps the most complex and widely followed mixed perennial-annual farming system in the densely populated

humid tropics of Kerala. A variety of trees form the components of the homestead farming to provide food, fodder, fibre, fuel, fertilizer and timber. Coconut palms, however, form the single dominant species from socio-economic-cultural considerations (Das, 1986). But the homestead farming in its primitive way had resulted in yielding light and irregular crops. There are problems of soil, water and nutrient management, and the problem of disease, pest and weed management, besides the far reaching consequences to environment, with the increasing rate of complexity through extremely low land:man ratio, the homestead farmings in Kerala have become less and less rewarding. In other words, the technical feasibility of coconut-based farming system is grossly misused, thus the opportunities to maximise the economic gains per unit area, input and time are lost (Das, 1988).

LONG-TERM ADVANTAGES OF SCIENTIFIC FARMING SYSTEM

In a scientifically laid out coconut-based farming, unlike the traditional ones, the resource use efficiency gets considerably enhanced from crop interactions in the system. The interspecific plant interrelationship of certain crop combinations is either complementary or supplementary or even both. The yield of coconut, for instance goes with synergistic response from cocoa, when both are grown in close association. There could be several combinations of compatible plant species with coconut which encourage the proliferation of asymbiotic N_2 fixers and phosphate solubilisers (Thomas and Shantaram, 1984). Proliferation of the beneficial microbes such as associative N_2 fixing bacterium, *Azospirillum* and VA mycorrhizal fungi in coconut-based farming system has also been reported (Ghai and Thoms, 1988; Thomas, 1988). Increased N_2 fixation was also observed due to synergistic interaction of *Rhizobium* and VA mycorrhizal fungi in leguminous green manure crops suitable for cultivation in coconut gardens (Ghai and Thomas, 1987).

R & D EFFORTS IN FARMING SYSTEMS

Since a vast majority of the smallholders pin their hope to homestead farming, research in this area needs much better attention than what is given to it now, at least from the socio-economic considerations. In order to derive the maximum returns from the coconut-based farming system as in other crop based systems, several component technologies are required to be developed through serious research efforts.

There is an urgent need for evolving suitable varieties for the polyculture. Breeding for multiple resistant varieties could be the practical solution to the problems. Our understanding on the interaction fo crop, weed, soil and moisture should also increase to plan better farming system models. The emerging roles of slow release fertilizers and drip irrigation and their interactions in biomass production are another important areas of research investigation. Besides these, research on integrated pests, disease and nematode management in farming system research assumes priority. On-farm-research should also be the correct approach for the transfer of technology on farming system as the component technologies could be evaluated in the field and recommended for adoption by the coconut growers. It is however, often felt that much could be achieved by improving institutional credit supply position and guaranteeing remunerative prices for the agricultural commodities, including coconut products.

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