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DSP Farm Mandya -
a vital source of coconut seedlings

Cocoa as a potential intercrop in coconut

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Articles, research papers and letters on different aspects of coconut cultivation and industry are invited for publication in this Journal. All accepted material will be paid for. The Board does not accept responsibility for views expressed by contributors in this Journal. All remittances and correspondence should be addressed to the Chairman, Coconut Development Board, Kochi - 682 011.

Coconut Development Board

The Coconut Development Board is a statutory body established by the Government of India for the integrated development of coconut cultivation and industry in the country. The Board which came into existence on 12th January, 1981, functions under the administrative control of the Ministry of Agriculture and Farmers Welfare, Government of India, with its headquarters at Kochi in Kerala State and Regional Offices at Bangalore, Chennai, Guwahati and Patna. There are five State Centres situated in the states of Orissa, West Bengal, Maharashtra and Andhra Pradesh and in the Union Territory of Andaman & Nicobar Islands. DSP Farms are located at Neriyamangalam (Kerala), Vegiwada (Andhra Pradesh), Kondagaon (Chhattisgarh), Madehpura (Bihar), Abhayapuri (Assam), Pitapalli (Orissa), Mandya (Karnataka), Palghar (Maharashtra), Dhali (Tamil Nadu), South Hichachara (Tripura) and Fulia (West Bengal) besides a Market Development cum Information Centre at Delhi. The Board has set up a Technology Development Centre at Vazhakulam near Aluva in Kerala.

Functions

❒ Adopting measures for the development of coconut industry. ❒ Recommending measures for improving marketing of coconut and its products. ❒ Imparting technical advice to those engaged in coconut cultivation and industry. ❒ Providing financial and other assistance for expansion of area under coconut. ❒ Encouraging adoption of modern technologies for processing of coconut and its products. ❒ Adopting measures to get incentive prices for coconut and its products. ❒ Recommending measures for regulating imports and exports of coconut and its products. ❒ Fixing grades, specifications and standards for coconut and its products. ❒ Financing suitable schemes to increase the production of coconut and to improve the quality and yield of coconut.

❒ Assisting, encouraging, promoting and financing agricultural, technological, industrial or economic research on coconut and its products. ❒ Financing suitable schemes where coconut is grown on large scale so as to increase the production of coconut and to improve its quality and yield and for this purpose evolving schemes for award of prizes or grant of incentives to growers of coconut and the manufacturers of its products and for providing marketing facilities for coconut and its products. ❒ Collecting statistics on production, processing and marketing of coconut and its products and publishing them. ❒ Undertaking publicity activities and publishing books and periodicals on coconut and its products.

The development programmes implemented by the Board under the project Integrated Development of Coconut Industry in India are- production and distribution of planting material, expansion of area under coconut, integrated farming for productivity improvement, technology demonstration, market promotion and Information and Information Technology. Under the Technology Mission on Coconut, the programmes implemented by the Board are development, demonstration and adoption of technologies for management of insect pest and disease affected coconut gardens, development and adoption of technologies for processing and product diversification and market research and promotion.

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Message from the Chairman's desk

Dear Readers,

It is necessary to change with the times and innovate. This is all the more relevant in case of agricultural sector where innovation in product size and shape, methods of processing and packaging etc are gaining momentum in recent times. Also as technology progresses, the innovations too have diminished life period. So innovation has to be continuous. Innovation in agriculture can be in cultivation processes in order to simplify the process of crop husbandry or increase its efficiency and effectiveness. In case of processing, it is more oriented to develop technology for the production of convenience foods or foods that increase immunity or enhance health. Health and beauty care segment is one of the most aggressively growing segment across the globe. And in case of our crop coconut, owing to its nutritive and health attributes, the potential applications are enormous and the prospects are sky high.

The fatty acid profile of coconut with the presence of medium chain triglycerides and high content of lauric acid aids in enhancing immunity and this has been innovated across many products in the world. The capsules of Virgin Coconut Oil are a typical example. Coconut oil has been traditionally used in dental care; this health aspect has found its application in products like oral rinses with Virgin Coconut Oil, white coconut tooth paste etc. The relevance of such innovations is that the health attribute is reaching the consumer through application oriented products. The same holds true in the development of various flavoured beverages using coconut milk which serves as an alternate beverage for milk for dairy intolerant/lactose allergic consumers. The increasing vegan population has also paved the way for increasing the potential for coconut milk as a dairy alternative. Coconut shell charcoal powder is marketed for dental care; it may be recalled that our forefathers used charcoal powder in earlier days for cleaning their teeth. The adsorptive capacity of coconut shell based activated carbon is now finding applications in the production of face masks and face creams. Coconut oil was increasingly used for topical application for centuries for glowing and smooth skin, now we have virgin coconut oil based lip balms and roll on sprays.

The list is enormous; but the thought that I wish to share is that to be relevant in this liberalized and globalised world, as producers of coconut and coconut products, we need to innovate and take the innovations to the consumer in an effective manner. Let us strive together towards creating healthy and nutritious products from coconut to the benefit of mankind.

Rajbir Singh IFS
Chairman

DSP Farm Mandya - a vital source of coconut seedlings

Jayanath R, Assistant Director, DSP Farm, Mandya, Karnataka &
Kumaravel.S, Development Officer, CDB, Kochi

1. Introduction

India is the global leader of coconut in terms of production and productivity. Coconut is cultivated in an area of 21.89 lakh ha with a production of 2120.67 crore nuts (All India 2nd Advance Estimate 2020-21) in 16 States and four Union Territories in the country. The quality of planting material plays a vital role in the production and productivity coupled with the management practices and expansion of area. The requirement of seedlings for new planting in non-traditional and traditional coconut growing areas and for replanting in traditional coconut growing areas is estimated at about 10 million and the supply is estimated to about 35% by the government and private sector.

With the objective of demonstrating the scientific cultivation of coconut to the farmers and also to produce quality planting material, Coconut Development Board (CDB) under the Ministry of Agriculture and Farmers Welfare, Govt. of India has established 11 Demonstration-cum-Seed Production (DSP) Farms in different parts of the country.

CDB established its first farm during 1982 in Pura Village near Loksara in Mandya District of Karnataka in an area of 20 ha. (50 acre) taken over from the Government of Karnataka. It is located 10 km south from Mandya Town and 45 km northeast from Mysuru and about 110 km southwest of the state capital, Bengaluru. The total area of the Farm is divided into 2 blocks (30 acre & 20 acre) and the plantation was established with elite planting materials collected from reputed sources.

2. Soil and Climate

The soil is red sandy loam with moram gravel with pH 6.5 to 7.5, which is well suited for coconut cultivation. The weather data of the last 10 years shows that the Farm receives 1127 mm average annual rainfall. The rainfall is not well distributed. About 62 % of the annual rainfall is received from August to November and the rainy days will be in the range of 40-50 days annually. The maximum average temperature recorded during the past 10 years is 30°C and the minimum is 19°C. The highest temperature of 40.3°C was recorded during April and May 2016 and the lowest of 13°C during January 2017 and 2019.

3. Production and productivity of Coconut

The current palm population in the Farm is 4095 (including 468 under planted COD) of which 3200 are yielding palms. The cultivars maintained in the farm are Tiptur Tall (899), West Coast Tall (199), Tamilnadu Tall (138), Laccadive Ordinary (66), BenaulimTall (120), Chowghat Orange Dwarf (1170), Malayan Yellow Dwarf (161), Chowghat Green Dwarf (297), Malayan Orange Dwarf (149), Hybrids (308) and Exotic varieties (120). The square, triangular, rectangular and single/double hedge systems of planting are adopted for demonstration value.

The Farm is getting an average yield of around 3.20 lakh coconuts annually with an average productivity of 88.40 nuts per palm. The yearwise breakup is presented in Table 1.

Table 1. No. of coconuts harvested in DSP Farm, Mandya from 2011-12 to 2020-21

Year	Tall	Dwarf	Hybrid	Hybrid-ized Nuts from Talls & Dwarfs	Total Nuts
2011-12	167836	131863	51390	80573	431662
2012-13	197872	128111	39252	58900	424135
2013-14	156187	109858	30081	43755	339881
2014-15	117346	51631	19982	31659	220618
2015-16	190284	185644	62038	85145	523111
2016-17	182121	58997	50270	34840	326228
2017-18	55140	79626	24409	24485	183660
2018-19	98701	42279	31114	9227	181321
2019-20	176896	153424	38879	42940	412139
2020-21	121121	26266	12340	3909	163636
Total	1463504	967699	359755	415433	3206391

The Farm reported the highest production of 5.23 lakh nuts during 2015-16 with an average productivity of 163.47 nuts per palm. Similar higher production was also reported during 2011-12, 2012-13 and 2019-20. The below normal monsoon results in water deficits and severe drought in 2016-17 has resulted in decline in yield in the succeeding two years. Reduction in yield observed during 2020-21 is mainly due to the lesser rainfall and severe whitefly infestation in the recent years.

As per the districtwise coconut production data (2016-17) available, Mandya district stands 3rd in productivity (11184 nuts/ ha) in the State behind Dakshina Kannada District (13058 nuts/ ha) and Udupi District (11196 nuts/ ha). From Table 1, it is observed that the productivity in the farm for the year 2016-17 was 16311 nuts/ ha (326228 nuts total production) which was about 46% higher than the district average.

The average productivity of hybrid palms in DSP Farm, Mandya is around 127 nuts per palm per year followed by Talls with 95 nuts and Dwarf with 76 nuts per palm. Among the Tall varieties, Tiptur Tall recorded the highest productivity of 111.84 nuts followed by WCT, Benaulim Tall and TamilNadu Tall. Malayan Orange Dwarf recorded the highest productivity of 103.78 nuts followed by MYD and COD, among the Dwarfs. The planting of dwarf varieties were undertaken during the period 1984-1986. Thus all the dwarf palms have completed 35-37 years. The average economic life span of Dwarf varieties is about 40 years. The COD blocks (I & II) that has shown decrease in productivity, is already under planted with seedlings of the same variety during 2015-16. The old dwarf palms in these blocks need to be removed in a phased manner for managing the

under planted seedlings more efficiently.

The average productivity of all the varieties is detailed in Table 2.

Table 2. Varietywise total production of nuts and productivity during 2011-12 to 2020-21

Variety	Total no. of palms	Total production of last 10 years (no. of nuts)	Avg. Productivity (nuts/ palm)/year
T.T.	899	1005412	111.84
WCT	199	151761	76.26
B. TALL	120	89361	74.47
T. N . TALL	138	99730	72.27
L. O	66	40276	61.02
EXOTIC	120	67316	56.10
Total	1542	1463525	94.91
HYBRID	308	390317	126.73
Total	308	390317	126.73
COD	1170	896649	76.64
CGD	297	151161	50.90
MOD	149	154633	103.78
MYD	161	140879	87.50
Total	1777	1352549	76.11
Grand Total	**3627**	**3206391**	**88.40**

Removal of un-economic palms and underplanting is being done in a phased manner to maintain the yielding palm population to support the nursery programme.

4. Irrigation and plantation management

Since the distribution of rainfall is not uniform, the farm mainly depends on water released from the Krishnarajasagara Reservoir Project. The plantation is being irrigated fortnightly from the canal water released from the KRS Dam. The below normal monsoon results in water deficits and reflects in the yield of the palms. However, water conservation measures like mulching with coconut leaves and shredded organic residues are practiced in the farm. Steps for improving the irrigation infrastructure is also being done.

The coconut palms are applied with about 50 kg FYM every year and incorporated in the basins. Chemical fertilizers @ 1 kg Urea and 2 kg MOP per palm per year are applied in two splits, during June-July and October-November. The application of phosphatic fertilizers is skipped from 2019-20 onwards for a three year period based on the soil analysis report and the recommendation of ICAR-CPCRI. 100g Borax and 500g Magnesium Sulphate are also applied along with second dose of chemical fertilizers to supplement the micronutrient requirement of the palms. Application of organic

manures/ green manures and organic recycling of farm residues is also being followed in the Farm as recommended by CPCRI. Four vermicompost production units are maintained in the farm with an annual production capacity of about 80 to 100 tonnes. The recent soil test results indicate the higher availability of Phosphorus. The organic matter content of the soil also has shown improvement.

