



Chocolate Tree

an intercrop in coconut garden for doubling farmers income

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Cocoa (*Theobroma cacao*) is one of the commercial plantation crops of the world and it is largely grown as a mixed crop in coconut garden in major coconut growing countries. Cocoa is now grown in 58 countries in more than 10.369 million ha. worldwide with a production of 4.434 million tonnes (Table I). Cultivation of cocoa is gaining momentum in India and is presently cultivated in an area of 87, 440 ha. (Table 2). However the productive area estimated is around 60,000 ha. Of these 29205 ha. is in Tamilnadu followed by 28656 in Andhra Pradesh. The country produces 19,866 MT cocoa annually with an average productivity of 580 kg per ha .

In India, production is too low (0.35%) when compared to the world production. Earlier the price of cocoa beans fluctuated widely, but now the position

has changed and the price is ruling between Rs. 150/- and Rs. 160/- per kg for dry beans depending upon the quality of the produce. This has provided an encouraging incentive to the farmers. The country is importing about 50% of the demand for cocoa and the demand is increasing in the country by 15% annually. At present, more than eight industrial enterprises and companies existing in the field are demanding nearly 50,000 MT of cocoa beans while the present production is only 19866 MT ie., hardly 40%. Netherlands and USA are the major consumers of cocoa and cocoa products. The other consuming countries are Ivory Coast, Germany, Brazil, UK and France. The world cocoa consumption is around 0.53 kg per head. However wide variations in consumption levels are observed between the regions. Europeans consume on an average 1.73 kg per head, Americans



Table -1 : World Area and Production of Cocoa -2014

Country	Area (Ha)	Production (MT)	Prodty. (Kg/Ha)
Brazil	14185	7164	505
Bolivia	704122	273793	389
Cameroon	670000	269902	403
Colombia	160276	47732	298
Coted Ivoire	2748357	1434077	522
Dominican Rep	150943	69633	461
Ecuador	372637	156216	419
Ghana	1683765	858720	510
Guatemala	4403	13109	2977
Guinea	20000	9439	472
Haiti	29862	14633	490
India	71000	15000	211
Indonesia	1727400	728400	422
Liberia	52900	7500	1020
Malaysia	16102	2665	166
Mexico	59624	26969	452
Madagascar	10204	8818	864
Nigeria	1374399	248000	180
Papua New Guinea	110371	45019	408
Peru	106635	81651	766
Philippines	12035	5428	451
Sierra Leone	44000	15879	361
Sao Tome and Principe	23033	3200	139
Togo	32813	30516	930
Uganda	51914	20979	404
Venezuela	63025	21735	345
Solomon Islands	12200	4825	395
Congo	26102	5000	192
United Rep. of Tanzania	7900	5645	715
Dem. Rep. of Congo	9549	2500	262
Total	1,03,69,756	44,34,147	428

Source: FAOSTAT(14.07.2017)

1.3 kg, Asians 0.1 kg and Africans 0.15 kg. In India the per capita chocolate consumption is low (about 200g per person) and is mainly consumed in urban areas. Cocoa products are being exported and India gains a foreign exchange of nearly Rs. 1089 crores during 2016-17.

Coconut monocropping is an inefficient land management system of low productivity and poor economic returns. Coconut is highly suited for crop mixing and is amenable for different types of coconut based farming system models with various crop combinations in inter cropping, mixed cropping, multi storied cropping etc. Intercropping is an intensive land use system in which one or more compatible crops are grown together with coconut, providing complementary benefits. It has proven as a best option for maximizing land use in coconut plantations.

Agro climatic preferences

Coconut and cocoa require tropical climate. Coconut requires an equal climate with high humidity. The ideal mean annual temperature is 27°C with a well distributed rainfall of 1000 mm to 3000 mm per annum. Cocoa requires moderate climate with a temperature range of 15-39°C with optimum of 25°C and annual rainfall of 1000 to 2500 mm. Both coconut and cocoa thrive well in a wide range of soil like laterite, coastal sandy or sandy loam soils rich in organic matter. Both the crops are sensitive to water stress and water logging.