The pest and disease management measures, including the recent invasive pest, white fly, are also being taken up on need basis, as per the recommendations of the CPCRI and NBAIR. A Parasite Breeding Laboratory was established during

1990 for the production of biological agents for the management of black headed caterpillar which is prevalent pest in the coconut growing tracts in the State of Karnataka and bio agents against Leaf Eating Caterpillar are being made available to the farmers.

5. Intercrops/Mixed Cropping

Demonstration Plots with crop combinations of (a) coconut, cocoa and nutmeg, (b) coconut and cocoa are also set up in the Farm to promote multi-species cropping in coconut and being maintained well.

6. Planting material production

To fulfill the main objective of production of quality planting material, 2695 mother palms have been identified for production of around 1.50 lakh coconut seedlings annually. The farm has nine selection varieties viz., Dwarfs - COD, CGD, MOD, MYD & Talls - Tiptur Tall, Tamil Nadu Tall, Benaulim Tall, WCT and Laccadive Ordinary. The details of seedlings produced in the farm during the last decade is furnished in Table 3.

Table 3. Production of coconut seedlings (no.) at DSP Farm Mandya from 2011-12 to 2020-21

Year	Tall	Dwarf	Hybrid	Total Seedlings
2011-12	60708	64613	10172	135493
2012-13	154171	92706	11215	258092
2013-14	150390	68508	9301	228199
2014-15	84882	51952	8755	145589
2015-16	111187	42018	7980	161185
2016-17	99325	55323	12565	167213
2017-18	83935	52583	10911	147429
2018-19	10790	38604	4343	53737
2019-20	35724	22001	2504	60229
2020-21	93067	53480	12680	159227
Total	**884179**	**541788**	**90426**	**1516393**

The Farm is undertaking hybridization programme for the production of high yielding DxT hybrids.A total of 90426 DxT hybrids were produced during the period. The highest annual production of 12680 hybrid seedlings were reported during 2020-21. Table 4 depicts the hybrid seedling production details.

Table 4. Details of Hybridization and Production of Hybrid seedlings at DSP Farm Mandya from 2011-12 to 2020-21

Year	No. of inflo-rescences emascu-lated	No. of hybridized nutshar-vested	No. of hybrid nuts sown	Production of Hybrid seedlings
2011-12	7141	80573	79871	10172
2012-13	6724	58900	54460	11215
2013-14	5489	43755	36045	9301
2014-15	7970	31659	31609	8755
2015-16	5222	85145	85145	7980
2016-17	4284	34840	34840	12565
2017-18	2220	24485	21857	10911
2018-19	5295	9227	6190	4343
2019-20	1099	42940	40720	2504
2020-21	1283	3909	3386	12680
Total	**46727**	**415433**	**394123**	**90426**

DSP Farm, Mandya is the leading supplier of dwarf coconut seedlings to southern States. The DxT hybrids produced in the Farm have huge demand in the area. The seedlings are made available to the farmers @ Rs. 80 each for Tall Varieties, Rs. 100 each for Dwarf varieties and Rs. 300 each for Hybrid/ NCDs. The farmers can register for seedlings and based on the availability of seedlings and the seniority of booking, the farmers will be intimated for lifting the seedlings.

7. Other activities

The Farm provides technical support to all the visitors including farmers who are directly visiting the farm; participants/ trainees under various extension & skill development programmes from KVK, Mysore& State Govt.; students and others, on various programmes of the Board and the activities being undertaken in the farm. The farm also organizes/ participates in awareness/ extension programmes for the benefit of the farmers in association with the State Agri./ Hort. Department, SAU and ICAR institutes.

8. Farm Receipts

Among the 11 DSP Farms of Coconut Development Board, the DSP Farm Mandya is one of the farms that have generated good income since its establishment. From the year 2011-12 to 2020-21, a total receipt of Rs. 1398.52 lakh has been accrued in the farm by way of sale of coconuts, coconut seedlings, intercrop produces, etc. The Farm has reported the highest income of Rs. 209.65 lakh during 2015-16 followed by Rs. 167.24 lakh during 2020-21. During the above period, a total of Rs. 908.86 lakh has been incurred for farm operational expenses and the coconut nursery. The yearwise expenditure and receipts are given in Table 5.

Table 5. Details of Farm receipts from 2011-12 to 2020-21

Year	Farm expenses (Lakh Rs.)	Farm receipts (Lakh Rs.)
2011-12	90.09	129.16
2012-13	104.22	144.56
2013-14	43.60	98.61
2014-15	132.37	164.26
2015-16	131.04	209.65
2016-17	93.96	138.24
2017-18	84.79	163.61
2018-19	81.31	53.11
2019-20	100.09	130.08
2020-21	47.39	167.24
Total	**908.86**	**1398.52**

9. Conclusion

From the above, it is very well enumerated that the Board's Demonstration cum Seed Production Farm located in Mandya District of Karnataka is playing a vital role in serving the coconut community by production and distribution of quality planting materials of different varieties/ hybrids of coconut. The Farm can be contacted over phone at 08232-298015 or E-mail f-mandya@coconutboard.gov.in

Cocoa as a potential intercrop in coconut in the root (wilt) disease prevalent tracts

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Cocoa (Theobroma cacao L) also known as 'Food of god' or 'Chocolate tree' is a tropical perennial, outbreeding crop belonging to the Malvaceae family. It is native to Amazon Basin and was introduced into Africa by Spanish and Portuguese seafarers. Today, cocoa is widely cultivated in most of the humid tropical regions of the globe. However, African countries contribute about 70 per cent of global cocoa production. Cocoa was introduced into India way back in 1798 at Courtallam in Tirunelveli District of the Old Madras State (Tamil Nadu) by East India Company. Cocoa was distributed then in the agro-climatic region covering Western Ghats and Plains of Malabar (Kerala) and Mysore (Karnataka) states, having more rainy days and short dry periods. However, cocoa as a commercial crop, has gained importance in India from early 1970s. From the traditional hilly regions, cocoa production has shifted and expanded to coconut gardens of non-traditional areas of Tamil Nadu and Andhra Pradesh states utilizing the 50% shade available in the gardens and irrigation.

In Kerala, most of the farmers belong to small and marginal category and the income derived from such small holdings is not sufficient to sustain even the small families. The net income per unit area in coconut plantation need to be increased. This can be achieved by increasing land use efficiency with inter cropping. Among the different crops, cocoa is one of the best suited intercrops for coconut to exploit natural resources like sun light, land and water. The cocoa industry in the country has expanded to a considerable extent in recent years. At present, more than 15 industrial entrepreneurs and firms existing in the field demand nearly 40,000 tonnes of cocoa beans, of which the present availability is only around 45 percent. Cocoa products are being exported and India had a foreign exchange earning of nearly Rs. 1108 crores during 2020-21. Considering the market growth in the chocolate segment in India, which is about 20 percent per annum, cocoa, has great potential to develop in the coming years.

Why as intercrop in coconut garden?

Coconut is amenable for different types of coconut based farming system models with various crop combinations in intercropping, mixed cropping, multi-storeyed cropping etc. As a

monocrop, coconut does not fully utilize the natural resources like soil, water and sunlight available in the garden. In a scientifically laid out garden with a spacing of 7.5 m x 7.5 m, 75 % of the planted area remains unutilized due to specific distribution pattern of the root system. The active root zone of coconut is confined within 25% of the available area since the active root region is concentrated within a radius of two 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, intercropping does not affect the growth of the palm and hence any crop can be integrated in coconut garden for maximum returns.

Why Cocoa?

The combination of cocoa and coconut has been found to be the most remunerative and mutually beneficial among the different crop combinations.

- Climatic requirement of cocoa (inter crop) and coconut (main crop) is almost similar
- Cocoa, being a shade loving plant that can be grown in 40-50% shade, is quite ideal in coconut gardens where the shade cast by the adult palms is optimum for its growth.
- There is no competition for water and nutrients as these two crops are having different type of root systems spread across varying depths of soil.
- Coconut is a monocot while cocoa is a dicot. This situation is again favourable in nutrient utilisation as there is a difference in the preference for certain nutrient elements by dicots and monocots.
- Pest and disease problems in both the crops won't affect each other.
- Field operations like pruning and harvesting doesnot interfere with each other.
- Cocoa is a 'women friendly' crop as it does not involve heavy physical labour and pruning, harvesting and post harvest operations can be done by women
- Cocoa adds lot of leaf biomass to soil which improves soil organic matter. Cocoa adds 5.3 tonnes of leaf litter per ha per annum.
- Leaf litter acts as mulch for soil moisture conservation and also for weed control
- It also improves soil micro climate and increases the microbial activity in the soil

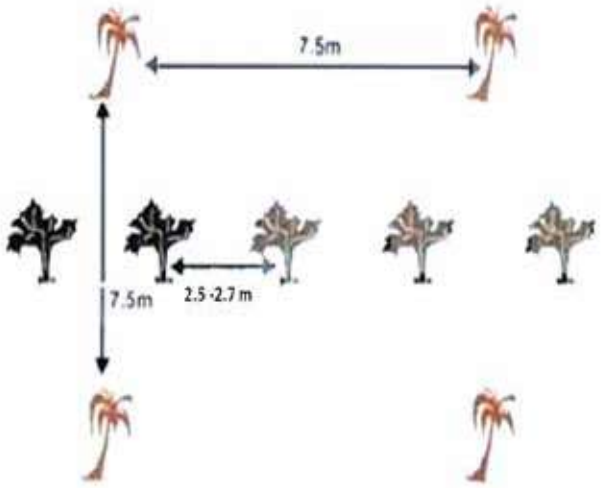

Fig 1. Cocoa as intercrop in coconut- Single hedge system

- Good yield potential and highly remunerative crop
- Assured marketing facilities and export potential of cocoa beans
- Create round the year employment, particularly for women
- Feasibility for processing and value addition on small scale

Earlier, marketing of cocoa beans was considered as one of the major problems in cocoa cultivation. However, today the situation has changed drastically. Many international companies have taken notice of procuring Indian cocoa. They are also willing to procure at a price higher than the international market price. The changed circumstances are the hope of the cocoa farmer today. Therefore, it is imperative to promote scientific cocoa cultivation.

Cultivation and care

Climate and soil

Cocoa is normally cultivated at altitudes upto 1200 m above MSL with an annual rainfall of 1000 mm to 2000 mm and a relative humidity of 80% with maximum 35^0C and minimum temperature of 15^0C. It is predominantly grown on red laterite soils. It thrives well on wide range of soil types with pH ranging from 4.5- 8.0 with optimum being 6.5- 7.0.

Varieties

There are three varietal types in cocoa namely Criollo, Forastero and Trinitario. Forastero types are known to perform well under Indian conditions. ICAR- Central Plantation Crops Research Institute, Vittal has released VTLCC-1, VTLCS-1 and VTLCS-2 and five hybrids namely VTLCH1, VTLCH2, VTLCH3, VTLCH4 and VTLCH5 (Netra Centura). Kerala Agricultural University has released seven improved clones of Forestero types namely CCRP-1, CCRP-2,

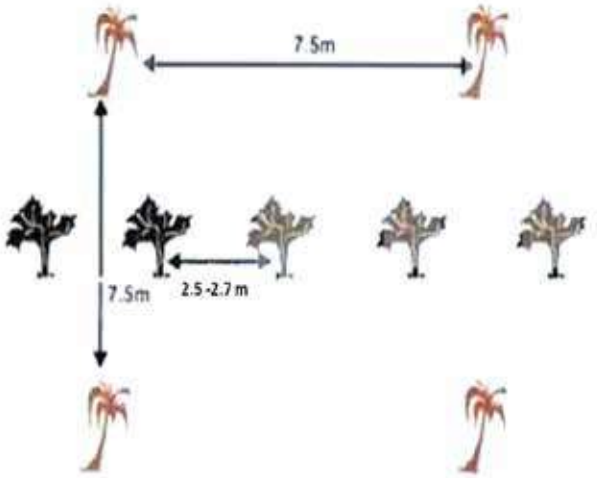

Fig 2. Cocoa as intercrop in coconut- Double hedge system

CCRP-3, CCRP-4, CCRP-5, CCRP-6 and CCRP-7 and 3 hybrids CCRP-8, CCRP-9, CCRP-10.

Propagation

Cocoa can be propagated by seeds. Seeds are to be extracted from pods. Cocoa pods take 150-170 days from pollination to attain the harvest stage. The stage of maturity is visible from the change of pod colour from green to yellow (Forestero) and red to yellow (Criollo). Collection of seeds from biclonal or polyclonal seed gardens involving superior self-incompatible parents is recommended to ensure genetic superiority of planting materials.

Selection of planting material

When seedlings are used as planting material, select vigorous and healthy seedlings from polyclonal garden. The planting material should be 4-6 month old seedling or grafted or budded plant.

Planting

Time of Planting : May- June (with onset of monsoon)

Spacing

Cocoa is generally grown as an intercrop in coconut, arecanut and oil palm plantations in India. The general recommendation is single hedge system i.e., planting one row of cocoa at a spacing of 2.5- 3 m in between two rows of coconut spaced at 7.5 m x 7.5 m (Fig. 1). Double hedge system of planting (ie., planting two rows of cocoa in between two rows of coconut) can also be adopted (Fig. 2). Thus, about 500-600 cocoa plants can be accommodated in one ha of coconut garden.

Pit size : 60 cm x 60 cm x 60 cm

Method and time of application of nutrients

Fertilizer application : N: P: K - 100:40:140 g/ plant/year

(Source: Cocoa Notebook, Technical Bulletin No.144, ICAR-CPCRI, 2019)

Majority of the feeding roots of cocoa are concentrated on the surface and horizontally they traverse from 1.0 to 1.5 meters. Thus nutrients have to be applied on the surface of the soil in the cocoa basin and mixed in the soil without damaging the roots to prevent the nutrient losses. The basin size will be smaller for young cocoa plants. The fertilizer should be applied when the soil has sufficient moisture. The time of application is decided by the moisture availability in the field and stage of the crop. In unirrigated crop fertilizers can be applied just before monsoon coinciding the months of May- June and after monsoon (September- October). When the crop is irrigated the pre-monsoon application can be advanced to February- March. As far as possible the fertilizers should be applied before main flush period, before flowering and two months before the peak of the main harvest. Cocoa in the first year of planting should be given $^{1}/_{3}^{rd}$ of the recommended dose of fertilizer for adult tree. In the second year $^{2}/_{3}^{rd}$ of the recommended dose and from third year onwards, full dose of fertilizer should be given.

Irrigation

Cocoa is generally a rainfed crop in the traditional cocoa growing countries. In India it is grown under coconut and arecanut as an irrigated crop. As rainfall occurs only from June to October, the remaining period remains dry. Hence, irrigation is essential for performance of the crop during post monsoon season.

Pruning

Pruning is an important operation in cocoa especially when it is grown as an intercrop. The main objective of pruning is to maintain the shape of the cocoa plant to make it more productive and efficient. Formation pruning and maintenance pruning are the two types of pruning generally practiced in cocoa.

Formation pruning

This is practiced for the young cocoa plants. The objective of pruning is adjustment of height of the first jorquette and control of vertical growth. Generally first jorquette is formed at a height between one and two meters. For easy operations in the field the preferable jorquette height is 1.5 to 2.0 meters. Normally the height at which the jorquette is formed depends upon the shade condition of the garden. Low shade intensity leads to jorquette formation

at lower height. When the jorquette is formed at lower height it will be removed at an early stage to facilitate upward growth. The jorquettes have five fan branches. Cocoa plants derived from fan branches tend to produce low and brushwood like canopy. Under such circumstances, the best formation pruning method is to leave 3-4 branches low down. The decision to control vertical growth depends upon the cropping system and the convenience of the farmer. Generally the vertical height is restricted to first jorquette. All the chupons arising from below the jorquette have to be cut regularly to maintain the height (Fig. 3)

Maintenance pruning

This pruning is done on mature trees to maintain the health and vigour of the tree by cutting all the diseased and unproductive branches, which is called sanitary pruning to maintain the structure of the tree. Sanitary pruning includes removal of all unnecessary chupons, dead branches, epiphytes, climbing plants, ant nests, diseased and rodent damaged pods and over riped pods.

Harvesting

Cocoa produces flowers from the second year of planting onwards and the pods take about 140-160 days to ripen. On an average, minimum 30-50 fresh pods per tree are obtained annually from a cocoa plant from the third year onwards. Average production per tree is 90 pods per tree. Generally Cocoa gives two main harvesting in a year i.e., April-June and September- January, though off- season crops may be seen throughout the year especially under irrigated condition. Ripe pods are to be harvested without damaging the flower cushions by cutting the stalk with the help of knife. The harvesting is to be done at regular intervals of 10- 15 days. The damaged and infected pods are to be separated to ensure better quality of beans after processing. The harvested pods should be kept for a minimum period of two days before opening for fermentation; however, the pods should not be kept beyond four days. For breaking the pods, wooden billet may be used. After breaking the pods crosswise, the placenta should be removed together with husk and the beans are collected for fermentation

Major diseases : Charcoal pod rot, cherelle wilt, Pod disease, Stem canker, Vascular

Streak Dieback

Major pests : Tea mosquito bug, Aphids, Mealy bug, Stem borer, Rats, Squirrels

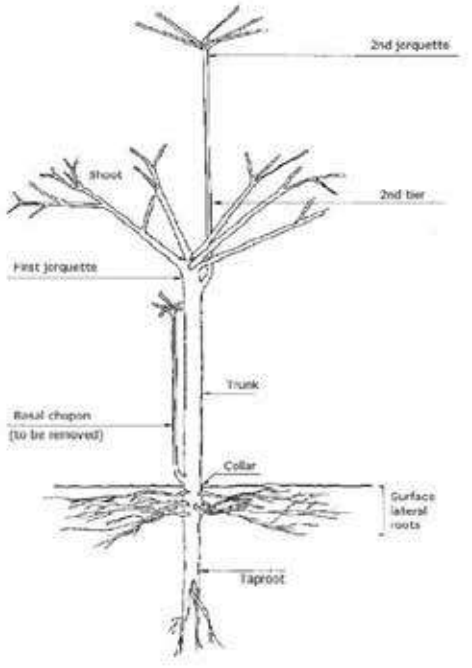

Fig 3. Schematic representation of the cocoa tree (adapted from Mossu, 1995).

Our experience of cocoa as intercrop in coconut in root (wilt) disease prevalent tract

As part of multi location trial, promising cocoa clones from ICAR- CPCRI, Regional Station, Vittal and Cocoa Research Station under Kerala Agricultural University are being evaluated as intercrop under coconut at ICAR-CPCRI, Regional Station Kayamkulam. The initial performance of cocoa under coconut is promising and the average productivity ranges from 50 to 120 pods per tree. The pest incidences noticed were mealy bug infestation and cherelle wilt at very low frequencies. The low productivity of coconut in the root (wilt) disease prevalent tract is a matter of concern and farmers are reluctant to invest in cultivation of intercrops which need more of investment and manpower. Our experience clearly shows that farmers can introduce cocoa as a suitable intercrop in coconut gardens in the root (wilt) disease prevalent tracts. Considering the additional income from cocoa and assured market for the produce, without any hesitation, farmers can plant cocoa as intercrop in coconut gardens.

Marketing

In newly cultivated areas, marketing is a problem faced by farmers. In Central Kerala, Cocoa Producers Cooperative Society, Mooleplavu, Manimala (Kottayam-686543) has procurement facility and offers reasonable price to farmers.

Hindi Fortnight 2021

Inauguration of Hindi Fortnight by Shri. R. Madhu, Secretary, Smt. Beena S, AD(OL) and Smt. Deepthi Nair S, Dy. Director are seen

Address by Shri. R. Madhu, Secretary, CDB during the valedicory function. Shri. Sadadindu Das, Chief Consultant and Shri. Hemachandra, Director are seen

Coconut Development Board observed Hindi Fortnight from 14th to 28th September 2021. The valedictory function was held on 05th October 2021. Shri R. Madhu, Secretary, CDB chaired the function. Shri Hemachandra, Director, CDB and Shri Saradindu Das, Chief Consultant, CDB were present on the occasion.

Shri R. Madhu, Secretary, CDB delivered the presidential address. Felicitations were delivered by Shri Hemachandra, Director, CDB and Shri Saradindu Das, Chief Consultant, CDB. Prizes were distributed to the winners of the various competitions conducted for the Officers and staff of CDB during the Hindi Fortnight. Prizes were also distributed to the children of the officers and staff of CDB who secured the highest marks in Hindi in the Tenth and Twelth examinations in the State Board/CBSE / ICSE streams. Prizes were also distributed to the winners of the various competitions conducted for the children of the officers and staff of CDB.Smt. Beena S., Assistant Director (Official Language), CDB welcomed the gathering and Smt. Sangeetha T.S., Senior Translation Officer, CDB proposed the vote of thanks.

Interested farmers may contact Mr. K.J. Varghese, President, Cocoa Producers Co-operative Society @ 9447184735

Conclusion

The combination of cocoa and coconut has been found to be the most remunerative and mutually beneficial among the different crop combinations. Growing cocoa as a profitable crop is possible when intercropping is done scientifically. As Indian beans are found to be best in the world, multi-nationals are looking Indian cocoa beans to make premium quality chocolates and cocoa products. Since scarcity of cocoa has been predicted on a global level, multi-national companies are investing in the cocoa plantations in India to avoid the scarcity. Thus, there is definitely huge potential for good profit margins from cocoa planted as intercrop in coconut.

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Graceful products from coconut garden remnants

Kumaravel S.
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Introduction

Coconut palm is a huge plant composed of several parts botanically differentiated into stem (trunk), leaf (frond, leaflet), inflorescence (spadix), fruit (coconut), roots, etc. The major economic part of the palm is the fruit, the coconut, which is harvested at different stages of maturity as per the markets or consumer's need. Coconut is used as tender coconut; matured nut for culinary, dessert purposes and for processing into several value added products; and fully matured nuts for seed value.

Value addition in coconut

Whatever be the purpose various parts of the nut fetch the farmer additional value. The encompassing husk in case of matured nut adds some revenue where the coir related activities are being undertaken. Coconut shell is a major byproduct in the processing chain of various products like copra, coconut oil, desiccated coconut, coconut milk, cream, milk powder, virgin coconut oil, etc. Coconut shell is used as fuel in these processing units or for making shell powder, charcoal and the high end product, activated carbon.

Other parts of coconut palm like leaves, leaflets, trunk, etc. are utilized for making thatches, broomstick, beams, furniture, etc. in various parts of the country. The unused portions of various parts of coconut palm are converted as manures for application in the coconut gardens or allowed to decompose in a normal way. Handicrafts, artifacts and other utility items made out of whole coconut, shells, coconut wood, leaflets are also popular across all coconut growing countries.

Utilisation of garden waste

Coconut inflorescences, which bear the coconut fruits, after removal of coconut, are mostly left out in the farm itself as a waste or used for fuel purposes. Though these do not find much industrial utility, it carry aesthetic values for artisans.

The coconut palms take around 5-7 years for the first bearing after planting, in case of Tall varieties. The Dwarf varieties start flowing from 3-4 years. The inflorescence, the cluster or bunch of flowers, of the coconut palm is called 'Spadix' that develops in the axil of each leaf. The spadix has a spear-like shape, stout and erect, with a length of about 1 to 1½ metre.

When the inflorescence is mature, the tough 'spathe' which encloses the inflorescence splits and opens over its entire length. The inflorescence is branched and lying close to the main axis. The branches are called 'spikes', which may count 20 to 65 in number. Female flowers, which later develop as fruits (coconuts) after pollination, are located at the base of the spikes while the rest of the spike being fully covered by male flowers.

The coconuts are normally harvested as whole bunches with the encompassing spathe and the coconuts attached to the spikes. The spathe and spikes attached to the main axis are left over in the field, after separation of coconuts.

Traditional uses

The coconut spathe is very hard and boat shaped. The spathe as such is cut into pieces of desired shapes and assembled as container. This is worn as a waist pouch by the coconut palm climbers to carry tools like knives, agricultural chemicals, etc. to facilitate harvesting of coconut or neera tapping and to undertake plant protection measures in the crown.

Traditional coconut climber with coconut spathe bag

Coconut Spathe Fiber

In the southern peninsular region of the country, the spathe is retted in water for few days and torn into longitudinal strings which are generally used for tying the coconut leaf thatches with the roof structure while making huts.

However, these things are not commonly used nowadays due to the availability of other alternatives. However, the bunch wastes can be upgraded to articles, which can have higher value than lying and decomposing in the farm itself.