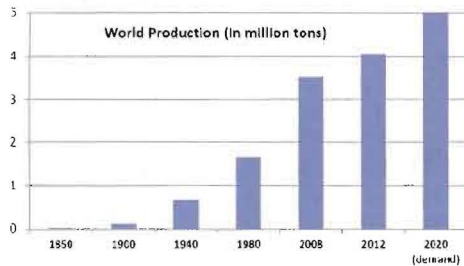
The ideal soil requirement of cocoa is humus rich forest soil. The natural habitat of cocoa is the dense shade of the warm rain forests. The soil should allow easy penetration of roots and capable of retaining moisture during summer. Clay loams, loams and sandy loams are suitable for cocoa. Shallow soils should be avoided. Cocoa is grown on soils with a wide range of PH from 6-7.5 where major nutrients and trace elements will be available. Cocoa does not come up in coastal sandy soils where coconut flourish.

Cocoa is hardly grown as a mono crop. Its imminent capacity to share the alley spaces of tall growing coconut and arecanut palms and its combining ability with the microclimatic conditions available in such

Table 2 : 1st Advance estimates of Area and Production for 2017-18

State	COCOA		
	Area (ha)	Production (MT)	Prodty (Kg/ha)
Kerala	15894	7507	750.00
Karnataka	13685	2541	450.00
Tamil Nadu	29205	1733	320.00
Andhra Pradesh	28656	8085	800.00
Total	87440	19866	580

Global Cocoa Scenario



- ❖ The production & consumption of cocoa growing
- ❖ Increased chocolate consumption in the emerging economies
- ❖ Uncertainty in major cocoa producing countries
- ❖ Widening gap in demand and supply
- ❖ Opening a world of opportunities for Indian cocoa farmer

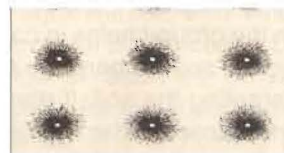
perennial gardens helps its cultivation in utilizing such areas without exacting for an independent growing climate of its own. In any groves of tall growing palms where 40-50% sunlight penetration is possible, cocoa stands first to absorb such solar energy, remaining symbiotic to the main crop and generating additional income as well, besides helping the amelioration of the soil conditions making beneficial not only for its own growth but also for the benefit of the main crop under which it takes its shelter. The light infiltration through the coconut canopy is in the range of 30 to 80% depending on the age of palms, spacing and the extent of canopy development and this shade is suitable for cocoa. Cocoa is biologically compatible and physiologically adaptive in coconut gardens. There is no competition for water and nutrients as these two crops are having different types of root system spread in varying depth of soil.

Coconut and Cocoa – Suitability for inter-cropping

Coconut is highly suited for crop mixing and is amenable for different types of coconut based farming system models with various crop combinations in inter cropping, mixed cropping, multi storied cropping etc. As a mono crop, coconut does not fully utilize the basic resources like soil and sun light available in the garden. In a coconut garden, with a spacing of 7.5 m X 7.5 m , 75% of the planted area remains unutilized due to the specific distribution pattern of the root system of the crop. The active root zone of coconut is confined within 25 % of the available area since the growing region of the root system is

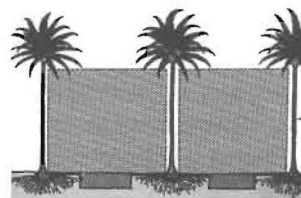
concentrated within a radius of 2 meter around the base. The space utilization of coconut is very low and plenty of sunlight infiltrates and falls on the ground. As much as 56% of the sunlight is transmitted through the canopy of coconut crown of 15 year old palms. Therefore any crop, either seasonal or perennial which does not affect the growth of the palm can be integrated in coconut garden for maximum returns from unit holding.