Novel ideas for utilization of coconut garden remnants

Artisans can visualize any item from a different perspective. The human brain can explore and showcase any item, whether it is a waste or a costly product, beyond imagination and recognition.

The spathe of coconut inflorescence has many uses. When green it can be easily cut and shaped. The only disadvantage of the spathe is that it catches molds easily especially during rainy season. But it can be washed. The spathe can be polished and varnished to make light in weighted strong containers. The spathes can also be bent to desired shapes. Sturdy handles can be made from the spathe for all types of baskets and purses. The spathe is widely used to make long tray like holders for food, arrangements and centerpieces. Wall hangings with spathe add aesthetic value.

The coconut bunch, the main axis and the spikes, after removal of coconut can be used for making beautiful craft items. These are hard structures and take years for disintegration in open conditions. The spikes are strongly attached to the main rachis. They are sturdy which remain erect at the angle attached to the main rachis, unless heavy accessories are fixed to add ornamental value. Similarly the perianth, called as coconut caps in general, at the top of the coconut fruit can also be put use in several handicraft items. Six perianth lobes are arranged in two whorls more or less of the same size and shape. The margins of petals overlap one another to make the perianth compact.

Several eye catching craft items are being created by the artificers using the coconut caps and the spikes. Bottle arts, wall hangings, flower bouquets, etc. are prepared. Similarly, the coconut leaf art can also be practiced. The coconut crown normally bears 30-36 green leaves of uniform length. The mean annual leaf production in mature Talls is about 14-16 leaves and for dwarf palms it is around 21. The leaf ranges upto 7 m in length in Talls and upto 4 m in Dwarfs. The main rachis of the leaf is fleshy.

The average length of the petiole may be about $^{1}/_{4}^{th}$ of the total leaf length and continues as the midrib of the leaf. It is slightly concave at the upper side and round at the underside. The leaf base connecting the stem is thick, fleshy, fibrous and broad. The petiole is attached to the stem by means of a sheath in the form of a bracket firmly clasping the stem with its wings almost around it.

When the leaves are cut and removed from the crown, the leaflet part either as such with midrib is used for making thatches or the leaflet midrib is separated for making broomsticks, in most of the cases. Thus petiole/ sheath are left in the garden itself, which are in general used for fuel purpose.

The 1 to 1.25 m long petiole can also be utilized for making craft items. Palm frond art is practiced by many artisans in India and abroad. Due to the strong nature and the typical shape of the coconut petiole, the artisans make them into art pieces of higher value.

One more part of the coconut that is discarded as a waste is the leaf sheath. Nowadays the cleaned and washed sheaths are cut into geometrical shapes of various sizes for using as canvas, base for wall hangings and other handicrafts.

In a new art form, figures are also created on coconut frond, the whole leaf with midrib and leaflets.

Market potential

The present day world is after

Coconut palm inflorescence perianth craft

Art on coconut palm fronds

novel items and organic products. 'Best out of waste' is the concept inculcated among the children since schooldays. The new term of 'Organic Sculptures' is getting popular among the urban flock and the interior designers. These art forms are now getting popular even in non-coconut growing countries. These hardy structures with suitable polish, varnish and colour paints can also be displayed outdoor. Use of organic painting materials adds value to the product. It is well known that art was used to be made with organic materials for millennia using pigments derived from mineral and plant matter, before the advent of synthetic chemicals.

The market demand for ornamental articles made from coconut wastes may be minimal but it can be taken up as main profession or as a part time activity by people of any sector for increasing the income. The coconut spathe, bunch waste and frond art are sporadically taken up as a profession by artisans in Tamil Nadu, Karnataka and Kerala. By random browsing in the internet, it is observed that the spathes are sold as high as 30 US$ per set of 5 no. Musical instruments like xylophones with coconut spathe as the base are also designed and marketed for about £13. Coconut sheath fibre sheets of size 5 inch x 7 inch (10 no.) are marketed for about £7.

Making artifacts from the coconut bunch waste require less skill and time compared to carving works with whole coconuts or coconut shells. Moreover the main raw materials required, i.e. the bunch wastes and leaves are abundantly available in the coconut growing parts of the country, stretching from Gujarat coast in the west end; southern States; eastern States of Odisha, Chhattisgarh, West Bengal and parts of Bihar; and to the Northeastern States, except Sikkim.

One can easily browse the internet with key words like coconut spathe handicraft, organic sculpture, coconut cap art, coconut palm frond art, coconut leaf art etc. and can get acquainted with these handicraft items. The same can be popularized among the public through the awareness programmes and skill development programmes organized by several agencies including Coconut Development Board. The SHGs and Farmers' Collectives can also encourage these art form among their catchment area to create more employment opportunities.

Industrial applications

Various experiments have been undertaken to utilize the waste of natural products into profitable and marketable raw material. In Sri Lanka the coconut spathe is processed for making coconut spathe charcoal, which finds wider applications in

Xylophone in coconut spathe

consumer goods. The coconut leaf sheath fibre with suitable treatment finds place as reinforcing fibre in polymer composites in addition to the coconut coir fibre. Natural fiber reinforced composites have gained better attention in recent years due to the exclusive properties of natural fibre like low specific weight, high specific length, high stiffness and biodegradability and eco-friendly nature. Natural fibre-composites have considerable potential to replace conventional materials like metal, plastic and wood in structural and non-structural applications, especially in furniture industry.

Coconut fronds can be used as raw material for making art paper as it has good amount of fiber and cellulose. The utilization of coconut fronds for making art paper can minimize the coconut fronds waste. Additionally, it also has an impact on forest conservation, since most of raw materials for paper pulp are coming from wood. Experiments also are being taken up on external coloring, shaping, forming, designing, and preserving coconut sheath in order to make it ideal for application on jewellery products.

Research and development works may be undertaken to widen the profitable industrial applications of these leftover parts to fulfill the manufacturing industry that needs renewable raw material. This will also help in generating faster profits and secondary income to the farmer while waiting for the coconut palm provide a regular yield.

Conclusion

Once these so called 'wastes' can be transformed into profitable 'material' and put in wider uses, the quality of the sheath, bunch remains, frond, etc. will be taken in the account by the buyers. The farmer will then be motivated to collect, clean, preserve and sell them as a product, which can marginally supplement his income.

The handicraft products made out of wastes may not sound quite appealing. But the proverb 'Beauty lies in the eyes of the beholder', that encapsulates the idea of perception.

The propaganda and market developmental activities for these kinds of products also have to be enhanced to create regular domestic and international demands, by the concerned agencies in a coordinated manner, for sustainable livelihood of the farmers and artisans. ■

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Improved varieties and technologies of yams for intercropping in coconut gardens for higher yield and income

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Greater yam *(Dioscorea alata),* White yam *(Dioscorea rotundata)* and Lesser yam *(Dioscorea esculenta)* are cultivated as commercial crops in India in an area of about 40,000 hectares with a total production of about 11.20 lakhs tons and an average yield of 28 tons per hectare. It is cultivated widely in 44 districts of 13 states in India and the important yam growing states are Andhra Pradesh, Odisha, Kerala, Assam, Gujarat, Madhya Pradesh, Maharashtra, Tamil Nadu, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. Yam is a crop with several nutritional and health benefits. Yam is rich in starch and has only moderate nutrient density with appreciable contents of potassium, vitamin B6, manganese, thiamine, dietary fibre, and vitamin C. Yam tubers contain mucilage which are bioactive natural products possess anti-tumour, anti-inflammatory, immune-modulatory and antioxidant activities. Yam has the highest potassium levels amongst the 10 major staple foods of the world.

General nutritional profile of yam	
Property	Quantity
Dry matter (% FW)	20-35
Starch (% FW)	18-25
Total sugar (% FW)	0.5-1.0
Protein (% FW)	2.5
Fibre (% FW)	0.6
Lipids (% FW)	0.2
Vitamin A (mg/100g)	0-0.18
Vitamin C (mg/100g)	5-27.6

Improved Varieties

Though many species of yams are cultivated by farmers in our country, greater yam, white yam and lesser yam are most popular among farmers in Kerala, Andhra Pradesh, Telangana, Odisha and North Eastern states. ICAR-CTCRI, Thiruvananthapuram, Kerala, has released 17 different varieties of yams and the recently released greater yam varieties are, Bhu Swar, Sree Nidhi and Sree Hima. Sree Haritha and Sree Swetha have also been released recently in White yam.

Scientific Cultivation Practices

The recommended agrotechniques to be followed for cultivation of greater yam and white yam in coconut gardens are given below. These two yams are ideal intercrops in coconut gardens with sufficient sunlight. It also fits well in many cropping systems as it is grown as an intercrop along with turmeric, maize, red gram etc.

Site specific nutrient management

The ICAR-CTCRI has developed special fertilizer mixtures exclusively for yams for major growing areas of the country and demonstrated in farmers' gardens of Kerala and Andhra Pradesh. The microfood (Micronol) for greater yam and other major tuber crops have also been commercialized to M/s Linga Chemicals, Madurai, Tamil Nadu (Phone no. 9994093178) and the products are now available in the market for large scale use by the tuber crop farmers for addressing the problem of micronutrient deficiencies and also to enhance the soil/crop health while increasing the crop yield to the tune of 10-15%. Farmers are convinced about the performance of the new fertilizer mixture and microfood as it could increase the yield and quality of tubers which could substantially increase the income of the yam farmers.

Harvesting

The crop becomes ready for harvest in about 9-10 months after planting and the average yield is 25-30 tons per hectare.

The crop attains maturity when total senescence takes place. During harvest, care should be taken to avoid injury to the tubers. Tubers devoid of any physical damage are ideal for marketing.

Storage method

Fully mature, graded and cured tubers should only be used for storage as planting material. The storage place should be well ventilated and cool. The tubers should be stored in a single layer. But if the storage place is insufficient, then they can be stored in two layers.

Varieties of Greater yam *(Dioscorea alata)*

Bhu Swar
Year of release: 2017, Maturity: 6-7 months, Yield: 20-25 t/ha, Starch (%): 18-20, Good culinary quality, Early maturing variety

Sree Nidhi
Year of release: 2017, Maturity: 8-9 months, Yield: 35 t/ha, Starch (%): 23.2, Good culinary quality, Tolerant to anthracnose disease

Sree Hima
Year of release: 2020, Maturity: 8-9 months, Yield: 58 t/ha, Starch(%): 26.3, Excellent cooking quality

Sree Haritha
Year of release: 2017, Maturity: 9-10 months, Yield: 46 t/ha, Starch (%): 24.02, Excellent cooking quality with good flavor, Drought tolerant

Sree Swetha
Year of release: 2017, Maturity: 9 months, Yield: 30 t/ha, Starch (%): 22.02, Dwarf, bushy and non climber, Good culinary quality

Marketing

The tubers are marketed at local places and also to various places of the country viz., Ernakulam, Chennai, Mumbai, Hyderabad, Bengaluru, Delhi. Some quantities are exported to Gulf and European countries.

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Particulars	Greater yam	White yam
Varieties	Sree Shilpa, Sree Karthika, Sree Keerthi, Sree Roopa, Orissa Elite, Sree Swathy, Sree Neelima, Bhu Swar, Sree Nidhi, Sree Hima	Sree Priya, Sree Subhra, Sree Dhanya, Sree Haritha, Sree Swetha
Time of planting	March- April	March- April
Planting material	Setts : 250-300 g	Setts : 250-300 g
Method of land preparation and planting	Pit reformed into mound	Pit reformed into mound
Spacing (cm)	90 x 90 (9000 plants)	90 x 90 (9000 plants)
60 x 60 (Dwarf) (20000 plants)		
FYM (tons per hectare)	10	10
N:P_2O_5:K_2O (kg per hectare)	80:60:80	100:50:100
Intercultural operations	Trailing the plants 15 days after sprouting; weeding & earthing up within a week after sprouting and 1 month later	Trailing the plants 15 days after sprouting; weeding & earthing up within a week after sprouting and 1 month later
Duration (months)	8-10 months	9-10 months
Average yield (tons per hectare)	25-30	35-40

FPOs
as agricultural technology promoters

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Coconut is essentially a small and marginal farmers' crop and perennial plantation being cultivated in contiguous area. This multiuse crop caters to the livelihood of more than 10 million families directly and provides industrial inputs to nutraceutical, beverages, beauty products, ayurveda, coir and coir products, in horticulture industry for replacing soil with coir pith, food products and essential oils. Coconut is an important horticultural crop being cultivated in 17 states and three Union Territories across the country and contributes 31% of world production, annually 21,500 million tons of nuts. The state of Kerala occupies 35% share of Indian coconut production followed by Karnataka (26.08%) and Tamil Nadu (25.03%). The productivity of coconut in Kerala improved by 68.85% from 2000–01 to 2018-19 period, whereas it was 24.57% in Tamil Nadu and 52.78% in Karnataka in the respective period (Source : Horticulture Division, Department of Agriculture and Cooperation, Ministry of Agriculture Development and Farmers' Welfare, Government of India). It is definitely due to better technology awareness and adoption by the farming communities. This needs further impetus, to bridge this gap in technology adoption for improved productivity from coconut cultivation. The major challenges are fragmentation of land holdings leading to low economy of scale, subsistence farming in homesteads with very small area, pests and diseases affecting the yield and health of the palms, varying resource base of coconut farmers with average land holding of 0.2–0.4 ha, as well as climate change being confronted at the grass roots. Technology dissemination scenario warrants reaching out to 4–10 farmers per ha, timely and adequate access to advisory services and critical inputs, perennial nature of palm crop with vegetative phase and long-term cultivation rendering the observability, trialability, transferability and results/ impacts of technologies on a different platform. Hence technology integration and social innovations are needed to address these challenges. Community-based institutions are silver lines for collectivism in augmenting technology awareness and for evolving social business or entrepreneurship through convergence and linkages with research institutions.

Indian Council of Agricultural Research – Central Plantation Crops Research Institute (ICAR – CPCRI) is evolving research results and recommendation for the mandate crops viz,. coconut, arecanut and cocoa, as the pioneer institute for the country and being the leader in international coconut research as well. This article is the case in point, of rapid social mechanism for the use of 'Kera Probio', a bio-input developed by ICAR–CPCRI and released during the year 2014. The technology developed was mainly for coconut seedlings, but proved to be beneficial for coconut palms and vegetables too, which are intercropped in coconut gardens.

''Kera Probio''- A bio boon to coconut cultivation

Coconut is a perennial tree crop with specific growth stages such as seedling, pre-bearing (juvenile phases) and bearing stages. Healthy and vigorous coconut seedlings with quality parameters contribute to performance of coconut palms in terms of yield and income for a long period of 80-100 years in the farmers' fields. ICAR - CPCRI, developed a talc-based bioinoculant containing plant growth promoting rhizobacterium, 'Bacillus megaterium' isolated from rhizosphere of healthy and high-yielding coconut. This talc-based product augments plant growth through production of auxins, gibberellins and suppression of disease causing organisms. in the soil.

'Kera Probio' also proved to support vigorous

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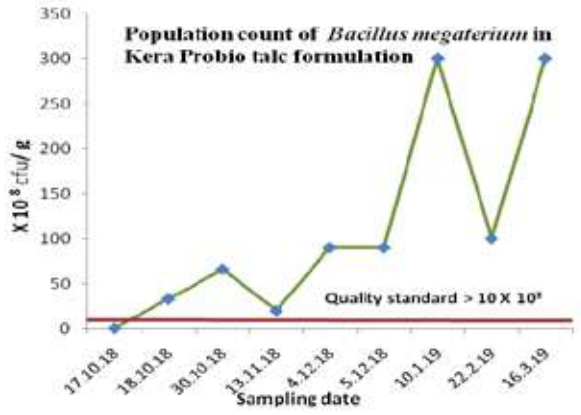
growth and yield of tomato, brinjal, chillies and other vegetables which are popular intercrops in coconut gardens. For coconut seedlings, the recommended dosage is 25g 'Kera Probio' mixed with 3-5kg of vermicompost or cow dung powder per seedling at the time of planting. Alternatively, dip coconut seedlings for 8–10 hours in suspension of 500g 'Kera Probio' in 5 liters of water and plant while adding vermicompost or cow dung or any other Farm Yard Manure (FYM). After three months, a booster dose of half-liter solution (prepared @ 500g 'Kera Probio' in 5 litre of water) to each seedling along with vermicompost or cow dung is beneficial. It is also recommended to apply 2kg 'Kera Probio' formulation mixed with 50 kg organic manure like vermicompost or cow dung powder for one acre of vegetable cultivation. The 'Kera Probio' packets should be kept in dry conditions without direct sunlight and ensure moisture in soil before or after application of bio-input. Care should be taken to give a gap of more than a week between its application in soil and that of chemical fertilizers, fungicides or weedicides. Farmers should take care of using it well before expiry date.

Technology access and ownership through FPOs

Farmer Producer Organizations are collectives of practicing small and marginal farmers mostly which can be registered as producer companies or cooperatives/societies. They have to deal with the vulnerability of farm value chain, which starts with production to processing and marketing. The critical ecosystem of FPO also cover credit, retail input services and other agricultural production services for the small and marginal farmers. ICAR – CPCRI formulated a Farmer Producer Organization (FPO) 'Odanadu Farmer Producer Company Ltd. (OFPC)' (Reg. No. U0110KL2019PTCO60976) in Alappuzha district, Kerala as an outcome of Farmer FIRST Programme (FFP) of ICAR. One of the major objectives is to sustain and grow upon the impact of technology and social innovations gained from the Farmer FIRST Programme (FFP) towards doubling farmers' income. The FFP is being implemented among 1000 farm families in an area of 1500 ha and majorities are homestead-based coconut farming systems. CPCRI-FFP innovated on transferring and technology utilization in a faster pace as a case study with the recent technology of 'Kera Probio' with OFPC as the 'technology promoter'. The convergence model in this regard by ICAR–CPCRI and the FPO towards achieving it as a social process is worth mentioning.

- Technology on 'Kera Probio' transferred to FPO based on mutually agreed upon memorandum of understanding (MoU) with the institute under payment of Rs. 50,000.
- Based on education level and entrepreneurship orientations, seven rural youths were selected and given hands on training for three days at the Microbiology Laboratory, CPCRI, Kasaragod by the scientists who themselves were the technology developers. They were facilitated and technical handholding provided in the subsequent period instilling confidence and scientific temper.
- Science-based rural enterprise was set up in the village with farmers, people's representatives and scientists' participation. A laboratory with basic facilities such as laminar air flow chamber for aseptic culture inoculation, glass wares, media and lab accessories for culturing bacteria, pressure cookers for media and talc sterilization, mixing and storage containers, packing covers and fire extinguisher for lab safety was set up with the support of FFP, facilitated by the scientists, such as laminar air flow, pressure cooker, fire extinguisher, culture room and mixing room. The low cost laboratory had an investment of Rs.4 lakhs initially, besides recurring contingencies. The lab was frequently visited by concerned scientists to ensure scientific support and corrective



measures if any, in the product preparation and quality control was strictly enforced. Also, the skilled team of rural youth was given prior informal access and opportunity to visit ICAR CPCRI for skill sharpening and expert advisories. The population count of Kera Probio samples taken during 2019 is furnished in Fig 2. indicating the high quality.

- The bio-input produced was branded as 'Kalpakam Kera Probio' with due acknowledgement to ICAR CPCRI as technology provider.
- Participatory demonstration of 'Kera Probio' for coconut seedlings in nurseries and farmers fields were implemented involving farmer groups/ Coconut Producer Societies (CPS), Women Self Help Groups (WSHGs), extension officials and people's representatives. Performance of the technology and the results were validated through social level triangulation. The decentralized ''Kera Probio'' production process was validated with participation of stakeholders, demonstration of attributes of the technology adoption among farmers and facilitation by scientists ensured both responsibility and transparency.
- The demonstrations of biopriming with 'Kera Probio' in 6000 polybag coconut seedlings were done during 2017-2021, in three decentralized nurseries of Chunakkara, Vallikkunam and Bharanikkavu Grama Panchayaths of Bharanikkavu Block Panchayat. Women Self Help Groups (WSHGs) were trained in the biopriming of polybag coconut seedlings and Vocational Higher Secondary Education (Agriculture) students of two VHSE schools also formed part of this intervention, as hands on practical sessions.
- The bio-primed seedlings were purchased by the coconut growers and they were satisfied about the bio-priming as a technology dissemination intervention. This process ensured the access of 'Kera Probio' a quality product at affordable cost (Rs.100/ kg). The sample of each lot of the product was tested by the experts and high quality was affirmed.
- The recurring cost of Kera Probio production were the costs of talc, broth, fuel for sterilizing, charges for sterilizing, inoculation, mixing and packing, and depreciation cost of machineries and maintenance, which comes to a range of Rs. 78 to 68 depending on variability of process. The production unit realizes a profit of Rs. 22 to 32 per kilogram.
- The level of acceptability of the talc based 'Kera Probio' formulation was assessed in terms of odour, purely organic product, positive effects on soil, crop and environment, packing, ease and simplicity of usage, price, quantity of application and clarity of usage instruction furnished. The overall acceptability was quantified in terms of very much acceptable, acceptable, somewhat acceptable and not acceptable. As per the table furnished, among the farmers who participated, 39.2% rated the product as very much acceptable and 48.5% as acceptable. None of the farmers rated it as non acceptable, indicating the farmer friendly bio-input developed by ICAR-CPCRI.

Table 1. Acceptability of Kera Probio by the farmers (%) (N= 110)

Sl. No.	Attributes of product	Very much acceptable	Acceptable	Not acceptable
1	Odour of the product	39.2	60.8	0.00
2	Positive effect on soil and crop	43.5	56.7	0.00
3	As an organic product	50.7	49.3	0.00
4	Ease and simplicity of usage	52.1	48.9	0.00
5	Price of the product	44.3	55.7	0.00
6	Quantity of application (dosage)	47.9	52.1	0.00
7	Clarity of instructions furnished	50.3	49.7	0.00
		46.80	53.30	0.00

Keraprobio training in Microbiology lab, ICAR CPCRI, Kasaragod

Amplifying positive impact of research

The participatory demonstration in decentralized nurseries indicated vigorous growth of 'Kera Probio' treated coconut seedlings with 48 percent more number of roots and 72 percent of the seedlings had more than 9 leaves compared to non-treated poly-bag seedlings. The healthy vigorous seedlings ensure healthy growth; an indicator of future sustainable yield and tolerance to moisture stress as per the perception of coconut farmers. Hence this long term impact is being documented through five model plots of these seedlings in each of the panchayath in farmer participatory mode.

- Commercialization of technologies through FPOs provide gateway to link business in science and faster technology transfer and adoption. Social level triangulation of the positive impacts leads to sustainable use of technology by farming communities.
- Technology transfer and adoption becomes a collective decision leading to confident individual level adoption and farmer-to-farmer technology spread.
- The rural youths equipped with science of the technology applied for start - up ventures and attracted youths to similar enterprises. They produced 7.2 tons of quality 'Kera Probio' in two years period, providing its adoption in 36,000 coconut seedlings, planted in 5 districts of Kerala.
- The technology transfer/ extension scientists-enabled identification of entrepreneurship-oriented youth, motivated business through networking, relationship management with stakeholders and community-based communication using social, print and mass media.
- Scientists could obtain direct feedback on decentralized production, extension and technology utilization stages.
- FPO obtained the ownership and control of this technology through horizontal and vertical

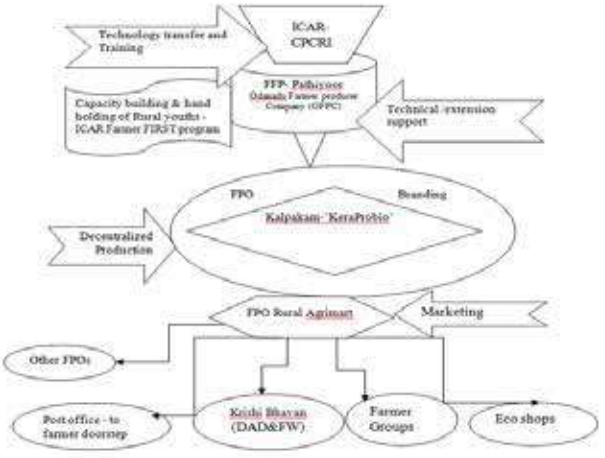


Fig 2. Diagramatic representation of the technology dissemination and social process with Farmer Producer Organization (FPO)

learning. The product is being marketed directly in Rural Agrimart of FPO, through other FPOs, Eco shops and utilizing post office parcel services for door delivery. Furthermore, 'Kera Probio' was included as an approved bio-input in the local government schemes for organic farming practices. Since 'Kera Probio' is compatible with Trichoderma, it was readily accepted by coconut and vegetable farmers. The social process of technology dissemination through FPO is furnished in Fig 2.