Cocoa has been found biologically compatible and physiologically adaptive in coconut gardens. Coconut provides shade to cocoa which is a shade tolerant crop requiring 40-70 % light for better yield. The diffused sunlight in coconut garden is ideal for growing cocoa. As cocoa is mainly cultivated under irrigated coconut gardens, availability of such areas in the states like Kerala, Karnataka, parts of Maharashtra, Pondicherry, Tamilnadu, Andhra Pradesh and West Bengal will offer considerable scope for its cultivation and its development as these areas are coastal belts where coconut is grown. Of the 2.04 million ha of coconut gardens in India, coconut growing belts in Karnataka, Pondicherry, Tamilnadu and Andhra Pradesh are irrigated in nature. In respect of other states, around 30-40% is under irrigation. Therefore not less than 4 lakh ha of available coconut gardens will be definitely suitable for cocoa as an intercrop besides the vast potential available in the North east region.

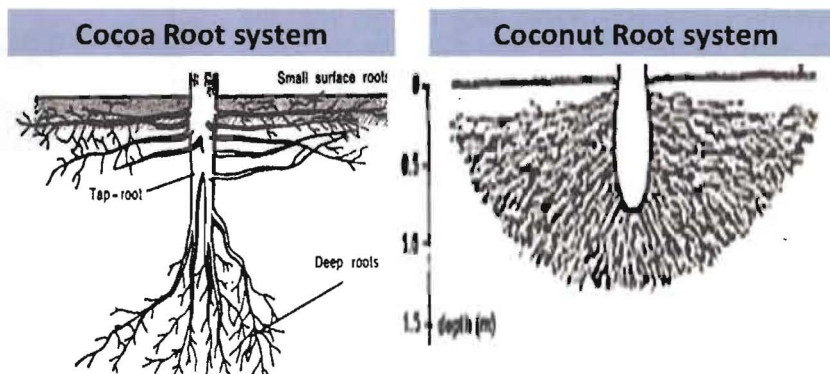


25% of total land only utilized by coconut

Maximum utilization of available land



Rooting pattern of coconut





Potential cocoa production from the irrigated coconut area in India	
Total coconut area in the cocoa belt	21 lakh ha.
Irrigated coconut area excluding coastal area (30%)	6.3 lakh ha.
Potential for cocoa production @ 500 kg/ha.	3.15 lakh MT/year.
Present area	87440 ha.
Present production	19866 MT.
World production	44.3 MT.

In a coconut garden of about 10 years with a spacing of 7.5X 7.5 m, cocoa can be planted at a spacing of 3 meter, between two palms in a single row system in the middle of two rows of coconut. In between each coconut palm in a row, one more coconut palm can be accommodated. Thus in one ha. of coconut garden, about 500 cocoa plants can be planted. Six month old F1 hybrid seedlings or graft is the recommended variety for planting in pit size of 50 cm x 50 cm x 50cm.

There is a symbiotic association between coconut and cocoa. The organic matter added by cocoa by way of leaf litter enriches the soil fertility status of coconut garden. Cocoa adds 5.3 tonnes of leaf litter per ha. per annum. Cocoa leaves contain 2.84% nitrogen, 0.26% phosphorus and 1.73% potassium which on an average supply 66.72 kg nitrogen , 4.97 kg P₂O₅ and 59.72 kg K₂O per ha per year. It also provides 14.27 kg magnesium oxide and 2.5 tonnes of pod husk which is rich in potassium (2.5 to 5.3%). The leaf litter that falls on the ground helps in conservation of moisture, regulation of soil temperature and control of soil erosion by carpeting the soil. It also improves soil micro climate and increases the microbial activity in the soil and controls weed growth by casting more shade.

Benefits

The crop combination of coconut and cocoa provides a buffering effect against drastic diurnal variation in its ecoclimate. Differences between the average daily values of maximum and minimum temperature and relative humidity were considerably less in the ecoclimate of the crop combination, while evaporation was only about 30% of that from the open area. Of the 56% sunlight available for cocoa as a mixed crop with coconut, the crop was able to intercept 63% when it was planted in a single hedge only(single rows of cocoa alternating with rows of coconuts) and at least 76% when planted in a double hedge (2 rows of cocoa + 2 rows of coconuts). However light available for cocoa on a per plant basis

was less in a double hedge, which resulted in less yield in the double hedge system.