- Active mechanism of farmer-to-farmer extension and peer level motivation is being driven in this process.
- Technology integration and encouragement of coconut seedling management is also a notable outcome among farmers.
- Scientists and science-in-convergence with field level stakeholders increases the transparency and scientific outlook and temper in technology adoption at field level.

The case is an indicator in upgrading FPOs as technology promoters ably supported by rural educated youths, among small and marginal farmers. The technology dissemination duration could be cut short and benefit coconut homestead with marginal holdings also and thus reaching out effectively. Scientific inputs with ensured quality are critical in adoption and improving crop production also. The convergence of farmer community organizations, scientists, agricultural extension workers, local self governments and local farmer leaders could play important role in faster technology dissemination. Technology from ICAR institutes is owned and disseminated with responsibility to farming community through convergence and local leadership of farmers as a bio enterprise. ■

Ball copra

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Copra is the dried coconut kernel made from fully matured (12 months) freshly harvested and stored nuts. The copra made in India may be classified into two groups, edible and milling. The edible copra is the superior class copra which is used for various food preparations and also is eaten raw, while the milling copra is used for extraction of coconut oil. The edible copra is made both in the form of balls and cups while milling copra is extracted form of cups only. Ball copra is soft, sweet, oily and cream coloured. In India, manufacturers of ball copra is mainly concentrated in the states of Karnataka, Kerala and and to a limited extent in Lakshadweep, Andaman and Nicobar Islands and also in some parts of Tamil Nadu and Andhra Pradesh. In North India, particularly during the winter and festival seasons there is heavy demand for ball copra. Govenment of India has increased the MSP for ball copra to Rs 10,600 per quintal (2021) from Rs 10,300 per quintal (2020).

Ball copra is made from fully matured, i.e. 11-12 month old nuts. Fully mature nuts after harvest are stored with the husk in a shed for a period of 9-12 months. Specially constructed platforms higher than the ground level are used for storing the nuts. Normally, the bamboo or any wooden platform made across the trusses supporting the roof of the shed is set under the platform to hasten the process of drying. The water inside the nut slowly gets absorbed into the kernel and the kernel gets detached from the shell after a period of 9-11 months. At this stage a rattling sound can be heard while shaking the nuts. The nuts are then removed from the storage and dehusked. The shell is broken and removed piece by piece using an iron knife. This copra will be in the form of balls which is very clean and hygienic and very sweet in taste.

Edible copra is made both in the form of balls and cups while milling copra is extracted form of cups only. Ball copra is soft, sweet, oily and cream coloured. Ball copra is made from fully matured nuts.

Ball copra is also prepared by drying coconut with artificial heat. The nuts are first kept in a two- storeyed structure. The floor and four sides of the building are made of wooden rafters fixed 3-4 inch apart and depending on the space requirement, the size of

the store room is determined. The nuts are stored for a period of 8- 12 months. The nuts are smoked with a slow fire on the ground floor of the store. This process will continue until the kernels are fully dried and detached from the shell. The nuts are kept in the store for some more time and then husked, shelled and ball copra is removed in the case of smoke drying different lots of nuts are kept in compartments separated by means of wooden planks in between. But in the ordinary method of drying they are placed in one compartment. The method adopted for drying and the period of drying depends on the season and the quality of copra to be made and varies to some extent in different localities. Coconut shell and coconut husk are used for heating or smoking nuts to hasten the drying process.

Evaluation of different coconut varieties for ball copra production indicated that early germinating varieties are not suitable for this purpose owing to the spoilage under storage. The variety Tiptur Tall was found better for this purpose as the size of the ball copra is optimum for drying and Laccadive Micro Tall is the best for this purpose however with small balls. The weather conditions prevailing in the maidan tract of Karnataka is suitable for ball copra production (Dry weather with Low RH, Low Rainfall and high temperature). The germination inside the storage chambers are almost absent at these places whereas upto 60 % spoilage (due to germination and rotting) has been observed under coastal conditions at Kasaragod with other varieties. The ball copra has good market mostly in northern India where the availability of fresh coconuts are difficult. Quality wise, ball copra is sweeter and has more shelf life.

Several grades and qualities of ball copra are recognized in the trade circles. These are mainly named after the places where the ball copra is made or after the names of the markets in which different grades or qualities are in demand. The ball copra is mainly graded according to the size, weight, colour and cleanliness. Three grades of ball copra are available on weight basis, viz., large, medium and small depending on the numbers of copra required for a weight of 4 kg (< 20 for large, 20 - 40 for medium and > 40 for small). The moisture content shall in all cases be below 7 %. The copra is classified into different grades according to size by visual assessment only and not by any definite size criteria. Details of different grades and important markets are given in Table 1 and 2.

Table .1 Ball copra grades and Major marke

States	Grades	Market
Karnataka	Mysore, Madras, Ras and Barik	Tiptur and Mangalore
Tamil Nadu	Dil pasand, Office copra, Kola copra, Kamal copra or Kachal copra	Thanjavur
Kerala	Calicut copra	Badagra and Calicut
Andhra Pradesh	Madras	Ambajipeta
Grade designation and definitions of quality of ball copra for edible use		
Grade	Size (Diameter) in mm	Foreign matter % by weight maximum
Grade 1	85	0.2
Grade II	75	0.2
Grade III	60	0.2

(Source: WDRA, New Delhi)

Note

- *Foreign matters includes sand, dust, straw and shell*
- *Mould and black kernels includes balls in which more than 5 % of the inner surface is covered with mould and /or is dark brown to black in colour*
- *Wrinkled kernels include balls that are shrunk out of normal shape or are not fully matured or developed or have a rubbery structure and uneven surface. Such kernels are often discoloured*
- *Chips include pieces of kernel which are smaller in size*

Ball copra produce in the Lakshadweep Island is comparatively smaller in size as compared to the copra from the main land but considered as very superior and fetches a premium price in the main land markets. Almost the entire quantity of ball copra produced in Karnataka is disposed off at Tiptur market which is the biggest market for ball copra in India. Ease of transportation and huge demand in North India are said to be the two important factors that have made the Tiptur market buoyant.

Ball copra is generally packed in gunny bags. Polythene lined bags are often used for extra protection against insect damage. Ball copra is mainly consumed in North Indian states where coconut is not grown and where it is economical to transport copra rather than coconuts. The copra besides being eaten raw as such or mixed with other dry fruits is used in the preparation of sweets for a garnishing in many dishes. It is also used as religious offerings and is an essential item during ceremonial occasions. ■

Vanijya Saptah

CDB Stall in the Vanijya Saptah at Kalaivanar Arangam, Chennai. Smt. Balasudhahari, Director CDB is seen

Ministry of Commerce and Industry, Government of India observed 'Vanijya Saptah' during September 20-26, in which a slew of programmes and events were organized across the country showcasing India as a rising economic force, and exporter conclaves. The programme was conducted as part of 'Azadi Ka Amrit Mahotsav' with focus on economic growth, especially promotion of exports from India.

Coconut Development Board, RO, Chennai participated in the "Vanijya Saptah" (Trade and Commerce Week) held at Kalaivanar Arangam, Chennai on 22nd September 2021 organised by Government of India through Ministry of Commerce & Industries, and various Export Promotion Councils (EPCs). Mr. M.K. Stalin, Hon'ble Chief Minister of Tamil Nadu inaugurated the conclave and announced the export policy for Tamil Nadu. In his inaugural address, he said that 'Made in Tamilnadu' should be heard all over the world. The Hon'ble Chief Minister along with Mr. Thangam Thennarasu, Hon'ble Minister for Industries, Tamil Nadu, Mr. T.M. Anbarasan, Hon'ble Minister for Rural Industries, Tamil Nadu, Dr. V. Irai Anbu IAS, Chief Secretary, Govt of Tamil Nadu and other dignitaries visited CDB stall and enquired about various coconut products. Board displayed various value added coconut products like Nata-de-coco, tender coconut water, coconut milk powder, coconut milk cream, desiccated coconut, coconut oil, virgin coconut oil, coconut flour and palm sugar from various manufacturing units which are assisted under TMoC scheme viz. M/s. Nata Nutrico Coconut Food Products ltd, Ernakulam, M/s. Sakthi Coco Products, Pollachi, M/s. Pure Tropic, Sengapalli, Tirupur, M/s. Madhura Agro Process Pvt. Limited, Coimbatore and M/s. Sriram Coconut Products, Batlagundu. The exhibition stall was affixed with well informative posters displaying CDB Schemes like TMoC, Export Promotion, etc. Leaflets on CDB Schemes and journals in Tamil, English and Hindi were distributed in the Coconut Development Board stall. Central Leather Research Institute, Council for Leather Exports, National Institute of Fashion Technology, Footwear Design and Development Institute, Leather Sector Skill Council, Agricultural and Process Food Products Export Development Authority (APEDA), Spices Board, Coir Board, DGFT, Export Council of India, HDFC Bank and etc exhibited their products and technologies in the conclave.

Entrepreneurs, business people, farmers from various districts of Tamil Nadu and other states visited CDB stall and gathered information on value addition of coconut, coconut cultivations, varieties, nursery, schemes for value addition and schemes of CDB. Also most of the visitors enquired on the export details of coconut based value added products and the schemes of the Board.

Another Export Conclave was held on on 24th September 2021 organized by Directorate General of Foreign Trade, Ministry of Commerce & Industry, Government of India, Coimbatore and District Industries Centre, Government of Tamil Nadu, Tirupur at India Knit Fair Complex, Anaipudur,

View of Board's stall in Vanijya Saptah held at Tirupur, TamilNadu

Tirupur. Coconut Development Board, Regional Office participated in the programme through DSP Farm, Dhali

The Exporters Conclave was inaugurated by Shri M.P. Saminathan, Hon'ble Minister for Information and Publicity, Government of Tamil Nadu in the presence of Shri K. Selvaraj, MLA, Tirupur South, Shri Vineeth, IAS, District Collector, Tirupur District, Govt. of Tamil Nadu, Shri D. Sridhar, ITS, Joint DGFT, Coimbatore and other senior officials of Central & State Government. Main theme of the conclave was "India's Rising Export Potential in Global Market". Technical session was conducted followed by the inaugural session. A one day exhibition was also held during the Exporters Conclave.

Various Central / State Government institutions, Nationalized Banks, NGOs, FPOs, District Industrial Centre, Coir Board, Canara Bank and Union Bank of India also participated.

Coconut milk powder, coconut milk, coconut cream, desiccated coconut, coconut oil, virgin coconut oil, coconut flour, palm sugar, coconut shell powder, coconut shell charcoal, activated carbon, coconut shell charcoal briquette, handicrafts made by coconut coir / shell / wood and well informative posters, banners, charts, leaflets, pamphlets and booklets about value addition in coconut, Board's Schemes were displayed in Boards stall. Board's journals and other publications were also distributed during the occasion.

Board displayed various coconuts products of nine manufacturing companies such as M/s. Coco Energy, Annur, M/s. Madhura Agro Process Pvt. Limited, Coimbatore, M/s. Sakthi Coco Products, Pollachi, M/s. Sun Bio Naturals India Limited, Valipanankad, Kangeyam, M/s. Sriram Coconut Products, Batlagundu, M/s. Indomitra Farm Products Private Limited, Arasur, Coimbatore, M/s. KLF Nirmal Industries Private Limited, Perundurai, M/s. Pure Tropic, Sengapalli, Tirupur and M/s. Indian Coconut Products, Eripatti, Pollachi under Board's banner. Shri G. Ragothuman, Farm Manager briefed on Board's Schemes especially Schemes under Technology Mission on Coconut to farmers, entrepreneurs, bank officials, NGOs and FPOs who visited stall.

The exhibition had the presence of international and domestic expertise which created a professional platform. Shri M.P. Saminathan, Hon'ble Minister for Information and Publicity, Government of Tamil Nadu, Shri K. Selvaraj, MLA, Tirupur South, Shri Vineeth, IAS, District Collector, Tirupur District, Govt. of Tamil Nadu along with senior officers of State and Central Government visited the Board's stall and enquired about the value added coconut products. Several visitors including farmers, students, business communities, officials from various Departments State & Central Government, nationalized banks, NGOs, FPOs etc visited the Board's stall.

View of Board's stall in Vanijya Saptah, held at Kavaratti, Lakshadweep

The Department of Commerce in association with UT of Lakshadweep, Director General of Foreign Trade & Marine Products Export Development Authority (MPEDA) organized Vanijya Saptah on 21st and 22nd September. 2021 at Panchmat stage Kavaratti. Shri A.Anbarasu, IAS (Advisor to the Administrator) UT of Lakshadweep inaugurated the programme. Shri Amit Satija, IAS (Secretary Finance), Sluipaipodhar. ATIFS, (Secretary Agriculture), Shri O.P. Mishra (Special Secretary Agriculture) were present in the programme. ICAR-National Bureau of Fish Genetic Research, ICAR-Central Institute of Fisheries Technology- Kochi, Coconut Development Board- Kochi, KVK, LDCL & Self Help groups of islands participated in the programme and displayed their products. Board's stall showcased various products like Coconut Oil, VCO, Desiccated coconut Powder, Coconut Milk Powder, Coconut Milk Cream, Tender coconut water, Activated carbon etc to familiarize different products of coconut to the people of island.

Effective use of technologies for coconut prosperity - Role of FPOs

An interface Programme on 'Effective use of technologies for coconut prosperity - Role of Farmer Producer Organizations' was organised by ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI) at ICAR-Indian Institute of Spices Research, Kozhikode on 21st October 2021.

Dr. Thamban C, Principal Scientist (Agrl. Extension) welcomed the gathering and presented the objectives and outline of the interface programme.

The Scientist-FPOs interface programme was inaugurated by Dr. Anitha Karun, Acting Director CPCRI. Dr. Anitha Karun in her inaugural address opined that Farmer Producer Organizations in coconut sector can play a significant role for empowering the small and marginal coconut growers to enhance adoption of scientific crop management technologies for higher productivity and to enhance income and employment opportunities through processing of coconut for value addition.

Sessions on role of FPOs for better utilization of coconut based income generating technologies by farmers, role of FPOs for better utilization of technologies for intercropping of spices in coconut gardens and potential for utilization of technologies for value addition in coconut based enterprises managed by FPOs were handled by Dr. Subramanian,Principal Scientist, ICAR-CPCRI, Dr. V. Srinivasan, Principal Scientist, ICAR-IISR and Dr. Shameena Beegum, Scientist, ICAR-CPCRI respectively.

In the session on 'FPOs in coconut sector-Status and challenges' representatives of Coconut Producer Societies, Coconut Producer Federations and Coconut Producer Companies from Kozhikode district presented the activities taken up by them, various constraints experienced and suggestions for strengthening FPOs in coconut sector.

Mr. Subashbabu. K, former General Manager, KERAFED and Deputy Director of Agriculture (retd.) presented the suggestions on different types of support required from coconut development agencies including CDB and State Department of Agriculture to revitalise the FPOs in coconut sector.

Dr. P. Rajeev, Principal Scientist and Head, Social Sciences, IISR suggested interventions for the effective marketing of coconut value added products by the FPOs.

Major suggestions evolved during the deliberations in the interface programme for revitalising FPOs in coconut sector included the following.

- Revitalise the functioning of FPOs in coconut sector through appropriate policies and interventions by Coconut Development Board and State Department of Agriculture, Government of Kerala
- FPOs in coconut sector may take up collaborative initiatives with research institutions and development agencies in coconut sector to organise farmer participatory technology transfer programmes to disseminate scientific crop management technologies
- Network of CPSs and CPFs in Kerala may be involved for the effective implementation of coconut development schemes by Coconut Development Board and State Department of Agriculture, Government of Kerala
- Steps may be taken for empowering the CPSs/ CPFs to organise community action for managing decentralised coconut nurseries to produce and market quality coconut seedlings, production

and supply of customised fertilizer inputs for soil health management in coconut gardens in different Agro-Ecological Units of the state and for taking up area-wide adoption of integrated pest/disease management in coconut gardens

• Technology support from coconut research institutions to the coconut based enterprises managed by FPOs may be made available on nominal charges modifying the prevailing rate of technology transfer fees

• Priority may be given to FPOs in coconut sector for the supply of coconut seedlings from the farms under coconut research/development agencies

• Facilitate formation of consortium of FPOs in coconut sector and common branding for the coconut value added products produced and marketed by coconut FPOs

• A corpus fund may be raised with government support for generating sufficient working capital of coconut FPOs

• Procurement of coconut from coconut growers may be facilitated through the network of CPSs/CPFs and primary processing of nuts facilitate the formation of a nodal agency for the collection of copra and central facility for safe storage/ warehousing

• It may be ensured that coconut oil produced using copra from nuts procured from Kerala only is purchased for sale by public sector enterprises under State Government of Kerala

Apart from scientists of CPCRI and IISR, representatives of coconut FPOs in Kozhikode district including Shri. Pradeepkumar, Chairman, Kozhikode CPC., Shri. Gopalan Panikkerkandy, Chairman, Koyilandy CPC., Shri.E.S. James, Chairman Perambra CPC., Shri. Sreedharan Palayath, Chairman Pazhassi CPC and Shri. Abdul Rahiman, Chairman, Thamarassery CPC participated in the interface programme.

Dr. Lijo Thomas, Sr. Scientist, IISR Kozhikode presented the summary report on the discussions held during the interface and suggestions evolved for enabling FPOs for the effective use of technologies for coconut prosperity. Dr. Lijo Thomas also proposed vote of thanks.

(Prepared by : Dr. Thamban. C, Dr. Shameena Beegum, Dr. P. Subramanian, ICAR-CPCRI Kasaragod and Dr. Lijo Thomas, ICAR-IISR Kozhikode)

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Cultivation practices for coconut
November

Irrigation for seedlings

- Seedlings are to be given irrigation either through drip or basin method. If drip irrigation is adopted provide on an average 10 litres of water per seedling per day. Through other methods like basin irrigation 40 litres of water once in four days is sufficient.

Irrigation for adult palms

- Irrigation can be started in coconut gardens, except in localities which receive rain through north east monsoon. Even in localities where rainfall through north east monsoon is not received in adequate quantity (rainless period extending for more than 10 days) irrigation has to be provided to the palms.
- If basin irrigation method is adopted, provide irrigation once in four days @ 200 litres per palm.
- Drip irrigation is the ideal method of irrigation for coconut. Small pits of 1'x 1' 1' size should be taken 1 m away from the tree trunk at four equidistant points within the basin. The pits are to be filled with coir pith. The drippers/microtubes are to be placed sub surface in these pits through a polythene conduit pipe. The number of dripping points should be six for sandy soils and four for other soil types. 30-45 litres of water per palm per day is to be provided through drip irrigation system.

Drainage

- Ensure adequate drainage facilities in coconut gardens in localities which receive rain through north east monsoon. Depending up on the soil type and water table drainage channels of appropriate size, minimum of 50 cm depth and width, can be taken either manually or mechanically. Drainage channels are to be constructed for every two rows of palms.

Manuring

- Drip fertigation may be started for coconut palms. Water soluble fertilizers like urea and Muriate of potash can be given along with drip irrigation system. For the coconut palms, these fertilizers as per the general recommendation (50% of the recommended dose ie 545 g urea and 1000 g of Muriate of potash per palm per year) can be given in equal splits through monthly fertigation schedule. However, quantity of chemical fertilizers is to be worked out based on soil test results and yield targeted.
- Wherever Boron deficiency is noticed 100 g Borax

may be applied in the basin.
- For coconut palms showing yellowing of leaves due to Magnesium deficiency, 0.5 kg of magnesium sulphate can be applied in the basins.

Green manuring

- In regions benefitted by north east monsoon like Tamil Nadu, the green manure plants can be ploughed back in to the interspace of coconut garden if the plants have attained 50 percent flowering. Similarly, green manure plants grown in the coconut basins also can be incorporated into the soil.

Mother palm selection

- Select mother palms for seed nut collection to raise quality planting material.
- In tall varieties, seed nuts should be collected

- from mother palms which should have attained an age of 20 years, yielding constantly more than 80 and 120 nuts per palm per year for rain fed and irrigated conditions respectively with nut weight more than 600 g and copra weight of 150 g and above. Further, the palm should have a minimum of 30 leaves and free of any disease. The trees should have short and strong petioles with wide leaf base firmly attached to the stem. The bunch stalk should be short, stout, strong and should not show any tendency to droop down or buckle. Palms which produce barren nuts or those shedding large number of immature nuts should be discarded. Very old age palms i.e., above 60 years may be avoided and growing in very favourable conditions e.g. trees near manure pits are to be avoided. Palms showing alternate bearing tendency also should be avoided. In dwarf varieties seed nuts can be collected from mother palms which have attained an age of 12 years or more and yielding more than 60 and 100 nuts per year for rain fed and irrigated condition, respectively. Further it should have a minimum of 30 leaves with nut weight more than 400 g.

Nursery management

- Weeding should be done in the nursery.
- Five month old ungerminated nuts and dead sprouts should be removed from the nursery.
- Mulching with coconut leaves or dried grass or live mulch by raising green manure crops can be done in the nursery
- Provide irrigation
- Need based plant protection measures against pests and diseases are to be undertaken. Soil drenching of chlorpyriphos @ 2ml/litre is to be done in the nursery, if termite infestation is observed. Spraying of water on the leaves can be done against white fly infestation in the coconut nursery.

Mulching

- Mulching of palm basins can be undertaken if not done earlier. Fallen dried coconut leaves available in the coconut garden can be used for mulching. In the non traditional areas like Bihar, Madhya Pradesh, Chhattisgarh and North Eastern states, ensure thick mulching in the basin to regulate soil temperature. Irrigation can be started to negate the effect of low temperature in such areas.

Plant protection

Currently, a drastic shift in pest damage level on coconut is being experienced in the event of unprecedented weather vagaries. Gradient outbreak of the invasive rugose spiralling whitefly (*Aleurodicus rugioperculatus* Martin) in Peninsular and North-East India, black headed caterpillar (*Opisina arenosella* Walker) in Karnataka and slug caterpillar (*Darna nararia* Moore) in Andhra Pradesh and Karnataka are classical examples to support this phenomenon. Rhinoceros beetle (*Oryctes rhinoceros* Linn.) and red palm weevil (*Rhynchophorus ferrugineus* Olivier) are cosmopolitan pests recorded predominantly in monsoon and post-monsoon periods in Peninsular India. The most unnoticed and a serious sucking pest observed during North-East monsoon phase is the attack by coreid bug (*Paradasynus rostratus* Distant). At least 2-3 bunches would be affected with complete button shedding leading to barren bunches. Incidence of bud rot disease, nut fall, leaf rot, stem bleeding and Basal Stem Rot/*Ganoderma* wilt also cause damage to coconut. Under the changing weather

conditions systematic monitoring is very crucial to suppress outbreaks of pests and diseases in coconut. Regular observation and monitoring should be done in the coconut garden to identify incidence of pests and diseases and need based and appropriate plant protection measures are to be adopted to avoid crop loss. Recommendations for the management of pests and diseases in coconut for the month of November are furnished below.