The NPK requirement of coconut can be reduced to a greater extent by growing cocoa as inter crop in coconut garden. The requirement of NPK in one acre of coconut garden is estimated at 35 tonnes, 22 tonnes and 84 tonnes respectively. Therefore the NPK addition from cocoa bio mass reduces the manure requirement. Deficiency of potassium and magnesium is now commonly noticed in most of the coconut gardens especially in the root wilt affected areas. Introduction of cocoa as a companion crop in coconut gardens improves the soil health and thereby the productivity of coconut on a sustainable basis. The feeding roots of cocoa grow laterally from the tap root up to 1.2 to 1.5 meter around the plant at a depth of 15-20 cm. This prevents any sort of competition for nutrients. Thus cocoa is a suitable crop which can be profitably grown in the inter space of coconut.

Economic analysis

Coconut bears fruit throughout the year after crossing its juvenile period. Traditional tall varieties are found to start bearing in 6-7 years while dwarf and hybrid varieties start bearing in 3-4 years. In the case of cocoa, where the climate and soil allow a continuous growth, the first crop can be obtained towards the end of 2nd year or in 3rd year. Cocoa also produces pods throughout the year enabling the



farmers to fetch regular monthly income like coconut. Experience of farmers reveal that average net income per ha. comes to Rs. 2,31,000 per year at a spacing of 3mX3m accommodating nearly 500 cococo plants and 160 coconut palms.

On an average, minimum 30 fresh pods per tree are obtained annually from a cocoa plant from the third year onwards. 10 pods will give 1 kg wet beans and 3 kg wet beans give one kg dry beans. The yield potential of a well managed cocoa is 100- 200 pods per tree. Average production per tree is 2-3 kg dry beans or 90 pods per tree. There are trees which produce up to 150 pods per year. As per the present price @ Rs. 40 per kg for wet beans and Rs. 160 per kg for dry beans, the minimum average additional income per hectare of coconut garden after four to five years of planting of cocoa is Rs. 85,000 per year. This is in addition to the income from coconut which is Rs. 3,20,000@ 100 nuts per palm per year (16000 nuts per hectare)@ Rs. 20 at the present price of coconut.

Economics of Coconut- cocoa farming system (CCFS)			
Yield of coconut and cocoa			
Crops	Plants/ ha (No)	Yield (nuts/ha/kg/ha)	
		Per plant	Per ha
Coconut (nuts no.)	160	100	16000
Cocoa (dry bean)(Kg.)	500	1.00	500

Economics (Rs./ha)	
Cost of production	174000 [144000(Coconut)+30000(Cocoa)]
Gross income	405000 [320000(Coconut)+85000(Cocoa)]
Net income	231000 [176000 (Coconut) +55000 (Cocoa)]

These are average income and with scientific management, significant increase is possible in the net income of farmers. Coconut garden offers tremendous scope for intercropping with cocoa, the chocolate tree, which possesses sustained demand. The irrigated coconut gardens in Kerala, Tamil Nadu, Punducherry, Andhra Pradesh, Orrisa and West Bengal can be effectively utilized for cocoa planting. Hitherto cocoa cultivation has been mostly the mono poly of the south. North east is now all set to embark on massive cocoa cultivation. Agro climatic condition congenial for coconut - cocoa cultivation is vastly available in north and north eastern areas of the country.

States like Assam and Meghalaya are all set



to become the coconut cocoa farming center under MGNREGA, ensuring 100 days work for the marginalized families. Assam having a higher coconut productivity than Kerala, can perform well in cocoa cultivation as well, taking the advantage of congenial agro climatic and other conditions suited both for coconut and cocoa. CDB is promoting the convergence of activities of various Central and State schemes for the sustained development of the coconut sector and is holding hands with various programmes in the different states.

Conclusion

Introducing food crops like coconut and cocoa would in the long run benefit to bring in livelihood security as well as food security in the disturbed and economically backward areas of the country. Ten prominent cocoa consuming companies in India require 60,000 MT of dry cocoa bean per year and it is growing at a rate of 15% per annum in domestic market. Current production is only 19000 MT per year, which shows that there is tremendous scope for introducing cocoa as a viable intercrop in coconut gardens. If cocoa cultivation is taken up in 10 % of coconut area, the production will surpass the demand. This crop combination can become a regular source of income for the small and marginal coconut farmers in the country. ■