Integrated Pest Management

▶ *Rhinoceros beetle*

- Adopt mechanical method of control by extracting beetles with beetle hooks, without causing further injury to the growing point of the palm
- The top most leaf axils may be filled with powdered neem cake/marotti cake (*Hydrocarpus sp/* pongamia) @ 250 g + fine sand (250g) per palm as a prophylactic measure
- Filling the innermost three leaf axils with 4 g each of naphthalene balls covered with sand (12 g/ palm) for juvenile palms
- Placement of two perforated sachets containing chlorantraniliprole a.i. 0.4% (5 g) or fipronil (3 g) or one botanical cake (2 g) developed by ICAR-CPCRI
- Incorporation of the biomass of weed plant *Clerodendron infortunatum* Linn. in the cow dung/ compost pit
- The breeding sites may be treated with green muscardine fungus (*Metarhizium anisopliae*)

▶ *Red Palm Weevil*

- Avoid causing injury to the palms, as they would attract the weevil to lay eggs. Mechanical injury if any, caused should be treated with coal tar
- While cutting fronds, petiole to a length of 120 cm is to be left on the trunk to prevent the entry of weevils into the trunk
- Removal and burning of palm at advanced stage of infestation would aid in destruction of various stages of the pest harboured in the trunk
- Prophylactic leaf axil filling suggested for rhinoceros beetle is very essential as this pest pave way for red palm weevil
- If damage occurs in the crown, the damaged tissue has to be removed and insecticide suspension, imidacloprid (0.02%) @1 ml/L of water may be poured in. In case of entry of weevil through the trunk, the hole in trunk may be plugged with cement/tar and the top most hole is made slanting with the aid of an auger and the insecticide solution is poured through this hole with funnel

▶ *Leaf eating caterpillar*

- Cutting and burning the heavily infested and dried outer most 2 - 3 leaves helps to prevent the spread of the pest.
- Improving soil and infested palm health through balanced dose of chemical fertilizers and organic manures.
- Since a very rich natural enemy fauna is associated with the pest in the field, chemicals are generally not encouraged for management of *O. arenosella.* As this pest is subject to parasitism by a good number of indigenous larval and pupal parasitoids, biological suppression is a feasible and viable approach. Augmentative release of stagespecific parasitoids viz., the larval parasitoids *Goniozus nephantidis* (Bethylidae) @ 20 parasitoids/palm, *Bracon brevicornis* (Braconidae) @ 20 parasitoids/ palm, the prepupal parasitoid, *Elasmus nephantidis* (Elasmidae) @49/100 pre-pupae, and the pupal parasitoid *Brachymeria nosatoi* (Chalcididae) @32/100 pupae at the appropriate time was found effective in the sustainable management of the pest. Combined release of the parasitoids is required in multi-stage prevalence of the pest in the field. Conditioning of parasitoids on larval frass before release enhanced the field level parasitism.

▶ *Eriophyid mite*

- Spraying on the terminal five pollinated coconut bunches with neem oil garlic soap mixture @ 2 per cent concentration (neem oil 200 ml, soap 50 g and garlic 200 g mixed in 10 litres of water)
- or spraying neem formulations containing 1 per cent azadirachtin @ 4 ml per litre of water
- or spraying palm oil (200 ml) and sulphur (5g) emulsion in 800 ml of water
- Root feeding azadirachtin 10,000ppm @ 10 ml + 10 ml water is also effective
- Along with the recommended dose of manures and fertilizers, 5 kg neem cake should be applied

▶ *Coreid bug*

- Spraying of neem oil-soap emulsion (0.5%) on the pollinated bunches. The emulsion can be prepared by adding 5 ml neem oil and 8 g bar soap in one litre water.

▶ *Rugose Spiralling Whitefly*

- No chemical insecticide should be sprayed on leaves
- Application of 1% starch solution on leaflets to flake out the sooty moulds.
- In severe case, spray neem oil 0.5% and no insecticide is recommended.
- Installation of yellow sticky traps on the palm trunk to trap adult whiteflies.
- Encourage build up of parasitoids (*Encarsia guadeloupae*) and re-introduce parasitized pupae to emerging zones of whitefly outbreak.
- *In situ* habitat conservation of the sooty mould scavenger beetle, *Leiochrinus. nilgirianus.*

Integrated Disease Management

▶ *Bud rot*

- Remove the infected tissues of the spindle completely. Two or three healthy leaves adjacent to the spindle may have to be removed, if necessary, for easy removal of all rotten portions and thorough cleaning. After removing the affected tissues apply 10% Bordeaux paste and cover the wound with a polythene sheet to prevent entry of rain water. The protective covering has to be retained till normal shoot emerges.
- Destroy the infected tissues removed by burning or deep burying in the soil
- Spray 1% Bordeaux mixture to the surrounding palms

▶ *Stem bleeding*

- Avoid burning of trashes near the tree trunk
- Avoid injury to the tree trunk
- The affected tissues should be completely removed using a chisel and smear the wound with 5% hexaconazole (5 ml in 100 ml of water) and drench the basins @ 25 lit. of 0.1% solution
- Smearing paste of talc based formulation of *Trichoderma harzianum* on the bleeding patches on the stem (The paste can be prepared by adding 50 g of *Trichoderma* formulation in 25 ml of water)
- Soil application of *Trichoderma harzianum* enriched neem cake @ 5kg per palm and adopt recommended irrigation/moisture conservation practices.

▶ *Leaf rot*

- Remove rotten portion of the spindle leaf and 2-3 successive leaves and pour fungicide solution containing 2 ml hexaconazole 5 EC in 300 ml water/ palm or talc based formulation of *Pseudomonas fluorescens* or *Bacillus subtilis* @ 50 g in 500 ml water/palm into the well around the base of the spindle leaf
- Undertake prophylactic measures to prevent rhinoceros beetle attack

▶ *Basal Stem Rot/Ganoderma wilt*

- Removal of dead palms, palms in advanced stages of the disease and destruction of the bole and root bits of these palms
- Isolation of diseased palms from healthy palms by digging isolation trenches of 2 feet depth and one feet width around the basin
- Avoiding flood irrigation or ploughing in infected gardens to prevent spread of the inoculum.
- Addition of 50 kg of farmyard manure or green leaves per palm per year.
- Application of *Trichoderma harzianum* enriched neem cake@ 5 kg per palm and irrigating the palm once in 4 days and mulching around the basin
- Raising banana as intercrop wherever irrigation is possible
- Root feeding of hexaconazole @ 2% (100 ml solution per palm) or soil drenching with 0.2% hexaconazole / 1 % Bordeaux mixture @ 40 litre solution per palm. ■

Prepared by : C. Thamban, P. Subramanian, Joseph Rajkumar and S. Jayasekhar, ICAR-Central Plantation Crops Research Institute, Kasaragod

Market Review – September 2021

Domestic Price

Coconut Oil

During the month of September 2021 the price of coconut oil opened at Rs. 17400 per quintal at Kochi and Alappuzha market and Rs. 17900 per quintal at Kozhikode markets.

The price of coconut oil closed at Rs. 17000 per quintal at Kochi and Alappuzha market and Rs. 17700 per quintal at Kozhikode market.

During the month the price of coconut oil at Kangayam market opened at Rs. 14800 per quintal and closed at Rs. 14533 per quintal with a net loss of Rs. 267 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.09.2021	17400	17400	17900	14800
04.09.2021	17400	17400	17900	14733
11.09.2021	17000	17100	17500	14333
18.09.2021	17000	17000	17500	14433
25.09.2021	17000	17000	17700	14533
30.09.2021	17000	17000	17700	14533

Milling copra

During the month, the price of milling copra opened at Rs.10750 per quintal at Kochi and Rs.10650 per quintal at Alappuzha market and Rs. 10800 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 10300 per quintal at Kochi and Rs. 10250 per quintal at Alappuzha market and Rs. 10650 per quintal at Kozhikode market with a net loss of Rs.450 at Kochi and Rs.400 at Alappuzha market and Rs. 150 per quintal at Kozhikode market.

During the month the price of milling copra at Kangayam market opened at Rs. 10100 per quintal and expressed a downward trend and closed at Rs.9900 per quintal.

**NR-Not reported*

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.09.2021	10750	10650	10800	10100
04.09.2021	10750	10650	10600	10000
11.09.2021	10300	10350	10500	9600
18.09.2021	10300	10250	10550	9700
25.09.2021	10300	10250	10700	9800
30.09.2021	10300	10250	10650	9900

Edible copra

During the month the price of Rajpur copra at Kozhikode market opened at Rs. 19000 and closed at Rs. 18900 per quintal with a net loss of Rs.100 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.09.2021	19000
04.09.2021	18700
11.09.2021	18900
18.09.2021	18600
25.09.2021	18600
30.09.2021	18900

Ball copra

The price of ball copra at Tiptur market opened at Rs. 16000 per quintal and closed at Rs. 16500 per quintal with a net gain of Rs.500 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal) (Sorce: Krishimarata vahini)	
01.09.2021	16000
04.09.2021	16000
11.09.2021	16200
18.09.2021	16300
25.09.2021	16350
30.09.2021	16500

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.15750 per quintal and and closed at Rs.15250 per quintal with a net loss of Rs.500 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.09.2021	15750
04.09.2021	15750
11.09.2021	15750
18.09.2021	15250
25.09.2021	15250
30.09.2021	15250

Coconut

At Nedumangad market in Kerala, the price of coconut opened and closed at Rs. 16000 per thousand nuts during the month.

At Pollachi market in Tamilnadu, the price of coconut opened and closed at Rs. 28500 per ton during the month.

At Bangalore market in Karnataka, the price of coconut opened at Rs. 22500 per thousand nuts and the prices continued at the same level throughout the month.

Weekly price of coconut at major markets			
	Nedumangad (Rs./1000 coconuts) (Source: Epaper,Kerala Kaumudi)	Pollachi (Rs./MT) (Source: Star market bulletin)	Bangalore Grade-1 coconut, (Rs./ 1000 coconuts) (Source: Krishimarata vahini)
01.09.2021	16000	28500	22500
04.09.2021	16000	28500	22500
11.09.2021	16000	28000	22500
18.09.2021	16000	28500	22500
25.09.2021	16000	28500	22500
30.09.2021	16000	28500	22500

International price

Coconut

The price of coconut quoted at different domestic markets in Philippines, Indonesia, Srilanka and India are given below.

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
04.09.2021	174	175	259	380
11.09.2021	173	228	270	374
18.09.2021	171	228	NR	381
25.09.2021	169	228	NR	381
				*Pollachi market

Coconut Oil

The price of coconut oil quoted at different international/ domestic markets are given below.

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/MT)	Domestic Price(US$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri lanka	India*
04.09.2021	1409	NR	1439	2785	1969
11.09.2021	1464	NR	1409	3025	1915
18.09.2021	1478	NR	1424	NR	1929
25.09.2021	1595	NR	1425	NR	1942
					*Kangayam

Copra

The price of copra quoted at different domestic markets in Philippines, Indonesia, and India are given below.

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
04.09.2021	798	880	1447	1336
11.09.2021	791	845	1513	1283
18.09.2021	802	842	NR	1296
25.09.2021	825	863	NR	1309
				* Kangayam

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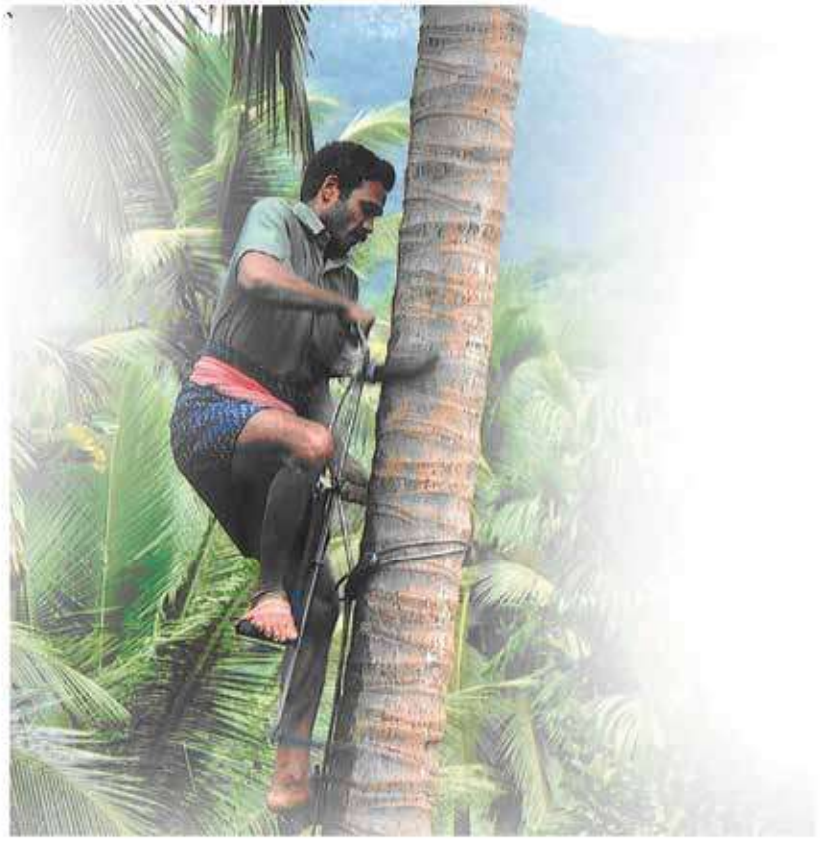

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